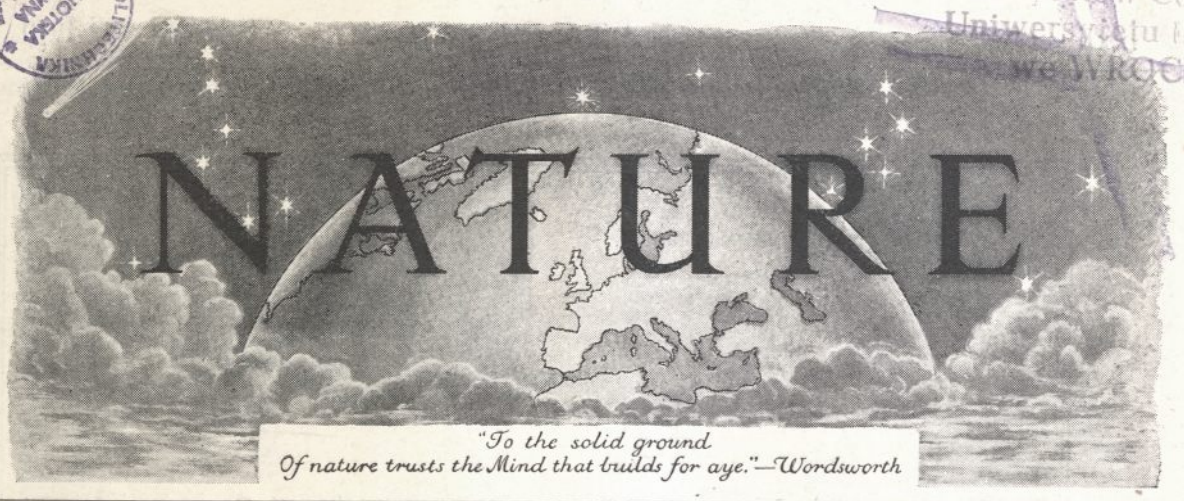

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NATURE

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FOOD POLICY AND EUROPEAN RECONSTRUCTION

IN the rude awakening which has come to public opinion in Great Britain and indeed elsewhere since the spring of this year, it is significant that the intensification of our national effort in the prosecution of the War has not eclipsed consideration of the problems which will confront us after the War in the task of reconstruction, whether in Great Britain or in the rest of Europe. In part it may be true that we are compelled to offer an alternative to the serf plan of European reorganization which Hitler offers. We cannot allow his plan to unite Europe to be propagated abroad without at least the broad outlines of a juster scheme which free men and nations could prepare.

The constructive and creative thought lying behind propaganda of this type is indeed a part of the war effort, to which it could well be argued that the Ministry of Information or the British Council might devote more attention and energy. The livelier and keener attention which is now being given to this question and the major problems it presents, as compared with the more academic debates of last autumn are not, however, primarily due to questions of propaganda or prestige. Fundamentally, they are due to the growing realization that the social and economic orders are changing and will demand a new type of society after the War if stability and security are to be achieved.

The mingling of the streams of social and international policy has thus forced us to consider reconstruction and the rebuilding of world order as part of the higher policy directing our war effort. It is indeed fortunate, as we have many times insisted, that much of the planning demanded primarily for war purposes frequently lends itself admirably to planning for reconstruction.

Prof. E. H. Carr remarks in "The Twenty Years Crisis" that ultimately the best hope of progress towards international conciliation seems to lie along the path of economic reconstruction. The same view that economic reconstruction to make it impossible for Europe again to be afflicted with economic distress like that of 1929–33 is a peace aim of the first importance has been repeatedly reiterated during the last twelve months. It is a main theme of Mr. J. E. Meade's admirable study "The Economic Basis of a Durable Peace" (London : George Allen and Unwin, Ltd., 1940. 6*s*. net.), in which he outlines a basis upon which a just and efficient system of international economic relations would be built.

A feature of the scheme is its endeavour to raise the general standard of living so far as possible and reduce inequality between nations and between classes. This would be done partly by the device recommended by the Bruce Committee and the editors of *Planning* of raising revenue to be spent in developing the more backward regions ; in enabling the Balkans, for example, to take full advantage of the technical knowledge, the experience and the superior credit of more prosperous States. The importance of this task to the rest of the world is well brought out by Mr. F. L. McDougall, the Australian representative on the Imperial Economic Committee, in a valuable pamphlet "Food and Welfare" (Geneva Studies, vol. 9, No. 5, November 1938. Geneva Research Centre). In that area of Eastern Europe the economy depends almost entirely on primary products and material civilization has been retarded by their unhappy history.

A European development fund administered in that area with no after-thoughts, with no purpose

except that of the improvement, economic and political, of those populations, would help to solve poverty throughout Europe in raising the level of life among the poorest peoples. These peasant populations, it should be remembered, provide almost virgin markets for industrial products. While the local consumption of protective foods must be increased in these peasant districts if a satisfactory level of health is to be ensured, these areas could still meet a large part of the demand for increased supplies of dairy products, eggs, fruit and vegetables for industrial Europe which national nutrition policies would postulate.

If, therefore, the war exigencies lead us to envisage and pursue an adequate policy of nutrition as part of our food policy, the development of that policy of nutrition in the very forefront of our economic policy on the lines recommended by the Bruce Committee should follow as a matter of course after the War. The placing by the industrial nations of improved levels of nutrition and rising standards of living in the forefront of their economic policies would create large new demands for food and raw materials. Besides stimulating their own agricultural production, especially of liquid milk, vegetables and the other more perishable forms of the protective foods, this would necessitate large increased imports of energy foods, animal feeding stuffs and the less perishable protective elements. Thus imports would be paid for by increased exports to the predominantly agricultural countries, with the result of markedly increasing world trade.

The profound disturbance to food production and distribution in Europe caused by the German occupation of Denmark, Holland, France and other countries in no way invalidates this conclusion that all nations feel the benefit of advances in nutritional policy, and it is against this background and in this prospective that we must assess proposals at present being put forward regarding the relaxation of the blockade or the storage of foodstuffs against famine. The appeals to the well-known philanthropy of the American people to break the blockade clearly derive their inspiration from enemy sources. The legal and moral issues at stake have been admirably summarized by Prof. A. L. Goodhart, an American who is professor of jurisprudence at Oxford in a letter in *The Times* of August 8. The distress which is already being felt in the countries occupied by Germany is largely the result of the deliberate policy of the German Government which has exploited these territories by denuding them of everything that could be added to German reserves or serve the purposes of German industry. The recent assertions from Germany that her food situation is absolutely secure further invalidates the claim that Germany should be relieved of responsibility for the feeding of those she has conquered and plundered.

The situation in Europe to-day presents no parallel or analogy with that of occupied Belgium in the War of 1914–18 when supplies were sent into occupied Belgium for distribution to the civilian population under neutral control. To-day no neutral control could be devised which would afford the slightest guarantee against abuse of any philanthropic enterprise. Any supplies reaching Nazi-occupied Europe are a direct or indirect asset to Germany and would be used without scruple for her own purposes.

If, therefore, any relaxation of the blockade of any country under German domination is unthinkable, reaffirmation of the integrity of the blockade might well be accompanied by an assurance of immediate relief as soon as that domination is removed. It is the constant purpose of Great Britain and should be a first concern of the Ministry of Information to strengthen the spirit of independence in the occupied countries, to encourage their will to resist and engender a consciousness of comradeship with those outside who are carrying on the struggle.

These are among the reasons which give fresh pertinence to the planning of a definite policy for the relief of Europe as soon as the downfall of Nazism is achieved. Such a policy would involve the co-operation of the United States and of other overseas countries, including the British Empire, some of whom have already displayed a special interest in nutrition problems.

If the situation is to be met, planning on scientific lines is essential. Much indeed of the basic knowledge is already available through the inquiries set on foot by the Bruce Committee. In the building up of large stores of surplus foodstuffs ready to be shipped into Europe as soon as Nazi domination comes to an end, as suggested by Colonel Meinertzhagen, we must take account not only of surpluses accumulating in the Americas but in Africa also. As Dr. Julian Huxley points out in a recent issue of *The Times*, if may be necessary to buy up surplus products, not only of human foodstuffs but also of animal foodstuffs

and other raw materials, if the entire economy of certain large tropical regions is not to collapse. Some surpluses, such as vegetable oils, require processing, involving in turn the purchase of suitable machinery from countries whose industry is not overtaxed by armaments production and this, like the provision of storage facilities, should form part of a comprehensive plan.

Dr. Huxley's proposals indeed merit close and immediate attention. To draw up such a programme now is not only an elementary measure of foresight. It would also demonstrate that democracy can plan for the needs of peace as decisively as a dictatorship, and without sacrificing the essentials of freedom. It is the most effective answer to the pretence that British policy is bringing starvation to Europe. It is not enough to point out that it is Nazi Germany which is starving Europe. Active preparation to feed Europe as soon as the present tyranny is overthrown is the first step to the establishment of a new European order enshrining the ideals for which Great Britain and those with her contend.

The supreme need behind such a plan is for enough public spirit and enlightenment to break through prejudices and inhibitions and act with courage and imagination. Alike in the prosecution of the struggle to which we are committed, and the building of a juster and more tolerable social order when victory has been achieved, there must be no weakness in the face of vested interests or conservative prejudice.

HENRY BESSEMER AND SIDNEY GILCHRIST THOMAS

Sidney Gilchrist Thomas

An Invention and its Consequences. By Lilian Gilchrist Thompson. Pp. 328+8 plates. (London : Faber and Faber, Ltd., 1940.) 12*s*. 6*d*. net.

IN 1856, an Englishman who had recently invented a rotating projectile was witnessing gun-trials with it on a French artillery practice ground near Paris. At that time, both gun and projectile were made of cast iron. These trials were a failure because of the frequency with which the gun burst, and the French commandant, who was in charge, said to him : "This invention of yours will require a better gun than one made of cast iron." So Henry Bessemer, for it was he, returned to England to make a gun tube that would not burst on firing.

He set to work at a foundry in St. Pancras, and after a few experiments conceived the idea of removing the impurities from molten cast iron without external heat, by blowing air through it and oxidizing them. He was a man of considerable financial resources, and in less than a month had carried out his experiments successfully. He constructed a 'converter', which was simply a pear-shaped iron shell with a fireclay refractory lining fitted with tuyeres through which the air was blown. The only difficulty he had in conducting the first experiment was with his assistant, who thought he was quite mad. However, he succeeded in making him pour the melted iron from the cupola into the converter and started to blow air through it. Neither of them knew what would happen and at first nothing did happen ; the reaction started quietly but then became very violent, and nearly set the place on fire. When it had finished, the converter was rotated downwards and the liquid metal poured out into a mould. In this way, he obtained an ingot of what he regarded as malleable iron. Malleable it certainly was, as numerous experiments showed. The product is what is to-day called 'mild' or 'soft' steel. He had within half an hour raised the temperature of a mass of fluid pig iron several hundred degrees, removing the greater part of the impurities without the use of any fuel, and produced a steel which was not brittle. This experiment inaugurated the era of cheap and plentiful steel.

But, to use a modern expression, Bessemer had 'got away with it' rather too easily. Quite by chance, he had used one of the few suitable brands of low-phosphorus pig iron made in Great Britain, and that is why his first experiment was successful. At that time, there was no such thing as the chemical control of the composition of cast iron. Various iron-makers set to work to repeat this process, using their own brands of cast iron, not knowing that what was right for the refinery or puddling-furnace was wrong for converters lined with siliceous materials. Almost without exception the irons produced were worthless since they were quite brittle. This brought about a complete reaction against the process which was denounced as the dream of a wild enthusiast, such as no sensible man could for a moment have entertained.

In those days there was no Iron and Steel Institute, and Bessemer had to try to solve his difficulties himself. He established the fact that it was the phosphorus in the cast iron, which was

not removed in the 'blow', which made the resulting steel brittle, and he then tried to remove it by various methods, but without success. By using Swedish non-phosphoric pig iron, however, he was always able to convert this into malleable steel. By now, however, the process was discredited and nobody would take it up, so that he was forced to become a steel-maker himself. He went into partnership with four other men and established a works in Sheffield. This partnership lasted fourteen years. The process was so much cheaper than the established methods of steel-making that their profits were very large. During this period they made eighty-one times their capital. Bessemer thus solved the problem of making steel without fuel from low-phosphorus pig iron. But his process was of limited applicability since the majority of ores distributed over the earth's surface contain too much phosphorus to be amenable to it.

Some fifteen years later, an evening-student at the Birkbeck Institute, listening to a lecture on cast iron, heard the sentence, "The man who eliminates phosphorus by means of the Bessemer converter will make his fortune". The student was at that time a junior clerk in the Thames Police Court at a salary of £90 a year, and his name was Sidney Gilchrist Thomas. That remark lit the flame of desire in his mind to solve the problem. He began experiments in his humble quarters, and enlisted the help of his cousin, Percy Carlyle Gilchrist, who was the chemist at an iron works at Cwmavon in South Wales. Both of them had to work with very slender resources in their spare time. Naturally, progress was slow and the results were frequently disappointing; but they persevered and in the end took out two patents. But by this time they had exhausted almost all their financial resources. However, Mr. Martin, the general manager of the Blaenavon Steel Company in South Wales, came to their assistance. Further experiments were made and, finally, a third patent was taken out in 1878. In the meantime, the Iron and Steel Institute had been founded (1869). Accordingly, Thomas and Gilchrist prepared a paper for presentation at its autumn meeting in Paris in that year. The paper was entitled "On the Elimination of Phosphorus in the Bessemer Converter". So little was its importance realized that it was not even read, but was adjourned until the spring meeting of 1879. In the interval, the inventors got into touch with Mr. Windsor Richards, of Bolckow, Vaughan and Co. The personality of Thomas, in particular, greatly impressed him. Accordingly, arrangements were made for a phosphoric charge to be blown at the works in question, and this was successfully done in April 1879. Thomas and Gilchrist had established that three essential conditions must be satisfied if the phosphorus was to be eliminated from the cast iron.

(1) It was necessary to line the converter with basic material, not merely of the correct composition but also of the requisite temperature stability, so that its adhesion to the converter walls during the blow was maintained. Such a lining could be manufactured from burnt dolomite.

(2) It was essential to form a rich basic slag at an early stage of the process.

(3) While carbon, silicon and manganese were removed at an early stage of the 'blow', the phosphorus was not diminished until later. This necessitated the so-called 'after blow' during which about 80 per cent of the phosphorus is eliminated.

This experiment was completely successful and accordingly, when Thomas and Gilchrist read their paper at the May meeting of the Institute in 1879, they were in a strong position. At this meeting, Sir Henry Bessemer was present and congratulated them on having solved the problem which had proved too much for him. It was admitted by the great majority of critics that they had established their case.

Thomas possessed a very acute mind, and his experience on legal matters at the Thames Police Court stood him in good case when it came to the filing of the patents for what is now known as the 'Basic Bessemer Process'. From being a poor man, he quickly became a well-to-do one. He and Gilchrist thus completed the original discovery of Bessemer by rendering it available for iron ores which contain sufficient phosphorus. In addition, in their process the slag produced is a valuable agricultural fertilizer, and may be regarded as an equally important product.

Although the above facts have been known for the last sixty years, the personal side of Thomas's life and work has only recently been disclosed. He, himself, died in 1885 when he was only thirty-five. His sister, Lilian Gilchrist Thompson, has published his life, under the title of "The Story of an Invention and its Consequences". She is in her eighty-first year. He left the money which he had made to her in a trust for charitable and social purposes. In writing this book, she has frequently let Thomas speak for himself, whether in the form of letters to his mother and herself, to whom he was devoted, or in a series of articles under the heading, "Technical Travel Talk", which he contributed to the columns of *Iron*. There are many who will be grateful to Mrs. Thompson for the story thus told. She has performed her task admirably. Thomas was a man who lived strenuously, and literally wore himself out. His is one of the great names in metallurgy, and he is one of the great benefactors of the human race.

H. C. H. CARPENTER.

CONTRIBUTIONS TO THE HISTORY OF SCIENCE

Osiris, Vol. 7
Edited by Dr. George Sarton. Pp. 616. (Bruges: St. Catherine's Press, 1939.) n.p.

TO those whose interest in science is wide enough to embrace the history of its development in all stages a volume of "Osiris" offers much attractive reading. The field covered is so extensive that few are likely to read all the articles with equal avidity. The contributors equally have shown complete diversity in their choice of subject and in the scale and manner of treatment. Thus the contents present a variety from which readers can make a choice according to their taste.

Each volume of "Osiris" is dedicated to some distinguished scholar. In this, the seventh of the series, tribute is paid to Prof. Gino Loria. His portrait, a biographical sketch by Prof. R. C. Archibald and a bibliography of his writings make a fitting opening of the volume.

A paper in German by Prof. J. Ruska follows, in which he attacks the problems set by the works of the Arabian alchemist Razi, the author of "The Secret of Secrets". These have had a curious fate, for while at least one MS. has passed unrecognized under another part of Razi's very elaborate full name, others which purport to be Latin versions have been mangled in the course of transmission and some have been attributed to Razi without any justification. To distinguish the true text is thus an arduous task, but this work of scholarship on which Prof. Ruska has embarked is essential for the history of alchemy.

The sexagesimal system retains its interest owing to the form of division still adopted for the hour and the degree. The origin of this system is attributed by M. F. Thureau-Dangin to the Sumerians; but his very interesting paper, which is translated into English, deals also with the wider subject of Babylonian mathematics. As this includes the solution of a quadratic equation by rules which represent the usual formula its historical importance is great. Whether this achievement is properly regarded as a beginning of algebra seems doubtful. It is a long way from Diophantus who used symbols, whereas the Babylonians certainly did not. Hence they deserve credit for remarkable skill in arithmetic, which is doubtless the parent of algebra, but the critical step from one to the other is surely to be found at some later date when algebraic symbols are explicitly introduced for the first time.

The development of geometry in the last century with the fundamental change of outlook involved is discussed by Prof. E. Nagel in a technical but very readable paper. He has traced the progressive advance towards more complete abstraction by which geometry has become more and more independent of physical content. Had it ceased to be "useful" in the process there would have been no need to agree with Santayana that it had become "a wasteful and foolish exercise for the mind" except in the same sense as the fugues of Bach. But of course geometry has not become less relevant to an understanding of the physical world through breathing a purer and wider atmosphere, and Prof. Nagel has not failed to consider the modified relation between the two spheres of geometry and observation.

The editor's charming study of Borodin goes far to justify a medium in which men of science can be treated as human beings. In his union of science and art Borodin was unique. As a professor of chemistry he gained his livelihood, played his part in the teaching of his generation and made a quite respectable contribution to the progress of chemical research. As a musician he was a composer of distinct originality and as such he will be longest remembered: *ars longa, scientia brevis.* A reference to William Herschel may be corrected on one point. It is true that Herschel did not run his art and his science in double harness all through his life. But it is not true that he was not a composer. Those who were privileged to hear a selection from his work played under the direction of Dr. G. Dyson at the Royal Astronomical Society conversazione a year or two ago learnt that Herschel's compositions are charming examples in the lighter eighteenth century idiom. In spite of their merit they remain unpublished in the possession of the family.

The paper by S. Gandz on the "Dawn of Literature" fills nearly half the volume and so is out of scale with the rest. That the author's industry in collecting material has been great is attested by some 750 references. But the whole has not been reduced to the form of a connected thesis, and it may be that the subject of oral tradition in the ages before writing was possible and afterwards is too wide for satisfactory treatment. It has many interesting aspects, alike in the religious and the secular, the literary and the scientific spheres. Here these aspects are neither exhausted nor brought into one clear focus.

Nothing need be said about the next paper by M. J. Pelsencer giving unpublished letters of Newton, because this has already been the subject of a note in NATURE. It is followed by one in

which Dr. E. C. Watson describes the prominent members of the Paris Academy of Sciences in its early days. This article is based on engravings by Sébastien Le Clerc, a number of which are reproduced. In 1670, Le Clerc was engaged by Colbert as Court engraver and in this capacity he contributed illustrations to several notable works produced by the Academy with the direct encouragement of the king. To this circumstance is due a pictorial representation of the membership and apparatus of the Academy in several settings. This pleasant account makes it a matter for regret that no contemporary artist gave similar attention to the Royal Society.

The volume closes with a short article by Sister M. E. Keenan on "St. Augustine and Biological Science". Perhaps natural history would be more appropriate, and indeed the subject is rather literary than scientific. The source of Augustine's allusions is clearly Virgil and Pliny rather than Nature, and though he may have treated current lore with some reserve, his powers of observation do not seem to have been more than moderate.

H. C. PLUMMER.

SCIENCE IN BREWING

Brewing

Science and Practice. By H. Lloyd Hind. Vol. 2: Brewing Processes. Pp. xiv + 507–1020 + 62 plates. (London: Chapman and Hall, Ltd., 1940.) 56*s*. net.

IT may be said, at some risk of repetition, that brewing is an art, developed throughout the centuries without aid from science. Science now steps in to explain what happens in the brewery, why certain procedures give good and others bad results. Research, both fundamental and technical, is increasing every year the value of science, now harnessed to the art of the brewer.

An example of this function of science in the brewery may be cited. The importance of aeration in securing a satisfactory brewery fermentation has been realized since Pasteur's time. In more recent times the purely mechanical function of aeration, that of 'rousing' or mixing the yeast back into the fermenting wort until it has finished the fermentation, has been stressed. Also within recent years the relationships between alcoholic fermentation, respiration and yeast growth have become much clearer. It now emerges that, fundamentally, aeration in the brewery fermentation vessel is merely necessary to secure healthy growth of the yeast from the small amount that the brewer seeds to the wort to the much larger amount that he normally removes from it. There is no scientific reason why a much higher yeast seed-rate should not be used in practice. This would result in a swifter fermentation and little time for multiplication. Aeration would be quite unnecessary in such a case. The fact is that beer is not, and never was, made in this way, and probably it would have a yeasty flavour and other different characters if it were so made. Moreover, the problem of a supply of healthy seed yeast would arise. But the apparent contradiction between theory (as propounded by Pasteur) and practice in breweries is explained. Science explains the brewers' empiricisms.

Such is one function of the excellent work under notice. To the technician in the brewing industry, it is of course, much more than a mere explanation of long-established practice. It is with its companion volumes a complete handbook of the brewer's art and craft.

The materials used in brewing had been exhaustively treated in vol. 1, which appeared about two years ago. The present volume deals with plant and processes, except that the whole of the processes involved in the bottling of beer are postponed for treatment in a third volume to appear later.

The chapters dealing with mashing are very good. Here, as elsewhere, the opportunity has been taken to incorporate into this volume recent scientific advances which have been published since the previous volume was written. There is also shown throughout a satisfactory blend of scientific discussion and practical empiricism. The processes of boiling with hops, cooling (involving flocculation of protein-tannin compounds), fermentation, conditioning of draught beer, and sections on relevant micro-organisms follow. An admirable chapter on bacteriology as it affects the brewer is contributed by Dr. J. L. Shimwell.

A large number of excellently reproduced photographs of brewery plant adorn the volume, whilst the photomicrographs of yeast in ultra-violet light are the best the reviewer has ever seen. A summary and list of references appear at the end of each chapter, whilst author and subject indexes terminate the volume. The author's long experience as brewer and chemist, supplemented by extensive reading and painstaking labour, have resulted in a book which should be of inestimable value to technicians engaged in the trade.

STUDIES IN FOSSIL BOTANY

An Introduction to the Study of Fossil Plants
By Prof. John Walton. Pp. x + 188. (London: Adam and Charles Black, Ltd., 1940.) 15*s*. net.

THIS book, intended for those who have had at least a year's university or college course in botany, will be welcomed not only by university students but also by those select readers who desire a brief, well-balanced account of the fascinating succession of floras that have clothed the earth. The value of the descriptive matter, which is clear and concise, is enhanced by the illustrations, which are generous in number and well chosen. The probable relationships between the living and the fossil representatives of the various groups of plants are adequately indicated, while fruitless speculation on the more problematical affinities has been avoided. D. H. Scott's "Studies in Fossil Botany" being now out of print, the book under review replaces it in the publisher's lists.

In his preface, the author expresses the hope that his readers will make a point of examining the actual specimens of fossil plants which are preserved in university and museum collections, and that they will institute active searches for fossils in such likely places as quarries and the spoil-heaps of collieries: such a course will indeed amply repay, in increasing understanding and zest, the trouble involved. Even the novice may hope to have the good fortune to find specimens which are worthy to be added to the priceless collections in our museums, and may also find hitherto unknown localities for fossils which may possibly yield a rich harvest of new forms.

The first chapter of the book classifies plant remains in general into compressions, incrustations, casts and petrifactions, and gives an excellent account of the many methods employed in investigating the specimens in the laboratory. Great advances have been made in a number of these methods in recent years, and Prof. Walton has been in the forefront of those who have made them; one of the most remarkable results of micro-palæobotanical research was his discovery of the oldest known (Carboniferous) liverworts (p. 22).

The body of the work deals with the chief groups of plants in the order of increasing complexity, each group being illustrated by a number of types. In the account of the Thallophyta it is shown that the recognition of fossil bacteria depends less on their external form than on the traces of their physiological activity. This would have been an appropriate place for a brief reference to the role of anaerobic bacteria in coal-formation and for mention of the recent work of Lipman, Farrell and Turner on the bacteria occurring in coal. On the other hand, the description of Pachytheca might well have been omitted, since its vegetable nature is open to doubt. The description of the early vascular plants is a particularly good review of exceptionally difficult material.

A reference to the spores which occur abundantly in most coal-seams is made in the account of the Lycopodiales, plants which disseminated spores in countless numbers. The preparation of graphs summarizing the vertical distribution of arbitrarily chosen spore-types in coal-seams has recently been pressed into service in the difficult task of endeavouring to correlate the seams. This method is, however, still in its early stages. While it may be doubted whether sufficient evidence has yet been adduced to warrant the statement (p. 57) that "a similar graph is usually obtained if the same seam is analysed in a different part of the coal-field", it is certainly not necessarily true that "a different seam will show quite a distinct form of graph".

The final chapter of the book, on the succession of the floras and climates, is full of interesting matter. The climate of Europe and North America during Upper Carboniferous times is described as "probably warm" (p. 135) and as "between temperate and tropical" (p. 174), but the plant evidence on this point may be regarded as less conclusive than even these statements imply. Furthermore, studies on certain other forms of contemporary life and on certain sediments have led to conclusions which are actually contradictory. Despite the uncertainty, as Prof. Walton points out, we have considerable evidence, important to the botanist, as to the ecological conditions under which the plants lived.

The text is completed by a representative bibliography and a useful index; the outline classifications given at the beginning of most of the chapters, and the several tables included in the text, are valuable guides to the complex botanical and geological divisions. This book is a stimulating account of the subject and admirably fulfils its purpose. Both the author and the publishers are to be congratulated on the production.

R. CROOKALL.

A Flora of Cambridgeshire

With an Appendix on the Origin and Drainage of the Fens. By Dr. A. H. Evans. Pp. xi+228. (London and Edinburgh: Gurney and Jackson, 1939.) 7*s*. 6*d*. net.

AS there has been no Flora of Cambridgeshire published since Babington's in 1860, a modern flora of the county was much to be desired. Unfortunately this book does not fill the gap adequately, and compares very unfavourably with such a book as the recently published "Flora of Devon". For most species no dates or authorities are given for the records. For example, twenty localities are given for *Astragalus glycyphyllos*, of which fifteen occur in Babington's Flora; the other five are new, but no indication is given of their date or of where the plant still occurs. Relhan's name is cited for the Shelford locality but not for Madingley or Impington, from which places no more recent record than his was known to Babington.

Unfortunately, also, the book contains many errors. *Prunus insititia* is not a green-twigged woodland plant nor is *Juncus bulbosus* "not uncommon" but very local. The Cambridge University Herbarium has not been properly consulted, so that many important records are entirely omitted. As examples may be cited *Medicago denticulata* (a plant not included in the Flora) from near March (Little), *Cardamine hirsuta* from Chatteris and *Apium inundatum* from Ditton and Hardwick.

While it is useful to have a record of the author's great personal experience of the plants of the county and while the book contains much useful information, the need for a good modern Flora of Cambridgeshire remains unfilled. E. F. WARBURG.

Essai de météoropathologie

Physique, clinique, thérapeutique. Par W. Kopaczewski. Pp. 296. (Paris: J.-B. Baillière et fils, 1939.)

THAT certain disorders are caused or influenced by environment, atmospheric conditions, weather, has been surmised from ancient times—for example, ague and swamps, rheumatism and dampness—and in his introduction to this book the author reviews the contradictory evidence thereof. It is also often difficult to disentangle purely environmental from other factors; thus, we now know that swamps generate ague only because they breed the mosquitoes which convey the disease. The author first surveys the physical factors of the air and sun concerned with climate, the physiological details connected with these, and meteorological data. Next, regulation of body function necessary in a changing environment is dealt with, followed by a discussion of the results upon the body of extreme variations in atmospheric pressure and temperature, exposure to actinic rays, and electric shock. Finally, the treatment of the 'shock' thus caused is considered.

Unfortunately, no information or discussion is included respecting the more subtle influence of minor meteorological disturbances upon body function, such as ordinary variations in barometric pressure, in humidity and in temperature, alterations in direction and force of the wind, and the like, and it is about these that we are still so ignorant. A valuable section of the book deals with the climate of France, with full meteorological data, and illustrated with fourteen excellent charts.

Aspects of the Calculus of Variations

Notes by J. W. Green, after Lectures by Hans Lewy. Pp. vi+96. (Berkeley, Calif.: University of California Press; London: Cambridge University Press, 1939.) 4*s*. 6*d*. net.

THIS little book contains valuable notes taken of lectures delivered at the University of California in the spring of 1938. The aim of the lecturer was to acquaint the student with a skeleton of the methods, rather than the theorems, of the calculus of variations. Familiarity with the chief methods used in the study of functions of a real variable is assumed.

The notes are divided into six chapters which deal with the derivation of the necessary equations for a continuous function to assume maximum or minimum values; quadratic problems in one variable; the Weierstrassian field theory; a general theorem on existence of absolute minima; an introduction to harmonic functions and the Dirichlet problem; Plateau's problem and conformal mapping. As the literature on these aspects is either of recent date or is not easily accessible, these interesting notes should be of much use to all students of this subject.

New First Course in the Theory of Equations

By Dr. Leonard Eugene Dickson. Pp. ix+185. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 10*s*. 6*d*. net.

THIS book is founded upon the author's earlier work but is written "in a more expansive style with many illustrations either following or preceding the introduction of new ideas or topics, and with minute attention to details". Proofs have been simplified, so far as possible; more exercises have been added, whilst others have been discarded and additions have been made to the text in order to bring it up to date.

Introductory chapters deal with complex numbers and the elementary theory of roots, after which cubics, quartics and the use of graphs are discussed. Then follow the various methods in use for solving numerical equations, brief discussions of determinants, matrices, symmetric functions, elimination, resultants and discriminants. Finally, the general theory of polygonal constructions is considered analytically. This is a logical sequel to an earlier chapter on some particular impossible constructions by ruler and compasses. The book closes with an appendix on the fundamental theorems of symmetric functions and of algebra.

As the subject naturally touches the borders of so many other fields of study, it is always difficult to render a treatment of the theory of equations in any way complete. Nevertheless, the author has produced an interesting first course which should be quite useful to students as an introduction to the subject.

THE SUPPLY OF ANIMAL FEEDING-STUFFS

By Dr. Norman C. Wright,

Director, The Hannah Dairy Research Institute, Kirkhill, Ayr

THE statement made recently by the Minister of Agriculture that British farmers should aim at self-sufficiency in regard to their supplies of animal feeding-stuffs raises the interesting question as to whether such self-sufficiency could, in fact, actually be achieved on a nation-wide scale.

Some two years ago I made an estimate of the total supplies of home-produced and imported feeding-stuffs available for the live-stock population of the United Kingdom[1]. A recent re-examination of the feeding-stuffs position[2] has confirmed this earlier estimate. Briefly, it may be stated that the total pre-War supplies amounted to about 42 million tons of feeding-stuffs (expressed as dry food), which provided some 22 million tons of starch equivalent and 3½ million tons of protein equivalent. Roughly 60 per cent of these nutrients were derived from British grassland, either in the form of grazing or hay, about 14 per cent were supplied by the home production of cereals and root crops, while various by-products (such as brewer's and distiller's grains and fish and meat meals) provided a further 1 per cent. The remaining 25 per cent had to be imported from overseas, either in the form of cereals (chiefly maize and wheat offals) or oilseed products. The volume of imported feeding-stuffs which the British farmer is urged to replace by home-grown produce may, therefore, be roughly estimated at 10 million tons, containing about 5 million tons of starch equivalent and 1 million tons of protein equivalent.

In considering how far this feeding-stuffs gap can be closed, three salient facts must be taken into account. First, of the total home-produced nutrients, about two-thirds are obtained directly from summer grazing. Any curtailment in the volume of imported feeding-stuffs will therefore result in a relatively larger gap in the winter supplies, and any increase in home production will, in consequence, need to take the form of feeding-stuffs which are capable of conservation for winter use.

Secondly, there are two classes of stock, pigs and poultry, which cannot utilize large quantities of coarse feeding-stuffs, and which have therefore to subsist chiefly on cereals and protein-rich concentrates. Such stock are liable to be particularly badly hit by any reduction in the feeding-stuffs imports.

Thirdly, it must also be realized that a reduction in overseas imports may not be the sole cause of a shortage of feeding-stuffs. Disorganization of the home fishing industry has, for example, already caused a reduction of about 60,000 tons in the supplies of fish meal, while the threatened raising of the extraction rate of wheat to 85 per cent would reduce the quantity of offals available for live-stock by as much as 900,000 tons. Again, the ploughing-up campaign, while adding materially to the total food production of the country, will itself cause a reduction of between 50,000 and 100,000 tons in the supplies of protein and starch equivalent which will be available for animal feeding.

The above facts will inevitably increase the difficulty of closing the feeding-stuffs gap. In attempting to close this gap, three lines of action are possible: first, the exploitation of new sources of supply; second, the adoption of modified feeding methods; and third, a compulsory reduction in the live-stock population.

As regards new sources of supply, a wide variety of methods has been suggested for increasing the home production of nutrients suitable for stock feeding. A recent review of these methods[3] indicates, however, that few of them are capable of making a really significant contribution towards closing the feeding-stuffs gap. For example, the more efficient utilization of kitchen waste, which was the subject of a special article in Nature[4], could at best only replace about half of one per cent of the pre-War imports, while improvements in the methods of conservation of slaughter-house offals might achieve an increase of about the same order. The pre-digestion of straw with alkali, the potentialities of which were explored by Germany in the War of 1914–18, is at present the subject of intensive research in Great Britain. The object of the treatment is so to improve the nutritive value of straw now used for litter that it can usefully be fed to live-stock. The treatment of, say, 10 per cent of such straw (an optimistic estimate in introducing a very novel practice to a very conservative industry) would, however, only replace 2 per cent of the energy content of

the pre-War imported feeding-stuffs, while it would have no effect on the supply of protein.

So far as the protein portion of feeding-stuffs are concerned, the use of synthetic non-protein nitrogen compounds such as urea has been advocated as a substitute for part of the protein in the rations of ruminants. In order to make good the low protein content of cereals *in the rations of dairy cattle alone* it would, however, be necessary to envisage an output of urea of the order of 50 tons per day, a quantity which is certainly well beyond the present capacity of the country's production plant. Again, it has been suggested that, as an alternative means of making good the protein deficiency of home-produced feeding-stuffs, the cultivation of protein-rich crops such as beans should be increased. This could, of course, only be done at the expense of an existing crop, say oats. If this latter fact is taken into account, even the doubling of the present bean acreage would only increase the supply of protein equivalent by about 10,000 tons (1 per cent of the pre-War imports), while it would simultaneously *decrease* the supplies of starch equivalent by about 16,000 tons. The same general finding applies to all other crops which have been advocated as potential sources of increased supply.

It is clear from the above facts that most of the suggested new sources of supply, while no doubt of use on certain individual farms, cannot be expected to contribute significantly towards the closing of the feeding-stuffs gap. There remains one further source of supply which has not been discussed, namely, grass silage. The Ministry of Agriculture is clearly pinning much faith on the development of this form of conserved fodder as a means of replacing imported feeding-stuffs. The immediate aim is stated to be the production of one million tons of silage from the present season's aftermath. This would, it is true, only replace about 2–3 per cent of the pre-War feeding-stuffs imports. The above figure is, however, clearly an interim one: a far greater effort would obviously be called for over a complete grazing season. In this connexion it may be noted that a ten-fold increase in the present objective, that is, an annual production of ten million tons of silage, would replace about a quarter of the pre-War imports—a really substantial contribution. Although such a large output might appear somewhat impracticable, it would require the provision of only three small (30–40 ton) silos on every agricultural holding of more than 150 acres—an achievement which should not prove impossible in time of really serious emergency.

It would not perhaps be out of place to mention at this point one other *indirect* method of increasing the proportion of home-produced nutrients, namely, a return to summer milk production and an intensification of summer meat production. The term 'indirect' is used because the method involves the storage of the finished products themselves (dried or condensed milk, cheese, meat, etc.), instead of the storage of the grass herbage as hay or silage. The method would entail a drastic changeover in management (for example, in re-arranging calving dates), but as a long-term measure has obvious advantages.

Taking into account all the above sources of supply, it does not appear that they could replace more than about one third of the pre-War imports of feeding-stuffs. For further savings it is necessary to turn to the second line of action, namely, the adoption on the farm of more economical systems of feeding.

There is no doubt that substantial savings could be effected by this means if rationing on a basis of modern feeding standards were to be adopted on a nation-wide scale. The general tendency of recent animal-feeding experiments, whether with cattle, sheep, pigs or poultry, has been to show that the older feeding standards can be markedly reduced without adversely affecting the health or productivity of the stock. Reductions of the order of 20 per cent may, indeed, be made in the protein and/or energy contents of most rations. Again, the methods of feeding beef cattle and sheep could well be modified under war conditions, when the provision of an *adequate quantity* of meat is more important than the attainment of *superfine quality*. Again, war-time methods of stock-feeding (for example the Lehmann system of pig-feeding) permit the use of more coarse feeding-stuffs (and therefore of more home-produced roughages) than is normally considered practicable.

It is not easy to estimate the total savings in imported feeding-stuffs which might be effected by the widespread adoption of these various measures. A recent review[3] indicates that such savings would probably amount to nearly a quarter of a million tons of protein equivalent and to more than a million tons of starch equivalent, that is, to more than a fifth of the estimated total feeding-stuffs gap.

New sources of supply and the more economical use of existing supplies together might, therefore, make good about half the pre-War imports of feeding-stuffs. The extent to which the third measure, a compulsory reduction in the live-stock population, would be necessary would then clearly depend on the level at which feeding-stuffs imports could be maintained during the War period. Up to the present, the supplies which have been released by the Ministry of Food have not fallen below the 50 per cent level, though the first preference accorded to certain classes of stock, notably

milking cattle, has involved particular hardship on many breeders of pigs and poultry. If imports were to fall consistently below the 50 per cent level, a reduction in the live-stock population would be inevitable, for there is no more wasteful method of utilizing feeding-stuffs than by dissipating them in the maintenance of an excessive live-stock population.

In deciding on the classes of stock to be reduced, and on the extent of such reductions, a number of factors would require to be taken into account. Among these would be the relative food values, for the human population, of the various animal products produced by each class of stock, the extent to which the imports of such animal products were themselves reduced, the relative efficiencies with which the different classes of stock could convert feeding-stuffs into human food, and finally the maximum rates of reproduction and therefore the potential rates of replacement of the depleted flocks and herds in the post-War period. Any detailed discussion of these points would, however, be outside the scope of the present article.

[1] Wright, N. C., "The Importance of Home-Produced Feeding-Stuffs", *Trans. Highland and Agric. Soc.* (1938).
[2] Wright, N. C., "Britain's Supplies of Feeding-Stuffs", *Empire J. Exp. Agric.* (1940).
[3] Wright, N. C., "Britain's Feeding-Stuffs Gap: Can it be Closed?", *Agric. Progress* (1940) (in press).
[4] Beharrell, J., "Kitchen Waste for Feeding Farm Stock", NATURE, **146**, 47 (July 13, 1940).

CHEMISTRY AND HYDROGRAPHY OF LAKES TANGANYIKA AND NYASA

By R. S. A. BEAUCHAMP

"JOHN MURRAY" Expeditions to Lakes Tanganyika and Nyasa have recently been undertaken in order to discover the chemical and hydrographical conditions obtaining in deep tropical lakes, and in the hope of explaining the faunal peculiarities of Lake Tanganyika.

The lakes are situated south of the equator in the African Rift Valley; both are approximately 400 miles long and 30 miles wide. Their long axes lie north and south, and their maximum depths are approximately 1,400 m. and 800 m. respectively. Superficially, they appear to be similar, but their fauna and flora are very different[1]. Seventy-five per cent of the species which make up the fauna of Tanganyika are peculiar to that lake, whereas the majority of species in Nyasa are common to other African lakes, or of world-wide distribution. The species peculiar to Tanganyika, notably the molluscs, resemble in many respects marine species. This led to Moore's theory[2] that at one time Tanganyika was connected with the sea, but geological evidence is entirely opposed to this theory. Later, Cunnington suggested that during an arid period the Lake contained a greater concentration of salts which led to the evolution of species resembling marine types. The research expedition has suggested an alternative explanation (see later) and supplied evidence against Cunnington's theory. I have given an account of the hydrology of Lake Tanganyika elsewhere[3].

Certain generalizations must be made to give point to what follows. Apart from the geographical situation of a lake, which determines the average temperature of the water and the quantity of sunlight, the biological productivity of any lake is largely determined by the amounts of nutrient salts present in the surface waters. These salts are supplied by decomposition of the bottom deposits, and by inflowing streams. The relative importance of these two sources of supply will vary from lake to lake, but usually the bottom deposits are the most important source. This is particularly so in such lakes as Tanganyika and Nyasa, where the volume of the inflows is very small indeed as compared with the volume of the lake. In Tanganyika the annual inflow is approximately equal to one two-thousandth of the volume of the lake, in Nyasa to one six-hundredth. Hence the biological productivity of these two lakes is mainly determined by the supply and transport of salts originating from the bottom deposits. These salts can be of no use until they are brought to the surface, where they can be utilized by the phytoplankton.

In shallow lakes, currents caused by winds may lead to complete circulation and complete mixing of the bottom and surface water, but in deep lakes this can only occur during the winter, when the whole lake is brought to a uniform temperature; in very deep lakes complete circulation may never be brought about. During the summer, the surface waters on warming become less dense and remain on a discrete layer, the epilimnion, which lies on top of the deeper cooler layer, the hypolimnion. Little or no mixing may occur between these two layers, with the result

that the salts in the epilimnion may become depleted by the phytoplankton, though considerable quantities may be present in the deeper water. Conversely, oxygen may be abundant in the epilimnion and completely absent in the hypolimnion. From this it is evident that the abundance of the phytoplankton, and the abundance and distribution of the zooplankton and bottom-living animals in deep lakes are determined by the degree to which the epi- and hypo-limnion are differentiated, and the length of time these layers are maintained. Tanganyika and Nyasa are markedly different in these respects.

The position and extent of layers can be illustrated graphically by plotting the temperature and chemical composition of the water at various levels. The transition from one layer to the next is marked by sudden changes of temperature and in amounts of dissolved salts and oxygen. A discussion of the amounts of nutrient salts present in these two lakes is beyond the scope of this article; it must suffice to say that silicates may vary from 0·2 to 1·0 parts per million in the surface water, while the deep water may contain 20 parts, that corresponding differences occur in the amount of phosphates, nitrates, etc., and that the deep deoxygenated water contains considerable quantities of ammonia and hydrogen sulphide.

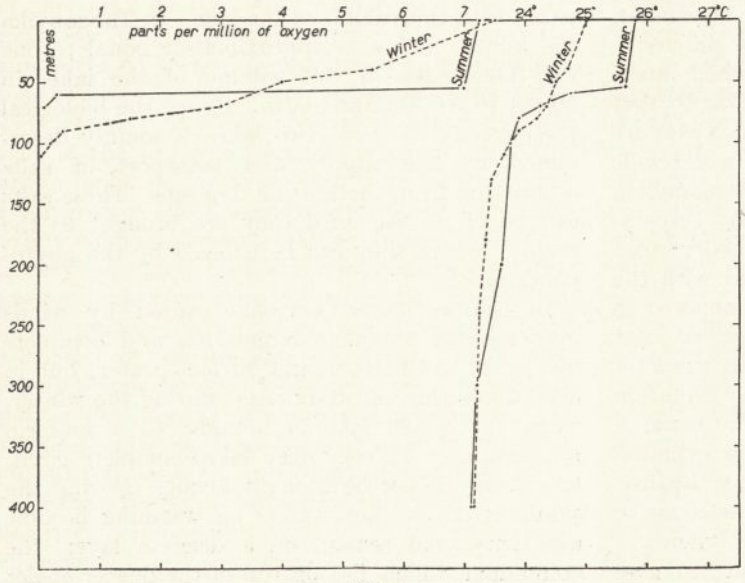

Fig. 1.

LAKE TANGANYIKA.

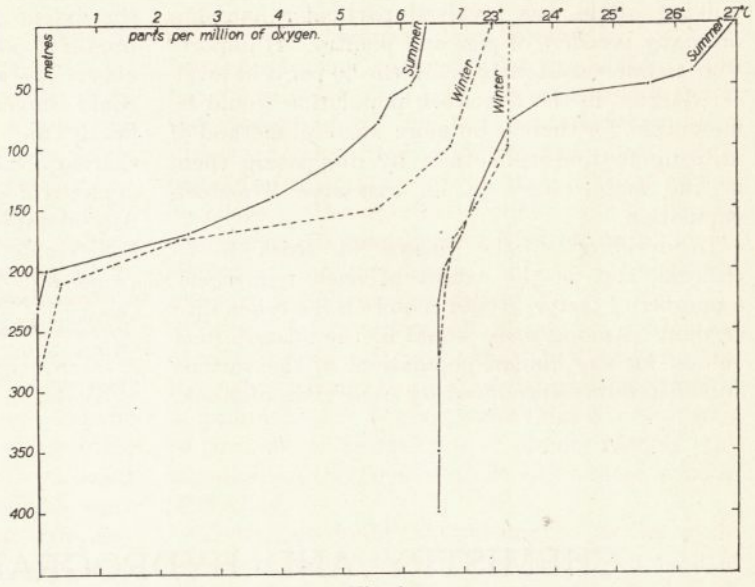

Fig. 2.

LAKE NYASA.

Figs. 1 and 2 show dissolved oxygen and temperature values for Tanganyika and Nyasa respectively. The continuous lines show values during the period of stability, the dotted lines during the period of maximum mixing. It can be seen that in the summer months there is a far greater temperature difference between the epi- and hypo-limnion in Nyasa than in Tanganyika, the deep water being one degree cooler, and the surface water on an average one degree warmer. In spite of this, considerably more mixing of the two layers occurs in Nyasa, as can be seen from the fact that oxygenated water has been carried down far below the thermocline, while in Tanganyika it does not penetrate below the thermocline. (The thermocline is the discontinuity layer between the epi- and hypolimnion.)

The explanation of this effect lies in the entirely different weather conditions which obtain in the two areas. In summer, Nyasa receives stronger and more variable winds, in winter much stronger winds than Tanganyika. This is because Nyasa lies farther south than Tanganyika, and nearer the coast, and so during winter (April to September), feels the full effect of the south-east

trade winds. These, locally known as the *Mwera*, blow with extreme violence, often for days on end, though usually abating at night. Thus a high degree of mixing of water in the lake occurs throughout the winter, penetrating deeper as the temperature gradient is lowered. Tanganyika being farther north, and being protected by the Southern Highlands, does not receive the full force of these winds, and very much less mixing occurs. In the summer months both regions are characterized by thunderstorms and rain, with variable winds mainly from the north or north-east, but in Nyasa the winds are both stronger and more variable than in Tanganyika.

It has been shown[3] that sudden changes in wind direction cause more mixing than steady winds. When winds blow steadily over a lake, a current is formed which circulates in the epilimnion. This induces a secondary current in the hypolimnion; the two currents remain distinct, and, in the region of the thermocline, flow in the same direction, causing little or no mixing between these two layers of water. A sudden change in wind direction, however, will reverse the direction of rotation of the epilimnial current, with the result that it now opposes the hypolimnial current, causing turbulence at the thermocline, and mixing between epi- and hypo-limnion. Thus the constant changes of wind direction during summer cause in Nyasa a considerable amount of mixing in spite of the fact that the temperatures of epi- and hypo-limnion differ greatly.

It might seem that any oxygenated water which finds its way below the thermocline will become mixed with the whole of the hypolimnion. Actually, this is not the case. It was found on occasions that the hypolimnion was divided into two or more layers. This is a matter of extreme importance. If the available oxygen in the upper limits of the hypolimnion were to be distributed throughout the whole volume of the hypolimnion, it would be impossible to maintain an oxygen concentration in it sufficient to support the life of the deep-living animals. But as the available oxygen is only distributed through part of the hypolimnion, sufficiently high values are maintained in this part to support life.

Differences in temperature and chemical composition between layers in the hypolimnion may be slight, which makes them difficult to observe from a single set of samples. But these layers become distinct when values for dissolved oxygen on consecutive days are plotted on the same graph. This is because the currents in each of the various layers tend to make each layer more homogeneous. This shows as a decrease in the amount of dissolved oxygen in the upper portion of each layer and an increase in the lower portion on the later date. Fig. 3 shows this effect. It will be seen that the oxygen curve for February 23 repeatedly crosses the oxygen curve for February 21. The areas enclosed by these two curves indicate a decrease and increase in oxygen content in the upper and lower portions respectively of each layer. The upper 250 m. of the lake is clearly divided into four layers; this discontinuity between these layers being also shown by the temperature curve. The transfer of oxygen to lower levels is demonstrated, as we would naturally expect; this can only be done at the expense of the upper layers. It should

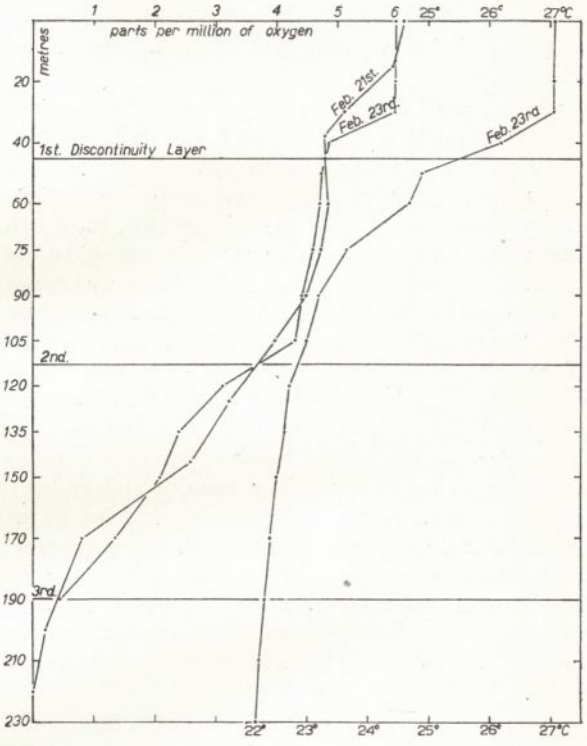

Fig. 3.

be noted in this connexion that the surface waters of Nyasa during the summer contain less oxygen than those of Tanganyika. Later a change in wind direction upsets the layered condition described above, and mixing occurs between each of these layers. This layering of the hypolimnion had previously been suggested on theoretical grounds, but has not hitherto been so clearly demonstrated.

Space does not permit of details concerning the density of the plankton, or the length of the productive period in these two lakes, but as we would expect from the above data, Nyasa is a much more productive lake than Tanganyika. During the long period of stability in Tanganyika, plankton development is very greatly restricted. This is due apparently to a shortage of nutrient salts, probably nitrates in particular. At the end of the winter

when mixing occurs, the phytoplankton starts to increase and is followed by an increase in zooplankton. In Nyasa, however, during the latter part of the winter when the *Mwera* is still blowing strongly, plankton development is slight, but as soon as the winds become less strong and a degree of stability is established, the plankton starts to increase rapidly. In this case it appears that plankton development is restricted, not by any shortage of salts, but by the too violent mixing of the surface waters. It may be supposed that phytoplankton is continually being carried down to depths in which photosynthesis is no longer possible. The evidence for this is not conclusive, but a parallel may perhaps be found in what occurs in the sea.

With regard to bottom-living fauna, Tanganyika cannot support an animal population below the level of the thermocline because of the lack of oxygen, but Nyasa does; notable among these forms are the Chironomidæ, which occur in enormous numbers. The adult Chironomids, on emergence, are swept into dense clouds and are carried often thousands of feet into the air by the 'thermals' which cause the offshore winds. These clouds of 'Kungen fly', as they are called, form a remarkable feature of Lake Nyasa, looking like two lines of bush fires occurring at intervals, along the length of the Lake seven to ten miles out from either coast. They usually appear very shortly after a period when mixing has led to an increase in the oxygen content of the deeper water. Sometimes these enormous swarms are blown on to the shore, when the natives, swinging baskets through them, collect enough of them to make compressed cakes, which are eaten with considerable relish.

Finally, certain peculiarities concerning the chemical composition of the waters of Tanganyika are important. It was found that the Lake contains relatively large amounts of potassium and magnesium. This is due partly to the natural accumulation of these salts, which is to be expected in a lake from which the main loss of water is by evaporation, and partly to the large amounts of these salts brought in by the Ruzizi. The Ruzizi flows into the north end of Tanganyika and is the outflow from Lake Kivu. These values, thirty-three and forty-four parts per million for potassium and magnesium respectively, may have caused the development of some of the species peculiar to this lake.

It was also found in Tanganyika that, though the total amounts of dissolved salts in the Lake are normal for fresh waters, the ratios of the amounts of magnesium to calcium and chloride to sulphate are high and resemble those found in sea water. As the inflowing waters do not show these proportions, they would seem to have been brought about by biological activity. For example, the molluscan fauna precipitates calcium, thus keeping its concentration low, while leaving magnesium to accumulate. Conversely, though this is certainly less important, the paucity of the flora, particularly the littoral flora, may result in an abnormally low rate of utilization of magnesium.

The high ratio of chloride to sulphate is not quite so simply explained. The low concentration of sulphate, which in the Lake is actually less than it is in the inflows, is presumably due to the removal of sulphur in the formation of all organic matter. On the other hand, though chlorides are essential for life, little chlorine is actually chemically combined to form organic matter. Hence chlorides are easily liberated from the bottom deposits. But sulphur, which is chemically combined in many proteins, is not easily liberated and appears mostly as hydrogen sulphide. Even then much of this hydrogen sulphide is probably precipitated again chemically as insoluble sulphides of copper and iron. Consequently, sulphates are continually being removed, either as undecomposed organic matter or as insoluble sulphides, while chlorides accumulate.

These and similar processes which alter the composition of lake waters occur to some extent in all lakes, but the extent to which they can be effective depends on the average length of time spent by water in the Lake. In Tanganyika this is an extremely long time, since the volume of the inflows is small compared with the volume of the Lake. In addition, the outlet from the Lake is small, and ninety per cent of the total inflow, including rainfall on the Lake, is lost by evaporation.

Reasons have been given[3] why the total concentration of salts in Tanganyika is no higher than four hundred parts per million, and why it is considered unlikely that the total concentration was at any time in the past considerably higher than at the present time. I suggest, however, that one of the causes for the marine appearance of a large number of the species found in Tanganyika may be due to the fact that in the Lake the ratios of chloride to sulphate and magnesium to calcium have become similar to those found in sea water. This theory will seem more convincing if a complete analysis of water from Lake Nyasa shows a more usual proportion of these salts. It is hoped that it will be possible later to have these analyses done by the Government Chemist, who kindly carried out the full analyses of samples from Lake Tanganyika.

[1] Cunnington, W. A., *Proc. Zool. Soc.*, 507 (1920).
[2] Moore, J. E. S., "The Tanganyika Problem" (1903).
[3] Beauchamp, R. S. A., *Int. Rev. Hydrobiol.*, **39** (1939).

OBITUARIES

Sir George Macdonald, K.C.B., F.B.A.

WE regret to record the death of Sir George Macdonald, the distinguished Scottish archæologist, which took place in Edinburgh on August 9 at the age of seventy-eight.

George Macdonald was born at Elgin in 1862, and was educated at Kelvinside Academy and in the University of Glasgow whence, winning the Ferguson scholarship for classics, he passed to Balliol College, Oxford, and graduated with first-class honours in Classical Moderations and Literæ Humaniores. For a few years he was engaged in teaching at Kelvinside Academy. In 1892 he became lecturer in Greek in the University of Glasgow. It was during this period of work in Glasgow that he was attracted to the study of numismatics, and it was not long before he won recognition as an outstanding authority in this subject. For fifteen years he devoted himself to the preparation of a catalogue and the classification of the remarkable collection of coins of the Hunterian Museum. His work was recognized by the Académie des Inscriptions et Belles Lettres by the award, in 1907, of the Prix Allier de Hauteroche. He also became honorary curator of the Hunterian Museum and of the Society of Antiquaries of Scotland, and was elected an honorary member of the Viennese and American Numismatic Societies. His work and his conclusions are summed up in his Rhind lectures on coin types delivered in 1905. In 1913 he was awarded the medal of the Royal Numismatic Society, and in 1921 that of the American Numismatic Society.

Macdonald's pre-eminence as a student of numismatics, though widely recognized, was, after all, mainly of preponderant interest to specialists in that subject, except when, as it tended to do more and more as time went on, his studies impinged upon archæological and historical topics connected with earlier Britain. To both the learned and outside worlds he was known best as classical scholar, an authority on Roman Britain, and a motive force in Scottish education.

In 1904 Macdonald left Glasgow for Edinburgh, where he entered the Scottish Department of Education, of which he became permanent secretary in 1922, succeeding Sir John Struthers. He retired in 1928 after a term of office marked by great activity and advance in Scottish education.

It was in the study of Roman Britain that Macdonald made his most lasting contribution to archæology in the broader sense. His study of coins while at Glasgow had attracted him to the problems of Roman rule and culture. He devoted much study to the Antonine Wall between Forth and Clyde, and not only took part in many excavations himself, but also was largely responsible for the organization of the excavations on Roman sites in North Britain for a period of more than twenty years. To mention a few only of his numerous contributions to the literature of the subject, in 1907 he published a report on the Roman forts at Bar Hill, and in 1911 on the Roman Wall in Scotland. On the death of Prof. Haverfield he was responsible for revised editions of "The Romanization of Roman Britain" and "The Roman Occupation of Britain" by his fellow-worker.

During 1921–26 he was president of the Society for the Promotion of Roman Studies, and in 1928 president of the anthropological section of the British Association at the Glasgow meeting. He served on the Royal Commission on Museums and Galleries in 1927, and the Royal Fine Arts Commission of Scotland in the same year.

Mr. A. H. Case

THE death on July 25 last, at the advanced age of eighty-two, of Mr. Albert Havelock Case removes a well-known personality from civil engineering circles in London. Mr. Case, who was a Whitworth Scholar, in addition to being a member of the Institution of Civil Engineers, received his early technical training in the old-established engineering firm of Stothert and Pitt, Ltd., of Bath. After some short service with the French State Railways, he was engaged on the staff of Sir John Coode in connexion with foreshore protection work at Spurn Point and Hastings. Then, under Sir John Wolfe Barry, he was resident engineer on dock constructional operations on the Tyne and in South Wales. Afterwards, he became engineer-in-chief of the Port Talbot Railway and Dock Company. During an association with Trinity House, he was resident engineer for the construction of Beachy Head Lighthouse, near Eastbourne. He also reported on the drainage of the Great Ouse basin.

By this time, Mr. Case was established in private consulting practice at Westminster, holding two appointments as engineer to Commissions of Sewers on the north side of the Thames. Later he was joined in partnership by Dr. Brysson Cunningham, with whom he carried out various land drainage and riverside works in south Essex and north Kent. The firm of Case and Cunningham also advised on port improvements at Montevideo, at Nassau and at Malta.

WE regret to announce the following deaths :

Prof. G. H. Fowler, C.B.E., formerly assistant professor of zoology in University College, London, on August 15, aged seventy-nine.

Count Giovanni Lorenzini, president of the Italian Biochemical Institute at Milan, known for his work on the vitamins, on July 24.

Mr. R. C. Mossman, meteorologist of the Scottish National Antarctic Expedition ; since 1920, climatologist to the Argentine Meteorological Office, on July 17, aged sixty-nine.

Mrs. Tyndall, widow of Prof. John Tyndall, on August 19, aged ninety-five.

NEWS AND VIEWS

Science in War Strategy

IN his review of the war situation before the House of Commons on August 20, the Prime Minister said: "It is a conflict of strategy, of organization, of technical apparatus, science, mechanics and moral. . . . Moves are made upon the scientific and strategic boards, advantages are gained by mechanical means." On many occasions we have emphasized the all-important part which men of science must play (and, indeed, are playing) in this world conflict of ideals. Just as important is the fact that in most of his speeches and reviews, Mr. Churchill has revealed how alive he and the present Government are to the important contributions of science. "There seems to be every reason to believe that this new kind of war is well suited to the genius and the resources of the British nation and the British Empire." For several years now, Great Britain and the rest of the Empire (together with the United States and other democratic countries) have consistently offered hospitality and opportunity for work to thousands of the victims of the hideous Nazi racial laws. These included many men of science. The ultimate benefit to the cultural life of democratic countries had never needed emphasizing. It was immediate, and it will be lasting. Now the immediate benefit is becoming more and more evident and was stressed by the Prime Minister when he said: "Since the Germans drove out the Jews and lowered their technical standards, our science is definitely ahead of theirs."

Food Policy

THE points raised in the leading article beginning on p. 243 have received the fullest support in the Prime Minister's speech. Germany has command of huge food supplies within her own frontiers and in the occupied territories. "The only agencies which can create famine in any part of Europe now and during the coming winter will be German exactions or German failure to distribute the supplies which they command." Furthermore, many valuable food-stuffs, such as fats, potatoes, milk, and so forth, can be used in the manufacture of war materials, such as explosives, motor spirit and plastics. Aid for any stricken country is therefore unthinkable while that country is under German control. This is, of course, a harsh policy to adopt, but it is an essential one. It can be offset, however, as pointed out in the leading article, by reserving foods in preparation for reconstruction after the War. We are now assured that this will be done by the Prime Minister who has said "we can, and we will, arrange in advance for the speedy entry of food into any part of the enslaved area when this part has been wholly cleared of German forces and has genuinely regained its freedom. We shall do our best to encourage the building up of reserves of food all over the world so that there will always be held up before the eyes of the peoples of Europe, including—I say it deliberately—the German and Austrian peoples, the certainty that the shattering of the Nazi power will bring to them all immediate food, freedom, and peace".

Man-power of the Nation

SOME words uttered by Sir William Beveridge in the course of a broadcast address on the recent Industrial Registration Order referring to engineers are applicable outside the strict context of the address. He emphasized that registration does not mean that workers will be taken off their jobs immediately and put to other jobs. The first object of registration is to obtain a survey of the position so far as available man-power is concerned. Having obtained such a statement, it is possible to consider the re-allocation of individuals in such a way that the war-time needs of the nation receive first consideration. Sir William also pointed out that, even after this survey, many workers will of necessity still be left in jobs which are not obviously of direct use in the national effort. "If after registration we leave a man where he is, he can feel satisfied that he is doing his duty there," Sir William said, and that must be the consolation of many who are denied more spectacular achievement. This Industrial Registration Order is "part of a general plan to ensure that all the brains and muscles of the nation are used in the right way, so that there is no waste and no injustice". Such a general plan will command widespread support, the only regret being that it was not initiated many months ago before the present intense stage of the conflict had been reached. It should be carried through speedily and put into effect at the earliest possible moment.

Political Issues in India

THOSE, if any there be, who may feel surprised at the reluctant, not to say sluggish, reaction of opinion in India to the terms of the Viceroy's proclamation on present and future conditions affecting the constitutional issue, will do well to examine with care the masterly and statesmanlike analysis of the elements of the deadlock and the effect of the Viceroy's proposals, both now and as regards the future, presented to the House of Commons on August 14 by Mr. L. S. Amery, Secretary of State for India. The differences, as he pointed out, are not between the British Government and the Indians, but those which exist among the Indians themselves —on one side, the Congress party, which has sought to make itself the national party, and would wish to speak for India as a whole; on the other, to name

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the three elements only to which Mr. Amery referred, the ninety million Moslems, the scheduled castes who stand outside the main Hindu community represented by Congress, and thirdly, the Indian princes whose territory covers a third of all India. These differences are based upon a long and powerful tradition rooted in religious belief and social regulation. They are, Mr. Amery said in speaking more particularly of the Muhammadans, "as deep as, if not deeper, than any similar differences in Europe". Because they impinge upon what is most vital in the life of the people, namely, their religious beliefs and cultural beliefs, and because they are faced with the familiar urge of Hinduism to absorb and assimilate, they emerge in the form of a profound mistrust of majority rule.

Mr. Amery himself does not despair of the situation. As he told the House, he does not regard the differences between these conflicting elements in India, which have been the subject of negotiation since October last, as unbridgable. That in actual practice they may be bridged is shown by the co-operation of individual members of the Moslem community, who have taken an active part in the work of the Congress party. In the main, however, he relied upon two factors. In the first place, whatever may be the barriers between the component elements, India is a distinct cultural unity, a self-contained and distinctive region of the world, boasting an ancient civilization and a long history common to all her peoples, of which all Indians were equally proud; and secondly, all parties are at one in their detestation of Nazi aggression and their endorsement of our common cause. Common effort in the present emergency and the opportunity for discussion and the promotion of understanding pending post-War deliberations cannot but strengthen these two forces making for unity, and help to bring about that readiness to accept agreement based upon compromise of rule by consent which is "the foundation of all free government and of all true democracy". By India's aptitude in displaying these qualities in the immediate future will her full and free acceptance of the democratic ideal be judged.

Causes of Accidents in Factories

EVIDENCE submitted by the National Federation of Professional Workers before the Royal Commission on Workmen's Compensation on May 16 calls for a revision of the maximum benefits payable and attaches great importance to replacing the flat rate maximum by payments proportionately related to earnings already recognized in the payments for partial incapacity. It was also urged that there is no justification for such a salary limit as exists at present. The Federation expressed the opinion that extension of the salary limit or its entire elimination would not upset the structure or balance of the Act. It was further urged that compulsory insurance should be extended to all classes of employment and the doctrine of common employment abolished as a defence against claims under the common law.

In a memorandum of evidence submitted it was stated that the majority of accidents in factories occur owing to the negligence of employees, and in an examination on this memorandum the representatives of the National Federation of Professional Workers stated that in many engineering concerns most of the accidents are due to negligence or, what was worse than negligence in a sense, some breach of statutory regulations or statutory duties. The failure of the material is often a matter of negligence at some more remote period and the Federation's conception of negligence was that it began in the Board Room. Breakdown of material, for example, could generally be attributed to failure to inspect sufficiently frequently, and in very busy works a good deal was taken for granted without inspection. It is considered that many safeguards could be arranged as an integral part in the design of the machine, and that is increasing in many makes of machinery. It was urged that much could be done in the drawing office rather than after the machine is installed to prevent accidents.

In explaining that the majority of accidents in factories occur owing to the negligence of employees, it was held that accidents are not caused by the negligence of the injured employee and this was linked up with the doctrine of common employment according to which where an injury arises owing to the negligence of a fellow employee the injured man cannot take an action. Apart from what one might call natural accidents it was safe to say that every accident occurs through some human agency. Much negligence, it was brought out in further evidence, was not necessarily culpable but might be due to fatigue. The Federation did not agree to a distinction between accidents due to the negligence of a manager or someone in special authority under a manager and accidents due to the negligence of the ordinary fellow worker. It is considered reasonable to hold the employer responsible for damages even when the negligence was not on the part of any official but on that of a fellow worker.

Blow-Guns for Clearing Away Dust in Factories

ACCIDENTS occur every year as the result of attempts to clear away dust, etc. by hand from moving machinery or electrical apparatus. Using rags or brushes for this purpose is often very dangerous. According to *Engineering* of July 26, pneumatic blow-guns are proving very useful for this purpose. They weigh only half a pound and are easily handled even in very awkward positions. The blow-gun is intended for use in workshops where compressed air is available, and below the hand-grips it has a hose connexion. The body is of aluminium and the renewable nozzle is of bronze. The nozzle can have a bore of $\frac{1}{16}$ in., $\frac{1}{8}$ in. or $\frac{5}{32}$ in., as desired. If used near live electrical fittings, it is made of insulating material so that safe operation is assured if accidental contact is made. Control of the air jet is effected by a push button actuated by the forefinger of the hand holding the gun. The valve is readily renewable.

It is stated that the blow-gun has proved most useful in blowing dust from foundry moulds and is particularly effective in getting rid of the dust

formed in machining operations in non-metallic materials, such as plastics, this dust being difficult to displace by means of brushes or rags. In woodworking machinery it is very useful in removing sawdust and shavings. To enable the gun to be readily connected to existing air supplies, the manufacturers have developed a neat pressure-reducing tube valve manufactured from bronze pressings and having a diaphragm of the oil-resisting rubber insertion type. The valve will reduce an initial pressure of 150 lb. per sq. in. to any pressure between 5 lb. and 100 lb. per sq. in., the adjustment being made by a thumb screw. The valve has a nickel-plated finish and is stated to be unaffected by oil or water and does not vibrate or chatter when in use.

War, Tradition and Natural Beauty

IN a war, which in so far as the greater includes the less, is being fought by the British people in defence of an ideal of the spirit which, we maintain, has run like a thread throughout our history, it is vital that every effort should be made to keep alive, even if necessary in attenuated form, activities which make for the preservation of the national tradition as embodied in our antiquities and places of historic interest, or in those vistas of our landscape which are not only beautiful in themselves, but also express something which is essentially in harmony with characteristics of the mentality of the British peoples. The recent pronouncement of the Council for the Preservation of Rural England makes a bold bid to reconcile claims arising out of present necessities with its objective of saving rural beauties from desecration.

How difficult this may become is strikingly illustrated in the recently issued report for 1939–40 of the National Trust. Here and there in the brief notes on the properties held by the Trust a hint is given of the difficulties which are being, or have had to be, overcome by those responsible for carrying out the objects of the Trust in securing that these objects shall not be irrevocably overridden, if that is at all possible, by the requirements of military authority or the necessities of food supply. The normal expansion of the work of the Trust cannot be expected to continue unimpaired in present conditions; and indeed the annual report for the period under review chronicles a reduction in receipts, not, indeed, as great as might be anticipated, which will make the realization of even working costs a matter of some anxiety. The work of the Trust, however, is, as has been said, of vital importance in maintaining much that is of the best in the national tradition, and its claims to public support should be among the last to be overlooked. An indication of the activity of the Trust in recent years is afforded by a comparative table given in the annual report, which shows that in the period 1914–40 there has been a tenfold increase in most of the figures. The number of properties has increased from 63 to 410, the acreage from 5,814 to 58,900; the capital raised and expended from £59,861 to £530,114, subscriptions from £559 to £6,193, and the gross income from properties from £1,461 to £27,553.

Preserves from the Garden

"GROWMORE" BULLETIN No. 3, of the Ministry of Agriculture and Fisheries (H.M. Stationery Office, 4*d*.), presents in a concise and practical form instruction for the housewife in the preservation of surplus fruit and vegetables for winter use. Full directions are given for the making of jams, fruit jellies, cheeses, and syrups, and the bottling and canning of fruit and vegetables. Instructive notes are provided on the peculiarities of particular fruits and their suitability for the various methods of preservation. A selection of recipes for jam and jelly made from the more important fruits is included, and in some of these the normal amount of sugar has been reduced to meet the difficulties of sugar shortage. A useful feature is a statement of the expected yield of jam from the amounts of fruit used. Various methods are given for sterilizing fruit for canning and bottling and the preservation of fruit in the form of pulp. The latter is a useful method for the storage of large quantities of apples and plums without sugar.

The preservation of vegetables is not so widely practised as that of fruit, and as pressure cookers are recommended for vegetable sterilization, this method will not be extensively used in the average household Several vegetables may, however, be preserved by pickling, which is briefly dealt with in the bulletin. Salted runner beans are invariably satisfactory, and as salt is cheap and the method simple, more use should be made of this usually prolific crop. Many fruits and vegetables can be dried for future use, a method which needs no preservative, and is adequately treated in this bulletin. The authors, Alice Crang and Margery Mason, have produced a very usable handbook, and are to be congratulated on the selection of the most useful and straightforward methods, as well as on the omission of technical details which are of little interest to the average housewife.

Organized Labour in Germany

ALTHOUGH written rather as if to prove a point, Dr. W. A. Robson's pamphlet, "Labour under Nazi Rule" (Oxford Pamphlets on World Affairs, No. 33. Pp. 32. Oxford: Clarendon Press. 3*d*. net) gives a concise and lucid account of the sweeping changes made by the Nazi regime in the status and organization of labour, from the liquidation of the highly progressive German working-class movement in 1933 to the system of unmitigated industrial conscription introduced since 1938. Prior to 1933, Germany was one of the most progressive countries in the world so far as the position of organized labour was concerned. By showing the extent to which industrial servitude and regimentation have been exacted as the price of Hitler's achievement in abolishing unemployment, Dr. Robson puts that achievement in its true perspective along with the Labour Front and the 'Strength through Joy' movement. This admirably written account of the present position of organized labour in Germany and the way in which it has arisen fully substantiates Dr. Robson's central thesis that the status, freedom, power, and conditions of

work of the employed workers in Germany have deteriorated to an almost inconceivable extent under the Nazi Government.

Supply of Electric Torches

THE supply of pocket torches for the coming winter months is already being discussed by wholesalers and manufacturers. According to the *Electrical Times* of August 15, the evidence as to shortage or abundance is conflicting. Manufacturers at present are said to be rationing supplies to the wholesalers rather severely. American torches are difficult to obtain owing to import licences being withheld. Belgian and Dutch torches have disappeared completely. Any bulk supplies received are got rid of very readily. The public grew so accustomed to using these handy little accessories last winter that they are now buying them quite briskly although the long summer daylight hours render them unnecessary. Many hope that the various restrictions will be relaxed with the approach of winter. If this happens, the machinery of home production has been increased so extensively that maintenance of a steady and adequate supply will become possible. Much depends upon the Government's attitude towards raw materials. This authority urges the public to hold off purchasing until the late autumn, for batteries are not things that can be held in store without rapid deterioration, especially if kept in damp places. Others hold a more optimistic view. They point to the great strides taken by manufacturers to increase production to such an extent that the disappearance of foreign-made torches will more than be made good before next winter sets in. Supply firms, it is reported, are confident that the rush demand of last winter will be less severe and that all wants will be steadily met although there will be a slight increase in price.

Greenkeeping Matters and the Gall Midge of Grasses

THE Board of Greenkeeping Research has adapted its research station at St. Ives, Bingley, Yorks., to war-time conditions. Some of its new activities have already been mentioned in these pages, and the first war-time number of the Board's *Journal of Greenkeeping Research* (6, No. 21, from the Director, price 3*s*. 9*d*. per copy post paid) contains a number of short papers which deal further with the altered needs of the present time. The Station's director, Mr. R. B. Dawson, outlines the general war-time policy of linking golf grounds with food production so far as possible, and Mr. R. B. Ferro describes "War-time Turf Policy" from the point of view of minimal attention without permanent damage. There is a very useful survey of gall midge damage to grass seed by Mr. H. F. Barnes of Rothamsted Experimental Station. Many species, mostly of the genera Dasyneura and Contarinia, are shown to have specialized relations with a number of separate grass hosts. The damage done to seed plots must be very great, but seedsmen are now willing to pay more attention to their crops. Mr. Barnes considers the possibility of biological control through the selection of early or late maturing strains of the various host grasses to avoid the period of egg-laying. The present number of the *Journal* also contains notes and abstracts of a number of papers and matters of interest to those who have to deal with grassland.

Swordfish Attacking Vessels

SINCE the seventeenth century, authentic accounts are on record of the spearing of ships by the swordfish (Xiphias) and its relatives the spear- or marlin-spike-fishes (Makaira) and the sail-fishes (Istiophorus). The stories of these attacks, their effects and their causes, with much incidental information, have been gathered together and discussed in a 100-page monograph, illustrated by seven plates and several text-figures, by Dr. E. W. Gudger (*Mem. Roy. Asiatic Soc. Bengal*, 12, 215–315 ; 1940). The attacks, which have occurred in all parts of tropical seas, are delivered with force, for not only have ships been shaken from stem to stern by the blow, but also the penetrations recorded include the piercing of the copper covering, a 4-inch birch plank, and 6 inches of the timbers of the brig *Tinker* of New York, and the remarkable case of the South Seas whaler *Fortune* of Plymouth, Mass., the timbers of which beneath their copper sheath were penetrated through 18·5 inches of hard wood, 14·5 inches being of dense oak. The speed of the swordfishes is, however, great, and that together with the size of the fish, which may weigh 1,200 lb. (Zane Grey's marlin), and the fine lines of the sword itself, accounts for the power and effect of the blow. The author describes the fishes as timid rather than pugnacious, and concludes that the attacks are generally made either by fishes which have been wounded and are dashing about in pain and fright, or inadvertently when the fishes are, particularly in darkness, following and attacking a shoal of fishes upon which they are preying.

High-Speed X-Ray Photography

SHADOW photographs taken with an exposure short enough to show a moving bullet while passing through a block of wood were shown and discussed at a meeting of the American Physical Society held on June 21. According to a Science Service report, the photographs were taken by using a very brief electrical surge of high voltage and amperage got by charging a condenser in several seconds, and then discharging it through the X-ray tube. For the short space of time necessary to take the photograph, the new tube will carry a current of about 2,000 amperes at 100,000 volts. In photographing rapidly moving objects, a fine tungsten wire connected in the timing circuit is broken by the moving object so that the energy stored in the condensers is released at the correct instant. Possible applications discussed were the use of the method to study internal strains in rapidly moving machine parts and in the bones of the body in vigorous action. The new X-ray tube and technique have been developed in the Westinghouse Lamp Division by Dr. C. M. Slack and his associates.

T'ang Pottery for the British Museum

A REMARKABLE example of T'ang pottery, well known to collectors and students, from the collection of the late Mr. George Eumorfopoulos, has been given to the British Museum by his widow to mark his long and close friendship for that institution, of which he was a generous benefactor. The gift is a pottery model of a saddled horse. It stands just under a foot high, and is an outstanding example of the technical skill and artistic feeling of the Chinese under the T'ang dynasty. This period (A.D. 618–905) was one of the most remarkable in the history of the Chinese Empire. A consolidation and expansion of the imperial power after a time of stress, combined with a revival in the spirit of Buddhism, inspired from its sources in India by the pilgrimages of Chinese priests, to give birth to a remarkable achievement in all forms of the plastic arts, but more notably as exemplified in pottery figures from tomb burials and in the paintings such as those collected in large numbers by Sir Aurel Stein and those who, after him, visited the Buddhist cave shrines of Tun-Huang. The piece of pottery which has now been given to the British Museum was for long highly prized by its former owner and was his favourite specimen. It is known as the 'Blue Horse' on account of the extensive splashing of blue on its glaze, which makes it unique among figures from the tomb burials which are the main source of our knowledge of this type of art in the period.

Racial Characters in Ancient India

EXAMINATION of a skull from Chanhu-Daro, a site of the Indus Valley civilization in northern India, by Dr. Wilton M. Krogman, of the University of Chicago, it is stated in a communication circulated by Science Service of Washington, has demonstrated a combination of characters more usually to be assigned to diverse racial types. The skull in question is that of a young female and had been placed in a jar after decapitation. It is thought that it may have been that of a princess or priestess. It was found in the course of the excavations now being carried out by an expedition of the Boston Museum of Fine Arts, and has been dated as belonging to a period some five thousand years ago. Dr. Krogman's report indicates a combination of such negroid characters as a flattened head vault, broad nose opening and low eye-sockets with Caucasoid features such as narrow nasal bones, small teeth, and narrow distance between the eyes, as well as in the shape of the palate. His conclusion is that it represents "a proto-Mediterranean type in which ancestral negro traits have manifested themselves" and he goes on to suggest that the modern Mediterranean race may once have had a mixture of negroid blood which has since been eradicated.

Children under Foster Care

THE July number of the *Journal of Psychology* contains an interesting study of children under foster care by James W. Layman, of the Mental Health Service, Des Moines, Iowa, based on the examination of eighty-three children. Each of the homes to which the children were admitted was investigated with reference to its environment, physical condition, family history of both boarding parents, financial security of the home, family home life, interests and recreation. The original problems presented by the children included high frequency of lying, truancy, petty stealing, enuresis, timidity, aggressiveness, school maladjustment, larceny of motors, and housebreaking. The age of the children at the time of admission to the homes ranged from six to sixteen years. The outlook was most favourable in the case of the younger children, while the least favourable prognosis was presented by the older children in whom family backgrounds showed a high degree of instability.

Vital Statistics of the United States

THE summary of vital statistics of the United States for 1938, recently published (*Public Health Rep.*, 55, 933 ; 1940), gives the following information. There were 2,286,962 births and 1,381,391 deaths, giving a birth-rate of 17·6 and a death-rate of 10·6 per 1,000 population. Of the total deaths 116,702 were of infants less than one year of age, giving an infantile mortality of 51·0 per 1,000 live births. There were 25,644 sets of twins, 262 sets of triplets and 1 set of quadruplets as compared with 24,881, 219 and 4 respectively in 1937. There was a net natural increase of 7·0 per 1,000 population, the largest since 1930. The infantile mortality rate has shown an interrupted decline from 68·7 in 1928 to 51·0 in 1938, while the maternal mortality rate has fallen continuously during the eleven-year period from 6·9 to 4·4. As regards the causes of death in infancy, premature births stand highest in the list, while pneumonia, diarrhœa and enteritis and congenital malformations come next in the order stated. The cancer death-rate in the United States has risen from 104·1 in 1934 and 112·0 in 1937 to 114·6 in 1938. The deaths from motor accidents in the United States in 1938 (23·5 per 100,000 population) was the lowest since 1923 (23·3). In 1937 the rate was 28·8.

Isis and *Osiris*

THE publication of *Isis*, an international and polyglot quarterly devoted to the history and philosophy of science, was begun in Belgium in 1912–13. Five issues had appeared when the publication was stopped by the German invasion. After the War, publication was continued, the journal being edited in the United States, but printed in Brussels, later in Bruges. In 1924, the History of Science Society was founded in Boston, Mass., in order to guarantee and promote the publication of *Isis*. During the past sixteen years, no less than twenty-five volumes of the journal have been published. With the invasion of Belgium this year, publication was again interrupted. The editor, Dr. George Sarton, Mass., informs us that No. 84 (completing vol. 31) of *Isis* and No. 85 (vol. 32) were ready for press, and it is hoped to issue at least No. 84 this year. Inquiries should be sent to the secretary-treasurer of the History of Science Society, Dr. H. R. Viets, 8 The Fenway, Boston, Mass. From 1941 on

(vol. 33 ff.) *Isis* will be printed in the United States. The first American number will include a list of all the papers and reviews which were to have appeared in No. 84 and vol. 32. *Isis* as prepared in America will probably be smaller than that of its Belgian predecessor, but the editorial policy will remain essentially the same. As regards *Osiris*, which was founded in 1936 in order to relieve *Isis* of the longer papers, it is not supported by the History of Science Society, and hence subscriptions to it or correspondence relative to it should not be addressed to the Secretary of the Society, but to Dr. Alexander Pogo (Harvard Library, 189, Cambridge, Mass.). At the time of the German invasion of Belgium, two volumes of *Osiris* were being printed, namely, vol. 8, dedicated to Paul Ver Eecke, historian of Greek mathematics, and vol. 9, dedicated to Max Meyerhof, historian of Arabian medicine. These two volumes will appear in due course. Vol. 7 is reviewed on p. 247 of this issue of NATURE.

July Earthquakes Registered at Kew

DURING July 1940 ten strong earthquakes were registered at Kew. Most of these were at a considerable distance, and five gave ground movement at Kew of greater amplitude than 10 μ. The greatest was on July 30, registered at 17m. 49s. past midnight G.M.T., which gave an amplitude of 45 μ at Kew. This shock had an epicentre some 3,020 km. distant from Kew and was the earthquake near Yozgad in Turkey (NATURE, August 10, p. 196). The earthquake with the greatest depth of focus which occurred during the month was on July 10, with a provisionally estimated depth of 600 km.

Scholarships in Agriculture

ON the recommendation of the Agricultural Research Council, the following awards have been made by the Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland: Ivor Isaac, University College, Swansea, a three-year research scholarship in plant pathology; J. S. Perry, University College of North Wales, Bangor, a three-year research scholarship in zoology; D. McFarlane, Glasgow Veterinary College and University of Glasgow, a studentship for research in animal health.

Awards in Engineering

THE following scholarships for 1940 have been awarded by the Institution of Electrical Engineers: *Duddell Scholarship*, annual value £150, tenable for 3 years, to D. LaW. W. King (Northampton Polytechnic); *Silvanus Thompson Scholarship*, annual value £100, plus tuition fees, tenable for 2 years, 1938 award to H. Darnell (University of Liverpool) renewed for a third year, no new award made this year; *William Beedie Esson Scholarship*, annual value £100, plus tuition fees, tenable for 2 years, renewable in approved cases for a third year, C. H. Bickerdike (London and North Eastern Railway Co.); *David Hughes Scholarship*, value £100, tenable for 1 year, J. H. Nicoll (Merchant Venturers' Technical College, Bristol); *Salomons Scholarships*, value £60, tenable for 1 year, H. H. Rosenbrock (University College, London); value £40, tenable for 1 year, P. H. W. Whyman (University College, London); *Thorrowgood Scholarships*, annual value £12 10*s*. each, tenable for 2 years, R. J. Post (London Passenger Transport Board), R. P. Gasson (Southern Railway Co.). No award of the Ferranti or Swan Memorial Scholarships or of grants from the War Thanksgiving Education and Research Fund have been made this year.

The following awards have been made by the North East Coast Institution of Engineers and Shipbuilders: Institution Scholarship (£100) to Ian Welsh Goodlet, an apprentice of Messrs. R. & W. Hawthorn, Leslie & Co., Ltd., St. Peter's Works, Newcastle-on-Tyne; bursary of £50 to Eric William Simpson, an apprentice of Messrs. A. Reyrolle & Co., Ltd., Hebburn-on-Tyne; M. C. James Medal to Mr. H. J. Tapsell, of the National Physical Laboratory, for his paper on "Creep at High Temperatures"; Thomas Fenwick Reed Medal to Mr. Harry Chilton, now at sea, previously with North Eastern Marine Engineering Co. (1938) Ltd., Sunderland (awarded biennially in recognition of evidence of ability to take a share in the control of industry); R. L. Weighton Medal to Wilfred Bailey, on the result of the Durham final engineering degree examination at King's College, Newcastle-upon-Tyne.

Announcements

THE title of professor of physics applied to medicine in the University of London, with the status and designation of appointed teacher, has been conferred on Dr. W. V. Mayneord in respect of the post held by him at the Royal Cancer Hospital (Free).

PROF. H. VINCENT, professor of epidemiology in the Collège de France, formerly inspector-general of the Health Service of the French Army, has been elected vice-president of the Paris Academy of Sciences.

DR. H. MARK, formerly professor of physical chemistry in the University of Vienna, has been appointed professor of organic chemistry in the Polytechnic Institute of Brooklyn. He will direct research in the field of high molecular weight compounds.

AT a meeting of the Society of Experimental Psychology recently held at the University of Pennsylvania, the Howard Crosby Warren Medal, which is given annually by the Society for outstanding research in the field of experimental psychology, was awarded to Ernest R. Hilgard of Stanford University, for his analysis of the conditioned response and his demonstration of its integration with the verbal and volitional processes in learning and retention.

BY acquiring the 335,000 Jews of the Baltic States the Soviet Union now has the largest Jewish population in the world, 4,835,000, made up approximately as follows: Russia proper, 3,050,000; Soviet Poland, 1,250,000; Bessarabia, 200,000; Baltic States, 335,000.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Polarization of Electrons by Double Scattering

THE general theory of the polarization of electrons by double scattering has been given by Mott[1], but detailed calculation of the percentage asymmetry to be expected in the azimuthal distribution after the second scattering at 90° has only been carried out for scattering fields of pure Coulomb type. In view of the fact that experiments have so far revealed no appreciable asymmetry under conditions when an appreciable percentage effect would be expected (for scattering of 79 kv. electrons by gold)[2], it is important that detailed analysis of expected effects for other types of scattering field should be carried out.

We have investigated the polarization effects arising from scattering by the atomic fields of gold, xenon and krypton (that is, screened Coulomb fields) for a wide range of electron energies (100 ev.–150,000 ev.). The differential equations involved have been solved in many cases by exact numerical integration and in other cases by use of Jeffreys' approximation[3], the validity of the latter having been first established. It is found that, in the energy range covered by Mott's calculations for the unscreened field of the gold nucleus, introduction of screening has no important influence, and the failure to obtain the predicted asymmetry remains unexplained.

An interesting effect of the screening is to make possible, in scattering by gold, the existence of large polarization in small energy ranges at low energies (of the order of a few hundred electron volts). Although the precise energy ranges in which these effects occur cannot be determined accurately by the theory, their existence can be demonstrated in the following manner. The percentage asymmetry involves the ratio of an asymmetry factor to a term which is proportional to the intensity of single scattering at 90°. In a screened Coulomb field, unlike an unscreened one, the latter term varies in an irregular manner with electron energy up to energies of some thousands of electron volts. In particular, for certain narrow electron energy ranges, it falls to very low values, as revealed from the experiments of Arnot on electron scattering in mercury vapour[4]. The asymmetry factor, on the other hand, does not vary so markedly. It is determined largely by the phase difference χ_1 at infinity between the wave functions for the $p\frac{1}{2}$ and $p\frac{3}{2}$ electrons. This we find remains, for gold, between 0·24 and 0·34 radians over an energy range of 250 ev.–100,000 ev. It follows, then, that at energies for which the single scattering at 90° is at a minimum value, the percentage asymmetry may be quite large. Owing to its association with low intensity of total scattering, it will be difficult to detect this experimentally, although there are advantages in using the lower energy electrons involved. Calculations reveal that for xenon and krypton the values of χ_1 are insufficient to give appreciable polarization at any energy.

As a further type of scattering field, as far removed from the Coulomb type as possible, we have considered the spherical potential well. This also is found to give rise to polarization effects, which tend to occur in narrower energy regions than for a Coulomb field.

Details of the investigation, together with its bearing on the nature of the modifications of the interaction energy between an electron and an atomic nucleus necessary to reduce the theoretical polarization, will be published in the *Proceedings of the Royal Society* when circumstances permit.

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[1] *Proc. Roy. Soc.*, A, **135**, 429 (1932).
[2] Dymond, E. G., *Proc. Roy. Soc.*, A, **133**, 638 (1932).
[3] Mott and Massey, "Theory of Atomic Collisions" (Clarendon Press, 1933), 90–92.
[4] *Proc. Roy. Soc.*, A, **130**, 655 (1931).

Derivation of Einstein Effect from Eclipse Observations of 1936

THE total solar eclipse of June 19, 1936, gave Japanese astronomers an excellent opportunity for solar research. The central line ran just parallel to the north-eastern coast of Hokkaido, facing Okhotsk Sea. More than twenty sites were occupied by Japanese and visiting observing parties. Our party, being the expedition from the Tôhoku Imperial University at Sendai, decided to make observations at Kosimizu, the co-ordinates of which are :

astronomical longitude : 144° 28′ 3″ E.
= 9h. 37m. 52·2s. E.
astronomical latitude : 43° 51′ 21″ N.

Our observing programme was mainly directed towards testing the Einstein effect. For this purpose, a special lens was made by Nippon Kogaku Kogyo K. K. (Japan Optical Industry Company, Limited) with aperture 20 cm. and focal length 500 cm. This lens was used horizontally with one cœlostat mirror.

The plate used was "Oriental 1200", size 25 cm. × 30 cm., thus covering a sky field of 2·9° × 3·4°. Duration of totality was 109 seconds, and during that time only one plate was taken with exposure of 80 seconds. Ten star images were recognized on the plate, but two of them were so near to the edges that they could not be measured.

After the lapse of about half a year, two comparison plates were taken at Sendai, not at Kosimizu. These comparison plates were called No. 115 and No. 119.

The plates were then brought to the Tokyo Astronomical Observatory. By the kindness of the staff of the Observatory, the use of the Zeiss blink

microscope was given freely, and with that instrument the relative displacements of the star images on the eclipse plate and on one of the comparison plates were measured very accurately. These measurements were corrected for differential refraction, differential aberration and proper motion, and then reduced by the method of least squares. In doing so, the so-called "Entartung" problem discussed by Dr. Freundlich was not touched, and the usual method of six plate constants and Einstein constant was adopted. The observation equations run as follows :

$$A + Cx + Dy + Fx^2 + Gxy + E\frac{R_\odot}{r}\frac{x}{r} = \Delta x,$$

$$B + Cy - Dx + Fxy + Gy^2 + E\frac{R_\odot}{r}\frac{y}{r} = \Delta y.$$

Here x, y are in the increasing directions of right ascension and declination. By forming the normal equations, the six plate constants A, B, C, D, F, G and Einstein constant E were calculated, with the following results :

$E = 2{\cdot}13''$ .. .. Eclipse Plate—No. 115,
$E = 1{\cdot}28''$ .. .. Eclipse Plate—No. 119.

The details will in due course be published in Vol. 18, No. 1 of the *Japanese Journal of Astronomy and Geophysics*.

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Evaporation of Water through Multimolecular Films

Hedestrand[1], Rideal[2] and Langmuir[3] have shown that unimolecular films generally do not reduce evaporation from water surfaces into air to an appreciable extent, the reason being that the evaporation resistance (the reciprocal of the evaporation rate) of unimolecular films is of the same order as the evaporation resistance due to collisions of the evaporating molecules with air molecules and subsequent deflection to the water surface. The only exception is cetyl alcohol, which shows appreciable reduction ; we found that octadecyl alcohol behaves similarly to cetyl alcohol.

F. Sebba and H. V. A. Briscoe[4] have recently shown that unimolecular films may produce substantial reduction when they are compressed. They have also investigated a thick film of lubricating oil showing the first interference colours and found a reduction of only a few per cent. However, with films of much greater thickness they found appreciable reduction.

We have investigated the evaporation through layers of 0·5–5 μ thickness of paraffin oil, which were obtained by the aid of spreading agents. The research was undertaken with a view to practical application in the protection of dams, etc., in the arid areas of the interior of Australia. The laboratory conditions had, therefore, to be similar to natural conditions, and it was for this reason that evaporation in open Petri dishes was investigated. No particular difficulty is experienced in obtaining a film of about 1–2 μ thickness which will reduce evaporation by 50–60 per cent. The most successful films are those obtained from dilute solutions (for example, 1 : 50) of boiled linseed oil, stand oil, terebinth oil, or high boiling fractions of eucalyptus oil in white paraffin oil. On the other hand, simple fatty acids and alcohols, added to paraffin oil, may cause initial spreading, but the films are unstable and collect into lenses after some time. Lubricating oils also do not generally spread well, although they no doubt contain 'amphipathic' molecules as a consequence of oxidation of paraffins.

Particularly high reductions (up to 99 per cent) have been obtained with thin films (0·5–1·0 μ) of certain high boiling fractions of the neutral oil of vertical retort tar. All these observations relate to films on neutral water.

The problem of the stability of these multimolecular films of hydrocarbons, spread by amphipathic molecules adsorbed in the interface, is still obscure. The films deteriorate with time under present experimental conditions. This is probably due to dust settling on the surface. Addition of dust, unless it be purely siliceous, always reduces the effectiveness of the film. There are indications of chemical changes (for example, polymerization) of the spreader, especially in the case of linseed oil and stand oil. However, it is doubtful whether they are responsible to any considerable extent for the deterioration, for no such deterioration is found within two weeks with paraffin – stand oil films investigated in a desiccator, if the film thickness is greater than 1 μ. Thinner films, however, show deterioration even under these conditions. We are at present examining the question of stability more closely and we intend to investigate the thermodynamic conditions directly by determination of the spreading coefficients.

The influence of winds on multimolecular films is interesting. It has been found by experiments in a wind tunnel that the reduction of evaporation in a wind is greater than in still air. This apparently surprising result is, however, readily understandable, since the wind increases the rate of evaporation from the free surface more than from a film-covered surface. In other words, the air resistance is considerably lowered by the wind, whereas the film resistance is but little affected. This holds, of course, only so long as the continuity of the film is not seriously affected by the wind. Under laboratory conditions, the film remained effective even when air was blown directly against the surface by a fan. Under natural conditions, on the other hand, the position is more unfavourable as a consequence of the great areas involved. During experiments on a dam of approximately 300 square yards area, it was found that on windy days the film was blown right into a corner, although it usually spread again after the wind had subsided. The main difficulty with respect to dams is, however, due to the short life period (a few days) of the films under natural conditions, most probably as a consequence of the action of dust and suspended material.

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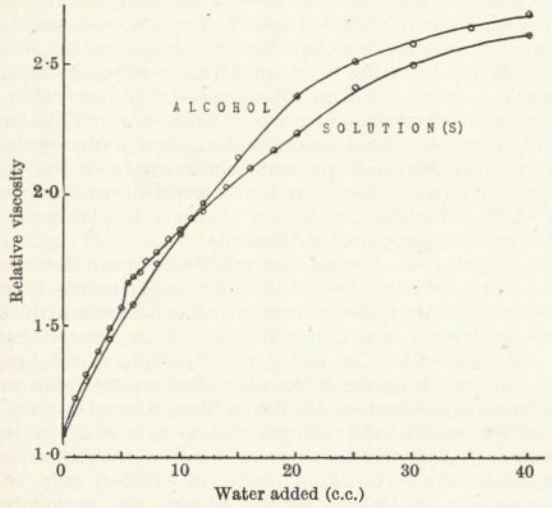
[1] Hedestrand, G., *J. Phys. Chem.*, **28**, 1244 (1924).
[2] Rideal, E. K., *J. Phys. Chem.*, **29**, 1585 (1929).
[3] Langmuir, L., and Langmuir, D. B., *J. Phys. Chem.*, **31**, 1719 (1927).
[4] Sebba, F., and Briscoe, H. V. A., *J. Chem Soc.*, 106 (1940).

Binding of Water by Stearanilide

I HAVE suggested[1] that in the hydrated anilides of stearic and palmitic acids, the 'bound' water is held by a micellar structure. Some further evidence supporting this view has now been obtained.

Quantities (0–40 c.c.) of distilled water were added to 50 c.c. samples of a 0·1 per cent solution of stearanilide in absolute alcohol (*S*). The mixtures were well shaken and allowed to stand for 20 hours. Mixtures containing 0–5·0 c.c. water were clear; slight opalescence developed in those containing 5·5–7·0 c.c. water; with more than 7 c.c. added water a white precipitate of hydrated stearanilide was formed. The bulk of precipitate increased gradually with the amount of water but became constant when this reached 15 c.c.; no further precipitation occurred on adding more water to the filtrates from solutions originally containing 15 c.c. or more of water.



Solutions containing a precipitate were filtered through sintered glass and the filtrates collected in dry vessels. The relative viscosities of all the solutions were then measured at 20° C., using a Höppler Viskosimeter. Afterwards the relative viscosities of a series of alcohol-water mixtures (prepared by adding 0–40 c.c. distilled water to 50 c.c. samples of absolute alcohol) were measured under the same conditions. In the accompanying graph are shown the viscosity changes brought about by adding water to 50 c.c. solution *S* and to 50 c.c. absolute alcohol.

Interpretation of these results may be attempted along the following lines: addition of water to solution *S* lowers the solubility of the stearanilide, but before precipitation occurs aggregation of the stearanilide molecules into micelles of colloidal dimensions takes place (this is shown by the development of opalescence and an abrupt increase in viscosity as the amount of added water is increased from 5·0 to 5·5 c.c.). Addition of more water has three effects: (1) hydration of the micelles in solution, (2) precipitation of hydrated stearanilide, (3) dilution of the intermicellar fluid. Factor (2), involving abstraction of water from the intermicellar fluid, tends to decrease viscosity and is operative in solutions containing 7–15 c.c. added water. Factor (3) has the opposite effect (the alcohol-water curve) and operates throughout the series. The influence of factor (1) on viscosity is obscure because two actions are opposed, namely, swelling of the micelles and removal of water from the intermicellar fluid. In the region where factors (1) and (3) only are in operation (that is, with 5·5–7·0 c.c. added water) the slow rise in viscosity suggests that the second action predominates.

The precipitation of hydrated stearanilide is complete when 15 c.c. water have been added to 50 c.c. solution *S*. At this stage the precipitated material contains about 95 per cent water of hydration as it floats in the liquid phase. This 'primary' bound water is difficult to remove by ordinary desiccation[1]. With the addition of water in excess of 15 c.c., further hydration of the precipitate takes place, as is shown by the widening of the gap between the two curves. Easily removed by ordinary drying methods, this 'secondary' bound water is probably held loosely on the outer surfaces of the swollen micelles. The amount of 'secondary' bound water taken up reaches a constant value when the quantity of water added to 50 c.c. solution *S* exceeds 30 c.c. (the attainment of complete hydration of the stearanilide is indicated by the two curves becoming parallel).

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[1] NATURE, **145**, 1019 (1940).

Does the Hypophysis Secrete a Pancreotropic Hormone?

EXPERIMENTS to determine whether the anterior pituitary lobe secretes a 'pancreotropic' hormone, that is, a hormone necessary for the maintenance and function of the pancreatic islets, have been made on the following lines:

(1) The pituitary gland was removed from a series of Wistar rats. The weight of the pancreas decreased, in proportion to the body weight, from an average of 0·57 gm./100 gm. of body-weight to 0·44 gm./100 gm. one month after hypophysectomy. At the same time the insulin extractable from this diminished pancreas was equal to or even greater than that of control animals, in proportion to the body weight[1,2]. Thus, 150 control rats contained 0·64 units of pancreatic insulin per 100 gm. of body-weight, while 77 animals weighing 118 gm. one month after hypophysectomy contained 0·62 u./100 gm., and 48 rats weighing 78 gm. under similar conditions contained 1·06 u./100 gm.

(2) When crude anterior pituitary extracts containing the pancreotropic factor[4] were administered to the hypophysectomized rat by injection, the relation of pancreatic insulin to the increased body-weight remained at or returned to the limits for control animals (0·69 u./100 gm. for thirty-five rats averaging 128 gm. at operation, and 0·58 u./100 gm. for thirty rats averaging 83 gm. at hypophysectomy).

(3) Implantation of tablets of œstrogen depresses growth by interfering with normal pituitary function. Under such conditions the size of the pancreas is not diminished in proportion to body weight and the insulin contained therein is significantly increased in

relation to the weight of the animals, as it tended to be after hypophysectomy (1·12 u./100 gm. in 41 rats 3–4 weeks after the subcutaneous implantation of two 15 mgm. tablets of stilbœstrol, and 1·01 u./100 gm. one month after implantation of one 12 mgm. tablet of œstrone). When rats carrying stilbœstrol tablets further received injections of crude anterior pituitary extract, the insulin increased in approximate proportion to the growing body-weight, remaining higher than in control rats (1·26 u./100 gm. for 42 rats after two weeks daily treatment with extract).

In order to demonstrate that the pituitary gland secretes a pancreotropic hormone it is necessary to show that removal of the gland results in a diminution in size and activity of the pancreatic islets (in proportion to the body weight) and that this condition may be cured or prevented by pituitary therapy. The evidence here presented does not support the assumption that the anterior pituitary lobe exerts a direct hormonic control over the islets of Langerhans, although extracts of this gland contain a pancreotropic substance capable of increasing the amount of islet tissue and of insulin, in the pancreas of the normal rat[3,4].

The results will be given in detail and discussed in a paper to be published by one of us (M. G.) in the *Journal of Endocrinology*. We wish to express our indebtedness to Messrs. Boots and Co. for the gift of stilbœstrol and for the preparation of the tablets.

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[1] Krichesky, B., *Proc. Soc. Exp. Biol.*, N.Y., **34**, 126 (1936).
[2] Haist, R. E., and Best, C. H., *Science*, **91**, 410 (1940).
[3] Richardson, K. C., and Young, F. G., *J. Physiol.*, **91**, 352 (1937).
[4] Marks, H. P., and Young, F. G., *Lancet*, i, 493 (1940).

Nature of Oxidative Phosphorylation in Brain Tissue

A CONNEXION between oxidation of pyruvic acid and esterification of inorganic phosphate with hexosemonophosphate to hexosediphosphate in brain preparations has been recently described[1]. I have now found that glucose can be substituted for hexosemonophosphate and the phosphorylation product is still hexosediphosphate. The necessity of 'adenine nucleotide' for the above reaction as well as the dependence of the oxidation on the presence of both 'adenine nucleotide' and inorganic phosphate[2] led to the assumption that the oxidation of pyruvic acid was linked up to a phosphorylation of adenylic acid to adenosinepolyphosphate, which would then transfer its labile phosphate groups to hexosemonophosphate or glucose. This is supported by the fact that either glucose or hexosemonophosphate can be phosphorylated to hexosediphosphate anærobically by transfer of phosphate from phosphopyruvic acid in the presence, but not in the absence, of adenylic acid. Half of the phosphopyruvate phosphate is set free and the other half is esterified with glucose or hexosemonophosphate. This is the same ratio as was found by Ostern, Guthke and Terszakovec[3] for the transfer of phosphate from adenosinetriphosphate to hexosemonophosphate in muscle extract. The phosphorylation of glucose under these conditions had not been so far observed in animal tissues.

The reactions taking place with glucose can be formulated as follows:

(1) 4 phosphopyruvic acid + 2 adenylic acid = 2 adenosinetriphosphate + 4 pyruvic acid.

(2) 2 adenosinetriphosphate + 1 glucose + 2 H_2O = 1 hexosediphosphate + 2 H_3PO_4 + 2 adenylic acid.

The sum of equations (1) and (2) is the overall reaction (3):

(3) 4 phosphopyruvic acid + 1 glucose + 2 H_2O = 1 hexosediphosphate + 2 H_3PO_4 + 4 pyruvic acid.

Recently Colowick, Welch and Cori[4] concluded that the oxidative phosphorylation of glucose in kidney extracts, previously studied by Kalckar[5], is linked up with the oxidation of succinic to fumaric acid. In brain dispersions oxidation of succinate does give rise to phosphorylation of glucose. However, if oxidation of the pyruvate—arising by subsequent oxidation of malate to oxaloacetate and breakdown of the latter—is checked by arsenite, the ratio atoms phosphorus esterified to molecules oxygen taken up is only about a half of that obtained when pyruvate is oxidized (in the absence of arsenite) as shown in the accompanying table. Arsenite, whilst fully inhibiting both oxidation of pyruvate and the accompanying phosphorylation, is without effect on the phosphorylation of glucose by transfer of phosphate from phosphopyruvic acid.

1·5 ml. dispersion from pigeon brain (dialysed 6·5 hours) to 2·3 ml. with additions including phosphate buffer *p*H 7·3 (0·025*M*), Mg++ (0·2 mgm.), adenylic acid (0·0007 *M*), glucose (10 mgm.), and NaF (0·02*M*). 35 min. in air at 38°. (O_2 uptake measured during the last 30 min.).

	No further addition	Na fumarate (0·005*M*) + Na pyruvate (0·013*M*)		Na succinate (0·03*M*)	
		No arsenite	0·008*M* Na arsenite	No arsenite	0·008*M* Na arsenite
μl O_2 uptake	0	320	19	276	178
mgm. P esterified	—	1·20	0·00	0·77	0·23
atoms P/mols O_2	—	2·78	0·00	2·01	0·94

The above suggests that the oxidative phosphorylation may be of a twofold nature; half of it being connected with the dehydrogenation of pyruvic acid as suggested previously[1], the other half with the transfer of hydrogen catalysed by dicarboxylic acids. This view would seem to be supported by the fact that when pyruvate is oxidized by brain dispersions, in the presence of fumarate, the P/O_2 ratio in the first few minutes is 4 atoms phosphorus to 1 molecule oxygen. It would be difficult to understand how the removal of 2H would give rise to an uptake higher than 1 atom phosphorus unless their further catalytic transfer is also linked up with phosphorylation.

I am indebted to Prof. R. A. Peters for his interest and to the Nuffield Trustees and the Rockefeller Foundation for grants in aid of this work.

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[1] Ochoa, NATURE, **145**, 747 (1940).
[2] Banga, Ochoa and Peters, *Biochem. J.*, **33**, 1980 (1939).
[3] *Z. physiol. Chem.*, **243**, 9 (1936).
[4] *J. Biol. Chem.*, **133**, 359 and 641 (1940).
[5] *Biochem. J.*, **33**, 631 (1939).

Distribution of Ammonia in Larvæ of *Lucilia cuprina*

IT has been established that sterile larvæ of *Lucilia sericata* excrete the bulk of their nitrogen in the form of ammonia[1,2]. Similar studies with larvæ of the Australian sheep blowfly, *L. cuprina*, support these findings. When reared on a medium composed of yeast, egg white and sodium chloride[3] the ammonia excretion per 100 larvæ increased after hatching until the larvæ were fully grown and then it diminished rapidly as they approached the pupal state.

This work has been extended to a microchemical study of the distribution of ammonia in the organs and tissues of larvæ of *L. cuprina*. For qualitative testing, mature larvæ were opened under isotonic saline (1·5 per cent sodium chloride). The saline was then removed and the reagent applied. Nessler's reagent and Riegler's reagent were each employed. The latter was prepared according to the directions of Feigl[4], saturated calcium hydroxide being used to render the solution alkaline.

For the quantitative study, the larvæ were reared on the artificial egg white – yeast medium containing 0·01 per cent brom cresol purple. As shown by Waterhouse[5], this indicator serves to define the acid mid-segment of the midgut. For each experiment, 10 larvæ were subdivided into the required portions. The dissections were performed under isotonic borax (2·5 per cent $Na_2B_4O_7$) to prevent the formation of ammonia during treatment and ammonia was estimated by adapting the permutit-Nessler method[6] to deal with micro quantities.

As shown in the accompanying table, the results obtained by the three methods agree fairly well.

Method	Fat body	Integument & skeletal muscle	Midgut			Hindgut		Malpighian tubes
			Anterior	Mid	Posterior	Anterior half	Posterior half	
Qualitative								
Nessler's Reagent	+	+	–	++	–	++	++++	+
Riegler's Reagent	+	+	–	++	–	+++	+++	+++
Quantitative mgm. per cent NH_3-N (Av. of 9 experiments)	21	3	11	27	4	206	544	77

These data help to elucidate the mechanism of ammonia formation and excretion in this organism. They are interpreted as showing that ammonia, produced in the midgut, is absorbed into the hæmocœle and transferred to the Malpighian tubes. The dilute ammonia solution, transmitted from the Malpighian tubes to the hindgut, is gradually concentrated by re-absorption of water as it moves along the hindgut towards the anus. This view of the mechanism of ammonia excretion, which implies that ammonia passes into the body cavity, is also supported by analyses of the hæmolymph, which contains 12 mgm. per cent NH_3-N. Acidity in the mid midgut would explain the high ammonia capacity of the gut contents in that region. Ammonia is occasionally detected in the crop if the diet has become rich in excreted ammonia.

Except in the alimentary canal and the Malpighian tubes, the ammonia concentration is relatively low. Some storage of ammonia occurs in a few cells of the fat body, and a portion resides in the integument, sometimes becoming visible as a thin brown line just beneath the cuticle when Nessler's reagent is applied.

A fuller discussion of this work will be published in Australia by the Council for Scientific and Industrial Research.[7]

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[1] Michelbacker, A. E., Hoskins, W. M., and Herms, W. B., *J. Exp. Zool.*, **64**, 109 (1932).
[2] Brown, A. W. A., *Biochem. J.*, **32**, 903 (1938).
[3] Lennox, F. G., Coun. Sci. Ind. Res. (Aust.). Pamphlet No. 90 (1939).
[4] Feigl, F., translated by J. W. Mathews, "Qualitative Analysis by Spot Tests" (Amsterdam: Nordemann Pub. Co., 1937).
[5] Waterhouse, D. F., Coun. Sci. Ind. Res. (Aust.), Pamphlet in press.
[6] Peters, J. P., and Van Slyke, D. D., "Quantitative Clinical Chemistry", Vol. 2. (Baltimore: The Williams and Wilkins Co., 1932.)
[7] Lennox, F. G. A contribution to the series "Studies of the Physiology and Toxicology of Blowflies".

Practical Science in Schools

I FEEL from my own teaching experience that practical work by pupils is essential in order to avoid that common type of 'learning' in which the pupil obtains credit for knowing work, and himself believes he knows it, merely because he is adept at quoting phrases of which he has not properly understood the meaning[1]. Recently the Spens Report has stressed the educational importance of 'activity' (that is, *use* of the pupil's knowledge and abilities), and of handwork. These imply that knowledge, if it is to last, must be tested and corrected by being put to practical use, and so converted into a habit; and that, in learning, the hand has an important part to play as an organ of sensation.

Would curtailment of practical work necessarily promote the consideration of social and humanistic contacts? I fear it would unconsciously encourage a dogmatic and authoritarian attitude, by removing that constant reference to observed fact which is the distinguishing mark of science. Since this experimental attitude permeates both the theoretical outlook of science and its technical use, it is an essential part of all its social values too.

If a science teacher asks himself, at each stage in his teaching, what aims he has in view, and applies an experimental outlook to the problem of how to achieve them, he will find that some traditional practical work can be omitted. But at the same time by watching how children react if allowed to do as they please with, for example, lenses, magnets, earthworms, mechanics apparatus (provided this is large enough for the forces to be felt by the organs with which we normally estimate forces—the sensory nerves of the muscles), he will find many suggestions for pupils' practical investigations bearing on everyday life, scientific method, applications of biology, local industry, etc.

With elementary classes one can often reduce expenditure by using robust commercial apparatus instead of fragile laboratory ware, commerical chemicals when pure ones are not needed, and the products of ordinary shops and of Nature whenever possible. This at the same time brings closer the social and humanistic contacts required.

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[1] See also NATURE, June 1, p. 863, June 29, p. 1023 and July 27 p. 133.

RESEARCH ITEMS

Stone Implements from Canberra, Australia

THE Canberra meeting of the Australian and New Zealand Association for the Advancement of Science was made the occasion by H. P. Moss of an exhibition and survey of aboriginal Stone Age material found in the Capital Territory (Report, 24th meeting, 1939). More than three hundred specimens were exhibited; with two exceptions, all were collected from the area constituting the City of Canberra, the author's first discovery being an axe-head found close to the Acton offices in 1919. At first sight the specimens, especially the scrapers and points, appear to suggest that there were two waves of Stone Age culture; the difference is to be explained by the fact that while much material was collected on ridges exposed to the winds as well as alternations of heat and cold, a considerable amount was recovered from depths ranging from two or three to six feet below the surface and had thus been protected against weathering. The depth of a find affords little criterion of age, as for example, in Crete, where twelve inches is estimated as the equivalent of a hundred years. In Canberra, high winds blowing continuously for a number of hours will cause a remarkable accumulation of sand deposit or an equally remarkable denudation. In regard to future investigation, at least five localities are indicated as worth examination in view of their suitability for aboriginal camps as regards both food supply (small game) and shelter from the prevailing wind.

Vaghers of Okhamandal

S. T. MOSES, while acting as director of fisheries, Baroda State, was brought into intimate contact with the historic and interesting community of the Vaghers, for whose relief a pearl fishery was organized recently. Observations were made and anthropometric measurements taken (*J. Roy. Asiat. Soc. Bengal, Letters*, **5**; 1939). They are undoubtedly among the earliest inhabitants of the Okhamandal district and are descended from the aboriginal inhabitants, the Kalas, one of the three tribes said to have sprung from the sweat of God. There has been great admixture, especially with races of Rajput origin. The first conqueror of the district was the king of the Yadavas, who was the eighth incarnation of Vishnu. The original occupation of the Vaghers was fishing, but they developed into a violent freebooting tribe, though authority has now persuaded them to take to agriculture, and many follow fishing, pearl-fishing and sailing as an additional occupation. Their speech is a jumble of Gujarati and Cutchi, a mongrel speech intelligible only after long residence. The men give a military salute instead of the more general salaam, while the women greet their relatives by cracking their fingers on the temples or on the head-scarf just above. In religion they are Hindus but, as is usual with many other Hindus, they go to the shrines of Muhammadan saints for the cure of diseases. Marriage, usually arranged by the parents, is preceded by a betrothal. The marriageable age is 15–20. The ceremonies differ in no way from those of surrounding castes, Brahmin priests officiating. Men seldom marry more than one wife and divorce is easy. The men are of medium stature, the range of variation being from 5 ft. 1 in. to 5 ft. 10 in., the cephalic index varying from 76·9 to 86·4.

Changes in the Colours of Birds

IN order to define more accurately the changes in the colour of plumage due to the wearing and the fading of feathers, Frederick H. Test has studied the plumage of flickers (Colaptes) (*Condor*, **42**, 76; 1940). Exposure of several kinds of fresh feathers to sunlight for sixty-five days produced distinct fading. The carotenoid colours (reds and yellows) of all feathers except the red malars and nuchal crescent feathers were strongly affected; the latter type of red was apparently unaltered. The changes in colour probably result from slow oxidation under the influence of sunlight. The melanic hues (browns, blacks and greys) were only slightly affected by the exposure. These experimental changes correspond with the conditions found in breeding birds, the amount of change varying with the degree of exposure to sunlight. The changes seen in the melanic colours are principally due to a loss of pigment through abrasion. Black regions scarcely change, because loss of pigment is slight and such loss as occurs is imperceptible on account of the great concentration of black.

Induced Evolution through Chromosome Changes

A. F. BLAKESLEE, director of the Department of Genetics, Carnegie Institution of Washington, read a paper on induced evolution in plants through chromosome changes before the Eighth American Scientific Congress. Evolution of plant types is dependent upon changes in their chromosomes. In addition to changes in individual genes, gross changes in chromosome structure may be induced by X-rays, radium, heat and ageing seeds. Chromosomes may be broken and their parts interchanged (segmental interchange) or a part may be attached to the end of another chromosome (simple translocation). By treatment with heat or a number of different chemicals, notably colchicine, it is possible to induce the chromosomes to double in number. We now have the three following ways of making new species by laboratory methods: (1) Combining interchanged chromosomes in such a way that to the end of a chromosome there is added extra chromosomal material which brings about changes in the structure and appearance of the plant. This method is not yet known in Nature. (2) Interpolation of the extra material inside another chromosome. This method is suspected in Nature. (3) Doubling chromosome number in sterile species hybrids to produce new pure-breeding types with enhanced vigour. This method is known to have occurred in Nature both in the formation of wild species and in the production of superior varieties of cultivated plants.

Salivary Gland Chromosomes

A STEP towards the elucidation of chromosome structure has resulted from the treatment of salivary gland chromosomes by solutions varying in *p*H of 1–14. M. Calvin, M. Kodani, and R. Goldschmidt (*Proc. Nat. Acad. Sci.*, **26**, 340–349: 1940) find that at the highest range (*p*H = 13) several changes take place. Initially the chromosomes lose their striations of disks, but retain a clear outline. The chromosomes then show two beaded strings with lamp-brush connexions between the beads. Afterwards, the two strings (chromatids) synapse and then condense.

Finally, the chromosomes lose the lamp-brush structure and may become invisible. The rate of these changes varies with the *p*H and the later stages may not occur in lower *p*H ranges. It is suggested that the phenomena are in keeping with the behaviour of a partially folded and partially extended polypeptid chain. The secondary bands are broken by the high *p*H which corresponds with the iso-electrical part of nucleoprotein. The double chromonema constituting one chromatid only becomes visible when the treatment by alkali concentrates the nucleic acid upon them. Other chromonemata are fully expanded to form the loops and bristles of the lamp-brush appearance. They have been named trophochromatin and are believed to provide reserve material for growth.

Cytogenetics of Maize

THE third chromosome of maize consists of two arms, the long arm being twice as long as the short arm. E. G. Anderson and R. A. Brink (*Genetics*, **25**, 299–309; 1940) have summarized their analysis of the genes and translocations of chromosome 3. The order of the genes on this chromosome is *cr*, d_1, *Rg*, ts_4, *la*, *na*, *a*; the linkage group consist of 103 units, while *cr* is positioned towards the short arm. About twenty translocations were found to be distributed from the position of d_1, on the short arm, almost to *a*, in the distal part of the long arm. The relations of the genes with the translocation and the cytological position of the translocations breaks on the chromosome were determined.

Early Mammals of South America

THE early Tertiary mammals of South America, found in a sequence of five formations between the latest Cretaceous and the latest Oligocene in central Patagonia, were discussed by G. G. Simpson in a contribution to the Eighth American Scientific Congress (May 1940). The earliest faunas contain marsupials, more varied than otherwise known outside Australia, armadillos, ground-sloths and highly varied, archaic, hoofed mammals. During the Oligocene, rodents allied to the tree-porcupines, cavies and chinchillas appeared. The author considers that the hypothesis that these faunas were of Australian origin is poorly supported. He thinks that the peculiarity of the assemblage that occupied South America raises a question that still defies any reasonable answer. W. B. Scott carries on the astonishing story of mammalian evolution from the Miocene to the Pleistocene. The Miocene Santa Cruz beds are mainly stratified ash in which the skeletons of mammals and birds are preserved with exceptional completeness. The fauna is very rich and varied, but is made up almost entirely of groups that are not known in any other part of the world, such as predaceous marsupials, peculiar hoofed animals, the bizarre astrapotheres, ground-sloths, armadillos, and rodents of the porcupine group. In the Pliocene appears the first mammal, a raccoon-like carnivore, of definitely North American origin. The mammals are much larger than their Santa Cruz ancestors, though smaller than their Pampean descendants. Most impressive is the huge marsupial Thylacosmilus, which imitates the sabre-tooth cats in a remarkable way. The Pleistocene fauna of the Argentine Pampean contains a large immigrant element together with a larger one of native origin. The post-Pleistocene extinctions removed the greater part of this assemblage, which included huge sabre-tooth cats, short-faced bears, giant raccoons and chinchillas, exceptionally large hoofed animals and an astonishing variety of edentates which ranged in size from an elephant to a tapir, and included a glyptodont which attained a length of 15 ft. or more.

Earthquakes of South and Central America

B. Gutenberg and C. F. Richter contributed to the Eighth American Scientific Congress, held in May 1940, a paper on the seismic zones of Central and South America. These zones are part of the circum-Pacific belt of activity, which includes a large majority of the shallow shocks of the world, a still larger proportion of those from intermediate depths (60–300 km.), and practically all those from great depths (300–700 km.). Of the branches from the main belt, one diverges in the region of Oaxaca and passes southward by way of the Galapagos Islands and along the Easter Island Rise; the area between the latter and South America is one of principally continental structure. Two other branches follow loops enclosing outlying areas of Pacific structure, one surrounding the Caribbean Sea and the other following the 'Southern Antilles' of Suess. For shallow shocks, the west coast of Mexico is among the most active regions of the world, with frequent great shocks. The activity of Central America is lower, decreasing to a very minor level in eastern Panama. That of the West Indies has often been over-estimated; it is only moderate. In South America, shocks at shallow depth are relatively infrequent, and occur chiefly close to the coast, except in the Mendoza region and in Peru. The high activity of the Andean zone is due mainly to shocks from intermediate depths, with epicentres usually distant from the coast. The great Chilean earthquake of January 1939 had a focal depth of about 70 km. A belt of intermediate shocks crosses central Mexico from west to east and another passes southward through Central America. Shocks from depths greater than 600 km. occur in a few areas far inland in South America. In another paper, presented by N. H. Heck, it is pointed out that of the 95 seismological stations of the Americas, 66 are north of Mexico, 16 are from there to Panama, and only 13 are situated in South America.

Seismicity of the Northern Pacific Coast of U.S.A.

A CRITICAL survey of the earthquakes of the north-west United States has just been made by Perry Byerly (*Bull. Geol. Soc. Amer.*, **51**, 255–260; Feb. 1, 1940). The earthquakes concerned had an intensity at the epicentre equivalent to that required to crack walls and cause chimneys to fall. Some of the facts noted by Byerly are that the most seismic regions in the area are the one about San Francisco Bay and the one just off the coast of Humboldt County. These lie in the more persistent fault zones of the coast ranges and their seaward extensions. It is noteworthy that epicentres practically cease at 42° N. and begin again off the coast of Canada. It is suggested that the San Andreas fault zone reaches the border of the continental mass near 42° N., 126° W., and that the stresses leading to earthquakes, which are common on the continent, do not persist in the ocean floor. Another zone of epicentres along the Sierra roughly parallels that just discussed. The only epicentre at sea off the Oregon coast lies roughly on an extension of this zone. The seismic quiet of

Oregon and Washington is marked. The few shocks about Puget Sound were just large enough to come within the classification stated, but were not large shocks. It is noted that it was in Marin County that the greatest fault displacement was observed in 1906. It appears that in this region and possibly in the region of the centre of the Fort Tajon earthquake (1857) farther south there is greater effective friction along the San Andreas Fault which prevents many small shocks and saves the accumulating strain for larger displacements. Perhaps we have here regions of greater pressure transverse to the fault.

Origin of Microseisms

A VERY thorough and important experimental investigation of the nature and origin of microseisms has been carried out at St. Louis, Missouri, by J. Emilio Ramirez (*Bull. Seis. Soc. Amer.*, **30**, Nos. 1 and 2, January and April 1940). The investigation was carried out during July–December 1938, and specially designed electromagnetic seismographs situated at St. Louis University, Washington University and Maryville College had the same timing arrangements by the same clock, being linked together by telephone wires. The results demonstrated beyond doubt that microseismic waves are travelling, and not stationary, waves, the speed of travel being 2·67 ± 0·03 km./sec. During the period mentioned, 80 per cent of the waves came from the north-east, none being recorded from south, west or south-west. The period of the waves was from 3·5 to 7·5 sec. and the wave-length was of the order of 14¼ km. The waves were found to have many of the characteristics of Rayleigh waves and over a period of more than a year the recordings of microseisms and microbarometric oscillations (recorded by specially designed microbarographs) showed no direct relationship in wave form, group form, period or duration of storms. The source of the microseisms was over the sea, the amplitude of the microseisms depending only on the intensity and widespread character of the deep barometric lows travelling over the ocean. The period of the microseisms appeared to be a function of the distance between the station and the source of microseisms, though no indication of the mechanism by which microseismic storms were caused was obtained, and large microseisms were evident at times when there was no surf near the coasts or winds blowing from land to ocean.

Accretion and Stellar Energy

R. D'E. ATKINSON has attempted to determine the maximum possible rate of accretion of diffuse matter by stars (*Mon. Not. Roy. Astro. Soc.*, **100**, 7 ; May 1940). Assuming that a product-formula of the type $A = k.a^x b^y c^z \ldots$ is applicable to all stars, the factors which may reasonably be considered are the star's mass, radius, speed through the diffuse matter, density of the diffuse matter, and the constant of gravitation. If, as is possible, it is necessary to consider temperature or the molecular weight of the diffuse matter, the method of investigation pursued in the paper breaks down. Even the five factors referred to constitute a formidable problem, but a safe assumption can be made regarding the density—that it is involved to the power + 1 only. It is found, however, that the problem of the radiation of bright stars cannot be solved by any admissible accretion formula. It seems impossible to find a formula which will give a high enough rate of accretion to account for the energy of the bright stars, using values of the parameters that are permissible. In addition, the rate of accretion cannot even be high enough to produce the dynamical effects considered by Hoyle and Lyttleton, except in the case of very slow moving stars. Even then, it is necessary to extend the time-scale to 10^{10} years or more, and this involves reducing very much the upper limit to the luminosity that can be accounted for by the transmutation of hydrogen, even with the help of accretion. It is possible that the rate of accretion is not given by any simple product-formula. If it is, then some additional factor is relevant, such as the molecular nature or molecular state of the diffuse gas. Finally, it is suggested that the total radiation of the bright stars requires an additional source of energy beyond that provided by the hydrogen they initially possessed and all that they can afterwards collect.

Ionic Character and Dipole Moment

PAULING has regarded the hydrogen halides in the normal states as superpositions of ionic and covalent states, and the fraction of ionic character as given by μ/er, where μ is dipole moment, r is internuclear separation. F. T. Wall (*J. Amer. Chem. Soc.*, **62**, 800 ; 1940) has developed the theory and shown that the sum of the dipole moments of two states resulting from resonance is the same as the sum of the dipole moments of the original states. By assuming a wave function $\psi = \psi_c + a\psi_i$ for a system resonating between covalent and ionic states, where ψ_c and ψ_i are the purely covalent and ionic functions and a is a parameter, values of $|a|$ are calculated both from dipole moments and from energy values and the two sets of values are found to be in approximate agreement.

Seasonal Variation in the Height of Meteors

R. A. MCINTOSH has examined (*Mon. Not. Roy. Astro. Soc.*, **100**, 7 ; May 1940) all available published real paths of meteors in an attempt to confirm the seasonal variation found by Öpik. The paper gives a very exhaustive analysis of the matter at McIntosh's disposal, but it is impossible to deal with the various refinements introduced to secure a high degree of accuracy in the results. Some of his conclusions differ considerably from those of Öpik, who used the data provided by the Harvard Observatory Meteor Expedition (*Tercentenary Papers, Harvard Observatory*, **105**, 549 ; 1937). Öpik found that there was a slightly greater range of heights in shower meteors, that is, meteors associated with the well-established showers on certain dates, some being connected with comets, than with sporadic meteors, but this was not confirmed by McIntosh. There is a decided seasonal variation in the case of sporadic meteors for the three points examined, appearance, mid-point, and disappearance, and the amplitude of the variation is greatest in the lower levels of the atmosphere, maxima and minima occurring earlier than in higher levels. It is obvious from these facts that the cause of the variation lies in the atmosphere. There is a similarly well-marked seasonal variation in the width of the meteor zone. McIntosh points out that Öpik's use of the harmonic mean heights has certain weaknesses and that it is more correct to use the arithmetic means. The author speaks highly of the accuracy of the work of British observers, and in particular of that of the members of the Meteor Section of the British Astronomical Association.

INCREASE IN ULTRA-VIOLET ABSORPTION OF CYTOPLASM AFTER THERAPEUTIC X- AND GAMMA-IRRADIATION

BY DR. JOSEPH S. MITCHELL,
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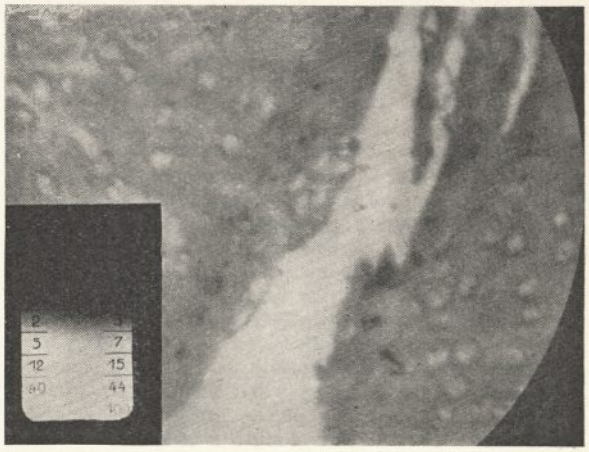
A RELATIONSHIP between the radiosensitivity of tissues and the metabolism of nucleic acid has often been suggested and receives support from certain work, including the possible correlation between the maximum of cellular radio-sensitivity in the premitotic phase[1,2] and the rapid increase in the nucleic acid content of nuclei preceding mitosis[3,4,5].

The aim of the present investigation is to examine the changes in the nucleic acid content, distribution and metabolism resulting from the therapeutic X- and gamma-irradiation of malignant tumours. A technique of ultra-violet microphotography has been developed quantitatively, on the basis of the methods described by Caspersson[3], and applied to biopsy specimens taken from cases during treatment.

The experimental method employs microphotography with light of the wave-length 2537 A., which was selected because of its proximity to the maximum value (2525 ± 10 A.) of the ratio of the absorption coefficients of nucleic acid and of typical proteins in solution. The required monochromatism is attained by employing a mercury-neon discharge tube as light source in conjunction with a chlorine-bromine filter and a photographic plate of correct sensitivity, and has been checked spectrophotographically. The quartz optical system is of the usual type (*cf.* [6,7]) employing a dry objective (6 mm. N.A. 0·70). Sections of control and irradiated tumour are photographed on the same field. From objective measurements of the blackening of the photographic plates under standard conditions, employing a neutral wedge for visible light and radial-sector diaphragms for ultra-violet light, the effective concentration at each point in the sections of nucleic acid or other known absorbing compound can be deduced. For this purpose, a microphotometer of non-recording type has been constructed and also in some cases curves have been obtained by means of a recording microphotometer. An interferometric method has also been developed to measure the small difference in thickness of the sections of control and irradiated tissue.

Measurements have been made on 12 specimens: these comprise 4 squamous cell carcinomata of the lip, 2 squamous cell carcinomata of the fauces, 4 carcinomata of the skin (1 squamous cell, 2 basal cell and one anaplastic carcinoma), 1 squamous cell carcinoma of the cervix uteri, and normal tadpole skin. In all instances the biopsies were taken before and 80 minutes after the end of irradiation; this time was selected to allow the cells caught in division at the time of exposure to complete mitosis. Three cases were treated with X-radiation (effective wave-length 145 X.U.), 8 with gamma-radiation from radium (applicators) and one with gamma-radiation from radon; the doses used varied from 248 to 4410 r. and the mean dosage rates from 0·317 to 29·7 r./min.



CONTROL IRRADIATED

Fig. 1.

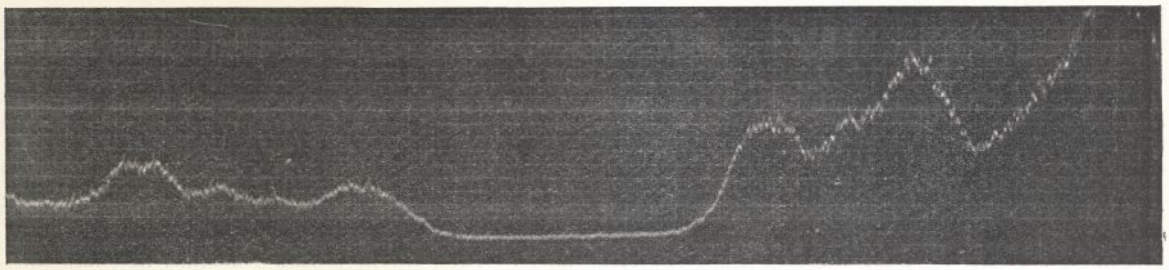
ULTRA-VIOLET MICROPHOTOGRAPHS SHOWING SECTIONS OF CONTROL AND IRRADIATED TUMOUR (CARCINOMA OF THE LIP) ON THE SAME FIELD, TOGETHER WITH A STANDARD NEUTRAL WEDGE (× APPROX. 330).

Control: specimen taken before irradiation.
Irradiated: specimen taken 80 min. after 248 r. in 4·45 hr.

(Treatment with double radium applicator.)

The most striking effect observed was a significant increase in the ultra-violet absorption of the cytoplasm after the X- and gamma-irradiation *in vivo*. This change has been detected after small doses of radiation such as 248, and 388 r. (see Figs. 1 and 2); but it appears probable that the mean dosage rate is a very significant factor in its production. Of the six specimens examined in which the dosage-rates were relatively high (0·91–29·7 r./min.) all gave an increase in cytoplasmic absorption. At low dosage rates (0·32 and 0·53 r./min.) two cases showed no increased absorption while of the 4 cases at intermediate dosage rates (0·53–0·91 r./min.) the two basal cell carcinomata gave a positive effect while the squamous cell carcinomata showed no change.

The increase in cytoplasmic absorption produced by irradiation is of interest in relation to the cytoplasmic absorption recently described[5,8,9] in growing tissues and attributed to pentose nucleotides. The absorbing material appearing after irradiation is not thymonucleic acid itself, as shown by the negative Feulgen reaction, but, at the wave-length 2537 A., corresponds in absorption to that of, for example, a 2 per cent solution of nucleic acid, as in Fig. 1. Thus the magnitude of the observed effect is certainly consistent with the possibility that the increased absorption may be due to purine and pyrimidine



CONTROL IRRADIATED

Fig. 2.

MICROPHOTOMETER RECORD OF ANOTHER CASE (CARCINOMA OF THE LIP).
Sections: Control and 80 min. after 388 r. in 6·42 hr.

derivatives. Further, microchemical tests have shown that the increased absorption is accompanied, at least in some cases, by positive pentose reactions in the cytoplasm. This work is in progress and it has been found that the absorbing material can be removed from the cytoplasm in the fixed sections by acid hydrolysis followed by alcohol extraction. Also, *in vitro* experiments have shown that it is unlikely that the observed effect could be due to direct 'photochemical' changes produced in the cytoplasmic proteins by the radiations. At present, little can be said concerning the mechanism of accumulation of the absorbing substances in the cytoplasm as a result of irradiation or of the processes by which they are removed.

On the clinical side, 10 of the cases were treated by myself, and among these there has been no obvious correlation between the response to treatment and the absorption changes described.

I wish to express my grateful acknowledgment to the Medical Research Council and the British Empire Cancer Campaign for financial assistance.

[1] Spear, F. G., *Brit. J. Radiol.*, **8**, 68, 280 (1935).
[2] Spear, F. G., and Glückmann, A., *ibid.*, **11**, 533 (1938).
[3] Caspersson, T., *Skand. Arch. Physiol.*, Suppl. 8 (1936).
[4] Caspersson, T., *Arch. exp. Zellforsch.*, **19**. 216 (1937).
[5] Caspersson T., *ibid.* **22**, 655 (1938).
[6] Köhler, A., and v. Rohr, M., *Z. Instrumentenk.*, **24** (1904) (*cf. J. Roy. Micro. Soc.*, **25**, 513 (1905)).
[7] Barnard J. E., and Welch, F. V., *J. Roy. Micro. Soc.*, **56**, 365 (1936).
[8] Caspersson, T., and Schultz, J., NATURE, **142**, 294 (1938).
[9] Caspersson, T., and Schultz, J., *ibid.*, **143**, 602 (1939).

GEOMAGNETIC RESEARCH IN THE AMERICAS*

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THE earth is a great laboratory in which Nature is constantly performing physical experiments. The student of earth physics labours under the disadvantage that systematic and trustworthy data are available for little more than a century. This period is too limited from which to draw many significant conclusions regarding the complex world-wide and cosmical causes and interrelations involved. In the collection of geophysical data, chief attention must be given to geographical and space-distribution and to variability with time characterizing the phenomena concerned. These data must include not only isolated observations on land and sea but also continuous observations at fixed observatories to follow simultaneous variations with time and co-ordination with experiment in the physical laboratories and astrophysical observatories.

The Americas, with their vast areas, their great river-systems, their mountain ranges rising to elevations second only to the Himalayas, and their surrounding Atlantic, Pacific, and Southern Oceans, offer fertile fields for geophysical investigations. Their natural resources are being made available for human use in large degree by the practical applications of geophysics. The magnetic and electric fields of the earth may be considered more in detail as an outstanding example of the opportunities offered such research in the western hemisphere.

Although a few crude determinations of magnetic direction had been made in the Americas toward the end of the seventeenth century, it was not until the historic oceanic magnetic survey during 1698–1700, sponsored by Edmund Halley, that reliable data in the western hemisphere began to be obtained, and then only for the direction of the compass. The magnetic equator—a line connecting all points where a magnetic force is horizontal—crosses Peru and Brazil. One of the agonics—the line along which the compass points true north—passes somewhat west of north from Montevideo through Brazil, western Venezuela, Cuba, and the United States of America. The delineation of the magnetic equator early aroused scientific interest. In 1802, Alexander von Humboldt located it in the Andes near lat. 7° S.

The Governments of the Argentine, Brazil, and the United States of America have been most active in their magnetic surveys. With the formation of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington in 1904 and the inauguration of its world magnetic survey of land and sea in 1905, thanks to the cordial co-operation received from all the American Governments, it was possible for that Department to add many stations to supplement the data already obtained. The distribution

*Abstract of a paper presented to Section VI (Physical and Chemical Sciences) of the Eighth American Scientific Congress.

of stations of the Carnegie Institution of Washington is densest in those countries not actually executing magnetic surveys. At various times, comparisons of standards with those of other countries have been obtained, and the establishment of absolute magnetic standards of reference has been greatly improved.

Of the 6,000 stations occupied during some two hundred expeditions on land (1904–40) and upward of 4,000 at sea on the *Galilee* (1905–8) and the *Carnegie* (1909–29), at least one third are in the western hemisphere.

The data obtained permit reliable discussions of the distribution of the earth's magnetism and of mysterious variations of its elements from year to year, the so-called magnetic secular variation. These ever-changing lines of magnetic direction and force of the earth, like scientific research, take no account of national boundaries.

Naturally, because of the later opening of new territory in the western hemisphere, Europe at the present time has a great majority of the permanent magnetic observatories. The Americas, however, at the end of the past and during the present century, have established some fifteen permanent observatories well distributed. It would be desirable to have additional observatories at Belem in Brazil and near the southern end of the continent.

Geomagnetic time-changes thus form a main source of information about the physics of the outer layers of the atmosphere, which are subject to distinct cosmical influences on the earth and shield the earth's surface from direct effects. Studies of these outer layers of the atmosphere—the ionosphere—by radio methods supplement magnetic data. Wireless wave-propagation is influenced by the earth's magnetic field, and the location of Huancayo, where the magnetic force is so nearly horizontal, is well suited for experiments on this phenomenon.

The long history of amity and cordial relations between the nations of the western hemisphere supplies a solid foundation upon which in South and North America efforts may be built and co-ordinated for the advancement of earth physics.

PHYSIOLOGY OF PYRIMIDINES*

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THREE pyrimidines have been found to occur in Nature as constituents of the nucleoproteins, the chief protein material of the cell nucleus. These pyrimidines are: uracil, thymine and cytosine. Recent investigations on the chemical structure of two vitamins, namely, vitamin B_1 and riboflavin, have shown that in these substances we are also dealing with pyrimidine derivatives. In spite of the widespread occurrence of the three pyrimidines present in the nucleic acid molecule, very little is known regarding the function of these substances in the animal economy.

The metabolism of uracil, thymine and cytosine has been studied by several investigators, and it has been found that they are catabolized with the conversion of the nitrogen into urea. The intermediate steps in this conversion, however, remained unknown until they were clarified by studies conducted in our laboratory. As a result of these studies, the following scheme for the intermediary metabolism of uracil was suggested: uracil → isobarbituric acid → isodialuric acid → formyloxaluric acid → oxaluric acid → urea + oxalic acid.

The mechanism suggested by us for the catabolism of uracil has been questioned by Krebs, who studied the action of kidney and liver tissue on uracil, thymine and cytosine. On the basis of his experiments, the details of which have not been reported, Krebs concluded that the pyrimidines were broken down by the kidney, and that the ammonia formed in this process was transformed into urea by the liver.

In view of Krebs's findings, a study of the metabolism of pyrimidines by the tissue slice method has been carried out in our laboratory. The experiments involved a study of the breakdown of various pyrimidines by tissue slices. The extent of the metabolism was determined by means of changes in the urea or ammonia content of the medium in which the tissues were suspended. In a series of experiments the effect of pyrimidines on the oxygen uptake of liver tissue was also determined.

In all the experiments there was no significant increase in either urea or ammonia formation in the presence of the pyrimidines investigated. These results seem to indicate that under the conditions used in our experiments there is no marked metabolism of these substances resulting in the formation of ammonia or urea.

The oxygen uptake of mouse liver tissue in the presence of all the pyrimidines studied, and especially in the presence of cytosine, was significantly higher than that of the controls.

The results of this investigation do not eliminate the possibility of other paths of metabolism involving the formation of substances other than ammonia or urea. The validity of the conclusions drawn from the results obtained is determined by the limitations of the tissue slice method. Since waste products cannot be removed, it is necessary to limit the duration of an experiment to a relatively short period. Consequently, if the rate of metabolism is slow, there may not be a sufficiently large accumulation of end-products to indicate a significant increase. A slow rate of diffusion of the metabolites or end-products would have the same effect. Another limitation of the method is that the cells are removed from their accustomed environment in the animal. Consequently, if the metabolite requires an activator that is not present in the cell itself or in the artificial medium surrounding the cell, metabolism will take place only very slowly and so may escape detection.

* Substance of a paper read before Section II (Biological Sciences) of the Eighth American Scientific Congress held in May 1940.

THE PHYSICS OF METALS*

CRYSTALLINE bodies owe many of their physical properties to the fact that they are made up of atoms which are more or less rigidly fixed in space so as to form a regular or symmetrical three-dimensional pattern. Metals and alloys consist also of ordered patterns of atoms and are crystalline. The positively charged atomic nuclei may be considered to be embedded in a matrix of surrounding negative electrons. This peculiar structure is responsible for the malleable nature of metals, for their electrical conductivity and for many other characteristic properties. Metal chemistry is thus as distinct a sub-division of chemistry as is organic and inorganic chemistry; each division depending on the particular form of bonding between atomic nuclei.

Those alloys which have valuable mechanical or physical properties, such as excessive hardness or strength, are usually not structurally homogeneous nor in true equilibrium. Consequently, it is necessary to discover not only the relative amounts of the various constituent atoms but also their arrangement in the crystalline pattern. Furthermore it is desirable to determine the particular treatment by which any required combination and distribution can be attained. Empirical metallurgical processes have been developed during the past thirty years with surprising success; but it is only recently that in certain cases the reasons for these processes have been disclosed by X-ray analysis. The ability to 'design' alloys with given properties is the next stage in the progress of metal chemistry. As an example, some advance has been made towards an understanding of the peculiar features of structure which give the new permanent magnet alloys their extraordinary power. This latter property was exhibited by a small magnet which lifted many hundred times its own weight.

The attainment of given mechanical properties may necessitate careful annealing, quenching from critical temperatures, cold working, etc. A series of X-ray analyses throughout successive stages of the process discloses some of the sub-microscopic changes which occur, and leads to a better understanding of the physics of metals and of the facts which determine their properties. Much of the X-ray work now being undertaken is resulting in the compilation of valuable data. The recent work by A. J. Bradley on the ternary systems NiFeAl, CuNiAl, and FeCuAl, discloses some of the underlying physical reasons for the occurrence of certain phases or types of crystalline pattern. In particular, the electron-atom ratios of the alloys appear, as was first pointed out by Hume-Rothery, to be one of the fundamental factors controlling the formation of given phases. On the assumption that iron and nickel have no free electrons, that copper has one and aluminium three, it is possible to predict approximately the phase boundaries in the conventional triangular diagrams which give the composition of these ternary alloys.

* Substance of the Norman Lockyer Lecture of the British Association delivered by Prof. W. L. Bragg at University College, Hull, on June 26.

MERCHANT SHIPPING IN WAR-TIME

IN *Engineering* of August 9 there is an instructive article on merchant shipping during war-time. To Great Britain at war, the preservation of the sea lanes leading to her ports is of the greatest importance. Canada can produce wheat and other essential materials, the United States can manufacture aeroplanes and military supplies, but facilities have to be available for their transport. The recognition of this need gave rise to grave concern at the relatively heavy losses incurred immediately after the outbreak of hostilities. The prompt institution of the convoy system and the active anti-submarine campaign greatly reduced such losses but as the economist observes, "So successful have they been that the seriousness of the shipping problem has not been fully recognized by the public. . . . Even if there were no submarines and no mines there would be a scarcity of shipping, for the War not only directly absorbs a number of ships in supplying the armed forces overseas, but it also greatly increases the quantities of some bulky raw materials that are required. When, in addition, the annual carrying capacity of shipping is reduced by the delays inevitably associated with the convoy system, the problem is still further increased". It is estimated that the convoy system reduces the effective carrying capacity of the merchant fleet by at least 25 per cent. Not only is the tonnage which enters the ports of Great Britain reduced by the actual destruction of vessels by enemy action, but also many neutral vessels are withdrawn from these routes. The effect of this was shown in the War of 1914–1918. In 1913 if the total of British tonnage with cargoes entering British ports is represented by 68, the foreign tonnage would be represented by 32, whilst in 1917, the corresponding numbers would be 46 and 10 and in 1918, 49 and 8.

Great activity in ship-building followed immediately after 1918. In June 1939 more than three million tons were idle and laid up, the large proportion being of British registry. The fleet of the United States showed the greatest expansion from 5·4 million in July 1914 to 12 million in 1939. The world's tanker tonnage rose eightfold to 11·4 million, held chiefly by Great Britain, the United States and Norway. The efficiency of the mercantile marine was greatly increased, the gain being estimated at about 60 per cent. Sailing vessels have all but disappeared.

The average speed has risen substantially. Oil-burning and motor-vessels have replaced the old coal burners. The British merchant marine, as well as being the world's largest, is one of the most efficient; less than 45 per cent of the ships have a top speed below 12 knots and 24 per cent have a speed in excess of 15 knots. In 1938 Great Britain launched only one million gross tons of new shipping as compared with 1·9 millions in 1913. It is considered probable that the 1940 total will approximate three million tons. For the first time in many years, shipyards in Canada and other parts of the Empire are working at full capacity. This activity will increase the new tonnage available for the replacement of losses and the continued expansion of the services made necessary by the exigencies of the War.

STRUCTURAL HINGES OF REINFORCED CONCRETE

IN reinforced-concrete, rigid-frame bridges, particularly in those of long spans, it is desirable, and in many cases necessary, to introduce some form of articulation at the bases of vertical members where high deformation stresses would otherwise occur due to temperature changes and shrinkage. What constitutes a suitable hinge for such a structure can be determined only by laboratory tests in conjunction with field experience, and a paper which has recently been issued (Bulletin No. 322, Engineering Experiment Station, University of Illinois) entitled "An Investigation of Rigid Frame Bridges: Part 3. Tests of Structural Hinges of Reinforced Concrete", by R. W. Kluge, deals with this important aspect of reinforced concrete design.

The purpose of the investigation described was to obtain information relative to the structural behaviour of several types of hinges adaptable to concrete rigid-frame bridges. Besides being sufficiently flexible to permit the required degree of rotation, a properly designed hinge should be capable of withstanding both compressive and shear forces, be economical to construct and easy to maintain, and the seven examples selected for test were such as might be expected to meet these requirements.

The specimens, which included tongue and groove joints, simple pivots, a modified Mesnager hinge and a flexure fulcrum hinge, were, with one exception, made from concrete designed to have a strength of 3,500 lb. per square inch at 28 days and were tested to destruction under vertical loads, oblique loads and rotation and time loads.

While the limited scope of the investigation did not permit of any general conclusions being reached, the results provide a basis for further study. They do, however, give information as to the most suitable designs for a given type of bridge and show that under vertical load the measured strength is in close conformity with the computed strength. In most cases, favourable figures under oblique load were recorded, while, with one exception, they all permitted an angular rotation of 0·004 radian without deterioration even after 10,000 reversals. Pending more detailed investigation, the details supplied in this bulletin are therefore of considerable importance and value to designers.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 1, No. 7: The Origin of Frogs. By Prof. D. M. S. Watson. Pp. 195–232. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.). 4*s*. 6*d*. [88

The Efficiency of Commercial Pasteurisation and the Phosphatase Test. By Ben Davies. Pp. 40. (London: United Dairies, Ltd.) [98

Other Countries

Henry Lester Institute of Medical Research. Annual Report, 1939. Pp. 58+3 plates. (Shanghai: Henry Lester Institute for Medical Research.) [88

Imperial College of Tropical Agriculture: Low Temperature Research Station. Memoir No. 16: Studies in Tropical Fruits, viii. Carbohydrate Metabolism of the Banana Fruit during Development. By H. R. Barnell. Pp. 39–72. (Trinidad: Imperial College of Tropical Agriculture.) [88

Annual Report for the Year 1939 of the South African Institute for Medical Research. Pp. 85. (Johannesburg: South African Institute for Medical Research.) [88

Durban Museum and Art Gallery. Annual Report for the Year ended 31st July 1939. Pp. 12+4 plates. (Durban: Durban Museum and Art Gallery.) [88

Union of South Africa: Department of Mines. Memoir No. 37: A Subject Index to the Literature of South African Geology and Mineral Resources for the Years 1921 to 1935 (inclusive). By Dr. A. L. Hall. Pp. 288. (Pretoria: Government Printer.) 7*s*. 6*d*. [88

Contributions from the United States National Herbarium. Vol. 28, Part 3: Marine Algæ of the Smithsonian-Hartford Expedition to the West Indies, 1937. By William Randolph Taylor. Pp. iii+549–562+plate 20. (Washington, D.C.: Government Printing Office.) [98

Brooklyn Botanic Garden Record. Vol. 29, No. 3: Gardens within a Garden; a General Guide to the Grounds of the Brooklyn Botanic Garden. By C. Stuart Gager. (Guide No. 10.) Second edition. Pp. 155–214. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) 25 cents. [98

U.S. Department of the Interior: Office of Education. Vocational Division Bulletin No. 13 (Agricultural Series No. 1): Agricultural Education, Organization and Administration. Revised edition. Pp. vi+50. 10 cents. Vocational Division Bulletin No. 206 (Home Economics Series No. 23): Credit Problems of Families; a Study of Credit as a Phase of Family Financial Planning; Suggestions to Homemaking Teachers. Pp. vii+100+3 plates. 20 cents. Vocational Division Bulletin No. 207 (Trade and Industrial Series No. 58): The Fire Alarm System; an Analysis of the Work of the Fire Alarm Bureau, with a Discussion of the Problems of Training likely to be Encountered. By Frank Cushman and H. A. Friede. Pp. vii+78. 15 cents. Vocational Division Leaflet No. 1: Teaching the Control of Black Stem Rust of Small Grains in Vocational Agriculture Classes. Revised edition. Pp. iv+12. 5 cents. (Washington, D.C.: Government Printing Office.) [98

OFFICIAL ANNOUNCEMENTS

BATTERSEA POLYTECHNIC

LONDON, S.W.11

Principal: G. F. O'RIORDAN, B.Sc.(Eng.), F.R.S.E., M.I.Mech.E., M.I.A.E.

Head of Chemistry Department: J. KENYON, D.Sc., F.I.C., F.R.S.

SESSION 1940—1941 begins 23rd Sept., 1940

The following Courses, both DAY and EVENING, are open to men and women students:

1. **DEGREE COURSES.** Matriculated students (Day and Evening) are accepted as Internal Students of the University of London.
2. **NATIONAL CERTIFICATES IN CHEMISTRY.**
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13. **CHEMICAL ENGINEERING.**
14. **MICROANALYSIS.**

Particulars of all courses and classes on application to the Principal.

UNIVERSITY OF ABERDEEN

SESSION 1940-41

The Winter Term of Session 1940-41 will commence on Tuesday, October 15, 1940.

The Certificate of Educational Fitness to enter the University must be exhibited to the Secretary to the University not later than October 1, 1940. Application forms for this Certificate may be had from the Secretary to the Entrance Board, 83 North Street, St. Andrews, or from the Secretary to the University.

Candidates for the Degree of M.A. must lodge forms, on which the subjects selected for the Degree must be entered, not later than October 1, 1940. Forms may be had on application to the Secretary.

The following Degrees are granted by the University—the total fees for the whole course for Graduation, including tuition, matriculation, and examination fees, are shown after each Degree:

ARTS: M.A. (Ordinary, £64), (Honours, £82 7s. 6d.), D.Litt. (£17 6s. 6d.).
SCIENCE: B.Sc. (Ordinary, £112 16s. 6d.), (Honours, £125 19s. 0d.), B.Sc. (Agr.) (Ordinary, £112 16s. 6d.), (Honours, £125 19s. 0d.), B.Sc. (For.) (£112 16s. 6d.), B.Sc. (Eng.), (Ordinary and Honours, £112 16s. 6d.), D.Sc. (£17 6s. 6d.).
DIVINITY: B.D. (£58 15s. 0d.).
LAW: B.L. (£48 5s. 0d.), LL.B. (£60 6s. 6d.).
MEDICINE: M.B., Ch.B. (£250, including Clinical Fees), M.D. (£22 11s. 6d.), Ch.M. (£22 11s. 6d.), Diploma in Public Health (D.P.H.) (£48 16s. 6d.).
EDUCATION: Ed.B. (£55 13s. 0d.).
COMMERCE: B.Com. (£64).

The Degree of Ph.D. (£18 7s. 6d.) is conferred in all Faculties.

A Prospectus containing the regulations for the various Degrees granted by the University may be had on application.

H. J. BUTCHART, Secretary.

UNIVERSITY OF MANCHESTER

PHYSICS DEPARTMENT

Full particulars of the Lectures and Laboratory Courses in Physics, preparing for both the Ordinary and Honours Degrees, will be forwarded on application to the REGISTRAR.

The SESSION COMMENCES on THURSDAY, SEPTEMBER 26.

UNIVERSITY OF BIRMINGHAM

APPOINTMENT OF GRADE II (c) LECTURER IN THE DEPARTMENT OF MECHANICAL ENGINEERING

Applications are invited for the post of Grade II (c) Lecturer. Stipend £350 per annum. Duties to begin October 1, 1940.

Four copies of application, together with four copies of not less than three testimonials, must be sent on or before August 31 to the undersigned, from whom further particulars may be obtained.

C. G. BURTON, Secretary.

The University, Birmingham, 3.
August 1940.

THE UNIVERSITY OF THE PUNJAB, LAHORE

Applications are invited for the post of University Professor of Physical Chemistry. The appointment will be up to March 31, 1942. in the first instance. Grade Rs. 600-40-1000. Initial salary within the grade will be fixed in accordance with the qualifications of the applicant selected.

Further particulars may be obtained from the Secretary, Universities Bureau, 88a Gower Street, London, W.C.1, to whom applications should be sent by September 1.

HUDDERSFIELD TECHNICAL COLLEGE

DEPARTMENT OF COAL TAR COLOUR CHEMISTRY

Applications are invited for certain *Research Scholarships* tenable in the above Department.

Value £75 to £150 a year with remission of fees.

Particulars and form of application may be obtained from the Principal, Technical College, Huddersfield.

UNIVERSITY OF LONDON

The Senate invite applications for the University Chair of Anatomy tenable at St. Mary's Hospital Medical School. Salary £1,000 a year. Applications (ten copies) must be received not later than first post on Wednesday, September 11, 1940, by the Academic Registrar, University of London, Royal Holloway College, Englefield Green, Surrey, from whom further particulars should be obtained.

KING EDWARD VII SCHOOL, SHEFFIELD

Wanted on September 1 a Laboratory Assistant. Some experience as Laboratory Assistant in a University or School desirable; alternatively a Pass in Science Subjects in the School Certificate. Ability to make up standard solutions for volumetric analysis, and to set up lecture and laboratory experiments in Chemistry and Physics will be a recommendation.

Wage £2 10s. per week, plus temporary War Allowance of 6s. per week.

Immediate application should be made to the Headmaster, King Edward VII School, Sheffield, 10, stating age, qualifications, experience, together with not more than three recent testimonials.

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