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Economic Problems of Native Communities

THE East African group of British colonies and dependencies has, during the last few years, had to endure a series of Government commissions, all undertaken with great pains and conducted by able chairmen. One of their main objects has been to determine the course of the political evolution of these regions, and the net results have been alternately to excite and depress the political aspirations of the resident European and Asiatic community, but the reflex effect on the more sophisticated section of the overwhelming black population cannot have been to its advantage.

The commissions culminated in a prolonged inquiry carried out by a Joint Committee of both Houses of Parliament sitting in London and presided over by the late Lord Stanley of Alderley, and after his lamented death, by Lord Onslow. This was a momentous business; it went on for some months and issued a monumental and well-balanced report. But inquiry was not yet to cease, for arising out of this Joint Committee is the report by Lord Moyne which is now before us; * one on railway economics, one on the financial position of Tanganyika Territory, and the Morris-Carter Land Commission are yet to come as sequelæ of the Joint Committee.

After the considerable expenditure of public funds involved by these extensive inquiries, it was pleasing to hear the Secretary of State for the Colonies recently declare, at the annual East African dinner, that inquiry had been overdone and would henceforth cease. Lord Moyne's report is, however, an admirable document; it is short, and it goes to the heart of things, namely, the economic position of the Colony. The old country, the heart of reserves of centuries of capital accumulation, has been shaken to its foundations during the last two years; the marvel therefore is that the colonies, all dependent on the production of raw materials which have slumped below cost of production, can have survived at all.

The main objects of Lord Moyne's inquiry were to ascertain the contribution made to taxation by the different racial communities, to review railway freights and import duties, and thus discover the extent to which each community in the colony benefits or suffers. Further, to ascertain as nearly as possible the amount of public money expended on natives and non-natives, and to what extent financial responsibility should be conferred on

* Report by the Financial Commissioner (Lord Moyne) on Certain Questions in Kenya. (Cmd. 4093.) Pp. vi+122. (London: H.M. Stationery Office, 1932.) 2s.

Native Councils. Lastly, to consider the general and economic situation in Kenya.

Lord Moyne approached his inquiry in an unbiased fashion, and conducted his mission with great rapidity; he has produced a document which it is impossible to controvert, and which should do much to dissipate a cloud of misinformation which has of late tended to obscure the situation.

Lord Moyne deals in detail with the incidence of the Hut and Poll Tax, which has up to now been the somewhat rough-and-ready way by which the native population of the country has made its contribution to the revenue. He puts his finger on the weak points of this system, and demonstrates how increasingly difficult it has become, particularly in some of the more remote districts, for natives to obtain the cash since the great slump in the values of produce occurred. He goes on to demonstrate how this fall in values has crippled the purchasing power of the natives, and so trade, generally, has greatly declined. The inequality, the inelasticity of this form of taxation, its lack of relation to prices of raw material, produced a considerable impression upon his financial mind, and he, moreover, pertinently remarks that "natives pay their tax not out of a fixed income but by means of additional production in the Reserves or alternately they may choose to earn the money by work in settled areas". For these reserves Lord Moyne recommends that the hut tax should eventually be replaced by a cultivation tax, that the poll tax should be a fixed sum, and in addition, there should be a live stock tax. There is much to be said for these proposals, but he does not appear to have considered fully the great increase of fiscal machinery these changes will involve when dealing with vast numbers of small cultivated plots. He next analyses the railway rates policy, and comes to the conclusion that their incidence is generally fair as between the racial communities. The same conclusion is also arrived at with regard to the incidence of import duties.

Perhaps the most difficult part of Lord Moyne's survey was the attempt to assess the amount of money expended in the interests of each community; and the impossibility of carrying out this aim with a great degree of accuracy is freely acknowledged. It is pointed out that the costs of various services, such as, for example, military and police, must be shown under general heads, for they benefit all communities. The plan of making two arbitrary divisions was thus adopted, namely, divisible and indivisible services. Even when this has been done, contrasts between racial standards of life make the

measure of equality of sacrifice in taxation even more difficult of assessment. Lord Moyne frankly admits that he has formed the opinion that "in the development of the undivided services in Kenya there has been a bias towards the conveniences of a civilisation in which the native so far shares little of the direct advantages". But he goes on to make it clear that there is no suggestion that the European community has taken unfair advantage of their opportunity; it was, however, only to be expected when on one side we find a well-organised, politically-minded body of Europeans and on the other a mass of Africans only faintly articulate and with a weak representation on the Legislative Council. But after considering every factor in the case, as Lord Moyne realises, it is not even then easy to assess a fair proportion of expenditure for each section.

In 1931 each European contributed nearly £29 to the revenue of the Colony and each native contributed 5 shillings; the individual gap is immense. The aggregate contributed by some 17,285 Europeans is £665,780 and that contributed by some 2,950,000 natives is £791,100, and the amount spent directly on the European community is about £171,250 and on the African £332,000. The difficulty of comparison is due to the fact that the bare standard of service necessary for Europeans can bear little relation to that necessary for Africans.

The greatest problem at present in all African countries is to raise the culture level of the native; it was rising slowly up to the occurrence of the world-wide depression, and was mainly due to the progress of the activities resultant on white settlement; and when prices rally this progress will be resumed. A rise in the culture stage of the native, however, cannot be delayed, and it is essential to educate him to the widest extent in the practical art of life, so that he may obtain a better yield from his land and conserve and improve its agricultural value, instead of ruining it as he is doing at present. If this can be achieved, we shall fully justify our presence in Africa. At the same time, with the progress of the prosperity of the village the native cannot fail to develop sociologically. The African to-day is avid for education, but too often confines himself to a desire to read and write.

In order to ensure a definite provision for steady progress in education, agricultural training, and medical hygiene, we find the recommendation that one-half of the revenue obtained from native direct taxation should be placed each year in what is termed a Native Betterment Fund, to be adminis-

tered by a special committee, with which natives are to be closely associated, and also representatives of the European colonists. This, if carried into effect, is a proposal which will be welcomed by native opinion and do much to demonstrate the solicitude of Government to give the natives a fair deal. The Kenya politicians may, however, plead that it is unconstitutional; as it will operate independently of the Legislative Council.

The proposal to found a Native Marketing Advisory Council is also one that is long overdue, for the victimisation of natives by Asiatic traders has for years past been a matter of concern.

Space forbids reference to many points of interest, but it is evident that, quite apart from its special reference to one Colony, Lord Moyne's report carries many lessons which are applicable to other dependencies of a similar class, for it demonstrates the importance of far-sighted discrimination in regard to local financial demands, and the necessity of firmer control than that which successive governors have, owing to political exigencies, been able to exercise in the past. C. W. H.

Recovery: A Scientific Programme

Recovery: the Second Effort. By Sir Arthur Salter. Pp. xvi + 306. (London: G. Bell and Sons, Ltd., 1932.) 10s. 6d. net.

THERE could be few more startling contrasts than that between the pedantic platitudes of the naval and military experts of the Disarmament Conference, their endless splitting of hairs, and the balanced and comprehensive survey of the events during the last thirteen years that have been mainly responsible for the present critical world position which Sir Arthur Salter gives us in his book "Recovery". Alike in his analysis and summing up of the various special problems of currency, finance, reparations and war debts, tariffs, industrial organisation, Government control and security, on which his experience as a high official of the League of Nations, as first general secretary to the Reparations Commission, and active participant in most of the international negotiations and acts in the first effort at post-war recovery render him an expert authority of the highest standing, Sir Arthur writes with a vision and a sense of values which only emphasises the narrow-mindedness and inadequacy of the military and naval experts. We have been accustomed in Britain to admit such experts to positions of high administration and authority from which the scientific expert is rigidly excluded. When allow-

ance has been made for Government pressure or for the absence of adequate instruction or definite policy from the Conference itself, the proceedings of the experts at the Disarmament Conference make a dismal record which may well endanger the future use of the expert in administration, in spite of the striking success which under appropriate conditions has attended the work of the expert committees of the League in health, finance, economics, transit and communications, etc.

The masterly diagnosis which Sir Arthur gives us of the causes of the world depression conveys the emphatic impression that the main cause of our present critical position is not monetary, economic, or political, but the persistent attempt to handle world problems on national and sectional lines—the same effort which, unless public opinion realises the danger in time, threatens to defeat the purpose of the Disarmament Conference. The whole book is an antidote to such small-mindedness. Writing with an essentially scientific outlook, Sir Arthur conveys not only a sense of perspective in viewing the complex reactions of the financial, industrial, economic, and political factors involved in the field of monetary policy, credit, commercial policy, economic organisation, government, and peace, but also gives us trenchant and constructive criticism which leads him to prescriptions for recovery and for a 'New World Order' set out in his concluding chapter.

To this chapter the majority of readers will turn most eagerly, and it should accordingly be noted that Sir Arthur reaches his conclusions as a result of impartial analysis of the relevant factors and a determined attempt to disentangle them from prejudice. Only in this way can we arrive at a satisfactory basis for adequate action, and this method of procedure will at once be recognised as fundamentally that of science.

Characteristic of the book is its note of confidence. Difficult as is our task, the problem facing us is, as Sir Arthur rightly reminds us, capable of human solution. "Never was Nature so prodigal in her gifts; never was man so well equipped in skill and scientific resources to utilise them." Or again, "We are, if we could but grapple with our fate, the most fortunate of the generations of men. In a single lifetime science has given us more power over Nature, and extended further the range of vision of the exploring mind, than in all recorded history. Now, and now only, our material resources, technical knowledge, and industrial skill are enough to afford to every man of the world's teeming population comfort, adequate

leisure, and access to everything in our rich heritage of civilisation that he has the personal quality to enjoy." This is the spirit in which the triumphs of science and of statesmanship alike have been achieved, and the book was worth reading if only for the reminder it gives us that by bringing to our task courage and magnanimity we shall assuredly find the wisdom to control our specialised activities and the waywardness of our sectional and selfish interests. The difficulties and problems created by defects in human organisation, planning, and direction, or from weakness in our financial and distributive systems, are essentially remediable evils and removable causes, requiring only for their elimination an effort of searching analysis and constructive reform in our western world comparable in boldness and determination with that which is now being witnessed in Russia, with however different a goal or method.

It is in this spirit that Sir Arthur is led to his constructive proposals. Accordingly, he sees the need for central institutions to put the credit and borrowing capacity of selected classes of those needing capital on the soundest foundation. Such institutions would be able to secure, far more economically and efficiently, the necessary experts to examine the technical merits of any proposed scheme. Suitable mechanism is also required to secure that any political factors involved should be examined by some agency of the League of Nations, to prevent any repetition of the discreditable borrowings of 1926-28, with their dangers to world peace.

Discussing commercial policy and tariffs, Sir Arthur Salter points out the fallacy of most of the so-called scientific tariffs and the way in which they tend to direct energy and attention from the improvement of industrial efficiency to the corruption of governments. The only scientific tariff, in Sir Arthur's view, is that offered temporarily and conditionally by a strong and competent government to stimulate and assist reorganisation of an industry. This authoritative comment indicates the wisdom of the policy advocated by Capt. Macmillan in regard to the functions of the Tariff Commission, and is an emphatic warning of the dangers attending the unregulated introduction of a tariff system. The dislocation and gradual stoppage of international trade is a danger to the world second only to the menace of world peace which the consequent disintegration into separate units and groups presents.

Part of the support for a tariff policy in Britain has come from those who recognise the need for a

more deliberate and collective planning of our economic life; and the existence of such support, which is likely to be conditional on an increasingly better planning for real public and social benefit, constitutes some hope of reform. For similar reasons, Sir Arthur, while frankly recognising certain dangers inherent in the growth of large industrial organisations, sees in them the means of securing the necessary planning of supply over the whole range of an industry, and so securing stabilisation as no national agreement could do except behind prohibitive tariffs. International agreements and cartels and National Economic Councils can in fact constitute a basis upon which a World Economic Council could effectively discuss, upon a world range, questions of finance and control of output, resulting in definite industrial planning through the world, and in addition, by cutting across national frontiers, they create interests and forces which will tend to counteract the competitive nationalism which is the world's chief danger.

These National Economic Councils are themselves a significant development of the last decade, and although at present largely experimental, may ultimately prove of great value in the machinery of government, which almost everywhere is now proving inadequate to the tasks which it has assumed. Sir Arthur's natural sympathy with *laissez faire* emphasises the policy of economic planning and radical reconstruction to which he is driven by facts and not by inclination. Only by such a policy can he see the mechanism of central direction and restraint sufficiently strengthened to control the specialised activities of men and the individual energy whether of persons or organised sections which threatens to destroy and not extend the common weal. Delegation of national government authority along such lines, drawing into the public service the great private institutions which represent the organised activities of the country, including chambers of commerce, banking institutions, industrial, professional, and labour organisations, and simultaneously the integration of the national organisation thus developed into an organ of world policy through the League of Nations, is the way in which Sir Arthur visualises government as becoming once more equal to its task. The whole framework, first and last, is based upon peace, upon the firm establishment of the collective system in the confidence of the world, until in the new world order the causes from which wars originate are eliminated.

Here is a programme worthy of earnest consideration by scientific workers individually and

through their professional and industrial organisations. Sir Arthur Salter has given us as it were a world map on which the broad lines of advance, the practical routes, are plainly marked. The details have yet to be filled in if mankind is to advance towards recovery, and that advance depends not more on the contribution of statesmen than of scientific workers and other individual sections of the community. To that task of systematic and scientific exploration each must bring their contribution in a spirit of adventure, of courage, of magnanimity which, for the moment, so many in this apprehensive world seem to have abandoned.

Some Extinct Horned Mammals

Department of the Interior : U.S. Geological Survey. Monograph 55 : The Titanotheres of Ancient Wyoming, Dakota and Nebraska. By Henry Fairfield Osborn. Vol. 1. Pp. xxiv + 701 + plates 1-42. Vol. 2. Pp. xi + 703-953 + plates 43-236. (Washington, D.C. : Government Printing Office, 1929.) 9 dollars.

THE Titanotheres are a group of odd-toed hoofed mammals which lived during the early part of the Tertiary epoch about the fortieth parallel of latitude in North America and Asia, and occasionally strayed into eastern Europe. They are peculiar in their low-crowned molar teeth, which never became sufficiently deepened to be useful for feeding on dry vegetation. They are also unique among odd-toed hoofed mammals in having the forefoot almost like that of the even-toed hippopotamus, with only a slight tendency towards the greatest weight on the third toe. So far as known, they first appeared at the end of the Lower Eocene period, when they were small hornless dwellers in swamps, evidently feeding on succulent vegetation. They became extinct at the end of the Lower Oligocene period, when most of them had grown to be as large as rhinoceroses or even as small elephants, adapted to live on hard ground, with prehensile lips for browsing, and with a pair of horns, supported by bony cores, on the top of the prominent nose. The fossil remains of these large forms were found first, and hence the name given to the group.

As the Titanotheres completed their evolution in so short a period of geological time, and as they are now represented in museums by the remains of very numerous individuals of many genera and species, they are of extreme interest to the palæontologist. They are also of value to the geologist

as marking successive layers in the early Tertiary rocks where they happen to occur. Science is therefore much indebted to the United States Geological Survey and to Prof. Osborn for the two handsome volumes in which these extinct mammals are most exhaustively described and discussed from every point of view. The monograph was planned many years ago by the late Prof. O. C. Marsh, who supervised the drawing of numerous plates which are now reproduced and used as effective illustrations. Prof. Osborn, with the aid of his colleagues in the American Museum of Natural History, has been engaged on it since the beginning of the year 1900. The result is the most elaborate work ever devoted to a group of vertebrate fossils.

All the known genera and species are described in detail in systematic order, with full references to the literature of the subject, and beautiful drawings and outline sketches of the fossils on which they are founded. The systematic descriptions are then supplemented by a valuable chapter on the probable muscular anatomy of the Titanotheres by Prof. W. K. Gregory, who also discusses the mechanics of locomotion both in these mammals and in the other odd-toed families. The central feature of the monograph, therefore, is a well-arranged collection of facts, which will always remain available for reference, however much opinions may differ as to their interpretation.

Nearly half of the monograph is devoted to general questions and the interpretation of the facts, which have already been dealt with by Prof. Osborn in preliminary papers during the progress of the work. These chapters are a little difficult to appreciate, on account of the literary style, frequent repetitions, and lack of conciseness; but they bring together a remarkable mass of material for which both geologists and palæontologists will be grateful. The numerous diagrammatic illustrations are especially helpful.

One preliminary chapter gives an elaborate account of the various American Eocene and Oligocene formations in which remains of Titanotheres occur, and concludes with a series of photographs of localities in which collections have been made. Another chapter discusses mammalian palæontology in general. Other chapters deal with various aspects of the evolution of the Titanotheres and their allies, and the possible ways in which they may have been exterminated at the time when they attained their maximum development and apparently maximum strength. It is especially interesting to notice that there seem to

have been several parallel groups all evolving in the same direction but at different rates—a phenomenon which is now becoming familiar to those who trace the distribution of extinct animals through successive geological formations.

When the monograph had been completed, the exploring party of the American Museum of Natural History in Mongolia made the first great collection of remains of Titanotheres from Asia. Prof. Osborn has therefore added a very interesting appendix on this discovery. It appears that most of the genera found in Asia are identical with those already recognised in North America, but they are represented by species which are about twice as large as those already met with in America. There is also a new genus, *Embolotherium*, comprising some of the largest Titanotheres known, in which the two immense horns are fused into a battering-ram. This animal was one of the latest members of the race, existing at the end of Lower Oligocene time; and when it became extinct, its place was taken in the Gobi region by the gigantic *Baluchitherium*, which belonged to the rhinoceros group.

Prof. Osborn's stimulating monograph, indeed, leads us to hope that it is only the first of a series which the United States Geological Survey will publish, when other groups of American fossil vertebrates have been studied in equal detail from our present point of view.

A. S. W.

Domestic Science

- (1) *Everyday Domestic Science and Hygiene*. By I. C. Joslin and P. M. Taylor. Pp. viii + 532. (London: Macmillan and Co., Ltd., 1932.) 6s.; Part 1, 3s.; Part 2, 3s. 6d.
- (2) *Household Physics*. By Walter G. Whitman. (The Wiley Technical Series for Vocational and Industrial Schools.) Second edition, revised. Pp. vii + 502. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1932.) 16s. 6d. net.

(1) **T**HE first of these books has been written with the object of providing a scientific foundation for a school course in household science and human physiology up to the standard of the General Schools Examination. The general plan of the book is excellent. The elements of physics and chemistry are first dealt with, and the pupils' interest in the subject is well maintained both by the experimental work and by the numerous examples showing the application of the principles to domestic work. A knowledge of food values is essential for the proper planning of meals, and the

authors have shown their appreciation of this fact by their very thorough treatment of this section of the subject. The source, preparation, and methods of cooking of the chief substances used as foods are described and many experiments are given. A chapter on micro-organisms well emphasises the necessity for cleanliness in the preparation and storage of foods—a subject which in Great Britain has, up to the present time, received far too little attention. Human physiology, personal hygiene, and first-aid are treated so far as “they may be studied appropriately in a general science course for girls”.

The authors do not give any indication of either the number of periods a week or the number of years required to complete the course satisfactorily. An examination of the book would indicate that three periods a week, one devoted to practical work and two to class work, for three years, would enable the work to be done in such a way as to secure the maximum value in educational training and a good knowledge of the subject. The book is one of the best dealing with this subject that has appeared in recent years; the sequence of practical work and class work is excellent, and the most recent developments are included. Among such may be mentioned the ‘Regulo’ device for controlling the temperature of the modern gas oven, the principles underlying the working of the household refrigerator, and the importance of vitamins in foods.

(2) The second of these books aims at presenting physics adapted for girls both in general and in home economics courses. The method is almost entirely instructional as distinct from educational, and every device used in the home, from electric lamps to ‘talking picture’ projection, and from carpet sweepers to twelve-cylinder motor cars, that depends in any way upon physics, is fully described. Most of the subjects are treated in far too great detail; for example, it is not necessary, for an intelligent understanding of the working of electric home appliances, to have a knowledge of magnetic fields around a solenoid or of the principles underlying the use of ‘step-up’ transformers. It is difficult to justify the inclusion of descriptions of such instruments as compound microscopes in a household physics course. The illustrations are numerous and excellent, and the subject matter is dealt with in a very interesting way. The book is one that would appeal to all mechanically minded boys, and would be a welcome addition to any boys' school library.

It will be noticed that though both the books have about the same number and size of pages and are equally well produced, the price of the first is 6s. and of the second 16s. 6d.

J. H.-S.

Short Reviews

(1) *Fortschritte der Biochemie*. Teil 2 (1924-1931). Von Prof. Dr. Felix Haurowitz. (Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 26.) Pp. x+152. (Dresden und Leipzig: Theodor Steinkopff, 1932.) 11 gold marks.

(2) *Les problèmes de la biochimie moderne*. Par Prof. G. Florence et Dr. J. Enselme. Pp. 312. (Paris: G. Doin et Cie, 1932.) 45 francs.

(1) THIS small book is a comprehensive review of biochemical literature during the period 1924-1931; it is a continuation of Part I. (1914-1924). An index mentions 900 authors, and more than one thousand papers must have been referred to, so that little of importance has escaped. The size of the book has imposed considerable brevity (wave mechanics are treated in a single page); hence it is scarcely a continuation of older textbooks, as the preface seems to suggest, but rather a valuable guide to the recent literature, which every biochemist should possess. There is even a useful final section on methods. Robinson on p. 14 should be Robison, and on p. 28 we are referred to a formula on p. 00 which does not seem to have been included anywhere.

(2) The title suggests a resemblance to the preceding, but a study of the contents reveals considerable differences. The French authors include older work and often little that is recent. Thus the section on muscle metabolism does not extend beyond 1928, and seems actually based on the junior author's M.D. thesis of 1924; it is consequently completely out of date. The sections on hæmin and chlorophyll are likewise antiquated. The range is smaller than that of the German book, and even those topics which have been selected are often treated inadequately, for example, the sterols. The section on carbohydrates is among the more satisfactory. Sometimes there is considerable detail; thus the (old) method of preparing glutathion (still a dipeptide) is described at great length, and the mathematical theory of Svedberg's ultracentrifuge is included, so that the book has its occasional uses. It is marred by numerous misprints. There is not only disregard for the spelling of proper names (Lotter-Maser; Deloye and Scherrer in the text, Debye and Sherrer in the index); such mistakes are merely inartistic to foreign eyes, but when it comes to Year instead of Goodyear, and the page of the journal is also wrongly quoted, these mistakes become distinctly inconvenient. G. B.

Across the Gobi Desert. By Sven Hedin. Pp. xxii+402+67 plates. (London: George Routledge and Sons, Ltd., 1931.) 25s. net.

THIS volume is the English edition of the account, originally published in Sweden, of Dr. Sven Hedin's great expedition to the Gobi Desert, or rather of the first stage, which in the winter of 1927-1928 brought him to Urumchi. The author considers this the greatest expedition of his life; and it was

certainly a marvel of organisation and equipment. Unfortunately, it was impossible to carry out one part of the programme. At Urumchi the governor of the Province of Sikiang refused to allow the eight German airmen to fly over the inaccessible parts of the desert and they had to return home. In other branches of investigation, but especially in geology, geography, and archæology, the expedition has achieved some remarkable results, of which the scope is outlined in this book.

In the summer of 1928 Dr. Sven Hedin returned to Sweden to raise funds for the continuance of the work, and the expedition then became a joint Sino-Swedish undertaking with a staff of Chinese scientific workers and students collaborating with the European members. The author speaks in high terms of praise of his Chinese colleagues, both in regard to their scientific work for the expedition and in reference to his personal relations with them. Although it may be inferred that there have been difficulties in his dealings with the Chinese, Dr. Sven Hedin has no criticisms to offer; and indeed in so far as he might be cited as a witness on the question of friction between Europeans and the Chinese authorities, he would seem to suggest that in some cases at least the Europeans rather than the Chinese are to blame. He is, of course, referring only to matters in which the interests of science are affected.

The interval which has elapsed before the publication of the English edition of his book has enabled the author to add chapters dealing with the discoveries which have confirmed the fact of the diversion of Lop Nor Lake to its ancient bed after five hundred years, and to give its exact position as determined by members of the expedition in April 1931.

An Introduction to the Mathematics of Map Projections. By R. K. Melluish. Pp. viii+145. (Cambridge: At the University Press, 1931.) 8s. 6d. net.

THIS book, in the earlier chapters, traces the history of projection, and presents an account of the general theory, together with deductions. Then follows a chapter on the theory of the indicatrix and the method of comparing one projection with another; next the question of finite measurements and the errors of finite representation. The last chapter is concerned with the selection, from mathematical considerations, of the best projection for a given country. The work is both useful and interesting, although not a complete treatment, even on the mathematical aspect of this subject. The title must not be taken to mean that the mathematics are therein explained. The reader will soon discover that it is assumed he has a fair knowledge of calculus to enable him to work out many details. The author has made no concessions to weaker mathematicians.

The book is "the outcome of a mathematical essay on maps written at Cambridge in 1922". The author was later influenced by Mr. A. R. Hinks, and by the late Mr. A. E. Young's work on the "Minimum Error".

In view of the interest which has recently been manifested in this subject of map projections, it is fortunate that a book dealing "comprehensively with the theories that underlie their construction" should have appeared. To the geographer with a mathematical bias this carefully prepared book will be especially welcome. J. E. C.

Properties and Mechanics of Materials. By Prof. P. G. Laurson and Prof. W. J. Cox. Pp. x + 353. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 17s. 6d. net.

WRITTEN for students of American universities and based on American standards and specifications, this book, within these limitations, constitutes a useful introduction to the subject, in that it combines an account of the stresses to which materials are subjected in constructional work with the description of the materials themselves. It is mainly of the nature of a preliminary survey, with the emphasis properly laid on fundamental principles, which it is desirable that the student should grasp thoroughly before allowing his attention to be diverted to specialised problems. The English engineering student will find in it a number of terms, units, and methods with which he may not be altogether familiar, but it will be useful to him in widening the range of his knowledge and giving him an insight into trans-Atlantic standards and practice. At the same time, the references to the conditions governing such characteristic American structures as the multi-story building, or 'skyscraper', are by no means prominent, and one looks in vain for information on the subject of foundations. There is a list of references for further reading, but it is entirely American; no British or European standard books are quoted. B. C.

Hydraulics: a Textbook covering the Syllabuses of the B.Sc. (Eng.), A.M.Inst.C.E. and A.M.I.Mech.E. Examinations in this Subject. By E. H. Lewitt. (Pitman's Engineering Degree Series.) Fourth edition. Pp. xii + 372. (London: Sir Isaac Pitman and Sons, Ltd., 1932.) 10s. 6d. net.

THIS is a textbook which has been compiled for the specific purpose of covering the examination syllabuses of certain universities and professional bodies. It is, therefore, somewhat narrow and rigid in its treatment of the subject, but that it is popular with engineering students is evident from the fact that the work is now in its fourth edition. Indeed, as an examination textbook, it is admirably clear and concise. But as a general review of the subject it is, perhaps unavoidably, a little lacking in breadth. The chapter on flow through open channels, for example, gives the Chezy formula with Bazin's values for the coefficient, but takes no note of the elaborate, and more generally recognised, expressions of Ganguillet and Kutter, or those of Hazen and Williams, Manning, Barnes, and others. The present edition of the book has been enlarged to include new material on the viscous resistance of a fluid, and the sections on hydraulic machines have been considerably amplified. On

page 174, the author is mistaken in attributing to the late Lord Kelvin the explanation of scouring at river bends: it is to his brother, the late Prof. James Thomson, that the credit is due. B. C.

(1) *Operational Methods in Mathematical Physics.* By Dr. Harold Jeffreys. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 23.) Second edition. Pp. viii + 119. (Cambridge: At the University Press, 1931.) 6s. 6d. net.

(2) *Cartesian Tensors.* By Dr. Harold Jeffreys. Pp. vii + 93. (Cambridge: At the University Press, 1931.) 5s. net.

(1) A NEW edition of this really useful book is to be welcomed. The author has returned to Heaviside's notation of p for the operator, a distinct improvement. The chapter on Bessel functions has been rewritten and illustrated with reference to submarine cable telegraphy.

(2) While vector algebra demands the learning of a new notation, the tensor method is only a concise way of writing a notation which is already familiar. Special simplifications are introduced by the use of rectangular Cartesian co-ordinates, and tensor algebra is then a simple and useful tool for obtaining general theorems in a concise manner. In this excellent little book the notation is explained and illustrated by applications to geometry, dynamics, elasticity, and hydrodynamics.

The Archaeology of Cornwall and Scilly. By Dr. H. O'Neill Hencken. (The County Archaeologies.) Pp. xvii + 340 + 12 plates. (London: Methuen and Co., Ltd., 1932.) 10s. 6d. net.

DR. HENCKEN'S volume on Cornwall and Scilly, while following the plan of the series, is somewhat broader in its method of treatment. For this, the material is in part responsible. It was inevitable that such topics as the Cornish megalithic monuments and the burial chambers of Scilly, the position of Cornwall in prehistoric trade, its tin mining industry, and the relation of its legendary history to its archaeology after the Roman evacuation should call for discussion on broad comparative lines. As a result, the book, while no less valuable to the archaeologist than its predecessors, is even more attractive to the general reader.

Zoologie biologique. Par Prof. Étienne Rabaud. Fascicule 1: *Morphologie générale et système nerveux.* Pp. xxi + 223. (Paris: Gauthier-Villars et Cie, 1932.) 45 francs.

THIS is the first of three volumes which deal respectively with general morphology in relation to the nervous system, nutrition, and reproduction. The first volume approaches the problem of general morphology by describing the fundamental structure of all animal forms in terms of the integument, organs of locomotion, and the body cavities.

The relation of the organism to the environment is approached by the study of the peripheral nervous system, with special attention to the nerve endings of ordinary and special sensation. The author has succeeded in introducing many of the conceptions of modern physiology into morphology.

Theories of Hearing*

By Prof. H. HARTRIDGE, F.R.S.

RIVALRY still exists between the theories of hearing, because the small size, the delicacy, and the inaccessibility of the internal ear make direct observation and experimentation wellnigh impossible. Among the rival theories are the telephone theory, the modified telephone theory of Boring, the modified telephone theory of Watt, the volley theory of Wever and Bray, the pattern theory of Ewald, the stationary wave theory, and the resonance theory. At the present day, controversy principally centres round the resonance theory and some form of telephone theory.

THE TELEPHONE THEORY

According to the telephone theory, the ear behaves like a microphone. Variations of air pressure in the ears, at the frequencies of sound emitted by the source, are followed by the passage of impulses up the auditory nerve fibres to the brain. Like the electric currents in a telephone wire, these nerve impulses are controlled by the frequencies, intensities, and the phases of the incoming sound waves. The temporal lobe of the brain, on receiving these nerve impulses, interprets suitably the changes in pitch and quality which are heard, and assigns them to the musical instruments which are being employed.

The telephone theory encounters the following difficulty: experiment shows that the ear can hear frequencies up to about 15,000 vibrations per second. A telephone circuit transmitting these high frequencies would undergo 15,000 fluctuations in voltage per second. The ear, if it were behaving like a telephone, should therefore send up the fibres of the auditory nerve 15,000 impulses per second. But experiment shows that the highest frequency at which mammalian nerve fibres can transmit impulses is about 1000 per second. A modification of the telephone theory, called 'the volley' theory, meets this difficulty by assuming that a suitable co-ordinating mechanism exists in the internal ear. By means of this mechanism the auditory nerve fibres are divided into groups and each group in turn is called on to transmit an impulse. If there were 15 such groups, a frequency of 15,000 vibrations per second could be conveyed to the brain by nerve fibres which individually can only convey 1000 vibrations per second.

THE RESONANCE THEORY

According to the resonance theory, the ear contains a number of tuned structures, the natural periods of vibration of which correspond to the range of audible frequencies. Separate nerve fibres connect the sensory organs on these 'resonators' with different parts of the temporal lobe of the brain. In consequence, when sounds of one frequency are received, and one group of resonators

vibrates, the sense organs of these resonators are stimulated and their nerve fibres convey impulses to one part of the temporal lobe. Sound waves of other frequencies will cause different groups of resonators to vibrate, and different parts of the temporal lobe will thus receive nerve impulses.

The resonance theory encounters the following difficulty: the vibrating structures in the ear have lengths of roughly half a millimetre, and the lowest audible frequency is approximately 20 vibrations per second. It is at first sight difficult to see how it is possible for such very short structures to perform vibrations in resonance to such low frequencies.

The formula for the fundamental frequency of vibration of a stretched string is as follows:

$$\text{frequency} = \frac{1}{2 \text{ length}} \times \sqrt{\frac{\text{tension}}{\text{mass per unit length}}}$$

If, therefore, tension is suitably decreased at the same time as length, then frequency remains the same. It is therefore possible to have a fibre 0.5 mm. in length possessing a natural frequency of 20 vibrations per second, provided that the tension has a suitable value. The vibrating structures of the ear satisfy the required conditions.

EXPERIMENTAL EVIDENCE IN FAVOUR OF RESONANCE

Much experimental work has accumulated during the last few years which is in favour of the resonance hypothesis and against the telephone hypothesis.

(1) When by surgical interference a limited part of the internal ear is damaged, not only does deafness over a narrow range of frequencies result, but also the frequencies concerned correspond with the part of the internal ear which has been damaged. That is to say, if the damaged fibres are short, then high notes are involved; if, on the other hand, the damaged fibres are long, then low notes are involved.

(2) Boilermakers, in course of time, acquire deafness to high notes. Microscopic examination after death shows that the short fibres of the internal ear have been pathologically affected. Also, when animals are subjected for considerable periods of time to loud sustained musical tones, they become deaf to the musical tone to which they have been subjected. A microscopic examination of their internal ears after death shows that the fibres affected correspond approximately in length to the frequency of the tone to which the experimental deafness has been produced.

(3) When a musical tone, transmitted by a telephone circuit, is suddenly changed in phase by a half-cycle, the voltage fluctuations in the circuit continue almost without interruption.

When a musical tone, which is causing a tuned structure to perform resonant vibrations, is suddenly changed in phase by a half-cycle, the

* Friday evening discourse at the Royal Institution, delivered on April 29.

vibrations of the tuned structure are first arrested and are then re-established. On performing a similar experiment with the human ear, just after the change of phase the musical note is heard to undergo a short interruption, that is, the ear behaves as if it contained resonators, and unlike a telephone.

(4) When a musical tone is interrupted for short periods of time, similar interruptions can be identified in a telephone circuit which is excited by the sound. When a musical tone, which is causing a tuned structure to perform resonant vibrations, is interrupted for a short period of time, the vibrations of the tuned circuit are found to continue with only a small diminution in amplitude. On performing a similar experiment with the ear, it is found that short interruptions cannot be detected; hence the ear behaves as if it contained resonators, and unlike a telephone.

(5) When two musical tones differing considerably in frequency, for example, 200 v. per sec. and 250 v. per sec., are sounded simultaneously into a telephone, the voltage fluctuations in its circuit are found to correspond to a single frequency of 225 v. per sec. with periodic increases and decreases of amplitude (beats) occurring 50 times a second. When the above two tones are caused to set up vibrations in a graduated series of resonators, two separate groups of resonators are found to be set into vibration, one corresponding to 200 v. per sec., the other corresponding to 250 v. per sec. A careful examination of the groups shows that neither of them is exhibiting appreciable beats. On performing the experiments with the ear, the two separate tones of 200 v. per sec. and 250 v. per sec. are heard and no beats are to be observed; hence the ear behaves as if it contained resonators, and unlike a telephone.

(6) When two musical tones having frequencies in the ratio of 1 to 3 are sounded simultaneously, the voltage fluctuations in a telephone circuit excited by them are found to be greatly affected by the relative phases between the two tones. In one phase relationship a single sharp peak curve is produced. In another phase relationship a double hump curve is produced. When the above two tones are caused to set up vibrations in a graduated series of resonators, two groups of resonators are found to be set into vibration, one group for each tone. The careful examination of the groups shows that neither their frequency nor amplitude is affected appreciably by changing the relative phases of the two tones. On performing the experiment with the ear, it is found that changing the relative phases of the tones has no effect on the sounds which are produced; that is, the ear behaves in accordance with the resonance theory and contrary to the telephone theory.

(7) It is well known that resonators exhibit the properties of selectivity (sharpness of resonance) and persistence, and that both these properties are related to the frictional losses to which the resonators are subject. In consequence of this, when different degrees of selectivity are multiplied by corresponding degrees of persistence a constant

value is obtained, as is shown in the following table:

<i>S</i> (selectivity).	<i>P</i> (persistence).	<i>S</i> × <i>P</i> .
1.5	40	60
2.0	30	60
3.0	20	60
4.0	15	60
6.0	10	60

(Selectivity in the above table is the percentage difference of frequency causing one-tenth the amplitude of that caused by the intune frequency at the same energy level. Persistence is the number of vibrations which correspond to the time required for the amplitude to be reduced to one-tenth its initial value.)

Now, the selectivity of a graduated series of resonators can be ascertained experimentally by finding the smallest difference of frequency which causes beats owing to the overlap of the two vibrating groups of resonators. The persistence of a series of resonators can be ascertained experimentally by finding the duration of the longest interruption in the incoming sound energy which produces no observable decrease in amplitude. Both these methods of research are applicable to the ear, and the table below gives the values I obtained. The last column shows that their product gives a reasonably constant value, as should be the case if the ear resonators are of the kind familiar to the physicist.

Tone.	<i>S</i> .	<i>P</i> .	<i>S</i> × <i>P</i> .
128	12.7	1.78	22.6
256	10.0	2.06	20.6
326	9.45	2.19	20.7
384	9.07	2.18	19.75
512	8.45	2.37	20.0
640	8.15	2.54	20.65
760	7.82	2.68	20.95
1024	7.22	3.01	21.70

REPLIES TO OBJECTIONS TO THE RESONANCE THEORY

(1) In a piano the wires are all separated from one another and are therefore free to vibrate individually. It is not difficult therefore to picture a small group of wires, or even a single wire, being set into resonant vibration. In the internal ear, on the other hand, the resonating fibres are seen under the microscope to be attached sideways to one another. How is it that these attachments do not impede or even stop resonant vibrations, or at the very least produce an irregular jangling?

In replying to this question, two points require emphasis; first, that when a group of resonators is being set into vibration by incoming sounds, those above and those below the frequency of the resonator which is strictly in tune with that of the sound are performing what are aptly called 'forced vibrations'. They do not perform vibrations at their own natural frequency, but vibrate at the frequency of the incoming sound energy. Thus, suppose a group of wires of a piano to be set into resonant vibration by a strong source having a frequency of 200 vibrations per second. Then, a stroboscopic examination of the vibrating wires should show that those on one side of the intune resonator are all moving towards or away from the observer at the same time.

Secondly, the number of fibres of the internal ear set into forced vibration by a pure source of sound is much more numerous than is usually supposed. If, having ascertained the fibre strictly 'in tune' with the musical tone, we count sixty fibres above it in pitch, on examining this fibre we should find that it is performing vibrations with an amplitude which is approximately one-tenth the amplitude of the 'intune' fibre. The sixtieth fibre below the intune one is also performing vibrations with an amplitude of one-tenth the intune one. Since so many fibres are affected, the difference in amplitude between one fibre and its next-door neighbours is very small; calculations show that they nowhere exceed 5 or 6 per cent. The attachments of the fibres to one another should therefore not markedly impede their vibration, and are therefore not incompatible with the resonance theory.

(2) So long as the incoming vibrational energy continues, resonators continue to vibrate; when this energy ceases, they gradually come to rest in an exponential manner. If the ear contained resonators, on the cessation of a musical tone we ought to be able to hear a gradual diminution of loudness. Everyday experience shows us, however, that silence appears to follow the cessation of musical tones almost immediately, and this is incompatible with the resonance theory. The explanation of this objection is as follows: If we know the threshold of stimulation of the sense organs attached to the fibres in the internal ear, and if we know the degree of persistence of the ear, we can readily calculate the time taken for the vibrations of the fibres to be reduced until 'silence' is reached. The values thus obtained for notes of medium loudness are given in the following table:

Tone.	Time in Seconds for Termination of Hearing.
128	0.057
256	0.036
512	0.021
1024	0.012

We see that these times are very short. Even for a tone of 128 vibrations a second, the time of the termination of hearing is less than one-seventeenth of a second. Our experiences, therefore, are not incompatible with the resonance theory.

(3) Pathological changes in the internal ear are sometimes found to produce deafness to one or more groups of frequencies. Whereas most tones, both high and low, are heard in a normal manner, there is deafness to certain intermediate ranges of frequency. It is often found that a frequency inside this range can be correctly perceived if its intensity be much increased. This finding is held to be incompatible to the resonance theory, on the following grounds: Suppose a certain number of fibres of the internal ear to be destroyed, then it is clear that the ear will be deaf to tones corresponding in frequency to the damaged fibres. If now a tone of sufficient intensity be sounded, which corresponds in frequency to the centre of the damaged region, normal fibres at the edges of the deaf region should be caused to perform vibrations. Provided that the stimulating tone be loud enough, the forced vibra-

tions should have sufficient amplitude to stimulate their respective sensory end organs. The individual should now hear one or more musical tones which correspond to the frequencies of these normal fibres. But experiment shows that what he does hear is a tone which corresponds to the frequency of the tone which is being sounded.

An example may make matters clearer. Suppose a man to be deaf to frequencies of from 200 to 240 vibrations per second, owing to complete destruction of the fibres which correspond to this region. Then on sounding a tone of 220 vibrations a second of ordinary intensity, nothing is heard by the affected ear. On sufficiently increasing the intensity of the sound, however, there should be, according to the resonance theory, forced vibrations on the part of the normal fibres just below 200 vibrations per second and just above 240 vibrations per second, and therefore the individual should hear two musical tones corresponding to these frequencies. Experiment shows, however, that what he does hear is a single musical tone corresponding to 200 vibrations per second, a result which, it is claimed, is incompatible with the resonance theory.

The reply to this objection is that its supposed pathological basis is unsound. Regions of deafness are not due to clean-cut destruction of certain fibres leaving neighbouring fibres intact, but rather to localised adhesions and exudates interfering with the normal vibrations of the fibres. In consequence, a tone of normal intensity sets the affected fibres into such feeble vibration that their sense organs receive insufficient stimulation. A more intense tone, on the other hand, may cause sufficient amplitude of vibration for the stimulating tone to be recognised. The behaviour of an individual with islands of deafness is not, therefore, incompatible with the resonance theory.

(4) It is found by experiment that a dog in which a limited number of fibres of the internal ear has been destroyed by a drill, exhibits afterwards deafness to a very small range of frequencies. Now, according to the resonance theory, many fibres are affected by a single frequency, and therefore deafness to a considerable range of frequencies should occur. Since this is not found to be the case, this experimental result is claimed to be incompatible with the resonance theory.

The reply to this objection is as follows: Suppose the part of the internal ear affected by the drill to be one millimetre in width. Then it is found by calculation that approximately 350 fibres would be destroyed. Now, we have evidence that one musical tone affects approximately 200 fibres, so that it is clear that the deaf region would correspond to the difference between these two values, namely, 150 fibres only. These would correspond to a piece of the cochlear 0.4 mm. in length, a length which is less than half that affected by the drill. The experimental finding that the deaf region is narrower than the destroyed region is in agreement with the resonance theory.

(5) In recent experimental investigations on the auditory nerves, Wever and Bray have detected

electric currents which correspond in frequency and phase to the sound waves falling on the ear. This would be the case if the auditory nerve were behaving like a telephone circuit, and if the internal ear was acting like a microphone. This evidence, which is in favour of the telephone theory, is at variance with the resonance theory. Now, Adrian, who has recently repeated Wever and Bray's experiment, found that freezing or crushing the auditory nerve, or putting novocaine on it, did not stop the effect, which cannot, therefore, be due to the passage of nerve impulses along it.

It would seem that the phenomenon, interesting as it is, has nothing directly to do with the behaviour of the internal ear, so far as normal hearing is concerned. There would appear to be no justification at the present time in claiming these experiments as being in agreement with, or in contradiction to, the various theories of hearing.

(6) According to the resonance theory, a great many fibres are set into vibration by a single pure tone, and fibres at the edges of the group differ from the centre one, which is 'in tune' with the incoming vibrations, by roughly a semitone. Why, then, do we not hear a dissonant noise when a single frequency falls on our ears? Gray has answered this objection by supposing that in some way the sense organs attached to the fibres are able to detect the fibre which is performing the maximum amplitude of vibration; and that the brain, receiving impulses of a special kind up the nerves connected with this fibre, is able selectively to receive the frequency corresponding to this fibre and to ignore the impulses from all the other more outlying fibres which are set into vibration by the tone.

Not only is it extremely difficult to see how a suitable physiological mechanism could be devised to do this, but also it would place the ear in a completely different category from that of vision and touch. In vision, we meet a corresponding phenomenon, for a point source of light stimulates not one cone sense organ of the retina but many cones. This effect causes no confusion. We always have seen point sources (for example, stars) that way. We presumably shall continue to do so all our lives. So with hearing. Single pure tones have always set a certain number of fibres into vibration; it is an effect to which we are accustomed. It would seem entirely unnecessary to invoke a special, and unusual, type of mechanism to deal with the phenomenon.

CONCLUSION

When, fourteen years ago, Wrightson published his book, the telephone theory received at his hands an impetus which was just what it required. The resonance theory had fallen into disrepute, the telephone was replacing it, and people were hesitating between the two. Unfortunately for the telephone theory, it was not long before criticisms of Wrightson's book began to accumulate. So serious were these criticisms that Wrightson's views had to be wholly abandoned. Since then, evidence has been accumulating in favour of the resonance theory. Objections to it appear in many cases to be based on erroneous ideas with regard to resonators and sense organs. It would seem, at the present time, that the resonance theory accounts satisfactorily for all the phenomena of hearing, and that no other theory does this.

Royal Society of Canada

ANNUAL MEETING IN OTTAWA

ON May 26-28 the Royal Society of Canada met in the new building of the Canadian National Research Council in Ottawa. Several features of the meeting arose out of the fact that the Society was celebrating its jubilee. Learned societies of Great Britain, France, and the United States sent delegates. The presidential address by Sir Robert Falconer, on the evening of May 26, was an eloquent and instructive survey of the remarkable progress of the intellectual life of Canada during the past half-century, as reflected in the proceedings of its Royal Society and, in fact, dominated by the fellows of the Society. This address and a series of detailed histories of the progress in special fields are assembled in an anniversary volume, entitled "Fifty Years' Retrospect". At the same evening meeting, delegates were received, a diploma was presented to the Prime Minister, Mr. Bennett, and the various medals were awarded, namely: the Flavelle Medal to Dr. J. S. Plaskett for his contributions to astronomy, the Lorne Pierce Medal to Dr. Archibald MacMechan for achievements in literature, and the Tyrrel Medal to Dr. Pierre-Georges Roy for his historical researches.

A new function of the Society appeared in the announcement by the Council of the award of ten fellowships endowed by the Carnegie Institution.

At the meetings of Section 1 (French Literature and History) twenty papers were read, and of Section 2 (English Literature and History) twenty-five papers were read.

The presidential address to Section 3 (Physics, Mathematics, Astronomy, and Chemistry) was delivered by Prof. A. Norman Shaw, who gave an interesting account of the developments in physics during the last fifty years. He paid tribute to the work done by physicists in Canada, dwelling especially on the contributions made at McGill by the late Prof. H. L. Callendar, Lord Rutherford, and by Prof. J. C. McLennan in Toronto. After reviewing the work in physics of the past and present fellows of the Section, he concluded his interesting address with a plea for closer co-operation between science and government with the words: "We await Governments which will devote their major expenditures of effort, time, and money in studying and directing the efficient harvesting and even

distribution of the knowledge and power which Science places at their disposal".

More than a hundred papers were presented to Section 3, which split up into the three divisions of physics, chemistry, and mathematics (including astronomy) in order to get through the programme during the meeting. In the physics division, interesting papers were given by Prof. L. V. King on "New Singular Solutions of Maxwell's Equations and Applications to the Calculation of Radiation Fields of Wireless Antennæ", in which he demonstrated that the exact theory of radiating antennæ could be given. Prof. J. A. Gray gave several papers on the scattering of β -rays. His results indicated that the range of β -rays from radium-E are much greater than the values found by other observers, the range in aluminium and lead being about the same. The loss of energy in the scattering increased with increase in angle of scattering, but could not be accounted for by penetration of the nucleus. The loss in energy, amounting to 20 per cent, went off in the form of radiation which was not X-rays. Dr. R. W. Boyle presented a number of papers by the members of the Canadian National Physical Laboratory on various topics. In a paper on the passage of ultra-sonic waves through thin plates of glass, the experimental results showed that Rayleigh's theory is inadequate. C. D. Niven spoke on heat insulation of fibre boards, G. C. Laurence on a new type of γ -ray ionisation chamber for radium calibration, and L. E. Howlett on "Some Theoretical Considerations on the Intensities of Raman Lines". Prof. A. N. Shaw described a new theorem by which all the thermodynamical relations involving first and second derivatives of the different variables for a simple substance can be rapidly deduced.

There were several papers on applied geophysics, amongst which Prof. L. Gilchrist's application of geophysical methods to the determination of stake resistances of earth contacts associated with power transmission lines and Prof. L. V. King's mathematical investigation on potential problems in semi-infinite stratified media were of interest. Dr. G. M. Henderson and S. Bateson spoke on a quantitative study of pleochroic haloes. Prof. A. S. Eve gave an interesting account of proposed experiments on the Kennelly-Heaviside layer during the total solar eclipse of Aug. 31 this year, when observations will be made to detect a possible eclipse of particles emitted by the sun. Dr. H. T. Henderson added some remarks on the work being undertaken in England on the determination of the height of the K-H layer. The secretary of the Section, Mr. J. Patterson, presented a paper on "A Source of Error in Measuring Radiation on a Horizontal Surface", and Mr. Andrew Thomson a paper on the results of an analysis of 171 pilot balloon observations taken in the central Pacific from the research yacht *Carnegie*, from which the trade and anti-trade wind circulation in the Pacific was deduced. Prof. H. A. McTaggart gave an account of a study of Brownian movement in thin films of various substances on water or aqueous solutions.

Among the numerous papers on spectroscopy, Prof. J. K. Robertson gave an account of the change in the type of spectra, from the spark to the arc spectrum, with the presence of continuous bands when thallium vapour at different temperatures is excited with the electrodeless discharge. Damped and continuous waves were used and different effects obtained. Prof. J. C. McLennan and his co-workers presented several papers. A definite change in the scattering of light was observed at the critical point in liquid helium. In association with H. D. Smith, the Raman effect in liquid and solid carbon dioxide was found to give four frequency changes which were the same as those found in the gaseous state. The absorption spectrum in the band spectrum of xenon was investigated, and in another paper the wavelengths of some copper lines in the extreme ultra-violet were accurately measured with a Fabry-Perot interferometer and a spectrograph. Prof. J. S. Foster described the mounting for a thirty-foot grating spectrograph for observing the flash spectrum during the coming solar eclipse. A paper on the Stark effect in the red region of the xenon spectrum, by J. F. Heard, indicated a Stark displacement in 89 lines.

Among the dozen papers in the mathematics and astronomy division, Prof. S. Beatty spoke on geometric characterisation of lineal transformations; S. A. Lischinsky and W. J. Webber on the representation of almost all positive integers in the form plus square; and Dr. J. Synge on variational principles and dissipative systems. Dr. W. E. Harper gave a paper on the wave-lengths of *A*-type stars and also one on the orbits of four spectroscopic binaries.

More than forty papers were presented in the chemistry division. Of the several papers presented by Prof. O. Maass and his students, two dealt with the absolute density of dry cellulose and the sorption of sodium hydroxide on cellulose and on wood. Another paper, by A. R. Williams, Prof. O. Maass, and Prof. F. M. G. Johnson, described the results of the measurement of the heats of solution of sulphur in carbon disulphide over a large range of concentration, from which an estimate of the total surface energy of sulphur was made. Energy transfer between complex gas molecules and solid surfaces was dealt with by E. W. R. Steacie and H. A. Reeve. Dr. R. H. Clark presented several papers on the separation of rare earth elements. Prof. H. E. Bigelow read a paper on the production of *p*-nitrobenzaldehyde by sodium arsenite, in which the results were materially different from those obtained when other reducing agents were used.

Prof. C. A. Chant was elected president of the Section for the 1933 meeting, and Mr. John Patterson continues as secretary.

Section 4 (Geology) received twenty-four papers, several of which were read by title. The papers actually presented evoked interesting discussion at the well-attended meetings. An important report by the National Committee on Stratigraphical Nomenclature was presented by F. I. Alcock. A

series of papers on batholiths was a prominent feature of the meeting, the contributors being S. J. Schofield, F. A. Kerr, H. C. Gunning, Prof. J. S. De Lury, and J. F. Wright. A new theory of the source of the siliceous solutions from which asbestos is produced was put forward by H. C. Cooke in a paper on their silica content. G. A. Young reviewed fifty years of geological investigation of the Canadian Shield, stressing the changes which have taken place and may yet take place in the fundamental ideas regarding this branch of geology. The president-elect of the section is Prof. E. L. Bruce.

In Section 5 (Biological Sciences) ninety-six papers were read, part of the time in divided session.

In his presidential address, Prof. J. B. Collip reviewed the work carried out under his direction on the oestrogenic substances and the anterior pituitary-like substance of the human placenta. Various aspects of this work were later discussed in detail by some of his collaborators. The interrelation of calcium metabolism with the parathyroid glands and with irradiated ergosterol was the subject of a series of papers by other members of the same department and also by Prof. N. B. Taylor. Prof. C. H. Best discussed the possibility of preventing fatty degeneration of the liver in diabetic animals by administration of choline, and presented a series of papers by Dr. D. A. Scott on the chemistry of insulin. Prof. J. G. FitzGerald read papers from his laboratory in the field of immunology. Important papers were also read by Prof. S. E. Whittall on the causes of exophthalmos, and by Prof. B. P. Babkin on the liberation of a hormone from the nerve-endings of the chorda tympani.

The life of reindeer and other mammals in relation to segregation, sexual isolation, and evolution of species was discussed by Prof. Seymour Hadwen. Prof. A. Willey described a new species, *Nebaliella Caboti*, the first of the genus recorded from the North Atlantic, and showed that another form, *Epineballia pugettensis*, is distinguished generically from *Nebalia* by the structure of the male. Prof. E. M. Walker presented several papers, amongst which may be mentioned one by F. P. Ide on the effect of the temperature gradient of a stream upon the insect fauna, and another by himself on prognathism and hypognathism in insects. One food chain of the sea, from diatoms to fish through cope-

pods, was demonstrated in a paper by C. W. Lowe, presented by Prof. A. H. R. Buller.

The botanical papers were varied and interesting. Those dealing with morphology, including a correlation of resin cyst production in hemlock, in response to wounding with seasonal growth; an account of the origin of rays in Gymnosperms in relation to taxonomy (both papers by M. W. Bannans); and an account of the organisation of the young sporophyte of *Isoetes*, based on anatomy, in comparison with that of other Pteridophytes (by W. K. W. Baldwin) were presented by Prof. R. B. Thomson. Prof. Marie Victorin recorded several examples of the transformation of the concretescent carpels of *Aralia nudicaulis* into five simple leaves or leaflets. Dealing with fungology were several papers from Prof. Thomson's laboratory on the subject of rusts and other fungi, and a very interesting account of hyphal fusions and their significance by Prof. A. H. R. Buller. Plant physiology included some important papers by Prof. G. H. Duff and Dorothy Forward, on respiratory metabolism and sugar changes in wheat leaves kept in the dark, and on the influence of this on their reaction to rust infection. Prof. F. E. Lloyd criticised M. Kruck's revival of the theory that the door of the trap of *Utricularia* is an irritable mechanism. An intensive study of the water balance of certain Canadian trees throughout the year and its bearing on problems of tree physiology was given in a paper by R. D. Gibbs. Dealing with cytology and genetics were papers by Prof. C. L. Huskins, adducing evidence of the homology between somatic mitosis and germinal meiosis, which indicated that the latter is brought about through retardation of the splitting of the chromonemata during the last premeiotic division. Taxonomy and ecology were represented in a series of papers by Prof. Marie Victorin and his associates. Of especial interest was the account of ecological modifications in the riparian flora of the St. Lawrence River, due to exceptional low water levels, and of the spread and adaptability (for example, to growth in deep water) of the introduced species *Butomus umbellatus*. Prof. J. G. FitzGerald was elected president of the Section.

The president of the Society for the ensuing year is Prof. Francis E. Lloyd, Macdonald professor of botany in McGill University.

Obituary

PROF. G. BALDWIN BROWN

WE regret to record the death of Emeritus Prof. Gerard Baldwin Brown, which took place at Edinburgh on July 12, at the age of eighty-two years. Born in London on Oct. 31, 1849, he was educated at Uppingham and Oriel College, Oxford—of which later he became a fellow—obtaining a second class in Honour Moderations and a first class in Literæ Humaniores in 1873. His success in winning the Chancellor's prize for an essay on "The Short Period during which Art has remained at its Zenith in Different Countries" was an early indication of

the bent of his mind, a bent which was further strengthened by his election as a fellow of Brasenose College, where he was brought into touch with Pater. He left Oxford to take up painting in London, and was afterwards appointed the first Watson-Gordon professor of fine art in the University of Edinburgh, at the early age of thirty-one. This chair he held for fifty years, retiring at the end of the academic year 1930, a period equalled only twice in the annals of the University.

Baldwin Brown's early essay in the history of art while he was still at Oxford had indicated that his

approach to art was archæological and historical rather than purely æsthetic; and interest in that line of inquiry grew as his life-work developed. His earliest book was "From Schola to Cathedral", a study of early Christian architecture. His outstanding and most enduring work is "The Arts in Early England", a monumental effort and an established authority, in five completed volumes and part of a sixth, published at intervals between 1903 and 1930, which displays a wide knowledge of the facts and indefatigable industry. In it, as in a smaller but comparable work, "The Arts and Crafts of our Teutonic Forefathers", he stressed—unduly, many archæologists would now say—the contribution of the Teutonic races in the artistic origins of Britain and North and Central Europe generally. The knowledge of æsthetic principles and theory which Baldwin Brown brought to bear on the archæological problem in his larger work was also used to advantage when dealing with palæolithic art in "The Art of the Cave Dweller" (1928), his Munro Lecture, a book for the preparation of which he had visited the caves of France and Spain, though then nearly eighty years of age, and in which the large number of illustrations, many of them of the less known examples of cave art, was used with striking effect in demonstrating with

precision, from what to most archæologists was a new point of view, the æsthetic qualities of palæolithic painting and engraving, as well as the intentions and achievement of the artist.

In addition to the books already mentioned, Baldwin Brown was the author of "Anglo-Saxon Architecture", "The Life of Anglo-Saxon England in relation to the Arts", "The Care of Ancient Monuments", and a number of books on individual painters or matters of artistic technique. He was a fellow of the British Academy, of the Finnish Archæological Society, of the Yorkshire Philosophical Society, an associate of the Royal Institute of British Architects, and hon. LL.D. and D.Litt. of the University of Edinburgh.

WE regret to announce the following deaths:

Prof. Fran Jesenko, professor of botany in the University of Ljubljana, Yugoslavia, known for his work on the genetics of wheat and rye, on July 14, aged fifty-seven years.

Prof. Graham Lusk, For.Mem.R.S., professor of physiology in Cornell Medical College, New York, a distinguished worker on the physiology of nutrition, on July 18, aged sixty-six years.

News and Views

A Century of Medicine

THE RIGHT HON. LORD DAWSON OF PENN delivered his presidential address at the centenary meeting of the British Medical Association on July 26, taking as his subject "A Hundred Years and After". Lord Dawson traced the art of healing from the Egyptian Imhōtep (*circa* 3000 B.C.), through the well-known Greek era, to the Christian era, where at the beginning there was a retrogression, Christianity at that time delaying rather than promoting medical progress. The greater part of Lord Dawson's address, however, was devoted to the directions along which medical knowledge has grown during the last hundred years. The Reform Bill of 1832 forced masses of the population to dwell in towns, with the result that the prevailing conditions, due to lack of knowledge of public health and sanitation, caused misery, ill-health, and discontent. During the year of the Association's birth, there was a cholera epidemic raging over England and Wales, during which the number of deaths exceeded 50,000. At that time the idea prevailed that epidemic diseases were visitations beyond our ken and control. Even then, however, great minds were working: Virchow in cellular pathology, Bernard in physiology, Bright in medicine, and Chadwick in sanitation.

Medicine and the Basic Sciences

THE dawn of the new era in medicine occurred, however, in 1857, with Pasteur's discoveries. These were soon followed by those of Lister, and thus began a quick succession of discoveries by men well known in the history of science and medicine. To-day there is a stronger link with medicine and the pure sciences.

Physics and chemistry, with physiology, have taken pride of place in their services to medical knowledge. Radiology has the discoveries of Röntgen and others as its basis. Chemistry has afforded incalculable aid to therapeutics. The value of the scientific investigations of the seven known vitamins to medicine need scarcely be emphasised. Hormones and virus diseases are now of great importance to the study of physiology and pathology. The kinship between medicine and education was also emphasised by Lord Dawson. Still closer co-operation is required in the quest for knowledge. The Medical Research Council is doing a great service in supporting and directing efforts, wherever they come from, and it maintains contact between workers and between the institutions to which they belong. "There is, however, need for further co-ordination among bodies which represent varied aspects of medical knowledge such as the basic sciences, medicine, surgery, obstetrics, education, and administration."

Progress of Rational Medicine

SIR CHARLES HASTINGS, founder of the British Medical Association, was a native of Worcester, and part of the centenary meetings of the Association took the form of a visit to Worcester on July 24 and a commemorative service in the Cathedral, with a sermon by Dr. E. W. Barnes, Bishop of Birmingham. Dr. Barnes's text was "Honour a physician with the honour due unto him" (*Ecclesiasticus*, xxxviii. 1). Modern science and medicine began with the publication by Copernicus of his heliocentric astronomy and the production by Vesalius of his work on the anatomy of the human body. Nearly four centuries have

passed since then, and the human mind, freed from the shackles of medieval authority, has advanced at an ever-increasing rate. Great progress has been made in medicine and science, and the "new biology exhilarates by its possibilities"; advance along present lines gives visions of a great measure of immunity from disease and a finer race of men than the earth has yet known. Progress depends, however, in medicine as in science, on the unprejudiced search for truth, on original investigation. During the nineteenth century, conditions became increasingly favourable for medical research, until now it is well organised and receives State support. But what of the future? Dr. Barnes fears that we are not yet safe from religious reaction. New aspects of truth often bewilder and arouse instinctive opposition, which in turn invokes religious sanctions. Pseudo-religious prejudice opposes eugenic measures, as dissection and vaccination were opposed in the past, and faith cures may be associated with impatience of the sufferer with half-won knowledge. Social leaders, religious teachers, scientific workers, and medical men must join in emphasising that man has been endowed with his rational powers in order that he may discover the truth. Science is dynamic, and our faith, likewise, is the more inspiring because it also is dynamic.

British Medical Journal

THE issue of the *British Medical Journal* for July 23 is a special number commemorative of the centenary of the British Medical Association, which has been celebrated during the past week in London. Sir Humphry Rolleston contributes a review on "Changes in the Medical Profession and Advances in Medicine during Fifty Years", and Sir D'Arcy Power, in "A Century of British Surgery", describes the progress of surgery. The history of the Association is surveyed in a special article entitled "The First Hundred Years", with portraits of Ernest Hart and Sir Dawson Williams, prominent among the editors of the *British Medical Journal*. A notice is also devoted to Sir Charles Hastings, the founder of the Association, and the Association's headquarters in Tavistock Square, London, are described, with a coloured plate illustrating the imposing Great Hall.

Park Wood, Ruislip

ON July 23, the Earl of Crawford and Balcarres, who is chairman of the Council for the Preservation of Rural England, declared Park Wood, Ruislip, in Middlesex, a sylvan area of 237 acres, and the property of King's College, Cambridge, as dedicated for public use, in perpetuity. It has been acquired through the assistance of the Middlesex County Council, coupled with that of the Ruislip-Northwood Urban District Council. Complementary to the above is the gift by the College of the ancient manor house, its farm buildings, old-world gardens, and lofty and impressively timbered barn, one of the largest in the country, which accommodated nearly three hundred persons at the ceremony. Lord Crawford expressed the hope that the woodlands might always remain as such, and be truly English in character. The kindly agencies of Nature would sanctify them through their flora and

fauna, and in particular there was the inspiration of bird life. Congratulations were extended to the provost and fellows of King's College on the happy arrangement effected.

THE Bursar of King's College, during his speech, recalled the original connexion of the College—extending over five centuries—with this Middlesex parish. It dated, in fact, from 1461, when Henry VI. granted to the provost, Robert Wodelark, and the scholars of the College, "the Manor of Ruyslepe . . . and all lands belonging". The king had, in 1440–41, entrusted to three commissioners his authority to proceed in the matter of a college which he proposed to found, and had indeed lived to see the magnificent chapel of King's completed. It was a sister foundation to that at Eton. In the nineteenth and twentieth centuries many changes have been experienced by the College, as trustees, whilst 'town-planning' schemes and urbanisation have cast their burden of responsibility. The Bursar disclosed that, so late as 1906, an offer of no less than £48,000 was made by a syndicate for the establishment of a racecourse; the offer was withstood, however, by the casting vote of the provost of that time.

Early Man in America

A FURTHER detailed research report on the discoveries of flint implements said to be associated with fossil remains of Pleistocene mammals in Nebraska, to which we referred in our issue for July 16, p. 87, has been made to Science Service, Washington, D.C., by Dr. W. D. Strong, of the Bureau of American Ethnology. It presents several points of interest. The Cumro find of an arrow-head, or rather 'point', associated with the extinct *Bison occidentalis*, lay under 16 ft. of loess of 'Peorian age', which is thought by the discoverer to be prior to the last or Wisconsin glaciation; but Dr. A. L. Lugin, of the University of Nebraska, the specialist in Nebraskan and Iowan Pleistocene deposits, regards this dating with some doubt, as some 'Peorian' deposits are unquestionably recent. On the other hand, the same authority, after a personal examination of the site of discovery of the second flint implement on the Platte River, also said to have been associated with *B. occidentalis*, while recognising that the exact age cannot be determined with finality, is of the opinion that the deposit shows considerable antiquity. It may be of 'Peorian' age; and it shows Kansan sands and gravels as the basal member. It has also transpired that the association of flint artefact and remains of *B. occidentalis* is supported by a hitherto unreported discovery in 1923, when a chipped point was found in association with a skull and part of the skeleton of this extinct bison in the Meserve quarry. By far the most interesting find, however, from the point of view of dating, is that at Angus, where the "Folsom type arrow-point" was associated with the mammoth. Unfortunately, here the association lacks corroboration; but the sands and clays in which the mammoth bones were laid down appear to belong to the Yarmouth interglacial, which corresponds with the Mindel-Riss of Europe. In any event, the implements belong to a hunting culture hitherto unknown in Nebraska.

Military Conquest and Civil Settlement

FOR his presidential address to the Devonshire Association on June 21 Mr. J. J. Alexander surveyed "The Saxon Conquest and Settlement". Although he gave a very wide interpretation of his subject, devoting a considerable portion of his address to the question of evidence—historical, legal, and scientific—yet he brought together a useful résumé of what has been written on the matter. He made great use of the recently published volume of the Place Names Society on Devonshire, and summed up his paper by arriving at six probable conclusions: the first, as to the sparsity of the population of the district in the seventh century, and the remaining five regarding the campaigns of the seventh and eighth centuries in the west of England. Mr. Alexander has not, however, distinguished quite sufficiently between conquest and settlement. The military leaders and their soldiers prepared the way for the settlers who later, and sometimes much later, came with their wives, families, and baggage and travelled perhaps by a different route from that by which the soldiers marched. The study of place-names is most important for the history of the Saxon period, but, besides archaeology and written history, it needs to be supplemented by studies of the varied systems of agriculture and the distribution of types of villages by the aid of the ordnance map—"that marvellous palimpsest which, under Dr. Meitzen's guidance, we are beginning to decipher", as Prof. Maitland has pointed out. Something has been done in this respect for eastern England, where the evidence is clearer, but in the west, where the evidence is more confused and difficult of interpretation, the subject has received little attention.

Prehistoric Society of East Anglia in 1931

THE recently issued *Proceedings of the Prehistoric Society of East Anglia* for 1931 (vol. 6, pt. 1) contains a number of communications of importance for prehistorians. The presidential address by Mr. J. P. T. Burchell on "Early Neanthropic Man and his Relation to the Ice Age" has already been the subject of reference in NATURE (Nov. 21, p. 879; 1931). It is printed here in full with ample illustration. Among the remaining papers, Mr. Bertram Brotherton describes a remarkable rostrocarinate implement of quartzite from Worcester, upon which Mr. Reid Moir remarks that it may be less ancient than its type suggests. Mr. Reid Moir himself chronicles further discoveries of flint implements in the brown boulder-clay of north-west Suffolk. He is now inclined to think that the brown boulder-clay was laid down before the Magdalenian period began. In a paper on the flint industries of the type station of La Madeleine, Mr. A. S. Barnes discusses their value as a basis for the classification of Magdalenian industries elsewhere. Mr. A. Leslie Armstrong deals with his further excavations in the Pinhole Cave at Creswell Crags and on a late Aurignacian site in Lincolnshire. Mr. A. L. Grimes, in dealing elaborately with the early bronze age flint-dagger in Britain, suggests that while it was undoubtedly introduced into Britain with the beaker culture, it shows resemblances to both the two main

Continental groups, the northern and the Mediterranean. An account of the excavation of an early iron age site at Great Wymondham, Herts, by Mr. C. F. Tebbutt, is especially noteworthy, as sites and finds of this 'early phase' (La Tène I. and II.) are rare in that area.

John Fitch, Pioneer of Steam Navigation

IN the June issue of *Mechanical Engineering*, Mr. W. H. Richardson gives a sketch of the career of "John Fitch: Patriot, Martyr, Pioneer Steamboat Inventor". Fitch was born in 1743 and died by his own hand in 1798, having during the last fifteen years of his life devoted himself with fluctuating fortune to the promotion of steamboat enterprises. He was the first in the world to form a steamboat company and to place a steamboat in service for carrying passengers. His work was done at a time when there were no engineering shops in America and when the export of machinery from England to the United States was prohibited, and there can be little question that had he had the assistance of Watt and Murdock and their fellows, his schemes could have been brought to a successful issue. Above all, however, he was a man of vision, and while realising the great value of steamboats on the great waterways of America, he once wrote of steam navigation, that "The Grand and Principle Object must be on the Atlantick, which would soon overspread the wild forests of America with people and make us the most opulent Empire on Earth". The earliest experiments of Fitch were made on the Delaware between 1786 and 1790, and were contemporary with those of Rumsey on the Potomac and of Miller and Symington in Scotland. To-day there is a monument at Trenton, on the "John Fitch Way" beside the Delaware, marking the site of the New Jersey terminus "of the first merchant marine highway in the world".

Heating the Soil Electrically

THE South Wales Electric Power Company of Cardiff is distributing pamphlets to farmers giving them useful information on the advantage of the electrical heating of the soil in frames used for growing vegetables and fruit for the early market. The soil is heated by means of a 'thermal' cable buried in the soil and carrying at certain times of the day electric current. British and continental firms are now manufacturing this kind of cable, and an electrical contractor will install it. This pamphlet demonstrates by photographs how much more rapidly a cucumber will grow in an electrical hotbed than in an ordinary frame. It is pointed out that Norwegian and Swedish market gardeners and farmers produce lettuce and other market plants at out-of-season periods by this method. It is also useful in growing cantaloup melons and other expensive fruits at times when they are very dear. It is suggested that the electrical heating of the soil may prove useful for the growing of mushrooms, and would be a pleasanter method than the one ordinarily used. Experiments with this end in view could easily be carried on in a cupboard or a cellar. Orders have been issued under the provisions of the Horticultural Products Act imposing

duties on vegetables, fruits, and flowers. One of the effects of this order will be to keep out luxury products, and will give gardeners an opportunity of capturing a market which has hitherto been beyond their reach. There is now to be a duty of eight shillings per cwt. on all foreign lettuce from Jan. 1 until April 30. It is easy to compute the exact cost of the electric installation required; and where electricity is cheap, much can be said in its favour.

International Industrial Agreements

IN a general report on the economic aspects of international industrial agreements recently prepared for the Economic Committee of the League of Nations, it is concluded that international agreements constitute an important attempt to remedy certain disadvantages of the present economic evolution. They are not a panacea and do not apply to all products; they may mitigate but not abolish economic crises. Like other human institutions, they are liable to error and even abuse, but experience has shown that they quickly pay for any mistaken policy, and a false step may even imperil their existence. When of long duration, their interest definitely coincides with the general interest, for example, in stabilising at moderate prices, eliminating dumping, stabilisation of customs duties, and of employment, and in minimising the fall of wages in periods of depression. The advantages of lower costs to producers are secured in various ways, such as regular production, diminution and standardisation of stocks, elimination of unnecessary transport, economies and increased efficiency in research and other technical matters, patents, marketing, sales organisation. The advantages of greater equilibrium between production and consumption and of relative stability in prices are equally beneficial to producer and consumer. Agreements do not eliminate competition, but the limitations they impose on competition are beneficial, as avoiding waste or destruction of capital. The existence of international agreements did not create the present crisis; on the contrary, the seriousness of the crisis intensified the movement for such agreements to mitigate its consequences. They are accordingly considered to constitute a valuable guarantee of the economic and political stability of the nations.

North American Oyster Fisheries

MR. H. P. SHERWOOD who, during 1930, was sent by the English Ministry of Agriculture and Fisheries to investigate the American methods of oyster culture, in his paper "The Oyster Industry in North America: a Record of a Brief Tour of some of the Centres on the Atlantic and Pacific Coasts, and of a Summer in Canada" (*J. Conseil*, vol. 6, No. 3, Dec. 1931), gives an interesting account of the industry in North America and the various beds visited. He spent a summer in Canada, working on oyster investigations in Malpeque Bay, Prince Edward Island, and also visited most of the oyster-raising areas on both coasts of the United States. Recent figures put the annual yield of the oyster industry in North America at about 73,000 tons of food, valued at more than

14,000,000 dollars. The oysters belong to large and small companies and individual owners of oyster schooners, or oystermen, who fish in shallow reserved portions of the public beds. The natural beds of *Ostrea virginica* on the Atlantic coast at one time flourished from Maine to Mexico, but have greatly dwindled, and on the Pacific coast the industry is now practically confined to inlets in the State of Washington. Cultivation lies chiefly in providing in the summer clean shell cultch on the beds for attachment of the larvæ, culling or separating and sorting oysters from clusters in the clutch, and planting spat and half-grown oysters, together with measures for destroying pests. There is a demand for a greatly increased supply of seed oysters in many of the oyster-growing areas, although natural falls may in some seasons be very prolific. A few years ago this stimulated renewed interest in the problem of raising spat artificially, but more recently research has been directed to extending the possibilities of securing good sets of natural spat and to destroying pests, rather than to developing hatchery methods.

The Gulf Stream

THE results of investigations on the behaviour of the Gulf Stream were communicated to a recent meeting of the American Geographical Union at Washington by Mr. P. E. Church. According to Science Service, Mr. Church discovered many irregularities in width and temperature but no clear seasonal fluctuations. The data were obtained by recording instruments installed on commercial vessels crossing the triangle of waters between Halifax, Bermuda, and the Georgian coast. Inshore water extends to about the hundred-fathom line, beyond which is a wide area of cool water, ending in a narrow band of cold water believed to be due to upwelling from the depths. The Gulf Stream lies beyond, and was found to be 50 miles wide off Cape Hatteras and not more than 70 miles wide south of Nova Scotia. Outside the Gulf Stream to the south-east lies a broad area of warm water reaching towards mid-ocean. During the winter months, and occasionally at other seasons, the Gulf Stream flows as a double stream, with a tongue of cold water between, which may pinch off the northern stream and push the main stream considerably southward. Mr. Church does not explain this deviation, but doubts if wind action is the cause. South of Halifax the northern edge of the Gulf Stream averages a distance of 290 miles offshore but varies between 230 and 420 miles.

Science and the Empire

THE July number of *Discovery* is devoted, in view of the Ottawa Conference, to the subject of science and the Empire. Sir Stephen Tallents manages to give in a very few pages a vivid picture of the varied scientific activities which, on the confines of the Empire, become particularly associated with agriculture, the mainstay of dominions and colonies alike. The close contact maintained between scientific work at different centres is emphasised in this review and

illustrated by specific examples, and this practice is commended to the statesmen now gathered at Ottawa. The Right Hon. Lord Lugard explains the plan of the African Institute, with the financial support of the Rockefeller Foundation, to make a detailed study over a five-year period of the results of the impact of European civilisation upon the tribal system. Dr. H. V. Taylor, Commissioner of Horticulture to the Ministry of Agriculture, writes upon science and Empire fruit growing. The keynote of this article is that variation of climate, in the vast area covered by the Empire, prevents standardisation of methods, so that the grower is thrown into the hands of the research worker. Wool research in New Zealand and Empire air routes are other topics akin to the main theme which are also discussed.

Acquisitions of the Natural History Museum

A SERIES of microscope preparations showing all the earlier stages in the life history of the graptolite *Climacograptus* has been presented to the Department of Geology of the Natural History Museum by the Sedgwick Museum, Cambridge. The preparations were made by Mr. Ian Cox from material which he collected from rocks of Ordovician age in Akpatok Island, Ungava Bay, Northern Territory, Canada. Graptolites occur in the oldest fossiliferous rocks, and are organisms of unknown relationships, but generally supposed zoologically to resemble the living sea-firs, or sertularians—minute colonies of polyps encased in a horny skeleton. In the material from Akpatok Island, the original horny skeleton is preserved in a matrix of limestone, which can be dissolved and the skeleton extracted entire. The minutest structure and ornament of the early chambers, or thecae, are visible, and the order and manner of budding of new thecae can be clearly determined. Miss K. B. Macvicar has presented the extensive herbarium of her brother, Dr. Symers M. Macvicar, to the Department of Botany. Dr. Macvicar was the recognised British authority on Hepaticæ and was the author of the standard systematic account of them, "The Student's Handbook of British Hepatics". The herbarium is very rich in British and Continental species, and these are the more valuable because they are the basis of the descriptions and comparisons in the "Handbook". Dr. Macvicar was a medical man whose home was at Acharacle, Argyll, and in his travels in western Scotland accumulated an unrivalled representation of the flora, particularly of the less frequented parts of Argyll and Inverness. The herbarium contains about 18,000 specimens (that is, labels) and, as well as hepatics and flowering plants, contains mosses, seaweeds, and lichens. Mr. A. H. G. Alston, assistant keeper in the department, has just returned from western Greek Macedonia, where, in company with Mr. N. Y. Sandwith, of the Kew Herbarium, he spent six weeks. He collected about 1200 specimens, chiefly flowering plants. These are of interest because the area along the Albanian frontier has been visited previously only by a Czechoslovakian collector; moreover, the districts visited overlap to some extent those from which some plants were obtained by the department during the War.

Protection of the Fauna and Flora of Poland

IF one may judge by the size and quality of *Ochrona Przyrody* for 1931, the publication of the National Council for the Protection of Nature in Poland, a very vital interest is taken there in the preservation of natural amenities. The articles contain proposals for the formation of reserves for the primitive flora of the Dniester valley and elsewhere; but, perhaps because the position of some of the animals is more precarious, we turned to find out what measures were being discussed for their behoof. The opinion is held unanimously that the chase of the red deer of the Carpathians during the period of rut is harmful to the species and is responsible for the annual degeneration noticeable in the herds. But agreement is not reached as to the best means of meeting the difficulty. The majority hold as a distant ideal the desirability of suspending all hunting during the period of the rut, but since the custom is old-established and widespread, a gradual approach to the desirable end is suggested. An interesting paper by Wladyslaw Burzynski, the chief forester, discusses the position of the bear in the eastern Carpathians. The War was responsible for the slaughter of much of the breeding stock, so that even now the number probably does not exceed three hundred in an area of about 300,000 hectares. A third paper describes a visit to the workings and lodges of two colonies of beavers, one on the Szczara, the other on the Niemen.

Research and the Wheat Quota

SIR ALBERT HUMPHRIES, chairman of the National Institute of Agricultural Botany, in the course of his address to the annual meeting of the Institute's fellows at Cambridge on July 21 showed how agricultural research helps the farmer to make good use of the wheat quota. The quantity of wheat grown in Great Britain has been steadily diminishing and the proportion used for poultry has increased, so that in the past season home-grown wheat represented only some seven per cent of the national grist. The wheat quota is likely to raise this figure considerably, and the quality of English wheat for bread-making may come into its own again. The Cambridge Plant Breeding Institute has produced, and the National Institute of Agricultural Botany is now testing, a variety of which the quality is markedly superior even to Yeoman. Yielding capacity is, however, of first importance, and there are often differences of up to 20 per cent between varieties. The Institute in 1930-1931 tested, by methods which can detect much smaller differences, some hundred varieties, of which twenty are new ones not yet on the market. Sir Albert Humphries urged that facts of this sort show the Institute to be working directly for the improvement of the farmer's financial position.

Courtauld Institute of Biochemistry

THE Courtauld Institute of Biochemistry of the Middlesex Hospital Medical School was given by Mr. S. A. Courtauld because the services of this department to the Hospital had increased so greatly that it was impossible to house it in the Institute of

Pathology any longer. The Courtauld Institute was opened in June 1928; the building consists of five floors devoted to general biochemical research, and particularly to clinical biochemistry. In this department all the routine analyses of the Hospital are performed. At the opening, Mr. Courtauld endowed the chair of biochemistry to the extent of £20,000. Unlike most donors, however, he has realised the heavy cost of running such a department, and being anxious that it should continue to be used to the very best advantage, has generously given the Institute a further sum of £20,000.

Dr. Otto Struve

It is announced in a Science Service bulletin for June 18 that Dr. Otto Struve succeeds Dr. E. B. Frost as director of the Yerkes Observatory. Dr. Struve represents the fourth generation of the Struve family that has made valuable contributions to astronomy. He is a great-grandson of Dr. F. G. W. Struve, who did pioneer work on double stars at Dorpat and Pulkova about a century ago. The latter was succeeded at Pulkova by his son Otto, who continued the work on double stars, and made a study of stellar distances and the solar motion. Both of Otto's sons carried on the family tradition, at Berlin and Dorpat respectively. His grandson, the new director of Yerkes, was born in Russia in 1897, and studied at the University of Kharkov. In 1921 he became an assistant in stellar spectroscopy at the University of Chicago, taking the degree of Ph.D. in 1923. He has been at Yerkes since 1924, being in succession instructor, professor, assistant director, and now director.

Announcements

THE Medical Research Council has awarded Dorothy Temple Cross fellowships for 1932-33 to the following: Veronica B. F. Dawkins, resident medical officer, Maltings Farm Sanatorium, Colchester; G. M. Dean, formerly of the Department of Surgery, University of Aberdeen; Evelyn M. Holmes, formerly assistant tuberculosis officer, Welsh National Memorial Association; J. N. O'Reilly, formerly house physician, Brompton Hospital, London; Dr. W. G. Scott-Brown, assistant surgeon, Throat, Nose, and Ear Department, Royal Free Hospital, London.

By an Order of the Committee of Privy Council, made after consultation with the Medical Research Council and with the president of the Royal Society, Prof. A. E. Boycott, Graham professor of pathology at University College Hospital, London, and Prof. E. D. Adrian, Foulerton professor of the Royal Society and fellow of Trinity College, Cambridge, have been appointed members of the Medical Research Council, in succession to Prof. Robert Muir and Sir John Parsons, who retire in rotation on Sept. 30 after four years' service.

THE ninety-second meeting of the German Association of Men of Science and Physicians will take place at Wiesbaden and Mainz on Sept. 25-29. Applications for membership should be made to Prof. B. Rassow, Gustav-Adolf-Str. 12, Leipzig, C.1.

THE ninth vacation course in practical air photogrammetry will be held in the Mathematical Institute

of the University of Jena on Oct. 10-22. The course will be exclusively in English, and will consist of lectures and practical work. The lectures will be given by Prof. Otto von Gruber, Prof. Hegershoff, and Dr. I. Tappen. The subjects to be dealt with include photographic apparatus and material, method of survey and navigation, plotting apparatus, and applications of air photogrammetry. Applications should be sent to Zeiss-Aerotopograph, Postfach 117, Jena, Helmholtzweg.

THE summer meeting of the Institution of Mechanical Engineers, under the presidency of Mr. William Taylor, will take the form of a visit to Canada and the United States on Aug. 19-Sept. 19. At the meeting, there will be a discussion on a paper read by Dr. F. A. Gaby on "The Generation and Distribution of Power under the Administration of the Hydro-Electric Power Commission of Ontario" and an address by Mr. C. L. Stevens on "The Point Plan of Rewarding Management and Labour". Many visits to works and power stations have been arranged. Further particulars can be obtained from the Secretary, Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1.

A JOINT autumn meeting of the Iron and Steel Institute and the Institute of Metals will be held at the Institution of Civil Engineers, Great George Street, S.W.1, and the Institution of Mechanical Engineers, Storey's Gate, S.W.1, on Sept. 12-15. A large number of papers will be presented at joint and separate sessions of the institutions. On Sept. 12, Dr. H. J. Gough will deliver the annual Autumn Lecture of the Institute of Metals on "Corrosion Fatigue in Metals". Among the excursions and visits to works are visits to the National Physical Laboratory, Teddington; the General Electric Company's Research Laboratories, Lamp and Glass Works, Wembley; the Mond Nickel Co., Ltd., Acton Refinery; and the Ford Motor Co., Ltd., Dagenham Works.

MR. F. EDWARDS, 83 High Street, Marylebone, has issued an important catalogue of books on America. It includes the rare first edition of Linschoten's "Discours of voyages into ye Easte and West Indies" (1598), John Calef's "Siege of Penobscot" (1781), Morton's "New English Canaan" (1637), Johnson's "Nova Britannia" (1609), and a fine copy of Sir Walter Raleigh's "Brevis et admiranda descriptio Regni Guianæ" (1599), as well as many other unusual items.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in mathematics at the Chelsea Polytechnic, London, S.W.3—The Principal (Aug. 4). A research fellow in glass technology in the Department of Glass Technology at the University of Sheffield—The Secretary (Aug. 6). An assistant lecturer in physics at University College, Nottingham—The Registrar (Aug. 10). A lecturer in applied chemistry at the Northampton Polytechnic Institute, St. John Street, London, E.C.1—The Principal (Aug. 22). A technical assistant for special investigation work in connexion with wireless valves—Messrs. Lissen, Ltd., Worples Road, Isleworth.

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.]

Nuclear Structure

THE experimental evidence for the existence of the neutron has given added support to the view¹ that the nucleus may be composed of protons, neutrons, and α -particles. Heisenberg² has recently found it convenient to use a model with protons and neutrons only as the building-stones. In various papers, Aston³ has determined the isotopic constitution of many of the chemical elements, but it has not been possible to say, from considerations of stability, just what isotopes may be expected to occur. The purpose of this note is to point out regularities for elements of low mass, and to suggest a possible building-up principle for such elements.

Starting with an α -particle, let us add alternately a neutron and a proton. The resulting nuclei are He 5, Li 6, Li 7, Be 8, Be 9, B 10, B 11, C 12, C 13, N 14, N 15, and O 16. With the exception of He 5, these, and only these, have been observed for this mass range. With O 16, this type of regularity ends, which might be interpreted as due to the formation of some sort of a closed shell. To a first approximation, let us suppose the mutual interaction of the added neutrons and protons to be small compared with their interaction with the α -particle. Then, when a neutron and a proton are added, the resulting field will still favour a neutron over a proton. If an analogy with the external electronic system subsists, then the α -particle may represent a closed s -shell, with two neutrons and two protons, while O 16 is obtained by adding on a closed p -shell, with six neutrons and six protons.

The continuation of this process is the addition of a d -shell, with ten neutrons and ten protons. The stability conditions appear to be different, two neutrons being more stable in the central field than a neutron and a proton. The order of addition is as follows: neutron, neutron, proton, proton, and repeat. This results in O 17, O 18, F 19, Ne 20, Ne 21, Ne 22, Na 23, Mg 24, Mg 25, Mg 26, Al 27, Si 28, Si 29, Si 30, P 31, S 32, S 33, S 34, Cl 35, and A 36. With A 36, this shell becomes closed. These nuclei, and only these, have been found for this mass range, just as in the previous case.

If n denotes the total number of neutrons and protons together, then, except for $n=3, 5$, and possibly 8, there exists an isotope for every value of n below 36, according to the experimental evidence. We should expect this to be a general property, holding for values of n greater than 36, also. In the range $36 < n < 64$, several points are missing, namely $n=38, 42, 43, 46, 47, 49$, and 57. The corresponding isotopes probably exist in small quantities, but until they are found, it is rather difficult to determine stability conditions for this mass range. However, simple considerations

lead to a prediction of certain isotopes. Since the neutron number for $n=37, 39$, and 40 is 20, it might be expected to be the same for $n=38$, giving A 38. Similarly, one can predict V 49, Mn 53, and Co 57. In this range $36 < n < 64$, which may correspond to an f -shell being completed, all the isotopes, except Cr 53, have even neutron numbers. This is so striking that one wonders whether or not the isotope reported for $n=53$ is really due to chromium.

The analogy with the external electronic structure seems to indicate that for large values of n , conditions may become quite complicated. The experimental evidence bears this out. More information seems to be needed, however, before stability questions in general can be settled. Whether or not the α -particle plays a fundamental part remains to be seen, but we can certainly disregard it for the lighter elements, and consider protons and neutrons as being the elementary constituents.

JAMES H. BARTLETT, Jr.

Zurich, July 1.

¹ J. Chadwick, *Proc. Roy. Soc., A*, 136, 705; 1932.

² W. Heisenberg, *Z. Phys.* (in print).

³ F. W. Aston, *Proc. Roy. Soc., 1927-31*.

Tidal Oscillations of Gravity

IN an earlier communication,¹ we reported the results of experiments to determine as exactly as possible the variations of gravity. We have now succeeded in increasing the accuracy and in eliminating the disturbances to such a degree that now the oscillations of gravity due to the attraction of the sun and the moon are directly perceptible in the

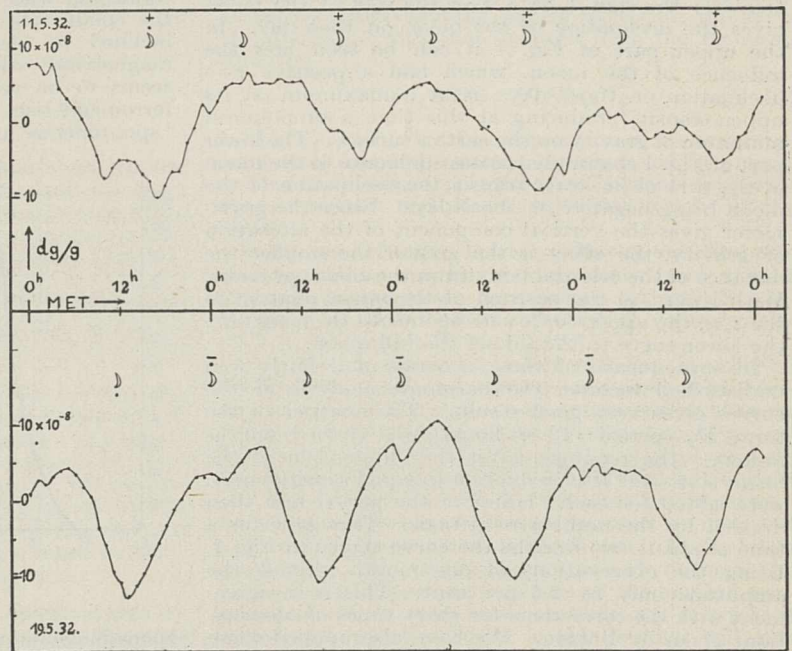


FIG. 1.

photographic registrations. The arrangement of the apparatus is the same as stated in our previous letter.² The principal success was achieved by using the alloy *WT 10* made by Krupp as material for the spiral spring. This material has an infinitesimal temperature coefficient of elasticity. By careful and repeated heating over a period of several months, it was also possible to reduce to a small factor the elastic after-effect. By this means the disturbances due to temperature are strongly suppressed, and also the uniform shift is very much diminished. The sensitiveness amounted

to a deflexion of 1 mm. for $dg/g = 10^{-8}$ at a distance of registration of 5 metres. With the aid of an electric method similar to the attracted disk electrometer of Lord Kelvin, the sensitiveness of the apparatus was often determined; therefore the indications of the registrations can be regarded as accurate to within $10^{-9}g$.

Fig. 1 shows an example of a record with no correction other than the elimination of the linear shift and the transformation of the readings to the same sensitiveness. Not only can the rough variation of gravity, especially due to the attraction of the moon, be seen,

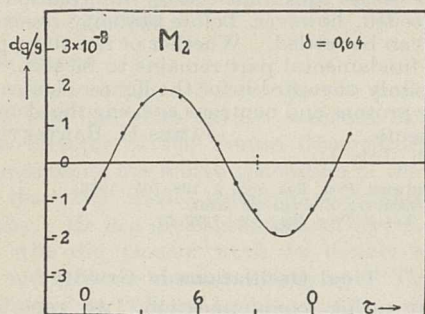


FIG. 2.

but also the finer features due to the alteration in the declination of the moon and in its position with regard to the sun. The transits of the moon over the meridian are marked (point above the sign is the upper transit); the sign + or - over the sign of the moon gives the declination of the moon on that day. In the upper part of Fig. 1 it can be seen how the influence of the moon, which had a positive (+) declination on those days, is at a maximum on its upper transit, producing at this time a pronounced minimum of gravity on the earth's surface. The lower part of Fig. 1 shows the greatest influence of the moon in the time of its lower transit, the declination of the moon being negative on those days. Since the gravimeter gives the vertical component of the alteration of gravity, the effect is the greater the smaller the distance of the celestial body from the zenith or nadir. With regard to the position of the moon relative to the sun, the upper curve corresponds to the neap tide, the lower curve to the tide of the full moon.

In consequence of these accurate and fairly well undisturbed records, the harmonic analysis of the curves gives very good results. The analysis of the term M_2 (period = 12.42 hours) was carried out as follows: the readings, after the elimination of the linear shift and after reduction to equal sensitiveness, were added for each 'hour' of the period and then divided by the number of periods. This gave for a time of about two months the curve shown in Fig. 2. Using the observations of one month altered the amplitude only by 2.5 per cent. This is in agreement with the corrections for short times of observations given by Børgen. We have also applied these corrections to the other terms of harmonic analysis. In this figure δ means the ratio of the observed amplitude to the expected amplitude, if the earth were perfectly rigid. The latter amplitude in Marburg is about $2.97 \times 10^{-8}g$ for the mean time of the observations. In Fig. 2 the dotted line on the axis gives the expected position of the minimum, the full line gives the observed position. In the same way we have also obtained the terms O (25.82 hour period, amplitude expected for perfectly rigid earth $dg/g = 3.1 \times 10^{-8}$) and even N (12.66 hour period, amplitude expected $dg/g = 0.58 \times 10^{-8}$) in very good agreement, both in amplitude and in phase, with

M_2 . The term S_1 , that is, the influence of the daily oscillations of the meteorological elements, appeared to be very small (if freed from the influence of K_1), especially compared with horizontal pendulum observations at the same depth (25 metres below surface-level).

The most significant result of the observations is, in the first place, that the observed amplitudes are smaller than the amplitude expected for a perfectly rigid earth, which seems to indicate a very much greater displacement of the surface than has been hitherto supposed. The second result is the displacement in phase of about three-quarters of an hour in the sense of a retardation of the maximum of variation of gravity. The ratio of amplitudes is for $M_2 = 0.64$, for O it is 0.74; this indicates an influence of the tides of the sea on the deformation of the solid earth, as is also observed in the experiments with horizontal pendulums. But this influence does not seem to suffice to explain the value of $\delta < 1$, which is in disagreement with the existing opinion.

R. TOMASCHEK.

W. SCHAFFERNICHT.

Physical Laboratory, University,
Marburg/Lahn, June 15.

¹ NATURE, 129, 24, Jan. 2, 1932.

² See also *Astron. Nach.*, No. 5844, 244, 257.

Mechanism of Superconductivity

It was often assumed that the transition from normal conductivity to superconductivity may be connected with a kind of 'spontaneous coupling' of the conduction electrons. Some authors were even inclined to identify this phenomenon with ferromagnetism. Although this extreme point of view seems to be very improbable, some analogies with ferromagnetism must surely appear if any kind of 'spontaneous coupling' between electrons is re-

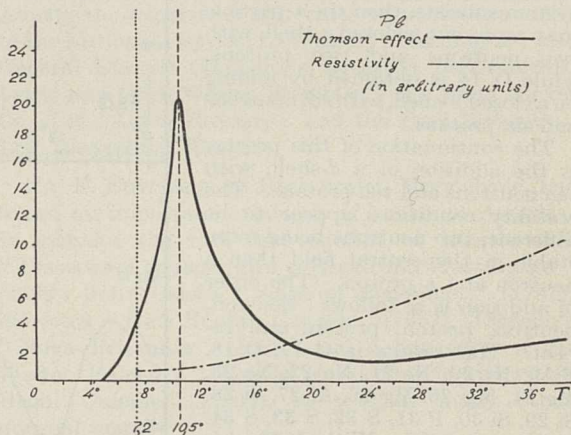


FIG. 1.

sponsible for superconductivity. For example, in this case the shape of the specific heat curve near the transition temperature must be analogous to that of ferromagnetic substances in the vicinity of the Curie point. W. Keesom and J. H. van den Ende,¹ and F. Simon and K. Mendelssohn² attempted to discover this anomaly of the specific heat in lead near the transition temperature (7.2° K), but they could not detect any trace of the effect. This result may be interpreted in two ways: either the hypothesis of the 'spontaneous coupling' of the conduction electrons in superconductors is completely wrong, or the number of the electrons which are concerned in conductivity is here so small in comparison with the number of

atoms that the specific heat anomaly of the conduction electrons cannot be detected with calorimetric methods.

As our measurements have shown, the specific heat anomaly of ferromagnetic bodies at the Curie point is so well pronounced in the thermoelectric effects (Thomson effect), that in spite of some difficulties concerning the sign of this effect, the order of magnitude of the specific heat anomaly can be computed from the purely thermoelectric constants in good agreement with calorimetric measurements. It is natural to try the same method in the domain of superconductivity. The recent investigations by J. Borelius, W. M. Keesom, C. H. Johansson, and J. O. Linde³ of the thermoelectric force for lead and tin at the lowest temperatures permit us to compute the Thomson effect for these metals and to draw conclusions concerning the specific heat anomaly. Fig. 1 represents the Thomson coefficient for lead (as calculated from the experimental data) as a function of temperature. This curve is quite analogous to that of ferromagnetic substances, and it seems quite probable that it represents the general feature of the specific heat of the electrons concerned in the conductivity effects. It is not clear, however, why the temperature of the maximum of this specific heat curve (10.5° K) does not coincide with the transition point (7.2° K). Perhaps theory will be able to explain this discrepancy in the future.

From these results two important quantities may be calculated: first, ΔC_e (the height of the maximum of the specific heat curve), and secondly, ΔW_0 (the energy difference between the normal and the superconducting state at absolute zero), both for one electron.

	ΔC_e cal./degree.	ΔW_0 ergs.
Lead	8×10^{-25}	1.7×10^{-17}
Tin	$\sim 10^{-25}$	$\sim 0.6 \times 10^{-17}$

If the number of the electrons was equal to the number of atoms of lead, the specific heat anomaly could certainly be detected, its numerical value being of the same order of magnitude as the normal specific heat itself. The precision of the calorimetric measurements permits us to determine the upper limit of the number of the electrons involved in the conductivity effects of lead. Actually it seems that the number of the conduction electrons is less than 1/200 of the number of the atoms in this case.

It is well known that magnetic fields destroy the superconductivity, the threshold value of the field H increasing as the temperature is lowered. By extrapolating the experimental data the value of H_0 may be found corresponding to absolute zero. We assume that the threshold value of the field is given by the condition that the magnetic energy of the electron $|\mu H_0|$ (where μ is the spin moment) is equal to ΔW_0 .

$$|\mu H_0| = \Delta W_0 \quad (1)$$

This assumption means that the superconductivity must be destroyed when the energy of the external forces exceeds the energy of the 'spontaneous coupling'. From (1) we may calculate H_0 for lead and tin, and compare them with the experimental results.

	H_0 expt. (gauss).	H_0 calc. (gauss).
Lead	2000-2500	2000
Tin	560	~ 700

According to the recent experiments of McLennan and his co-workers,⁴ superconductors cease to be superconducting for high frequency currents if the frequency ν exceeds a certain threshold value. For

tin at absolute zero, $\nu \sim 10^9$ may be found by extrapolation of the experimental data obtained at higher temperatures. It is interesting to notice that by assuming

$$h\nu_0 = \Delta W_0 = |\mu H_0| \quad (2)$$

(where h is Planck's constant), we obtain for the same metal $\nu_0 = 1 \times 10^9$.

The remarkable coincidence between the observed and the computed data seem to support the general trend of the assumptions developed in this note. It is interesting to notice that the frequency of the Larmor precession corresponding to H_0 is equal to ν_0 ; thus the correlation between the two factors destroying the superconductivity may be found either on the lines of energetics or on the lines of the short time periods. Which of these interpretations corresponds to the real mechanism remains unsolved at this moment.

J. DORFMAN.

Physical-Technical Institute,
Sosnovka 2,
Leningrad (21), U.S.S.R.,
May 23.

¹ *Comm. Leiden*, 230 d; 1930.

² *Z. Phys. Chem.*, B 16, H. 1, 1932.

³ *Proc. Amsterdam Acad.*, 34, No. 10, 1931.

⁴ *Proc. Roy. Soc.*, A, vol. 136, No. 829, 52; 1932.

Application of Knudsen's Law to the Evaporation of Water

RECENTLY it has been shown¹ that the maximum rate of evaporation of liquid carbon tetrachloride measured experimentally agrees to within the error of experiment with that deduced from the Knudsen equation

$$m = 43.75 \times 10^{-6} P \sqrt{\frac{M}{T}} \quad (1)$$

In this equation, T is the temperature of the evaporating surface and P the saturated pressure of the vapour at that temperature, m is the mass in grams evaporating per second, and M the molecular weight of the liquid.

In the case of water, however, the experimental rate of evaporation was found to be only from 1 to 2 per cent of that given by equation (1), and the discrepancy was ascribed to reflection of vapour molecules at the surface of the liquid.²

It will be seen from equation (1) that, in order to calculate the mass evaporating per second, it is necessary to know the surface temperature and the vapour pressure at this temperature. In the case of poorly conducting liquids, the surface temperature will be considerably below that of the liquid in bulk (20°-30° C. for water at 25° C.), and in the above-mentioned experiments it was measured by means of a thermocouple immersed in the liquid. As the latter evaporated, the thermocouple passed through the surface and so gave an estimate of the surface temperature. It is clear, however, that any instrument introduced into the liquid in this manner will give only an approximation to the surface temperature, since it actually measures the mean temperature of a thin layer near the surface. This average temperature will necessarily be higher than that of the true surface layer at which rapid evaporation is taking place. Hence the true value of T in (1) must be smaller than that given by the thermocouple, and it thus remained possible that, if more accurate values of T and P were obtained, the rate of evaporation deduced from equation (1) would agree with the experimental rate and the assumption of reflection would be rendered unnecessary.

It is hoped, however, that this possibility has been

eliminated in a new experiment in which the temperature of the surface has been deduced from measurements of the surface tension of the evaporating liquid. As this surface tension must be controlled chiefly by the temperature of the outermost liquid layers, a very close approximation to the true value of the surface temperature should be obtainable in this way.

As was to be expected, the surface temperature so measured was lower than that recorded by the thermocouple, so that the ratio (f) of the experimental to the theoretical rate of evaporation was somewhat greater than before. The difference was, however, not very marked. Whereas the surface temperature measured by the thermocouple gave values of ' f ' ranging from 1 to 2 per cent, those deduced from the surface tension measurements gave values between 3.5 and 4.5 per cent.

The experiments therefore indicate that when the temperature of the actual evaporating surface layer is measured as accurately as possible, there is still a very considerable discrepancy between the theoretical and experimental rates of evaporation of water. This would seem to confirm the earlier suggestion that not all the vapour molecules striking the liquid surface are able to enter.

A detailed account of these experiments will be published shortly.

T. ALTY.

University of Saskatchewan,
Saskatoon, Saskatchewan,
June 27.

¹ Alty and Nicoll, *Canadian Journal of Research*, 4, 547; 1931.

² Alty, *Proc. Roy. Soc.*, A, 131, 554; 1931.

Proper Name of the Amœba

PROF. T. D. A. COCKERELL concludes his letter in NATURE of May 14, p. 726, on this subject, by the question: "What, then, is the proper name of the common amœba?" While we are awaiting the decision of the systematists, I should like to make some relevant remarks.

In 1916, Schaeffer classified those rhizopods which had the characteristics of Leidy's *Amœba proteus* into three species. Later, in his monograph on the "Taxonomy of the Amœbas" (1926), he raised them to the rank of genera. Mast and Johnson (*Archiv für Protistenkunde*, 1931), in the paper that provoked Prof. Cockerell's letter, would reduce these three genera to the status of mere varieties. *Amœba discoides* (*Metachaos discoides*) has never been recorded in Scotland, so I cannot make any statement about the validity of its specific value, but in my long experience of the other two large amœbæ, so generally employed for class purposes, I should like to affirm that, in my opinion, Schaeffer rendered a real service when he cleared up these differences amongst the rhizopods commonly called by Leidy's name *Amœba proteus*. Confusion between the species to which he (Schaeffer) in 1916 applied the names *Amœba proteus* and *Amœba dubia* respectively had been responsible before that time for retarding progress in our knowledge of these animals.

Since 1916, other information has been forthcoming, all of which goes to support Schaeffer's contention that at least two distinct organisms had been confused under Leidy's name *Amœba proteus*. We now have a fuller knowledge of the life-history of one of these forms, namely, *Amœba proteus* (*Chaos diffluens*), and of the details of its nucleus (in development as well as in the adult state). These latter differ markedly from the corresponding details of *Amœba dubia*. Prof. Chambers finds that the cytoplasm of *Amœba dubia* is more suitable for micro-injection experiments than

that of *Amœba proteus*, which seems to point to a fundamental difference in the cytoplasm of the two species. In short, the same specific name cannot be applied to them without resulting confusion.

There are of course well-marked varieties of *Amœba proteus* (*Chaos diffluens*). One variant, owing to an almost entire absence of crystals, is peculiarly translucent; it was the subject of much discussion at the Glasgow meeting of the British Association (1928). Other varieties due to size of nutritive spheres, etc., are also known. There is also a great variety in size (volume) in different strains of *Amœba proteus* cultivated under different conditions of food supply and temperature.

In discussing the contrasts in behaviour between Rösels's "kleine Proteus" and Leidy's *Amœba proteus*, Mast and Johnson state that they have never known any tendency of the latter to aggregate on the sides of the vessel. As a matter of fact, this condition is easily brought about in *Amœba proteus* (*Chaos diffluens*) by altering the food in the culture. This species is very fond of a diet of rotifers. Now, *Rotifer vulgaris* tends to form little clusters of individuals on the sides of the vessel. The amœbæ creep up after them, sometimes forming a beautiful carpet of individuals on the sides of the vessel containing the culture. Amœbæ also like encysted flagellates. These aggregate in the surface vegetable scum which often collects in cultures of amœbæ. In this 'scum' the agametes produce agametes, as may easily be proved by skimming off a small quantity for inoculation into a new medium, when the young amœbæ may be seen hatching out of the cysts.

In my experience, isolated examples of *Amœba proteus* (*Chaos diffluens*) as well as of *Pelomyxa carolinensis* often develop the yellowish tinge referred to by Mast and Johnson—not, however, as they suggest, due directly to the colour of the food organisms present in the food vacuoles. I have always attributed this appearance in *Amœba proteus* rather to unfavourable environmental conditions. The same effect may be produced by slight lowering of the hydrogen ion concentration of the surrounding water. If the pH be not corrected, the specimens showing this yellowish tinge die off. Such facts should not be ignored when discussing the systematic position of Rösels's "kleine Proteus".

MONICA TAYLOR.

Notre Dame, Dowanhill, Glasgow,
June 10.

Pelomyxa carolinensis in Great Britain

CONSIDERABLE interest is attached to the name of the common large free-living amœba (*Amœba proteus*, Leidy) used extensively for teaching purposes. In recent discussions by systematists on this point, an organism known as *Pelomyxa carolinensis* plays an important part. This animal was renamed by Schaeffer (1926) *Chaos chaos*. Mast and Johnson (1931), quoting Schaeffer, say it has never been reported from Europe.

As I am at present engaged in a research on this animal, I should like to state that I have several records of its occurrence in the British Isles.

I am indebted to Sister Bernardine (Dr. Lucy Carter) for lending me some unpublished drawings of this species made by her from specimens obtained in Birmingham, Killarney, and the River Auchter (near Wishaw, Scotland), and to Sister Monica Taylor for records of its occurrence in the small pools along the shores of the head of Loch Fyne and in a tributary of the Allander River (Scotland). I myself at present am obtaining supplies from Loch Tannoch.

The specimens are smaller than those measured by Wilson (1900), as were those studied by Kepner and Edwards (1917), but the environmental conditions of the material I am collecting are almost identical with those described by Wilson.

ISABELLE P. MCGUIRE.

Shepparton, Milngavie.

The Whale Shark, *Rhineodon typus*, among the Seychelles Islands

THE publication in a recent number of *Science* of notes¹ on the occurrence of the whale shark in Bornean waters and on the Florida coast has led me to look over my notes and to put on record its occurrence and abundance in the Seychelles.

About six hundred miles north-east of Madagascar and four degrees south of the equator is found the Seychelles archipelago, formerly a French dependency, but now a British colony. To these islands, in 1868, came an Irish naturalist, E. Perceval Wright, for a six months' stay. To him we owe our first knowledge (and only published accounts) of the occurrence of the whale shark in this locality, where it is called the 'Chagrin'. He took photographs of two specimens (male and female), dissected two fish, and saw a number of others in the waters around the islands. It is greatly to be deplored that Wright made so little use of his opportunities to study this great fish. He wrote no article on it, nor did he publish his photographs (presumably the first ever made of the whale shark). Brief accounts, however, are given incidentally in four of his publications, in none of the titles of which does the name of the shark occur. There is nothing to form a guide, and only by running down obscure clues did I find accounts of the whale shark in the works listed below.²

The whale shark is as abundant around the Seychelles to-day as it was in 1868. In 1914 Dr. A. G. Mayor, director of the marine biological work of the Carnegie Institution of Washington, planned to send me to the Seychelles to study *Rhineodon*. Seeking information, I got in touch with Mr. P. R. Dupont, curator of the botanic station on Mahé, who informed me then, in 1919, and again in 1925, that the fish was comparatively common in the Seychelles. He had this information from many fishermen, and the managing director of the St. Abbs Whaling Company, situated on Mahé Island, also told him that the whale shark was abundant on the Seychelles Bank. Moreover, Mr. Dupont himself had at various times seen specimens, to the number of five or six. He further ascertained from an old fisherman that about 1865 there had been carried on by a family, of whom he was the only living member, a fishery for the 'Chagrin' to obtain oil from its liver. This man named eleven "grounds" where the fishing had been carried on, and said that when he was a boy of fifteen at Frigate Island the 'Chagrin' could be found all the year round. Mr. Dupont adds that to-day it is almost always to be found there in calm weather.

The War made the trip to the Seychelles impossible, so it was October 1919 when I again heard from Mr. Dupont. He reported that whale sharks were comparatively plentiful around the south end of Mahé Island, where a number had been seen a few days previously. As a result of this information, tentative plans were again made to go to the Seychelles, but the untimely death of Dr. Mayor in 1922 put an end to these.

In the meantime Mr. Dupont, who had been severely wounded in the War, was transferred to Mauritius, but returned to the Seychelles in 1924. Under date

of July 27, 1925, he wrote me that *Rhineodon* was still not uncommon, and added:

"According to our local fishermen, *Rhineodon* comes over to the Seychelles when *Caranx gymnostothoides* appears in enormous shoals from May to August, during the trades which blow heavily from the S. of Java toward the N. end of Madagascar, bringing on their way a good deal of fish to our archipelago. Advantage no doubt is taken by migratory fish of the currents which run in the same direction at this time."

Here then we have a suggestion as to how the whale shark has reached the Seychelles. This will become more apparent when one learns that *Rhineodon* is found in numbers in the East Indies and especially around Java. The abundance of the whale shark at the time of the schooling of the *Caranx* is not because the former feeds on the latter, but because both feed on a certain small sardine called 'tauve' and upon a little octopus called 'vauve', which abound in vast schools. In fact, the fishermen are guided by the presence of the 'Chagrin' to indicate good fishing grounds for *Caranx*. As to the breeding of *Rhineodon* in the Seychelles, the fishermen were in doubt, but Mr. Dupont definitely says that "The breeding season occurs in June". From this and from the statement that the fish is found all the year round, we may judge that, while it may have originally come from the East Indies long ago, it is now native to the Seychelles.

In my last letter to Mr. Dupont (September 1925), I asked him for any data that might have recently come to hand, and stated that I would like to bring together and publish that which he had sent me. Having had no answer, I fear that he has succumbed to his wounds. So the data about *Rhineodon* in the Seychelles have been collected and are now published in order to put the facts on record and to give Mr. Dupont credit for the information which he so kindly gathered and communicated.

E. W. GUDGER.

American Museum of Natural History,
New York City, June 17.

¹ Here, A. W., "The Whale Shark on the Coast of Borneo", *Science*, 75, 413; 1932.

Gudger, E. W., "The Fifth Florida Whale Shark—1932", *Science*, 75, 412-413; 1932.

² (1) "Six Months at the Seychelles." Dublin, 1868, 16 pp. (Privately published and later included as one of the component parts of the next number—of which only 75 copies were published.)

(2) "Spicilegia Biologia." Dublin, 1870, pt. i., pp. 64-65.

(3) "On a New Genus and Species of the Family Pandarina [Found Parasitic on the Whale Shark]", *Proc. Roy. Dublin Soc.*, 2, ser., 2, 583-584; 1877.

(4) "Animal Life, or the Concise Natural History." London, 1879, p. 463.

Light and Sexual Periodicity in Indian Buffaloes

DR. MARSHALL has stated¹ that "in tropical countries where environmental conditions are similar throughout the year, such as the Cameroons, the native birds have no restricted breeding season but breed at any time". The data I collected in 1929 with regard to the buffaloes is of interest in this connexion.

The Government of Madras has stationed two buffalo bulls for stud purposes at the Agricultural Research Station, Kovilpatti (lat. 9° N.). During 1926-29 I noticed that a greater number of buffalo cows were brought to service in particular weeks of the months, which suggested that there was some periodicity in these animals coming on heat. The prevailing opinion amongst cattlemen was that more animals came on heat during periods of dark nights. With the aid of Tamil almanacs, I worked out a frequency curve of the services by these bulls during the previous ten years with respect to the new moon and full moon days occurring in each month. It was interesting to note (Fig. 1) two modes in the curve,

the higher falling on the new moon day and the smaller on the full moon day. This clearly indicated that the position of the moon would also influence

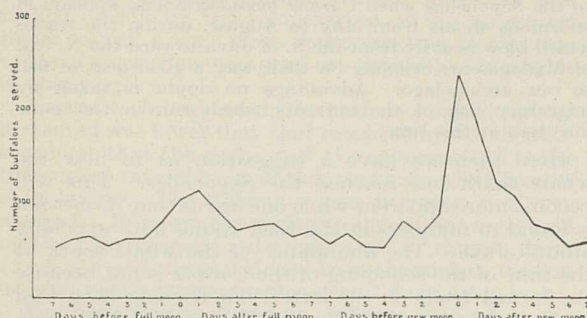


FIG. 1.

the onset of oestrus in buffaloes, if the buffalo cows brought to service could be taken as random samples of the buffalo population of the tract. When these data were retabulated according to the calendar months, a seasonal variation was also apparent.

	No. of Animals served.	Length of Nights on 1st of each Month.
January	287	12 hr. 58 min.
February	250	12 27
March	248	12 13
April	204	11 54
May	218	11 36
June	167	11 24
July	169	11 21
August	156	11 31
September	132	11 46
October	155	12 5
November	199	12 23
December	272	12 36
Total	2457	..

It would appear from the above grouping that there exists an association between the length of nights and the number of oestrous animals. But when these figures were compared with the agricultural seasons of the year, it was found that the variations were more closely related to the availability of fresh grass than to the length of nights.

O. RAMANATHAN.

Agriculture College and Research Institute,
Coimbatore, May 19.

¹ NATURE, 129, 344, March 5, 1932.

Further Purification of Gonadotropic Hormones (ρ -Factors)

DURING the past six months a further advance has been made in the purification of the gonadotropic hormones (ρ -factors, prolans) based on methods previously described, in particular the observation¹ that certain coloured hormone solutions can be selectively filtered in such a way that the filtrate is strongly coloured, although possessing extremely low gonadotropic activity compared with that of the original solution. The filters most useful for this purpose were the 'ultrafein', 'mittel', and 'fein' filters supplied by the Membranfilter Gesellschaft of Göttingen; the first allows rather more rapid filtration, but is somewhat more porous to the active ρ -factors.

A solution of 2 gm. of ρ -factors (20,000 units per

gm.) in 100 c.c. of distilled water is adjusted to about pH 7.2 and concentrated to about 10 c.c. by filtration. The residue is washed on the filters with successive portions of distilled water, and finally washed carefully off the filter and centrifuged to remove a small amount of insoluble matter. The solution (20 c.c.) is then treated with 100 c.c. of absolute alcohol plus 100 c.c. of ether. The flocculent precipitate is removed by centrifugation, washed with alcohol and ether, and dried. The yield is usually about 0.15-0.2 gm., and the activity is increased to 200,000 units per gm., provided that the washing on the filter has been sufficient. The process described takes about 8 hours up to the alcohol-ether precipitation, using two filters of 5 cm. effective diameter, but is a very trustworthy one for the preparation of small quantities of a highly active salt-free product.

In the absence of inorganic salts (as in this preparation) the ρ -factors cannot be precipitated from aqueous solution by alcohol alone, and further addition of ether is necessary.

This highly active product contains no sulphur, phosphorus, or halogen, and has a nitrogen content of about 8.4 per cent (9.1 per cent on an ash-free basis). Further, it does not give the ninhydrin reaction for α -amino acids until hydrolysed by dilute mineral acids, although it is inactivated by heating in neutral solution at 100° for half an hour. From these facts it would appear that the active principles are nitrogen-containing compounds, probably polypeptide in character, as has been previously postulated,^{1, 2} although, in view of their thermolabile nature, one may be dealing with a case of adsorption.

P. G. MARSHALL.

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Institute of Animal Genetics,
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¹ Marshall, *Quar. J. Exp. Physiol.*, 21, 315; 1932.

² Wiesner and Marshall, *ibid.*, 21, 147; 1931.

Eradication of Slugs and Snails

IN the note on the "Eradication of Slugs and Snails" in NATURE of July 16, p. 90, reference is made to many of the accepted methods of dealing with these pests. The trouble with barriers of repellent material is that spreading plants such as violas, certain asters, carnations, etc., are difficult to surround without injurious contact to the foliage, and the slugs live amongst the roots. They appear, moreover, to prefer the flowers and foliage of these plants to the baits variously used, and extensive trials this spring with orange skins, bran, and bran mixed with Paris green were entirely ineffective. Examination after dark showed that each viola plant or carnation had as many as forty or fifty small white slugs feeding on it. As hand-picking was out of the question, a small pot containing a very strong solution of salt and permanganate of potash was carried, and each slug was touched with a knitting needle dipped in this solution. Half an hour spent each evening of one week has almost removed the trouble. I am not sure whether a solution of permanganate of potash without salt would be equally effective, and less harmful to the foliage if it touched it, but a single crystal of this salt will quickly kill a large snail. It is, however, not difficult to avoid damage to the foliage. For small upstanding plants, such as zinnia and dahlia seedlings, a collar of sheet zinc about one inch high is an absolute deterrent, and does not require renewal.

A. H. HALL.

Woodlands,
South Farnborough, Hants,
July 19.

Research Items

Anthropology of Carpathian Ruthenia.—A study of the racial characters of the Ruthenian inhabitants of the upland valleys of the Carpathians has been made by Prof. V. Suk, of which a preliminary report has been published (No. 150, *Pub. Fac. Sci. Univ. Masaryk*). The native Slavonic population lives in long narrow villages which often extend for several miles along the deep valleys of the mountains. They fall into two groups, between which there are considerable cultural differences. They speak the same language but with dialectical variation. The Huculs, the eastern group, have dark hair, eyes, and skin, and are of tall stature, averaging five feet eight to nine inches, many men reaching six feet. The head is brachycephalic (av. index 84). Dinaric faces are not rare; but these have green-blue or dark blue eyes. Other members of this population have features approaching the Alpine; but the average complexion is darker than is usual in 'alpine' countries. On the whole, they are healthy. Tuberculosis is rare; but goitre is common. The western group, known by different names locally, is much poorer and of lower status. The skin is lighter than in the east and at times shows a yellowish tinge. The eyes are brown, green-brown, and blue, the latter usually with brown hair of the lighter shades. The stature is lower and the Dinaric face is absent, but faces of Laplander type are common. There is also a number of indeterminate types, some of which approach the 'alpine' type, though with lighter complexions. The people are much less healthy than the Huculs. Tuberculosis is common, in some villages rising so high as forty per cent among the children. Adults without goitre are rarely seen.

Ancient Jewelry from Yasin.—Sir Aurel Stein figures and describes in the *Indian Antiquary* for June a collection of ancient jewelry from the once cultivated tract of the Dasht-i-Tana in the Hindu Kush valley of Yasin in the Gilgit Agency. The find was made by villagers while digging up a small mound, and no particulars of the circumstances are available. As most of the objects were of gold, it is probable that 'specimens' only were given up. Comparison with objects cleared from burial deposits in 1913 suggests a similar provenance. Of the Yasin objects, two provide more definite chronological evidence than those found elsewhere. Of these two objects, one is a small bronze figure of a Bhodisattva $3\frac{3}{4}$ inches high and $2\frac{1}{2}$ inches broad at the base. The figure is seated and the right hand is held, palm outwards, at the level of the knee, while the left holds some indistinguishable object. The metal is too corroded to allow details of features or dress to be made out; but around the neck is an ornamental band or chain and the folds of the drapery are disposed in the Græco-Buddhist style of Gandhāra. The lotus seat is of a style which persists in Buddhist sculpture from the early centuries of our era down to a late period. This little figure may be an import from outside, as is certainly the second object, an intaglio set in the bezel of a fine gold ring. It is cut in an onyx-like stone, much cracked by exposure to great heat. It represents a helmeted male head which is of a late Hellenistic or Roman style of workmanship. Similar intaglios from Khotan and other parts of Chinese Turkestan have been dated at second-third century A.D. The number of such seal stones found in Central Asia and north-west India suggests that they were a frequent article of import from the west.

Birds of Guatemala.—The bird-life of this limited area, lying between two distinct zoogeographical regions, the nearctic and the neotropical, is wonderfully rich in racial forms. The American Museum of Natural History possesses collections of birds made there by Austin Paul Smith and A. W. Anthony, excelled only by the Salvin-Godman collection in the British Museum, and these collections have been reported upon by Ludlow Griscom in a monograph of 439 pages (*Bull. Amer. Mus. Nat. Hist.*, vol. 64, 1932). The wealth of the bird-life of the area is traceable to a number of factors, of which the chief are the antiquity of the country and its position between the two zoogeographical regions of the New World. To the first is due the survival of some elements of a once rich pre-glacial avifauna; to the second the influx of fresh contingents of birds from the north during the Pleistocene period, and of southern tropical elements during post-glacial time. These various elements in the bird-life have been so modified by time, in association with diverse topography, much local isolation, and half a dozen different climates, as to produce the 736 species and subspecies recorded in this monograph. The author, refusing to commit himself, leaves the reader to decide whether the compelling factors in this evolution were the latent potencies in the germ plasm or the stresses of time and change of environment, but he reminds us that the outcome of systematic and zoogeographical studies has been to show that, granted variation is limited by the latent potencies in the germ plasm, such potencies are of no value with the great majority of birds unless subjected to environmental stresses. Where environmental stresses are many and diverse, there is extraordinary diversity in the bird fauna, as in Guatemala or in Colombia or Ecuador; where environmental stresses are few or too severe, there is a relatively uniform and poverty-stricken bird fauna, as in New England, which is just recovering from the glacial epoch.

Free-living Nematodes of the Belgian Coast.—This, the first account of the free-living nematodes of the Belgian coast, is based on the collections in the Natural History Museum in Brussels and on material collected by dredge or net from twelve stations. The authors (J. H. S. Stekhoven, jr., and W. Adam, in *Mém. Mus. Roy. d'Hist. Nat. de Belgique*, No. 49; 1931) direct particular attention to the material from the surface of *Aleyonium* and from oyster beds. The colonies of *Aleyonium* dredged at two of the stations were covered with a rather thick layer of fibrous substance (probably the mucus coagulated on fixation), on the inner surface of which nematodes were present in large numbers and in almost identical proportions in both cases. Oyster beds are favourable for those nematodes which are detritus feeders, and a ship's hull with its rich fauna of hydroids afforded excellent conditions for an opulent nematode fauna. Twenty-six genera, including twenty-seven species, eight of which are new, are recorded. The geographical distribution of each species is stated, and notes on the characters, including the Cobb formula, are given for most of them. While these nematodes are essentially marine, some of the species are capable of penetrating into waters of lower salinity.

Mosaic Disease of the Bean.—"Investigations in the Mosaic Disease of Bean (*Phaseolus vulgaris* L.)", by Ray Nelson (*Michigan State College Tech. Bull.*, No. 118; 1932), gives the results of very extensive studies

into the behaviour of the virus diseases of the runner bean. The malady known as mosaic has a world-wide distribution, and is one of the few viruses which are transmitted through the seed. Many aspects of the problem have been studied, but great efforts were directed towards cultivating the virus or finding a causal parasite. A coecoid body was isolated from diseased tissue and appeared to have a close association with mosaic, but would not reproduce this disease when inoculated on to healthy plants. Rugose mosaic, a virus disease distinct from ordinary mosaic, has also been studied.

Geology of South-Eastern Manitoba.—*Memoir 169* of the Geological Survey of Canada, by J. F. Wright (1932, pp. 150 and map), is devoted to the geology and mineral deposits of the area between the south end of Lake Winnipeg and the Lake of the Woods, just east of the junction of the Canadian Shield with the Great Plains. Apart from Quaternary deposits and the nearly horizontal early Palæozoic strata which overlap the crystalline complex of the Shield, the rocks are of ancient Pre-Cambrian age, and consist (a) of an assemblage of sedimentary and volcanic strata and their metamorphic equivalents intruded upon by (b) a widespread series of igneous rocks ranging from peridotite to granite. The supercrustal assemblage is known as the Rice Lake Series, and is divisible into the Manigotagan phase of sedimentation (fine-grained arenaceous and argillaceous deposits); the Beresford Lake phase of volcanic conditions (basalt, andesite, dacite, and rhyolite, now largely altered to green-schists, with greywackes, chert, and iron-bearing formations); and the Winnipeg phase of renewed sedimentation (greywacke, arkose, quartzite, and slate). The series is typical of geosynclinal conditions and is lithologically similar to the Couchiching and Keewatin. The deep-seated intrusives include peridotite and gabbro, associated with nickel-copper sulphides, and both are known to be earlier than the granodiorites and granites. The end phases of granite invasion are represented by microcline- and albite-pegmatites. Tin and lithium deposits occur with the latter, and one of the albite-pegmatites contains uraninite, which H. V. Ellsworth finds to have a lead-ratio of 0.260 to 0.265 (*Amer. Min.*, 1931, p. 569). This is the oldest mineral yet known, and it is of interest that the conglomerates of the Rice Lake Series contain pebbles of a still older granite.

Cavities in the New Jersey Traps.—The crystal cavities in the Triassic trap rocks of the New Jersey zeolite region have long excited the interest of mineralogists. A detailed study of the phenomena has been made by W. T. Schaller (*Bull.* 832, U.S. Geological Survey, 1932, pp. 90). The cavities occur in an altered basalt that as lava flowed into pre-existing lakes occupying depressed areas in which glauberite and other saline minerals had accumulated. Where the lava poured over dry Triassic shale it contains no cavities. The mineral history is as follows: (1) Solidification of basalt; (2) formation of anhydrite and glauberite derived from the lake waters; (3) formation of quartz, albite, etc., replacing the lava; (4) solution of glauberite leaving *rhombic cavities*, precipitation of prehnite, datolite, pectolite, etc., and solution of anhydrite leaving *rectangular cavities*; (5) zeolite formation from lime and soda supplied by the solution of the saline minerals; (6) deposition of calcite and changing of remaining anhydrite to gypsum and thaumasite. In addition to the two main types of cavities mentioned above, there are also lamellar types representing anhydrite and possibly calcite and babingtonite, and a miscellaneous series

after apophyllite, quartz, calcite, natrolite, pectolite, and other minerals. Although no glauberite now remains in the region, the rhombic cavities sometimes contain pseudomorphs in quartz the measured forms of which prove to be identical with those of glauberite.

Rainfall of Sumatra.—Dr. J. Boerema has published detailed monthly and annual maps of the rainfall of Java and Madura (*K. Mag. Met. Obs. Batavia*, Verhand. 14, vol. 2). Similar information is now available for Sumatra (Verhand. 24, vol. 2). The figures relating to rainfall are derived from observations extending over at least five of the fifty years 1879–1928. In a few instances they refer to the whole fifty years. Anyone making use of these statistics should bear in mind the great difficulty of securing accurate and comparable figures from a large number of voluntary observers, and should also note that figures based on periods of varying length are not strictly intercomparable, even if free from error, owing to differences in the general character of the weather in the different periods—the ‘errors of sampling’ of mathematical statistics. In spite of these difficulties, the material is obviously of great economic importance, besides being a big contribution to climatology. Sumatra is famous for its luxuriant vegetation. Except on the higher mountains, the mean temperature of every month is high, and bearing this fact in mind, an inspection of the rainfall statistics provides a sufficient explanation of this luxuriance. It is significant that on the map of annual rainfall no tint is provided to represent a rainfall anywhere near so low as London’s 600 odd millimetres. On a part of the mountain chain that lies not far from Padang, on the west coast, the annual total is shown as more than 7000 mm. (23 ft.), and there is an almost equally wet region towards the north end of the island. If more detailed information is required, the reader must refer to Verhand. No. 24, vol. 1, which contains tables of rainfall relating to 3293 stations in the Netherlands Indies, for the period 1879–1928 or a portion of that period. This volume includes the data for Sumatra.

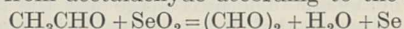
Thermal Expansion of Bismuth.—An investigation of the thermal expansion of a bismuth single crystal has been made by A. Goetz and R. C. Hergenrother (*Phys. Rev.*, June 1), which is of importance in bringing out the difference between the macroscopic and microscopic properties of solids. The expansion was measured by two methods. The first, which has been carried out several times for this substance, was similar to the standard macroscopic work of Roberts. The second consisted in examining the temperature shift of an X-ray beam, when reflected from the (111) plane in a modified Siegbahn apparatus, and tells how the crystal lattice changes in size with change in temperature. The results of the latter determinations show that an empirical relation, due to Grüneisen, which states that expansion coefficient and specific heat bear a constant ratio to one another, was accurately satisfied up to almost the melting point, whereas a departure from this, outside the range of experimental error, occurs if the macroscopic expansion coefficients are used. The interpretation of the discrepancy, based on the assumption that there is an amorphous component in the crystal as well as the component with a regular lattice, is that the relative amount of the former increases with increase in temperature, but little, if any, obvious advance has even now been made towards the outstanding problem of why a pure substance melts sharply.

Stellar Structure.—A review of the recent work of the constitution of the stars was given by Prof. E. A.

Milne in a lecture on "Some Aspects of Stellar Structure", delivered before a joint meeting of the University of Durham Philosophical Society and the Newcastle-upon-Tyne Astronomical Society on March 4, an abstract of which has just been published (*Proc. Univ. Durham Phil. Soc.*, vol. 9, pt. 1). The lecture gives a descriptive account of the properties of the 'two phase' stellar model and the conclusions to be drawn from them. This model consists of a degenerate spherical core, approximately isothermal, surrounded by a gaseous envelope of constant opacity. The essential variables taken are L/M , the ratio of the luminosity of the configuration to its mass, and r_1/r_2 , the ratio of the core radius to that of the whole configuration. The relations between these two variables, as worked out mathematically, are exhibited as a series of curves connecting L/M with r_1/r_2 for each constant M . The curves show that for certain values of L/M and constant M there are two distinct configurations possible, corresponding generally with the phenomenon of the rearranged 'Russell diagram'. Certain of the curves of high mass show a position where dL/dr_1 is infinite. This is the limiting position giving a maximum L for that particular mass. It is shown that at this point the core radius is indefinite and pulsations are likely to occur, suggesting an explanation of the cepheid variables, which thus appear only in certain classes of configurations. The curves also exhibit the possibility of discontinuous changes. During one of these the core radius increases cataclysmically and the external radius decreases cataclysmically, with the consequent evolution of energy.

The phenomena resemble those of a nova outburst. The curves of low mass and certain portions of those of high mass yield an approximately linear relation between L/M and M for corresponding configurations. They also throw light upon the giantism of some stars, the dense characters of the nuclei of planetary nebulae, and the general relationship of dense stars to non-dense stars. The complete mathematical investigation has since appeared in *Mon. Not. R.A.S.*, vol. 92, No. 7.

Oxidations with Selenium Dioxide.—Riley, Morley, and Friend (*J. Chem. Soc.*, June) show that selenium dioxide is capable of oxidising acetone to methylglyoxal and acetophenone to phenylglyoxal on heating, the selenium dioxide being reduced to selenium. Similar reactions giving other derivatives of glyoxal were carried out. A methylene group adjacent to the carbonyl group of an aldehyde is readily oxidised to carbonyl by selenium dioxide and the preparation of glyoxal from acetaldehyde according to the reaction



may be caused to proceed almost quantitatively. In some cases the reaction may be carried out by passing the vapour of the substance over selenium dioxide in a heated tube. The reactions show that selenium dioxide has a specific oxidising action on aldehydes and ketones of various types, whereby 1 : 2 diketones and aldoketones are conveniently obtained in quantity, compounds which contain a methylene group activated by proximity to a negative group being specifically oxidised at reasonably low temperatures.

Astronomical Topics

A New Algol-Variable in Andromeda.—*Astr. Nach.* 5877 contains a paper on this star by its discoverer, Herr K. Lassovszky. He found it on a plate that he took at Neubabelsberg on April 27, 1931; its position for the equinox of 1855 is $23^{\text{h}} 42^{\text{m}} 18^{\text{s}}$, N. Decl. $44^{\circ} 58' 4''$, and its designation 381, 1931 Andromeda. He took a series of plates on fifteen nights between July 23 and Aug. 21, 1931, to study the light curve; the period is 0.79365^{d} or about 19 hours. The magnitude is 11.26 at maximum, and falls to 11.87 at minimum; the duration of eclipse is 0.160^{d} ; the light-curve appears pointed at minimum, showing that the eclipses are not annular, as in that case the curve is flat at minimum. The observations do not show any trace of a secondary minimum, such as occurs in Algol; it may be concluded that the eclipsing star is much fainter than the other. The star is less than 2° distant from "Selected Area No. 43"; Herr Lassovszky utilised this fact to obtain the magnitudes of his comparison stars by comparing them with stars in that well-surveyed region. It reflects credit on a single observer to have both discovered the star's variability and deduced an accurate light-curve in the course of a year.

Astronomical Notes for August.—Mercury is well placed as a morning star at the end of the month, being in elongation on Sept. 3. Venus is conspicuous as a morning star, being at its greatest brilliance on Aug. 5. Jupiter and Neptune are both near the sun; the former is in conjunction on Aug. 26; it will be about 5° from the eclipsed sun on Aug. 31. Neptune will be less than a degree from the eclipsed sun, and may be recorded on some of the coronal plates. A small partial eclipse at sunset will be visible from parts of Galway and Mayo and the islands of Skye and Lewis. Prof. S. Chapman has pointed out that

the British Isles are within the region in which effects of the eclipse on wireless transmission may be looked for. Saturn passed opposition on July 24, and is therefore visible for most of the night; but its south declination of 20° makes observation difficult. Uranus is approaching opposition, and may be observed after midnight.

There will be an occultation of the Pleiades on the morning of Aug. 24; disappearances of three stars at the bright limb occur at $1^{\text{h}} 20^{\text{m}}$, $1^{\text{h}} 41^{\text{m}}$, $1^{\text{h}} 50^{\text{m}}$; the times and angles of reappearance of five stars at the dark limb are $2^{\text{h}} 6^{\text{m}}$, 198° ; $2^{\text{h}} 25^{\text{m}}$, 242° ; $2^{\text{h}} 44^{\text{m}}$, 272° ; $3^{\text{h}} 1^{\text{m}}$, 227° ; $3^{\text{h}} 10^{\text{m}}$, 276° . The angles are reckoned from north through east and south.

The Perseid meteors should be looked for about Aug. 10, especially after midnight, as Perseus is then higher; the moon sets at $10^{\text{h}} 30^{\text{m}}$ p.m. on Aug. 10.

Newman's comet may be observed with moderate telescopes; the following ephemeris for 0^{h} is from *Harvard Card 229*:

	R.A.	N. Decl.
Aug. 1	$14^{\text{h}} 51^{\text{m}} 42^{\text{s}}$	$26^{\circ} 5'$
5	14 51 7	27 2
9	14 51 6	27 54
13	14 51 38	28 42
17	14 52 41	29 28
21	14 54 14	30 11
25	14 56 16	30 53
29	14 58 46	31 34

The comet has been observed to throw off nebulous objects; its neighbourhood should therefore be examined.

A minimum of Algol occurs at $0^{\text{h}} 5^{\text{m}}$ on Aug. 7.

Add one hour to all times to reduce to Summer Time.

Geology and Archæology of Kharga Oasis, Egypt*

THE second season's exploration of the Prehistoric Research Expedition of the Royal Anthropological Institute to Kharga Oasis, Egypt, under Miss G. Caton-Thompson and Miss E. Gardner, was devoted to the further examination of the 'fossil' or dead springs of Pleistocene age, discovered in the first season, which promised a fruitful line of inquiry in palæolithic stratigraphy and palæo-climatic conditions, and the dating of the tufa deposits and sheets of gravel on the eastern scarp.

On the scarp, the oldest deposit of the 'drift' sequence is a massive crystalline tufa, here named the Plateau Tufa to distinguish it from the later Wadi Tufas. It has no fauna or human evidence and provisionally is placed at Plio-Pleistocene. This was followed by a period of great erosion, causing the formation of transverse and longitudinal valleys, again without cultural evidence. The next stage was the filling in of these valleys in their upper reaches with accumulations of angular breccia, now standing in places as high as 25 metres. This represents a long dry period. On its passing, lower palæolithic man appears on the scene. Rain encouraged vegetation, and the earliest of the Wadi Tufas was formed on the breccia. Unrolled Acheulean tools have been found, thus dating a tufa deposit in Egypt for the first time. The formation of the plateau gravels belongs to this phase. They also have yielded Acheulean tools.

The fifth episode bridges lower and middle palæolithic. An unrolled Acheuleo-Levallois industry has been found in situ sub-tufa. The plateau gravels were eroded and spread in a secondary sheet ("Exogyra gravels"), also containing a mixed Acheulean and Levallois industry.

The middle palæolithic stage is one of considerable but ultimately decreasing rainfall. Another tufa forms over silts and gravels and the formation of the modern drainage system begins. These tufas also are dated by tool floors beneath them. The implements are the products of a tortoise core industry; but it includes so many forms unrecognised in Mousterian industry that it has been named provisionally "Pre-Sebilian". The mode of formation of the tufa is found to be the ponding up of the primary valleys. Pre-Sebilian man frequented the shores of the pools, as is indicated by the collections of tools made from sub-tufa silts.

In the following period the streams grow weaker, and terrace gravels are formed, dual and triple. In an upper terrace were found Pre-Sebilian tools, and on it, in a bed of silt 0.40 m. in thickness, an Aterian flaking site, indicating a lower upper palæolithic date for the Aterian. Here the physiographic sequence

* "The Royal Anthropological Institute's Prehistoric Expedition to Kharga Oasis, Egypt", by Miss G. Caton-Thompson, *Man*, June 1932.

ends, and man abandoned the wadis and gravel plateaux surrounding them for the Libyan plateaux where occur the Capsian and Capsian-Tardenoisean sites.

The great flint mines discovered in the first season were re-examined and found to be purely of neolithic age, and not of mixed age as was believed at first.

On the depression floor a magnificent collection of five hundred Acheulean hand-axes was discovered. These were in an area not exceeding 30 sq. metres. and were in mint condition, but glazed. The glaze was certainly produced by sandy waters in a spring and was not due to desert exposure. The hand-axe types are remarkably varied, normally lanceolate forms predominating. With them were their flake industry and cores. In size the axes range from 21 cm. to miniatures less than 4 cm.

A large fossil spring was excavated to a depth of 9 metres. Interstratified gravels, the lowest at a depth of 4 metres, yielded an abundant tortoise core industry which is not Aterian, but its relation to the Levalloisean and Pre-Sebilian on the scarp is not yet clear.

A Capso-Tardenoisean surface site was discovered on the sandrock deposit sealing a fossil spring. The formation of these sandrocks is the final stage in the history of all the fossil springs, and it may, therefore, be inferred that desert conditions obtained prior to the date provided by the surface site.

The cultural elements of the Kharga neolithic were identified. Hearths were discovered in the capping sandrock. Little holes were pierced in the capping sandrock for the supply of water. The curious stone-capped mounds, standing three to four feet high, have been examined and discovered to be the remains of hearths which had originally been holes sunk in the soil and lined with flat pieces of limestone. Since the hearths were abandoned, desert erosion had lowered the ground level. When the stone lining of the hearths was reached, this acted as a protection to the underlying ground and prevented further erosion, so that in course of time the hearth survived as a mound. This indicates a lowering of the desert surface by as much as 6 ft. since neolithic times.

In the matter of general conclusions, it would appear that neither Kharga nor the Fayum is of fluvial origin, as has been suggested, and earlier views as to the non-existence of a lake in the floor of the depression are confirmed. The deposits formerly attributed to a lacustrine agency are wind-borne loess-like material. There is no dating for this arid period, but it appears to be pre-human.

After neolithic times the Wadi appears to have become uninhabitable and not restored to prosperity until Persian engineers tapped the artesian water bed.

Spectrographic Analysis

BULLETINS recently issued by Messrs. Adam Hilger, Ltd., give particulars of recent advances in methods of spectrographic analysis and in apparatus. The first, No. 168, describes a method of analysis originated by Judd Lewis (*Chemistry and Industry*, 51, 271-274; 1932) and a range of salts, mixtures called "ratio mixtures", and solutions of high chemical purity under the name of "specpure substances", for use in that scheme of analysis. The method, essentially, is for the determination of elements present in minute proportions, and it applies to all the metals, together with the non-metals silicon, boron, phosphorus, and arsenic. The major con-

stituents having been determined by ordinary chemical analysis, each minor constituent is determined approximately as a ratio of one or other of the major constituents by comparison of the spectrograms of the sample containing the metals in the form of sulphates with spectrograms of the specpure ratio mixtures. Finally, from the data thus obtained, the substance is synthesised by means of the ratio solutions, and a spectrographic comparison is made between the specimen and its synthesised counterpart.

According to the scheme, the specimen and the ratio substances are so prepared that the comparisons are conducted throughout with chemically similar sub-

stances. Lewis has worked chiefly with the electric arc, using electrodes of copper, but it is claimed that the principles involved are applicable to spark and flame spectra, and that the analysis can be made on as little as a milligram of metal, mineral, or ashes of animal or vegetable tissues; further, that good approximate results may be obtained in ordinary practice with no more than average experience.

The ratio mixtures are an extension of the well-known H. S. Brand metals and the R.U. powders detailed in Hilger's booklet No. 94/5. This method, evidently, marks a distinct advance in spectrographic analysis, and it should help to extend the use of the spectrograph in chemical laboratories, in which it is now too rarely employed.

Bulletin No. 169 describes the Müller-Hilger Universal Double Monochromator, which, embodying the principle of double spectroscopic purification, is especially suitable for producing powerful radiations which are strictly monochromatic. The form of construction is original and is the subject of several patents in Great Britain and abroad. Both wave-

length setting and focusing are effected simultaneously for the whole instrument by means of a single drum engraved to read in wave-lengths. The optical system is crystallised quartz, and the range of the standard instrument extends from wave-length 0.185μ in the ultra-violet to 4.0μ in the infra-red. The relative aperture varies from $F/4$ for 0.185μ to $F/5.8$ for 4.0μ . The operative beams are axial and the lenses corrected by means of Hilger's interferometers; so that not only are the isolated parts of the spectrum in accurate focus but also every line throughout the spectrum is of good definition.

Messrs. Adam Hilger, Ltd., have just opened new offices and laboratories at 98 King's Road, adjoining their works. The extensions consist of 4400 sq. ft. of office space and 3400 sq. ft. of additional laboratory space, providing ample room for departments which recently have been much congested. The optical glass department will now be housed in the space formerly occupied by the offices. There are at present seventeen principal sections in the works, with eleven chief technicians and four heads of departments.

William John Macquorn Rankine

IN an oration delivered in the University of Glasgow on June 15 at a meeting "in Commemoration of Benefactors", Sir James Henderson paid a tribute to the memory of Macquorn Rankine, who occupied the chair of engineering from 1855 until his death in 1872. Rankine was once described as "the first really powerful thinker in this country to bring the highest mathematical resources to bear on engineering subjects", while the late Prof. Archibald Barr said that he ranked as "the greatest Professor of Applied Science who has yet appeared".

There is a sketch of Rankine's life in the "Dictionary of National Biography", and another by Tait is included in Rankine's "Miscellaneous Scientific Papers", while an obituary notice by Mayer appeared in NATURE of Jan. 16, 1873, but there is still no complete biography of him. In view of this, Sir James Henderson's tribute, printed in full in the *Engineer* for June 24, will be read with interest.

Rankine, who was born on July 5, 1820, died on Dec. 24, 1872, at the early age of fifty-two years, having, however, accomplished an amount of work seldom surpassed by any one. His works on "The Steam Engine" (1859), "Applied Mechanics" (1859), "Civil Engineering" (1862), "Machinery and Mill-work" (1869) and other subjects are among the classics of engineering, while to these must be added many scores of scientific memoirs. As a boy of fourteen he read Newton's "Principia" in the original Latin, and at sixteen gained a medal for an essay on "The Undulating Theory of Light"; and in spite of his

being trained and his experience as a civil engineer, mathematical physics always made the strongest appeal to him. His work in this direction claimed the chief part of Sir James Henderson's address.

Up to the year 1848, said Sir James, Rankine seems to have been continuously employed as a civil engineer in various schemes, but in that year there occurred a sudden change which it is impossible to explain. The practical civil engineer suddenly becomes the theoretical physicist, and from 1848 until he became professor in 1855, Rankine's energies seem to have been devoted almost entirely to those researches in molecular physics which gained for him the fellowship of the Royal Society in 1853. His early work on this subject was followed by researches in elasticity, hydrodynamics, and thermodynamics. Rankine's contribution to thermodynamics Prof. Tait described as his greatest work. He laid the foundation of the mathematical science as it is known to-day; he applied the second law to heat engines of all kinds, steam engines, air engines, and explosive engines, while in steam engines he introduced the cycle now known as the Rankine-Clausius cycle, which is used as the ideal for engines and refrigerators using vapours as the working substance, and he pointed out that this law is only a particular case of a wider law applicable to all sciences.

At the conclusion of his address, Sir James endeavoured to recall what manner of man Rankine was, and his remarks helped to emphasise the regret that none of Rankine's contemporaries had written his life.

Utilisation of Empire Timbers

AT a recent meeting of the Royal Society of Arts, Maj. J. R. Cosgrove of the Forest Products Research Laboratory read a paper entitled "Empire Timbers, with special reference to their Uses for Furniture and Decoration" (*J. Roy. Soc. Arts*, vol. 80, No. 4136, Feb. 26, 1932). In introducing the lecturer, the chairman, Sir Richard Allison, said that the lecture was opportune, since "in all directions British citizens are faced with the demand to 'Buy British'. With such a commodity as timber apparently much propaganda is necessary to bring home to potential users the possibilities of Empire supplies, and also the beauties of the many woods available for decorative and furniture purposes." He added that for several years past the architects at the Office of Works have concentrated entirely on

Empire hardwoods, having satisfied themselves that all their requirements in connexion with buildings can be adequately met by Empire supplies. It is most satisfactory to have such a declaration publicly made, and it would appear to give force to the opinion recently expressed in these columns that the forest services of the Empire require strengthening rather than curtailment, in order to be able to give an answer to the question as to whether supplies of the, at present, mostly unknown timbers could be extracted in sufficient amounts and placed on the markets at an economic price. Without this certainty, it will remain difficult to overcome old-established preferences.

Maj. Cosgrove correctly said that the past few years seem to have caused a profound change of outlook in the people of the British Empire, and with the appeal

increasingly made to support Empire industries he proposed to discuss certain of the timbers obtainable within the Empire, either from home or overseas, which in some form or other may be used for decorative purposes and in the making of furniture. An approximate calculation showed that the value of timber, excluding pulpwood, entering the British market, amounts annually to £40,000,000—£45,000,000, of which about 30 per cent represents hardwoods, much of which goes into utility and decorative work. Of the totals, therefore, of £30,000,000 for softwoods and £12,000,000 for hardwoods, the Empire's share at present works out to somewhat less than 10 per cent for softwoods and less than 30 per cent of the hardwoods; of which latter, however, a large amount, in value at least, is for teak from Burma. The wide use and popularity of foreign timbers is attributed by Maj. Cosgrove to a number of causes—such as the volume in which supplies have been available, their suitability and relative cheapness, the preparation which has been bestowed upon them in the form of careful manufacture, grading, and conditioning, and so forth. This implies that the timbers in use have an assured position, and that users will as a rule purchase them from descriptions alone and usually without preliminary inspection.

After discussing briefly the value of research work, Maj. Cosgrove enumerated some of the hardwoods, from both the British Empire and foreign sources, which are well known on the markets. He then discussed the possibilities of timbers which are particularly suitable for decoration and furniture from Great Britain, India, British North Borneo, Australia, New Zealand, British West Africa, British Guiana, West Indies, British Honduras, and Canada.

Advances in Stereo-Chemistry

THE sixth Messel Memorial Lecture was delivered before members of the Society of Chemical Industry at Nottingham on July 14 by Sir William Pope. Reviewing "Forty Years of Stereo-Chemistry", Sir William Pope traced the important developments of the present century in this branch of organic chemistry, which about 1890 was comparatively dormant, and had largely remained so since the work of Pasteur, van 't Hoff, and Le Bel. Development recommenced with the introduction of an improved technique for the resolution of synthetic mixtures or racemic compounds which followed from the discovery of the sulphonic acids of camphor and their halogen derivatives. The further demonstration that optical activity may be associated with the presence in the molecule of asymmetric atoms of other elements such as sulphur, tin, silicon, phosphorus, as well as the verification among ethylene derivatives of van 't Hoff's prediction of the optical activity of allene derivatives of the type $abC:C:Ccd$, led chemists generally to realise that the chemical molecule is spread out in three-dimensional space, and prompted subsequent attempts to ascertain the way in which the properties of compounds are influenced by the shape of the molecules.

Sir William Pope referred to the way in which the conception of the asymmetric carbon atom has tended to divert attention from the conditions of mirror-image isomerism defined by Pasteur. The asymmetric carbon atom covers only one, though the commonest, class of mirror-image isomerism. The fundamental condition is that the molecular configuration may possess any elements of geometrical symmetry except a centre of symmetry or a plane of direct symmetry. Thus the molecular configuration of an optically active compound need not be asymmetric or entirely devoid of geometrical symmetry. In the Hantzsch and

Werner theory of the configuration of the eximes, illustrated by Mills, or the optical activity and mirror-image isomerism among diphenyl derivatives, discovered by Kenner, are other examples of the way in which the whole of organic chemistry has acquired a stereo-chemical aspect.

While our knowledge of certain branches of stereo-chemistry is rapidly advancing, the space configuration of the benzene ring and of aromatic compounds in general remains an unsolved problem. Similarly, our knowledge of the combination to a homogeneous crystalline compound of substances with mirror-image configurations is developing but slowly, and little attention has been given to the question of racemic combination between dextro- and laevo-isomerides in the liquid state. Although as yet the novel and powerful methods of modern physics for determining the arrangement of the atoms or even of the components of atoms in solid, liquid, or even gaseous substances, such as X-ray diffraction determinations, the measurement of dipole moments, or the quantitative study of the behaviour of films only a few molecules in thickness, have merely enabled us to confirm the structures assigned on chemical grounds, Sir William Pope suggested that we may be on the verge of fresh developments which will convert the new physical methods into much more searching weapons for the determination of molecular configuration than any formerly at our disposal.

University and Educational Intelligence

CAMBRIDGE.—Applications for the Benn W. Levy research studentship in biochemistry should be addressed to Sir Frederick Gowland Hopkins at the School of Biochemistry before Aug. 1.

A pension of £540 a year has been granted to Sir Joseph Larmor on his retirement from the Lucasian professorship of mathematics, and to Mr. H. A. Roberts on his retirement from the secretaryship of the Appointments Board.

At Clare College, Mr. E. T. C. Spooner, University demonstrator in pathology, has been elected to an official fellowship.

At King's College, E. S. Shire has been elected to an R. J. Smith studentship, and A. G. D. Watson and D. Purdie to Harold Fry studentships.

Dr. P. A. M. Dirac has been elected Lucasian professor of mathematics in succession to Sir Joseph Larmor, who retires on Sept. 30.

EDINBURGH.—At a meeting of the University Court on July 18, Mr. W. L. Edge, fellow of Trinity College, Cambridge, was appointed lecturer in the Department of Mathematics, in succession to Dr. E. L. Ince, who has resigned.

The Cameron prize in practical therapeutics has been awarded to Prof. Edward Mellanby, professor of pharmacology, University of Sheffield, in recognition of his discoveries regarding the therapeutic actions of the fat-soluble vitamins.

LONDON.—The following appointments to University readerships have been made, to take effect from Oct. 1: experimental pathology (Lister Institute of Preventive Medicine), Dr. E. W. Hurst, formerly pathologist to the Millbank Research Fund at the Lister Institute; mathematics (Imperial College—Royal College of Science), Dr. W. H. McCrea, lecturer in mathematics in the University of Edinburgh; pathological chemistry (the Cancer Hospital), Dr. J. W. Cook, research chemist in the Research Institute of the Cancer Hospital. The title of University reader was conferred on the following in respect of posts held at the colleges indicated: geography, Dr. Hilda Rodwell Ormsby (London School of Economics); civil engineering,

Mr. John Purser (Imperial College—City and Guilds College) and Mr. M. K. Rice-Oxley (Imperial College—City and Guilds College); mechanical engineering, Dr. J. V. Howard (Imperial College—City and Guilds College) and Dr. S. Livingston Smith (Imperial College—City and Guilds College).

WALES.—At a meeting of the University Court on July 20, reference was made by the pro-chancellor to the very grave financial position of the University, which has arisen owing to the decrease in the contributions of local authorities since the passing of the Derating Act. Unless there is a favourable outcome to the negotiations which are now proceeding, the University will suffer a reduction in income of about £10,000 a year.

The Council of the Welsh National School of Medicine has appointed Sir Ewen J. Maclean to be an emeritus professor.

IN connexion with the Geneva Institute of International Relations, a conference on Training for World Citizenship will be held at the Institute on Aug. 19–23. Particulars can be obtained from the Secretary, Education Committee, League of Nations Union, 15 Grosvenor Crescent, London, S.W.1.

THE sixth International Conference of University Women is being held at Edinburgh. The Conference was opened on July 27 and will continue until Aug. 4. Included among the lectures being given in connexion with the Conference is one by Dr. Johanna Westerdyk on "Epidemics of Plant Diseases", and another by Mme. M. L. Puech on "Intellectual Co-operation". For the first time, the group discussion method will be introduced, the subject being "Does the University offer to the Modern Woman the Training needed to fit her for Life?": the discussion will be opened by Dr. Aurelia H. Reinhardt.

EDUCATION for commerce was discussed at a meeting of the Royal Society of Arts under the presidency of Sir Francis Goodenough on April 27. A full account of the lecture by Mr. H. Ramsbotham, Parliamentary Secretary to the Board of Education, which preceded the discussion, and of the remarks by a number of authorities, eminent in business and education, who took part in it, has now been published (*J. Roy. Soc. Arts*, June 17). Mr. Ramsbotham emphasised the imperative necessity of co-operation between employers and teachers in connexion with the framing of curricula, recruitment for employment in commerce, and part-time further education of employees. Now that so large a proportion of the younger generation, who would in former times have gone into the factory or the office at the age of fourteen years, remain in school for another two years, it is of vital importance that the needs of the factory and office should not be ignored by the schools. In the course of the discussion, many practical problems were dealt with and elucidated by reference to particular instances. Mr. Chorlton referred to effective training methods in use on the continent, especially Czechoslovakia, where the number of part-time day students of 16–20 years of age is thirtyfold greater in proportion to population than in Great Britain. Mr. Harold Sanderson described a successful experiment in the Burslem (Potteries) district in secondary education with an artistic bias. Miss Ford, H.M. Staff Inspector of Schools, suggested that American experience in child guidance and vocational guidance showed that we do not in Great Britain devote enough attention to detailed systematic examination of children to find out what their aptitudes are. Other speakers dwelt on the necessity for a better understanding on the part of university authorities of the qualifications appropriate for employment in commerce.

Calendar of Geographical Exploration

July 31, 1908.—Interior of New Guinea

D. Mackay and W. S. Little landed in New Guinea and explored the Upper Purari River. They suggested that coal existed in the interior of the island, and as a result Staniforth Smith in 1910–11 opened up for the first time a large area north-west of the Gulf of Papua and east of the basin of the Fly River.

Aug. 1, 1862.—The Kara Sea

P. von Krusenstern, jr., started from the Pechora River on his second attempt to reach the Kara Sea. His boat became fixed in the ice near Yugor Shar and drifted across to the east coast of the Kara Sea, his narrative forming the first complete sketch of a journey from west to east of that sea. He and his men had a series of hairbreadth escapes: their vessel was nipped in an icefield and eventually had to be abandoned. They made their way across the ice, sometimes leaping on to pieces of drift ice which had to be towed by boathooks, but ultimately reaching land and travelling in reindeer sledges to Obdorsk. A curious incident was the attempt of six walruses to accompany them on to a piece of drift ice.

Aug. 2, 1904.—Tibet and the Mustagh Pass

Sir Francis Younghusband reached Lhasa on a political embassy. On the return journey, the Brahmaputra from Shigatse to its source, the Sutelj from its source to the borders of India, and the Gartok branch of the Indus were surveyed by members of the party—a most important contribution to the geography of south and south-west Tibet. In 1886, Younghusband and H. E. M. James set out from Manchuria for India, during which journey they discovered and crossed the Mustagh Pass in 1887. Younghusband's work markedly extended the amount of accurately surveyed area in these regions; he also proved that the Mustagh is the true water parting west of the Tibetan plateau.

Aug. 3, 1868.—Scientific Exploration of China

Baron F. von Richthofen sailed from San Francisco for China, where he carried out his classic survey of that country. In 1859 he had accompanied a Prussian diplomatic mission as geologist, visited Ceylon, Japan, Formosa, the Philippines, and Java, and made an overland expedition from Bangkok to Moulmein. Unfortunately, his records and collections on this journey were lost. In 1877–85 he published three volumes and an atlas dealing with the geology and geography of China, including a notable study of the loess regions. He directed attention to the coalfields of Shantung, to the importance of Kiaochow as a port, and to many other possibilities of economic development. Between 1868 and 1872 he made seven expeditions into the interior of China, visiting, among other regions, Shantung and South Manchuria, central China, Chih-li, and Szechwan.

Aug. 4, 1482.—Mouth of the Congo

Circumstantial evidence points to this as the probable date on which Diego Cam or Cão discovered the mouth of the Congo River. Cam was the first explorer to carry stone pillars to mark newly discovered points, instead of relying on wooden crosses or carved trees. He put up four pillars altogether, two on his first and two on his second voyage. Fragments of the pillar he set up on Shark point to commemorate his discovery of the Congo River still

remain. Cam thence sailed south along the Angola coast and erected a second pillar at Cape Santa Maria in $13^{\circ} 26' S.$ On his second voyage (1485-86) he reached Cape Cross in $21^{\circ} 50' S.$ Thus he discovered 1450 miles of the West African coast-line, and paved the way for the voyages of Diaz and da Gama. An inscription on Behaim's Globe of 1492 suggests that he accompanied Cam on his second voyage, but doubt has been cast upon this statement.

Aug. 4, 1819.—Arctic Exploration by Ship and Sledge

W. E. Parry with the ships *Hecla* and *Griper* reached Lancaster Sound, whence he proceeded westwards, discovering Barrow Strait and parts of the coasts of Bathurst and Melville Islands. The winter was spent on the latter island. In 1821, Parry, on a second voyage, discovered the Fury and Hecla Strait between Baffin Island and Melville Peninsula. On April 3, 1827, Parry set out in the *Hecla*, proposing to attempt to reach the pole by travelling over the ice in sledge boats. He reached $82^{\circ} 45' N.$, thus establishing a record which remained unbroken for nearly fifty years. Experience had shown that efforts to sail to the pole were fruitless; to him and to Sir John Franklin belongs the credit of the introduction of the method of polar investigation by sledge journeys.

Aug. 6, 1538.—Exploration of Colombia

Gonzalo J. de Quesada founded the city of Santa Fé de Bogotá. He reached this region, which he called New Granada, after a difficult journey through uninhabited country along the Magdalena River, which he finally abandoned for the valley of the Opon.

Aug. 6, 1584.—Early Journeys in Siberia

Yermak, the Cossack who opened the path for Russia's expansion in northern Asia, was drowned in the Irtysh River. Provided with funds by the Stroganov family, merchants of Perm interested in furs, he penetrated, between 1579 and 1584, to the confluence of the Ob and the Irtysh. He reached the Tura in 1580 and wintered on the site where Tiumen now stands: in 1581 he captured the native fortress of Isker or Sibir, near the present Tobolsk. The Cossacks made their journeys in sailing boats, which were dragged across portages from one stream to another. Yermak is said to have used sails to dam up a stream and thus provide sufficiently deep water for his boats. Cossack bands, after Yermak's death, continued to explore north-eastern Asia. No tributaries with easy portages connect the Lena to western rivers, and the Russians who sailed the Lena to its mouth and attempted to explore the arctic in their primitive boats suffered severe hardships, whole parties being often completely wiped out. The importance for geographical knowledge of their journeys was long overshadowed by greed for tribute, and thus the records of their routes were forgotten.

Aug. 6, 1855.—Greenland and the Canadian Arctic

Dr. Kane and his party safely reached Upernavik in small boats, having been compelled to abandon the *Advance*, in which they had set out in 1853. Kane's work included the survey of the east coast of Smith Sound, the discovery and naming of the Humboldt Glacier, the survey of 800 miles of the coast of Greenland, and the discovery and survey of part of the coast of Washington Land. His vessel, the *Advance*, reached $78^{\circ} 37' N.$, and sledge parties penetrated to Cape Fraser in Ellesmere Island and to Cape Constitution in Greenland. A relief expedition under Hartstene found the party at Upernavik.

Societies and Academies

LONDON

Optical Society, June 9.—R. A. Houstoun: A new trichromatic colorimeter. The instrument is on a new principle, the intensity of the comparison field being altered by an iris diaphragm, and the colour by moving a magenta-yellow and a blue-magenta filter relatively to one another.—T. Y. Baker: The parallel plate micrometer. A plate of parallel glass placed in the convergent beam of a reading microscope is a useful means of obtaining the 'fine-reading' of a divided circle. The fine-reading scale is uniform if its length is proportional to the tangent of the angle through which the plate is tilted and if the refractive index of the glass is 1.60.—J. Adamson: A study of the cyclo-rotational powers of the eyes. An expression for the 'false torsion' of the eye is derived in terms of the direction of its line of fixation, and is used in calculating the extent of the compensatory cyclo-rotational powers of the eyes.—T. Smith: The hiding power of diffusing media. From theoretical considerations an expression is constructed as a numerical measure of the power of a sheet of a diffusing medium to hide the brightness contrasts of a surface on which it is laid. The dependence of this factor on the transmission and reflection factors of the sheet is exhibited and the effect of varying the thickness of the sheet is discussed. A comparison is made of these theoretical results with published experimental observations. The properties of all sheets may be expressed in terms of two constants, of which one is the reflection factor for an infinitely thick sheet, and the other is a factor for converting sheet thicknesses to the proper numerical scale.

Geological Society, June 22.—Jane Longstaff (née Donald): A revision of the British Carboniferous members of the family Loxonematidæ, with descriptions of new forms. Many Carboniferous species have been referred to the genus *Loxonema* (Phillips) which do not strictly belong to it. This is the case with Etheridge's Catalogue, where 25 species are given. Some of them, however, belong to the family Loxonematidæ as defined by Koken, and are referable to several of the genera into which it has since been divided. These are *Zygopleura* Koken, *Katosira* Koken, *Microptychis* Longstaff, and *Hemizyga* Girty. Three new genera are suggested for other species. The genus *Zygopleura* Koken contains by far the largest number of the species; one of these, *Z. rugifera* (Phillips), exhibits a considerable amount of variation both in size and ornamentation. The nuclear whorls, also, accord more with that genus than with *Pseudozygopleura* Knight. Twenty-six species and several varieties are described, 13 of the former being new. Six had been previously noted by de Koninck as common to Belgium, and another is now recorded: namely, *L. subconstricta* de Koninck.—Archibald Allison: The Dalradian succession in Islay and Jura. The author outlines results recently obtained by himself through the application of the criteria of current bedding and graded bedding, restricting his attention to the Dalradian rocks north and east of the Loch Skerrols thrust. Previously, this method of study has scarcely been used in Islay. The evidence of original order of succession is abundant, widely dispersed and consistent. Combined with the fact that the Maol an Fhithich Quartzite appears naturally to underlie the Mull of Oa Phyllites, it leads the author to conclude that the structure of Islay is an anticline, in part steeply overturned towards the north-west, in complete agreement with the views of Prof. E. B. Bailey as expounded in his paper on the Islay anticline.

DUBLIN

Royal Dublin Society, April 26.—T. A. Bennet-Clark :

(1) A method of automatically recording the rates of oxygen intake of living tissues. The tissues are enclosed in a container forming part of a closed system through which the air is circulated by means of a special form of pump. The carbon dioxide evolved by the tissue is absorbed in baryta water in a series of Pettenkoffer tubes, as in Blackman's apparatus. The oxygen absorbed is replaced automatically by oxygen generated electrolytically whenever the fall in pressure in the apparatus, due to absorption, raises the liquid electrolyte in a differential manometer tube so as to make contact with an electrode. This enables the composition of the air surrounding the tissue to be maintained constant for a long period of time without constant attention. The rate of oxygen supply is recorded automatically, and the volume of carbon dioxide is found by titration every two hours.

—(2) The respiratory quotients of succulent plants. Some measurements on *Sedum prealtum* leaves, with the apparatus described above, are in harmony with the view that the large variations which occur in the respiratory quotient (the ratio of carbon dioxide evolved to oxygen absorbed) for many hours after the leaves have been placed in darkness may be explained by variations in the quantity of malic acid present in the leaf.—E. J. Sheehy : Factors which determine the nutritive value (stock carrying and fattening capacity) of untreated natural pastures. Neither the chemical composition nor the digestibility of the dry matter of a pasture may be used as a criterion of its nutritive value. Fattening capacity depends upon the percentage of dry matter and on the density of the herbage, while stock carrying capacity is affected in addition by its rate of growth. These factors are correlated with the botanical composition.

PARIS

Academy of Sciences, June 13 (vol. 194, pp. 2093-2180).—H. Deslandres : Simple relations between the molecular spectrum and the structure of the molecule.—Gabriel Bertrand and L. Silberstein : The presence of mineral sulphides in an arable soil. A soil which reacted unfavourably towards growing plants was found to contain sulphides, decomposed by hydrochloric acid but not by acetic acid.—d'Arsonval : The medical applications of radioactive emanations, from the works of G. Vaugeois. A description of a method due to the late G. Vaugeois of utilising the emanation, for which certain advantages are claimed.—Léon Guillet, Auguste Le Thomas, and Marcel Ballay : The properties of copper-nickel alloys containing tin and silicon used for steam valves. The working properties of copper-nickel alloys are improved by the addition of tin and silicon. Detailed results with 37 alloys are given.—C. Camichel and L. Escande : Similitude of under-load without real linear dimensions. A discussion of Reynolds's equation of flow of incompressible viscous fluids in systems, such as submarine currents, which have no real linear dimensions.—Maurice Janet : The explicit determination of certain minima in problems without conditions at the limits.—P. L. Srivastava and S. P. Jain : The singularities of the Laplace-Abel integral.—C. E. Winn : The relation between a given series and another derived series with the same interval of oscillation.—N. Cioranescu : New problems on partial differential equations of the second order and of hyperbolic type.—W. Orlicz : Some theorems on orthogonal series.—Mlle. M. L. Cartwright : Some properties of the directions of Borel of integral functions of finite order.—Pierre Ernest Mercier : The intrinsic forms of the laws of plane motion (permanent motion).—Émile Sevin : Concern-

ing the rôle of the rotation of material particles in the evolution of the universe.—Lew Kowarski : Very thin crystals with curved outlines. From a study of the crystals formed by the sublimation of some organic substances, especially *p*-toluidine, it is concluded that an entirely polyhedral form is not a necessary attribute of the crystalline state ; it is only the final term of an evolution. Certain substances can show curved surfaces.—D. G. Dervichian : Surfaces and molecular volumes in superficial solutions.—R. Lucas and P. Biquard : New optical properties of liquids submitted to ultra-sound waves. Photographs of interference effects produced by passing a beam of light through water submitted to ultra-sound waves (3-15 million periods a second).—Jean Cabannes : Laws of polarisation of Raman lines in crystals.—Constantin Salceanu : The influence of temperature on the natural and magnetic rotatory dispersion of three pinenes.—Réné Wurmser and Mlle. J. De Boe : The oxido-reduction potential of the system lactic acid, pyruvic acid.—W. S. Reich : Contribution to the study of glycogen. By an elaborate process of purification, the author has produced glycogen containing less than 0.002 per cent phosphoric anhydride. The purified substance retains all the essential properties of glycogen ; and hence it is concluded that phosphoric anhydride is not an essential constituent of glycogen.—Hardouin, Cochet, and de Fleury : Viscosities of flux and slag in the fusion of magnesium.—Urion : The thermal decomposition of the acyloins.—Maurice Leriche : The traces of an estuary formation, of Ypresian age, changed at the base of the Lutetian at the western edge of the Paris basin.—H. Vincienne : The horizontal disengagements in the south of the Jura : the tectonic and morphological rôle.—Edouard Roch : Geological observations in the region of Entifa and Beni Ayatt, to the north-east of Marrakesh (Morocco).—V. Frolow : The dissolved salts in the underground waters of the Palmyre region. The variations in the dissolved salts in three springs in this region with the time of year have been determined, and the results given graphically.—A. and R. Sartory, J. Meyer, and M. Antonioli : Cytological researches on the development of *Actinomyces Allenbachii*.—Paul Becquerel : The revivification of dried seedlings after placing in a vacuum and at very low temperatures. Seedlings of wheat, rye, lucerne, and annual sunflower, after prolonged drying in a vacuum, with subsequent exposure for 18 days at -190° C. (liquid nitrogen), and to a further treatment at -269° for 9 hours and -271° for one hour (liquid helium), with two exceptions, developed normally.—R. Echevin : The autumnal migration of phosphorus in the leaves of trees. During the change in colour from green to yellow, the protein phosphorus diminishes.—Mme. H. Heldt : Fertilisation in *Parapenæus longirostris*.—Paul Wintrebert : The primitive streak of amphibians ; a new phase of the development shown by the coloured markings.—Marcel Avel : An experiment permitting the regeneration of the head in the proved absence of the ventral nerve chain in *Lumbricus*.—E. Biancani, H. Biancani, and A. Dognon : The action of ultra-sound waves on isolated cells in suspension.—Georges Deflandre : The genus *Podamphora* and its relations with the Ebriciæ.—F. Labrousse : The fluorescigen function in the phytopathogenic bacteria. In two bacteria studied, the fluorescence depended on the amount of magnesium phosphate in the culture fluid.—A. W. Sellards and J. Laignet : The control, by a test on *Macacus rhesus*, of the protective power of the serum of men vaccinated against yellow fever with mouse virus. The tests prove the high degree of immunity conferred by this method of vaccination.—E. Roubaud and J. Colas-Belcour : The adaptation to submerged life during the winter in the larvæ of *Anopheles plumbeus*.

CRACOW

Polish Academy of Science and Letters, March 17.—A. Skapski: Endosmosis through a semipermeable spherical membrane.—Mlle. A. Dorabalska: Researches on the anomalous thermal effects given by some radioactive minerals. It has been proved that these anomalous effects cannot have been caused by secondary physical actions, such as adsorption of vapours or gases. From the study of two minerals, orangite and monazite, the thermal effect has been found to reside in the fractions containing the elements of the lanthanum and yttrium group. Cerium and erbium do not give out thermal energy.—M. Centnerszwer and S. Lewi: The influence of the temperature on the velocity of solution of thallium in nitric acid. The temperature coefficient $K_{35^\circ}/K_{25^\circ} = 2.06$; agreeing with the data of van't Hoff for the effect of temperature on chemical reactions.—M. Centnerszwer, Mlle. C. Weker, and Mlle. S. Majewska: The velocity of evaporation of liquids in a current of air. Experiments on the velocity of evaporation of water, benzene, and toluene and its variation as a function of the velocity of the current of air.—K. Dzięwoński and J. Moszew: A new method of synthesis of compounds derived from quinoline.—Mlle. M. Turnau: Some remarks on the geometric analysis of rocks.—H. Teisseyre: The morphological problems of the eastern Polish Sub-Carpathians.—W. Friedberg: The Miocene Pectinidæ of Poland and their stratigraphical value (1).—F. Rogoziński and Mlle. J. Ciechanowska: Experimental rickets (4). Wheat as a food causing rickets. The rickets produced in white rats and chicks by an exclusive wheat diet can be prevented by adding calcium salts in sufficient quantity to ensure a proper ratio of calcium to phosphorus.

ROME

Royal National Academy of the Lincei, Feb. 7.—U. Cisotti: Motion with 'wake' of a flexible profile (1).—L. Lombardi: An absolute voltmeter for the measurement of large differences of potential. On May 1, 1931, Prof. W. M. Thornton described an absolute voltmeter composed of a metallic ellipsoid of revolution, suspended between two plane parallel armatures, with its major axis inclined at 45° to the direction of the field. This device was applied and exhaustively discussed by the author in his doctorate thesis at Zurich in 1895.—G. Giorgi: New ideas on the theory of relativity. The theory of relativity has passed through three stages, the first termed restricted relativity, the second improperly named generalised relativity, and the third including the scheme of Einstein for a unitary description of gravitational and electromagnetic fields and those of other authors having the same purpose. Suggestions are now put forward which may lead to a further advance.—E. Paternò: (1) Cellulose xanthate and viscose.—(2) Soluble or peptonised cellulose. The form in which cellulose exists in its colloidal solutions is discussed.—(3) Composition of artificial silk. The experimental results described indicate that viscose silk is not hydrocellulose, but a mixture of a form of cellulose not yet defined with a substance which may be dissolved from the silk by soda solution.—T. Boggio: Certain vectorial formulæ in curved, three-dimensional spaces. The way in which some of the more common formulæ of ordinary space are modified in curved spaces is considered.—G. Sansone: Zeros of the polynomial solutions of the equation $(a_1x + a_0)y'' + (b_1x + b_0)y' - nb_1y = 0$ (ii).—C. Miranda: The summation of Hermite's series by Poisson's method.—L. Campedelli: Double planes with curve of branching of the eighth order.—N. Sakellariou: The calculus of variations.—Giacinta

Andruetto: Saint-Venant's formulæ for curved spaces of three dimensions.—G. Krall: Asymptotic effects of the tides on the motion of the celestial bodies. (1) Generalities and problem of two bodies.—R. Serini: The Doppler phenomenon for vibrating cords.—V. Zagami and V. Famiani: Comparison between the food value of certain vegetables and that of certain cereals. Experiments with young albino rats show that increase in weight and development of the genital organs are retarded by exclusive feeding of the animals on peas or lentils, and that still greater effects are produced if cereals form the only food. Less pronounced calcification of the skeleton and other bodily defects are also observed.—Giulio Cotronei: Zoological constitution and grafting (9).—M. Curzi: Contribution to the knowledge of the biology and systematics of strains of *Sclerotium Rolfsii*.

Forthcoming Events

Congress

AUG. 1-6

FIRST INTERNATIONAL CONGRESS OF PREHISTORIC AND PROHISTORIC SCIENCES, London. (See NATURE for July 16, p. 104.)

Official Publications Received

BRITISH

The Journal of Armstrong College Mining Society, July. Pp. xxi+91. (Newcastle-on-Tyne.) 1s.

Canada: Department of Mines: Mines Branch. The Clay and Shale Resources of Turner Valley and nearby Districts. By W. G. Worcester. (No. 729.) Pp. v+126. (Ottawa: F. A. Acland.) 20 cents.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1444 (T. 3156, 8170, 8192): Torsion and Flexure of Cylinders and Tubes. By Dr. W. J. Duncan. Pp. 78. 8s. 6d. net. No. 1445 (T. 3127): Interference between Bodies and Airscrews. By C. N. H. Lock and H. Bateman. Pp. 38+5 plates. 1s. 9d. net. No. 1458 (T. 2980c): Measurement of Take-Off and Landing Runs. By D. Rolinson. Pp. 3+2 plates. 4d. net. (London: H. M. Stationery Office.)

Memoirs of the Geological Survey of India: Palaeontologia Indica. New Series, Vol. 18: The Fossil Carnivora of India. By Dr. Guy E. Pilgrim. Pp. vi+232+10 plates. (Calcutta: Government of India Central Publication Branch.) 13.12 rupees; 22s. 8d.

Indian Institute of Science, Bangalore. Investigations on the Spike-disease of Sandal. 5: Report of Progress made during the Quarter ending 31st March 1932. Edited by Dr. V. Subrahmanyam. Pp. ii+18. (Bangalore.)

FOREIGN

The Bashford Dean Memorial Volume. Archaic Fishes. Edited by Eugene Willis Gudger. Article 4: The Structure of *Dinichthys*; a Contribution to our Knowledge of the Arthrodira. By Anatol Heintz. Pp. iv+115-224+9 plates. (New York: American Museum of Natural History.)

Mémoires de la Société de Physique et d'Histoire Naturelle de Genève. Vol. 41, Fasc. 2: Études sur la Partie Occidentale du Lac de Genève; Courants et Températures. Par A. Bétau et G. Perrenoud. Pp. 225-293+12 plates. (Genève: Georg et Cie.) 20 francs.

Proceedings of the Imperial Academy. Vol. 8, No. 5, May. Pp. ix+143-216. (Tokyo.)

Bulletin of the Earthquake Research Institute, Tokyo Imperial University. Vol. 10, Part 2, May. Pp. 273-498+plates 39-58. (Tokyo: Iwanami Shoten.) 3.40 yen.

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 84. Birds collected in Northeastern Nicaragua in 1922. By Wharton Huber. Pp. 205-249. Notes on Montana Orthoptera. By Morgan Hebard. Pp. 251-257. Notes on the A. Blaney Percival Collection of East African Birds, Part 1. By W. Wedgwood Bowen. Pp. 259-280. Angolan Birds collected during the Second Gray African Expedition, 1930. By W. Wedgwood Bowen. Pp. 281-289. (Philadelphia.)

Contributions to the Genetics of the Domestic Rabbit. By W. E. Castle and Paul B. Sawin. (Publication No. 427.) Pp. iv+50+12 plates. (Washington, D.C.: Carnegie Institution.)

Journal of the Faculty of Science, Hokkaido Imperial University. Series 2, Physics, Vol. 1, No. 3, April. Pp. 87-119. (Sapporo.)

Annual Report of the Meteorological Observatory of the Government-General of Tyosen for the Year 1930. Pp. 170. (Zinsen.)

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 13, 1931. ii. Nederbörden i Sverige. Pp. 159. (Stockholm.) 5 kr.

CATALOGUES

Zenith Resistances and Rheostats. Pp. 80. (London: Zenith Electric Co., Ltd.)

The Eagle Eye of your Camera: Zeiss Tessars. Pp. 24. (London: Carl Zeiss (London), Ltd.)