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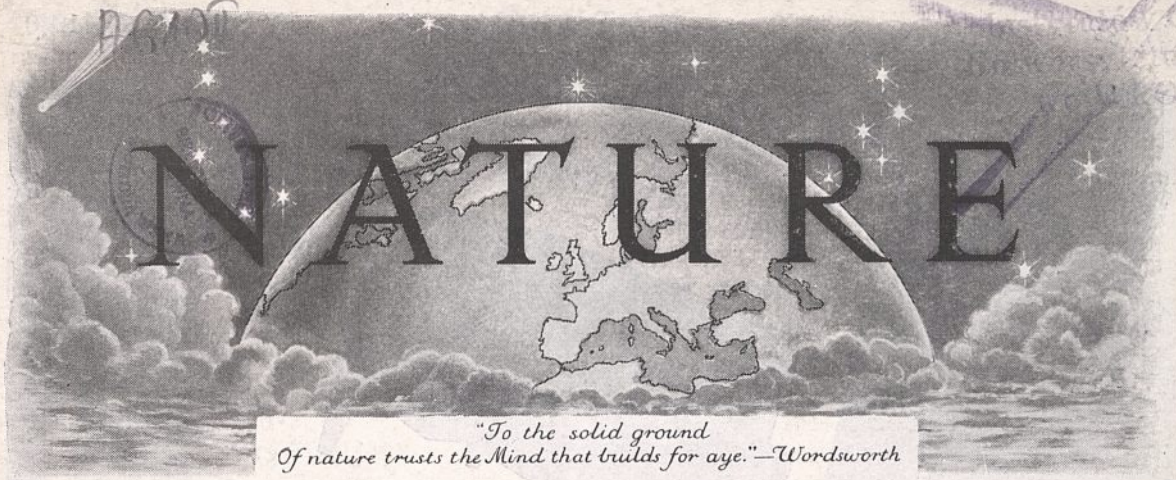

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NATURE

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SCIENTIFIC MANAGEMENT IN ADMINISTRATION

IN the reviews of the progress of the War which have been given from time to time by the Prime Minister in the House of Commons, the preliminary testing of many of the plans drawn up for the organization of the nation in time of war has been revealed. In these reviews, however, the actions of the armed forces or diplomatic matters have figured largely, and the home front as a whole has scarcely received the attention it merits. Particular aspects have been noticed, but the balanced and critical view of the whole economic effort of the nation, which is one of the main points in the argument for a Ministry of Economic Affairs, has been lacking.

Accordingly a broadsheet on the home front issued by Political and Economic Planning (P E P) a few weeks ago is the more welcome for the careful survey of the position and its constructive criticism of matters on which Government spokesmen have said little or nothing. The first of the subjects reviewed in this broadsheet, that of the higher machinery of Government—the functions of the Supreme War Council and the War Cabinet—has also been touched upon in two admirable articles by Mr. Hugh Quigley and Mr. L. Urwick in successive numbers of *Industry Illustrated*.

The P E P broadsheet, reviewing the establishment of five new ministries for war purposes and the vast new functions of three other departments, points out that the Cabinet secretariat remains the only body concerned with co-ordination over the whole field. While the appointment of Lord Stamp as adviser to a Cabinet Committee on Economic Co-ordination shows a recognition of the importance of planning an economic policy on a much wider basis, the new office in its present form does not constitute an Economic General Staff. Moreover, the development of regionalism in civil defence holds immense implications for a possible peace-time reorganization of our administrative system.

Mr. Quigley's and Mr. Urwick's articles make interesting comment on the question put by P E P, whether the Civil Service can meet the greatest demands made on it since it assumed its present form, and adapt itself to the new conditions with their primary call for decisions and planning. Mr. Quigley, emphasizing the importance of the efficient conduct of industry and of fitting the needs of war to an industrial machine which is allowed to develop normally and with the minimum interruption, makes the point that regulations tend to conceal the need for initiative and bold planning, when in truth more efficient management is needed.

No country appears to have made any serious effort to determine what are good and valuable industrial products in a period of war and what are bad and non-essential. Such knowledge, however, is basic for the efficient use of a country's industrial resources, and this kind of assessment requires the experience and knowledge of those in control of industry. Accordingly, Mr. Quigley urges the importance of bringing management into consultation to ensure the maintenance of the important volume of normal production, and to determine the limits beyond which any strain on industry or any further loss of its man-power would be a source of dangerous weakness.

Mr. Urwick, while endorsing Mr. Quigley's argument as to the support which industry and management could render in maintaining the economic life of Great Britain in a planned and ordered relation to the whole national effort, lays his main

stress on the value of the principles and practice of scientific management in solving a whole series of difficulties now facing civil, military or naval authorities. Little progress has yet been made in the application of such principles and practices to the task of government, and Mr. Urwick indicates two directions in which scientific management could give important assistance. The first of these concerns ministerial co-ordination. At the very top, the British Government affords an example of infringement of the vital principle of span of control, according to which no man can co-ordinate effectively the work of more than five subordinates whose work interlocks. He urges that a true War Cabinet of half a dozen senior ministers without departmental responsibilities, giving continuous attention to policy and each responsible for co-ordinating a group of departments dealing with some special aspect of the national effort, is a necessity for the effective conduct of the War. Existing arrangements are technically faulty and therefore fundamentally unworkable.

Mr. Urwick's second suggestion, concerning the assistance which scientific management could give in the training and control of clerical staff in the Army, is illustrative of a number of directions in which the application of modern management principles could be of service in fields where administration generally is probably as efficient or more efficient than in industry. The importance of utilizing such services grows as the field over which control becomes essential is extended, and as the checks on autocracy are weakened through the suspension of municipal or parliamentary elections, or the disappearance of local initiative and radical modification of the whole basis of local government.

To neglect such matters is to court disaster, or at least to imperil the very work upon which we depend for the sustained effort and sacrifices demanded in a protracted struggle. Mistakes have already been made, as in the indefensible commandeering of schools and hotels, which have more seriously damaged the credit of the Government than its spokesmen care to admit. The absence of reform or evidence of contrition in such matters as these has consequences which are not the less serious because they are not immediate, and they may easily sap confidence at the very moment it is most essential.

Criticism in Great Britain of the control already exercised is indeed directed, not against the principle of control, but against the way in which some controls have been effected. The authors of imperfect plans—and the bunglers of good plans—cannot claim immunity from constructive criticism merely because we are at war. On the contrary, the onus lies on those who designed or are administering the controls to say where criticism is not justified. That such criticism has frequently been justified by its results and led to the withdrawal or modification of such schemes as those for the control of fish marketing, war risks insurance, or the Ministry of Information, is one of the most hopeful signs that the Government is not unresponsive to public opinion or unmindful of the necessity of safeguarding the liberty of the subject and inviting the co-operation of the public.

The most serious effect of such errors of judgment as the commandeering of hotels and schools is not the individual hardships involved, or the general irritation at stupid blundering, but the lack of confidence engendered in the smooth working of the vast national plans as a whole. The P E P broadsheet does not, with all its constructive criticism, suggest that there is anything essentially wrong with the principles of our war-time planning, though it indicates details in which criticism and public co-operation might improve matters. It does indicate, however, the existence of conflicting orders and a lack of co-ordinating authority, and the necessity of facing a drastic revision of traditional policies.

These points are specially stressed in relation to finance, to the planning of priorities, of man-power, agricultural policy and food control. All these, moreover, are clearly interlocked. In regard to finance, the war budget relies almost completely on the old system of taxation. The vital issue is to decide how much of the national income can be taken for war purposes, or what combination of price control, inflation, taxation and borrowing should be used for diverting enough of the national income from civil to military needs. One of the most difficult problems of war finance is how to control the dislocating effect of a vast increase in Government expenditure and the consequent widespread distribution of purchasing power at a time when a large proportion of the country's resources—labour, capital equipment and raw materials—is diverted from the provision of goods for current consumption to war purposes. The suggestion recently put forward by Mr. J. M. Keynes for dealing with this question of control of consumption by compulsory saving is a departure from the traditional policy which deserves careful

examination, although good results are already being obtained by voluntary effort.

Such questions of finance are linked inextricably with the maintenance of export trade, and the question of exports and the distribution of export effort between the old heavy industries already fully engaged with war work and the newer light industries. It affects questions of prices, wages and profiteering and the planning of priorities. Clearly the Central Priorities Department should be used to plan the whole economic output of Great Britain and not just the supplies of the defence services. The needs of the civil population and of the export trades must also be considered and balanced against each other, if the most efficient use of available resources is to be secured.

Planning the utilization of Great Britain's resources of man-power to the best advantage is the function of the Ministry of Labour in consultation with the Labour Sub-committee of the Ministerial Priorities Committee. There is already evidence that lessons have been learned from the blunders of twenty-five years ago, and the compilation of the National Register should provide information for planning man-power much more comprehensively than before. It is doubtful, however, whether the true value of the Register in the scientific organization of a civilized community is yet realized. The Central Register has already proved its usefulness in placing certain classes of scientific workers where their services are most urgently needed; but it should be remembered that the whole register is experimental, and that experience is likely to suggest many improvements and extensions.

Complex problems of labour are bound to arise not merely in the munitions industry but also in agriculture and through the relations between rail and road transport, where fundamental reconsideration of the positions of both industries is urgently required. In agriculture, itself so closely linked with the question of food supply and rationing, a general clarification of aims is urgently required. Modern industrial, economic and scientific technique finds little reflection in much of the farming still practised; the pooling of all available knowledge in the service of war-time efficiency on the farm is as important as pooling labour, machinery, horses or even the land where the units are now too small to operate economically.

If, however, control and rationing are to be accepted with good grace, there must be confidence that adequate co-ordination of the national effort exists, and that steps have been taken to secure the scientific and impartial utilization of the full resources of the nation in the one purpose that counts. Rationing, whether of petrol or food or other commodities, will be accepted without demur so long as the private user does not feel that he is deprived of supplies for officials to waste. Scientific workers, who have their own contribution to make in so many widely different fields, should not therefore be unmindful of this supreme need for insisting that the fullest use is made of the methods and principles which scientific management puts into our hands, for securing the due co-ordination and efficient operation of any enterprise in the fulfilment of its purposes, whether they be those of a private business or of a nation at war.

THE ORIGIN OF LIFE

Life's Beginning on the Earth

By Prof. R. Beutner. Pp. x + 222. (London: Chapman and Hall, Ltd., 1939.) 12*s*. 6*d*. net.

THE "Manager of the Performance" as Prof. Beutner invites his readers to regard him, apparently supported by the Provost, Dean and staff of his Institute, stands on the stage before the curtains are drawn for the film. The technique is useful in that exact references to literature are unnecessary and concentration of eye and brain is secured. There is also no index and the mind is not usually disturbed by references to the sources from which the pictures are derived. These lapses make the film less useful to scientific men, while causing less strain on the commencing students of science and medicine for whom it is perhaps primarily intended. To these, all comparisons between the reactions of living and non-living matter cannot but present helpful analogies, which may well prove of great value to medicine, as suggested in the epilogue. The subject, however, has a wider appeal, for evidently certain of its sides have been the author's research life for many years. It deserves more than a passing reference.

As a practical presentation we suggest that the manager has reversed the order of the pictures of

his film. We would feel greater happiness in leading off with the reactions of the oil drop to its environment in comparison with Amœba, because the layman learns the reactions called 'living' in connexion with tangible analogies that he can the better understand. Beutner, following on the pioneer work of Jennings, studied here, using Telkes drops made from fresh brain material which, of course, is rich in the lipoid lecithin. These are more complex than the drops of vegetable oils, but their method of preparation precludes the idea that they contain living matter. Experimentally they present many varieties of pseudopodia and of movement such as are found in the naked Protozoa[1], but there is never any increase of the mass. They exhibit respiration which in places lowers surface tension. The drops formed from the brain of an exhausted animal no longer show the mass of tiny fibres usual to those from the healthy animal. Poisons such as strychnine inhibit respiration and stop all movement, while, if free access of air is prevented, suffocation follows. No reactions can be recorded in pure water, for the drop is starved. The author next proceeds to a set of analogies in the phenomena of electrical actions in the nerve impulse, Lillie's researches freely quoted. He has studied the electric organs of fish and made artificial fat batteries which yield by analogy helpful results. His experiments suggest to him that poisons *may* kill by interference with the electrical mechanism rather than by their reactions on enzymes.

We pass by the numerous analogies between the actions of living cells compared with those of artificial gelatin cells, the formation of semi-permeable membranes and the magnitude of osmotic pressure. In this matter Traube's research (1860–70) can be read profitably by biologists even to-day, together with its subsequent development by Pfeffer. Leduc's imitations of many living forms are well illustrated, these artificial osmotic structures that counterfeit plant-growths amazingly well. "Salt and water are a part of life itself."

The consideration of the unique nature of carbon and its compounds leads the reader to basal considerations. The chemist, using elaborate technique, can make many carbon compounds that the organism produces with the greatest ease by means of enzymes or ferments. The most widely known is chlorophyll, the utility of which requires no comment. Usually any action necessitates the employment of several enzymes, so that the extraction of some in pure form has had no practical results. To this category perhaps belong the plant-formed vitamins, which in animals must be re-fed to the body continually to avoid disease. Then there are the hormones made inside the body and carried to where they have the highest activating influence, the best known being insulin. To-day, it is within our imagination to transform one of these bodies into a living body as, by radioactivity, elements can be transmuted. Naturally the search is for the smallest living matter and so we are led to the filtrable viruses[2], the disease-producing effects of which are well known. Their actions so closely simulate those of bacteria that life must be allowed to them. From these, crystalline substances were obtained by Stanley in 1935 using tobacco-mosaic leaves, afterwards those of phlox and spinach. These were repeatedly crystallized and found to produce the diseases at will, all facts being reasonably "explained on the assumption that the different virus proteins are in fact the different viruses". The problem for the chemist is to synthesize the enzyme and, this accomplished, to endow it with the property of self-regeneration. On this basis an idea of the development of cells is possible, with all that this entails.

We have omitted reference to the chapter devoted to "vital growth and crystallization" in which, as living matter is made up of diminutive crystals, the building forces are deemed to be similar in the living and non-living world. This leads to Beutner's review of Oparin's work "The Origin of Life", 1938. Condensations of nebular matter from the sun are assumed to produce planets[3], first carbon, then a series of metals, finally water, leaving the atmosphere as we know it; this is in contrast to the planet Jupiter with its methane-ammonia surround. Oparin suggests that organic substances were present in the early ocean as colloidal solutions. The interaction of various colloids caused segregation resembling crystallization, these "coazervates" gradually developing into living organisms. In this process enzymes must have formed in them so that they were able to assimilate substances from their environment. In contrast, Beutner maintains that self-regenerating enzymes formed by electric discharges were the earliest appearance of life—and it necessarily follows that such enzymes may have been formed at all ages in the world's history.

To summarize: research has shown developments of non-living matter strikingly resembling certain features of life, and the further development of such researches may at any moment illuminate the cosmic miracle by which life can only be supposed to have been produced either on this or any other world. J. STANLEY GARDINER.

[1] This is perhaps due to liquid crystallization, a process seen in the central filaments of the Heliozoa. The surface covering of Amœba consists of protein and lipoid molecules so that the pseudopodia must be quite different.

[2] Their size is that of the molecule of hæmocyanin.

[3] This view is ascribed to "J. Jeans", who will scarcely desire to be termed "a Russian astronomer". Oparin apparently was not acquainted with Stanley's researches, for they are not included in his bibliography.

SALT DEPOSITS

Steinsalz und Kalisalze: Geologie
Von Prof. Franz Lotz. (Die Wichtigsten Lagerstätten der "Nicht-Erze", Band 3, Teil 1.) Pp. xxvii + 936. (Berlin: Gebrüder Borntraeger, 1938.) 84 gold marks.

SALT deposits are of surpassing interest from many and varied aspects. The details of their depositional succession, their complexity and association, and the post-depositional changes which they have undergone provide a vast series of physico-chemical problems which have furnished material for the classic researches of van 't Hoff and a host of others. They are of no less interest to the geologist, who examines in them the record of those rarer episodes in the earth's history when the customary sequence solid-to-solution was reversed. Besides, salt, because of its great chemical and physical reactivity, is the most temperamental of rocks. So soon as it is laid down it is liable to be dissolved, transported, modified by solutions from above or below, and this any number of times. If it is involved in folding of the crust or tectonic events of any kind it reacts like no other rock; instead of folding as other rocks do, it flows, and under continued pressure it may become unstuck from its associates, penetrate higher levels of the crust in intrusive fashion as diapirs and salt plugs and may even flow out on the surface as salt glaciers. Countless surprises are possible if salt deposits are members of a rock series the geological history of which is at all lively.

Lastly, natural salts form one of the most important raw materials of industry. Like other mineral deposits, they are not uniformly distributed among the nations of the earth. In time of war, therefore, certain minerals become "strategic"—as the Americans put it—and of major importance among the strategic minerals are the potash salts. Germany, by virtue of her geographical position in the centre of the dried-up shallow sea of the great salt-building period of the Permo-Trias, has almost a monopoly of potash salts; it should be added that with regard to practically all other strategic minerals her native resources are inconsiderable. It is fitting from the academic point of view that Prof. Franz Lotze, of the University of Berlin, *ein guter Kenner der Salzlagerstätten*, should provide a monograph on the rock-salt and potash salt deposits of the world. It is fitting, too, from many other aspects, that this monograph should now be available at this present time to certain interested, but non-German, parties.

The *Salzband* of this well-known series dealing with the non-metallic mineral deposits is to consist of two parts. The first is the bulky volume under notice here and is concerned entirely with the geological relations of salt deposits. The second part, by Prof. Leonhardt, will provide an account of the mineralogy and petrography of natural salts; the physical chemistry of salt deposition is mentioned only incidentally in the geological part.

Every aspect of the geology of the deposits of sodium and potassium salts of the world is examined in complete detail. The book is divided into two sections. In the first a general geological account is given; in the second special descriptions of the world's salt occurrences are provided. As a start, salt formation at the present day is dealt with, and here is included a good discussion of the origin of the salt in the sea. Halley, as early as 1715, suggested that this was derived from the weathering of the rocks of the continents and thus started a notion which is still current and which, indeed, has formed the basis of one method, now discredited, of estimating the age of the oceans. But the oceanic waters have a content of chlorine far greater than could have been provided by the weathering of primary rocks. It is suggested that whilst the salt of the sea is all derived from primary sources, it has nevertheless arrived in the sea by two routes, the metals from primary igneous rocks, the non-metals from volcanic emanations—the two groups of components are separated by igneous processes but are reunited in sea-salts.

After describing the many types of salt deposits being formed at the present day, Lotze deals with the general geological principles of salt deposition in the past. The relation of salt formation to the great mountain-building periods, the southward migration of the salt-belts during the course of geological time and the origin of *thick* salt deposits are among the topics of interest discussed.

After an account of the secondary changes that salt deposits are liable to undergo so soon as they are laid down—a matter that will presumably be discussed in greater detail in Leonhardt's mineralogical part of the *Salzband*—there follows a full description of the almost fantastic tectonics of salt deposits. The various intrusive, unglued and rootless forms of salt bodies are related to the tectonic styles of the portions of the crust in which they

occur. Structural geologists will find here matter of absorbing interest. The first section of this book, that dealing with the general geology of salt deposits, closes with some twenty-one pages of references.

In the second or 'special part' of the volume, detailed descriptions of the salt occurrences of the world are given, the general arrangement being based upon a regional geological foundation. Special attention is directed to the salt deposits of Europe and North America in relation to the large-scale tectonics of these continents. During the War of 1914–18 the virtual monopoly in potash salts possessed by Germany had become forcibly realized by other nations, and consequently there has been, in the post-War period, a strenuous search for new supplies, especially in the United States and the U.S.S.R. Most of the results of these campaigns, especially the Russian, are not readily available, but still Lotze provides a considerable amount of information on non-German occurrences of potash salts. He devotes most space—more than two hundred pages—to the consideration of the immensely important rock-salt and potash salt deposits of the Permo-Triassic basin of Middle Europe, which include the magnificent German potash salt fields and the not inconsiderable rock-salt deposits of the Trias in Great Britain. The elucidation of the various depositional cycles of the German fields, of the facies changes in them and of the palæogeographical conclusions to be drawn therefrom is made particularly clear. Details of national production are not given; these may be found in the current statistical summaries, such as Roush's "Mineral Industry". This 'special part' of Lotze's volume concludes with nearly fifty pages of references.

Fortified with its bibliographical detail, an index of more than a hundred pages, 353 text-figures and numerous tables, this work provides a summary of all that is known about the geology of a group of rocks of outstanding scientific, economic and international importance.

H. H. READ.

THE AMERICAN OUTLOOK ON COTTON

Cotton

History, Species, Varieties, Morphology, Breeding, Culture, Diseases, Marketing and Uses. By Dr. Harry Bates Brown. (McGraw-Hill Publications in the Agricultural Sciences.) Second edition. Pp. xiii + 592. (New York and London: McGraw-Hill Book Co. Inc., 1938.) 30*s*.

IN the enlarged second edition, as in the first, the merits and weaknesses of this book are equally evident. It is a remarkable single-handed production giving the reader a wide view of every part of the cotton field, from the germ cell to the world crop of three million tons. Taxonomy, physiology, agriculture, merchanting, spinning, weaving and statistics are all included. We know of no better comprehensive presentation, and the quality of the citations is such that it can be used as a book of reference.

Its weakness results from the fact that extreme specialization on such a versatile crop as cotton involves the specialist in contacts with every subject under the sun, and in many of these he must be, however unwillingly, a dilettante. Also, he must reside somewhere, and when that residence is in the country which produces half the world-crop of his subject, his presentation must be biased by a tendency to overlook the smaller contributors.

Now, from a cotton-grower's point of view, the United States is mainly a mass-producer of unspecialized raw material, under conditions which as expressed in terms of yield per acre, are also unspecialized. Thus, while America must form the background to any book on cotton, the most advanced and informative work on cotton is nowadays to be found outside it, from countries where small crops present local difficulties, where specialized crops demand special care, or where, as in Lancashire, economic difficulties demand intensive study and research on the industrial end. This widespread area of information outside the United States of America has not been entirely neglected by the author, but it has not been adequately examined. We doubt whether it could be searched and critically sifted single-handed, but the transactions provided by the Shirley Institute in the *Textile Institute Journal* would be expected to provide some of the references in the chapter on cotton-spinning. Similarly, while Egypt is growing her whole crop from pure-line seed under a system of routine seed-renewal, with a yield per acre which is three times that of the United States and a price per pound which is half as big again, some references to Egyptian publications of later date than contributions by the present reviewer published more than twenty-five years ago should surely be of interest.

Substantially our criticism condenses to the title. If this were "Cotton from the American Point of View", we could praise without reserve.

W. L. B.

SOCIAL STUDIES IN ENGINEERING

(1) Spanning Space
By Claude A. Claremont. ("Science in Action" Series.) Pp. 125. (London: Sir Isaac Pitman and Sons, Ltd., 1939.) 3*s*.

(2) The Development of Power
By Eugene C. Wittick. Pp. xiv+164. (London: Cambridge University Press; Chicago: University of Chicago Press, 1939.) 5*s*. net.

THESE two small books deal with engineering subjects in a popular way, and though their methods of treatment differ, there is a considerable measure of unity of plan to be observed in them.

(1) The first volume is an English publication, one of the "Science in Action" series the purpose of which is to describe, in a readable way, interesting and important activities and the scientific principles underlying them. Here the object is to explain to the general reader the several types of bridges in use and the ideas and principles on which their designs were based. The author, besides being an engineer, is co-principal of the Montessori Training College, London, and has dedicated his book to two small boys. He reasons out, in simple yet graphic language, the fundamental concepts in the design and construction of twelve different kinds of bridge. One could wish that such a book were largely adopted by teachers. The main subject is so familiar both to teacher and child. The historical notes and development, the properties of the materials suitable for each type, and the constructional details make up an impressive picture of purposeful adaptation which must convey a valuable lesson to a child's mind.

(2) In the second volume, the range of the subject is wider. It treats of the several sources of power and describes the machinery used to develop or transmit power in its different forms. The historical notes provide a background which explains and adds interest to later developments. This American publication is intended as a college text-book to stimulate the minds of students and to provide a source of information regarding the influence of this branch of engineering on social life. It may well be imagined that the Egyptian who had roughly devised a wheel which he could turn to raise water more easily than by buckets must have noticed that the flow of the river caused the wheel to turn. By combining the two functions he got a self-operating means of irrigation which left him free for other pressing work. The same simple impulses are at work to-day, though not so obviously, and if such books as these two were generally read and understood, the basic laws operating in our social life would be better appreciated.

A COURSE OF PHYSICAL CHEMISTRY

Kurzes Lehrbuch der physikalischen Chemie
Von Prof. Dr. Karl Jellinek. Heft 1: Grundprinzipien der physikalischen Chemie, Lehre von den reinen Stoffen und Mischungen von Nichtelektrolyten (Physikalisch-chemische Thermodynamik). Pp. xiv+314. 8.50 fl. Heft 2: Elektrochemie Phasenlehre, Lehre von den Phasengrenzflaechen (Kolloidchemie), chemische Kinetik. Pp. xii+292. 7.50 fl. (Deventer: N. V. Uitgevers-Maatschappij Æ. E. Kluwer, 1938, 1939.)

THESE are the first two of four parts of Prof. Jellinek's book, each part being independent. The first part deals with fundamental principles and their application to pure substances and mixtures of non-electrolytes.

The subjects fall under the two main headings of thermodynamics and kinetic theory, and in both cases the subject is fully and clearly treated, all mathematical requirements except the elements of the calculus being explained. There are many worked examples, and this is a very good feature of the book. The diagrams are neat and instructive, although the lettering is sometimes rather small, and there are some useful tables of numerical data. The symbols are well chosen, but a list of them would have been useful. The subjects include Nernst's theorem, which is dealt with from the modern point of view of entropies, and activity as far as it concerns non-electrolytes.

In most cases, alternative proofs of thermodynamic formulæ are given, one based on a cyclic process and the other on the thermodynamic functions, so that the reasoning is always made perfectly clear.

The second part of the book treats of electrochemistry, phase rule, surface and colloid chemistry, and chemical kinetics. The section on electrochemistry deals with electrolytes (including

the modern theory of strong electrolytes), electrode potential and galvanic cells, and chemical equilibria with electrolytes (including indicators, heterogeneous equilibria, and fused salts). Although the Debye-Hückel equation is not actually deduced, it is very fully explained and illustrated by examples, and the idea of activity is introduced and used in a very complete and practical manner. The numerical examples frequently interpolated in the text make everything clear and intelligible, and there are many good figures.

The section on the phase rule deals only with one- and two-component systems but comprises well-chosen examples. The treatment of reaction kinetics includes the recent theories of active molecules as well as the classical examples, and the treatment of heterogeneous kinetics is very full, including a discussion of overvoltage and passivity, also comprising modern work.

There is no doubt that this book is likely to prove extremely helpful to both students and teachers, since the author has spared no pains to make the subject clear, understandable, and modern. A good feature is the close relation which is always preserved between theory and practical methods, the latter being explained briefly but adequately. If the remaining volumes of Prof. Jellinek's treatise are as good as these, the complete work will be an excellent survey of modern physical chemistry which will be certain of a warm welcome. The paper and printing are very good, but the number of small misprints is much larger than that included in the short list of errata.

OXFORD MEN OF SCIENCE

Early Science in Oxford

By R. T. Gunther. Vol. 11 : Oxford Colleges and their Men of Science. Pp. xvi+430+50 plates. (Oxford : The Author, The Old Ashmolean, 1937.) 30*s*.

DR. GUNTHER must be praised for the enthusiasm and hard work which have led him in the period between the Wars to found a museum for the history of science in Oxford and to give to science eleven volumes of part of its history. Some of this work has not escaped criticism, but the reception of most of it has been good. The present work is one that deserves a friendly welcome and an accessible place in the libraries of men of science and especially of Oxford men. Dr. Gunther has worked at his task with great energy and purpose, amassing from many sources, many of them little known (unfortunately not listed here), a large amount of interesting information on the personalities, aims and achievements of Oxford men of the past. Dr. Gunther happens to be more attracted to the antiquarian than to any other aspect of the past, to the biological sciences than to the physical, to instruments than to scientific ideas, to museums, perhaps, than to laboratories, and all he writes reflects the man. If we agree to accept Dr. Gunther as he is, and not to expect a cold, impartial historian, we shall have little to criticize and much to praise in this, his eleventh, volume.

The book begins with a survey of the whole subject in lecture form : the inaugural lecture given by the author in 1934 as first reader at Oxford in the history of science. Separate chapters, twenty-one in number, are then devoted to the colleges whose alumni in both the distant and recent pasts have made contributions to science. There is a final chapter on men like Robert Boyle who did scientific work in Oxford independent of the colleges, and there is a gather-up of material, not all of it relevant, in the form of seven appendixes.

In the chapters on the colleges, the worthies of each are presented in turn, their scientific achievements briefly described, and often some odd or out-of-the-way piece of information added ; sometimes a portrait is reproduced. 'Oxford man' is rightly interpreted widely, as anyone of scientific attainments who has been connected with a college, and not necessarily one who had been an undergraduate there. Thus, in the chapter on Merton College we are told of William Harvey, who was not originally an Oxford man, as well as of men like Sir Henry Savile and Grant Allen who were ; Robert Hooke properly comes under Christ Church, although much of his best work was done at the Royal Society in London. If the embrace had been less catholic, Dr. Gunther would have had little to do, for in the far past the number of Oxford men, in the narrow sense of having been undergraduates there, who stayed on after taking their degrees to do great scientific work, could be counted on the fingers of one's hands.

In the descriptions, a little expansiveness on the author's part would occasionally not have been amiss. In the chapter on Oriel College, we are told of the mathematical work of Prof. Baden Powell. Dr. Gunther might have added that Powell, who was elected into the Royal Society

so long ago as 1829 and was old enough to have fought at Waterloo, was the father of the present Chief Scout. In the chapter on Christ Church, 'Dr. Tupper' is described simply as an inventor, a D.C.L. and an F.R.S. But he had these six welcome letters after his name before he was thirty-seven years of age, and he was the versifier whose christian name was Martin. Again, V. H. Veley, of University College, is mentioned as having shown that pure nitric acid has no action on copper, but nothing is said of the far greater work of H. B. Dixon, of Balliol, and H. B. Baker, of Christ Church. There was, in fact, at one time in Oxford a school which appeared to set out to show that pure things do not do what it is commonly supposed they do do, one member showing that pure nitric acid does not etch copper, another that carbon will not burn in pure oxygen, a third that pure iron does not rust, and a fourth that pure ammonium chloride does not dissociate thermally. Possibly Dr. Gunther would not regard these investigators as coming into the field of "Early Science".

As was to be expected, this book is well illustrated. The choice has been carefully made and the reproductions are numerous and very good. They include many little-known portraits of Oxford's scientific sons. A. S. R.

AMERICAN VEGETABLES

Vegetable Crops

By Prof. Homer C. Thompson. (McGraw-Hill Publications in the Agricultural Sciences.) Third edition. Pp. xi + 578. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 33*s*.

THIS book is the third edition of a standard American text-book dealing with the production and marketing of vegetables. Particular attention is paid to vegetables cultivated in the eastern States, and all the subtropical products from limited areas of Florida and elsewhere are omitted.

Nine years have elapsed since the previous edition, and opportunity is well taken to bring the text up to date, and to include consideration of recent research, carried out for the greater part at the Cornell Agricultural Experiment Station.

As in previous editions the earlier chapters deal with the principles and methods of cultivation, with soils, manures and fertilizers, and irrigation. A brief consideration of marketing and storage problems is included, but the major portion of the text is devoted to a systematic study of the commoner vegetables.

Although the underlying principles of cultivation do not differ from those laid down in most other countries, the very real differences between local climates and soil conditions, together with differences experienced in transport and marketing, overshadow these similarities. Further complications arise for English readers due to differences in nomenclature, to synonymy, and to different methods of varietal classification. An example or two must suffice: there is no entry in the index of haricot beans, a term applicable to certain varieties of dwarf French beans of which the young pods, but more especially the dried seeds, are so valuable; although the reader will find an alternative classification of beans according to their use, he will yet have to decide whether to include his haricot under snap beans (with edible pods) or dry shell beans. Similarly the classification of cabbages, although based on sound morphological lines, would not be entirely suitable for all our English varieties.

In regard to pests and diseases there are some of major importance in the States which fortunately are not yet with us, but our crops suffer from other pests and diseases which are of such little importance in America that they naturally receive brief attention in these pages; the pests of the potato illustrate this point.

The author includes the deficiency troubles due to a lack of boron, shown in cauliflowers by hollow stems and brown curds, in beet by black spotting, and shown by the brown heart of rutabaga, better known in Britain as swedes.

Although there are brief descriptions of the somewhat uncommon chayote (*Sechium edule*), and okra (*Hibiscus esculentus*) and martynia (as *Proboscidea Jussieudi* Keller) the author omits the yams (*Dioscorea sps.*), the Chinese artichoke (*Stachys tuberifera*), and the Peruvian oca (*Oxalis, crenata*) and other rarer vegetables.

A valuable feature of the book is the literature cited, comprising some five hundred titles, mostly of recent American work. The book appears in the well-known format of the series by the McGraw-Hill Publishing Co., and it is somewhat expensive.

The success of American and British growers in breeding and selecting varieties suitable for their own conditions tends to make this book of somewhat limited use to growers in another country, although its value to students, for whom it is written, is not thereby seriously impaired.

LIVE STOCK POLICY DURING WAR-TIME

By DR. CHARLES CROWTHER,
PRINCIPAL OF THE HARPER ADAMS AGRICULTURAL COLLEGE

SINCE the eighties of last century, the main effort of British agriculture has been steadily and increasingly diverted from crop growing to the production of live stock and live stock products. According to recent statistics these now account for about two thirds of the total value of the agricultural output of England and Wales, and an even higher fraction of the Scottish output. This expansion of live stock production with a dwindling arable acreage has only been made possible by the import of feeding-stuffs, which has shown a corresponding rise to a level in recent years of about $7\frac{3}{4}$ million tons per annum. This represents, according to Wright's estimates, in terms of 'starch equivalent' about 22 per cent of the total nutrients consumed by live stock in a normal year (1935), the balance of 78 per cent being obtained from home-produced fodders, roots and corn. In these terms of gross supply, the proportion of imports does not appear to be unreasonable ; but in terms of concentrated foods the balance assumes a very different aspect, since imports are entirely of this class and amount to more than twice the home-grown supply of concentrates. It is inevitable, therefore, that in times of crisis involving shipping difficulties the supply of imported feeding-stuffs, unless vast reserves have previously been accumulated, must rapidly become a serious problem for the live-stock industry, compelling some change of policy, more or less drastic, for the early stages, if not for the whole period, of the crisis.

The general lines along which such adaptation must take place were evolved by force of circumstances during the War of 1914-1918 : increase of home production of arable crops, utilization of household and other food waste, and rationing of available concentrated feeding-stuffs with priority to those classes of animals which either make more economical use of these concentrates or give a product that is of special importance in the national dietary. In the present emergency, therefore, it has been possible from the outset to formulate the war-time policy for the production of live stock and live stock products along these lines, and with varying degrees of grace the broad principle of the policy appears to have been accepted by the industry.

The necessity for the 'speed the plough' and 'dig for victory' campaigns in the interests of the human consumer are obvious ; but both may also be made to contribute substantially to the home supplies of food for live stock, the former through the farm, and the latter through allotments and gardens. A parallel increase must also be effected on our grasslands, where modern research has greatly extended the possibilities of improved management and utilization, and of conservation of surplus produce for winter use. No great expansion of the artificial drying of grass by private enterprise on farms is probable, but serious consideration should be given at once to the possibility of establishing a national grass-drying organization, for which a large nucleus of raw material would be available on aerodromes and other large areas from which the grass needs to be cut and removed periodically through the growing season.

On the majority of farms a corresponding increase in conserved grass supplies would be more readily effected by ensilage, using improved modern methods, and an intensive propaganda directed towards this end ought to be initiated without delay.

By these two methods of conserving young grass, a very substantial reduction in the requirements of ruminant live stock for concentrated foods could be effected, and substantial help thereby given to the solution of the difficult problem of maintaining an adequate head of our non-ruminant stock.

It is on the latter—the pig and the fowl—that the penalty of depleted supplies of concentrates must necessarily fall most heavily, since they can only utilize coarse fodders to a very limited extent, not even sufficient to cover their maintenance requirements, and consequently must depend for the most part upon supplies of grain and meals. According to Wright's estimates of the normal requirements of these classes of live stock under prevailing systems of management, poultry receive 94 per cent, and pigs no less than 97 per cent, of their nutrients (expressed as starch equivalent) in the form of cereals and other concentrates. When these proportions are compared with the corresponding 15–20 per cent for cattle and sheep, and account taken of the paramount importance of maintaining an adequate supply of milk, it is clear that even with drastic changes in systems of management and feeding it will be practically impossible to prevent a considerable fall in the numbers of pigs and poultry. A considerable reduction in the output of pig meat, poultry meat

and eggs from the normal sources of home supply can thus scarcely be avoided, although since the best stocks will be retained the fall in output from these sources will not be proportional to the drop in numbers. Greater recourse will also be made by pig and poultry farmers to the feeding of food refuse from hotels and camps, and of grassland and surplus greenstuffs. So far as the use of grass and greenstuff is concerned, however, it is one of the ironies of the situation that the main responsibility for this task of replacing concentrates by greenstuffs should fall upon the two classes of live stock that are least fitted for dealing with large quantities of this bulky, fibrous type of food.

If home supplies of eggs, poultry meat, and pig meat are to be substantially maintained, a new body of producers must be brought into existence, and that is the task now allotted to the cottager, 'back-yarder', and allotment holder. Every household and every vegetable garden produces a certain amount of waste, useless in the house but serviceable as food for small live stock. Such material is generally more easily and completely disposed of through the pig than the fowl, but for most people, especially in suburban areas, pig-keeping will be impossible, and the effort must be concentrated on fowls and rabbits. War-time economy, moreover, will surely reduce the normal volume of household 'scraps' available, and the keeping of even a few fowls or rabbits will only be possible where an organized collection of the scraps from several households can be arranged. In a community properly organized for the purpose, the best plan of all would be for the edible refuse of all kinds to be collected and taken to a communal live stock feeding centre where expert management and proper facilities for the preparation of the food could be provided. Such a centre, with good management, might well be a substantial source of profit to the community.

Before taking up poultry keeping, the 'back-yarder' will be well advised to bear in mind that his household scraps and garden refuse alone will not suffice to maintain his birds in good health and production; but that he will also need to obtain a quantity of suitable meal, probably at least $\frac{3}{4}$–1 lb. per head weekly. Furthermore he must be prepared to go to a little trouble in boiling or cooking the scraps, as they may be unsuitable or even unsafe in the raw condition. Where garden waste is more abundant than house scraps he would probably be better advised to keep rabbits than poultry, since the rabbit can deal effectively with larger quantities of greenstuffs than the hen, and is generally less fastidious in its appetite for this class of food. Incidentally also, it is perhaps less liable to create a nuisance. German war-time policy for the 'back-yarder' definitely favours the rabbit before the hen, and its possibilities might well receive more attention and publicity in Great Britain than they have yet received.

Whatever class of live stock is favoured, however, it must not be assumed to be a simple matter on which no expert advice is required, and every community in which this class of activity develops should provide an organization through which such help can be readily obtained. There should be no difficulty in any town in forming an advisory panel of experienced men and women, with whom might be associated the adviser on small live stock from the agricultural educational staff of the adjoining county authority. Further assistance is also available in the special leaflets issued by the Ministry of Agriculture and Fisheries.

With all the assistance that may come from the cottager and 'back-yarder', however, the major part of the problem of conserving the greatest possible nucleus of our live stock must lie with the farmer, and must turn upon the efficiency with which our grassland and our reduced supplies of concentrated foods are utilized. There is general agreement that in the interests of children and others for whom milk is almost a vital necessity, and in view of our entire dependence upon home supplies of this commodity, priority in the allocation of feeding-stuffs must be given to milch cows. Beef cattle and sheep are regarded as having the next best claim to consideration, partly because of their relatively low requirement of concentrated feeding-stuffs in proportion to their total food consumption, and partly because of the slowness with which any reduction in our cattle and sheep stocks can be remedied after the War. Poultry and pigs follow without any special discrimination between them in the national policy, although the poultryman may justly claim precedence on grounds of the special nutritive virtues of the egg, through its combination of high nutritive energy with 'protective' factors. From this point of view, indeed, the hen may claim to rank next to the dairy cow in the basic importance of its contribution to the national dietary.

Placed at their present disadvantage in the order of priority, the pig farmer and poultry farmer have clearly the right to insist that every care shall be taken to ensure that the more favoured classes of live stock are efficiently managed, especially as regards their user of imported feeding-stuffs. This can only be effected satisfactorily through an organized scheme of rationing of supplies. Under such a scheme the dairyman, cattleman and sheepman should only receive priority supplies for their surplus production beyond the level that they may reasonably be expected to cover from home-grown supplies of fodder and grain. Furthermore, the

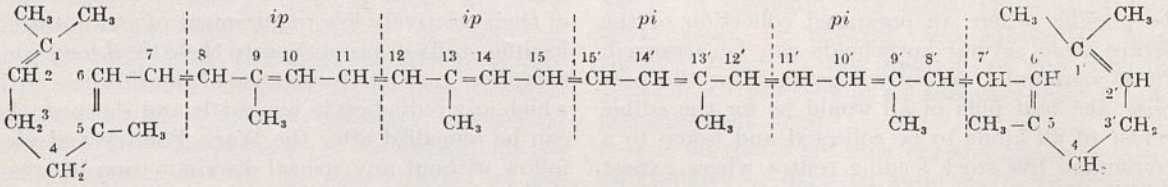
total volume of milk and meat production in respect of which priority of foodstuff supply is given should be restricted to the *essential* needs of the public. A volume of milk, for example, that is ample for the needs of infants, adolescents, invalids, etc., must be assured at all costs; but in view of the serious position in which pig and poultry producers are placed, it is difficult to see why any priority should be given for the production of unlimited supplies of milk for consumption by the adult population.

With the increased arable acreage and intensified utilization of grassland the requirements of the ruminant live stock for imported concentrates should be very substantially reduced, and the pig-man and poultry-man have every right to expect this measure of co-operation from their more favoured fellow farmers.

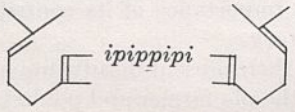
In the case of the poultry-man, and to a smaller degree the pig-man, there are also other weighty considerations that must be taken into account in the development of national policy. A very large section of the poultry industry is in the hands of 'small' people scattered throughout the countryside, whose living and life-savings are entirely bound up with the maintenance of their small enterprises. The welfare of this smallholder element of the agricultural community has always been regarded as being of great importance to the interests of the State, and any ill-considered reversal of this policy, even in war-time, may have grave sociological consequences. Their problem is for the time being extremely difficult, but must receive serious consideration before we can resign ourselves to the inevitability of human sacrifice on the home food production front.

CAROTENE AND ALLIED PIGMENTS*

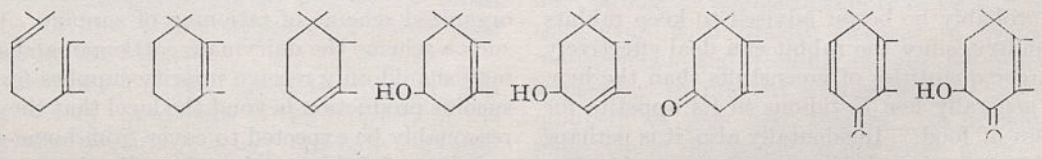
THE simplest carotenoid is lycopene, $C_{40}H_{56}$; on complete hydrogenation to perhydrolycopene, $C_{40}H_{82}$, thirteen bonds disappear. Quantitative degradation by means of ozone, permanganate and chromic acid as oxidizing agents leads to the formula:



The central polyene chain, C_8–$C_{8'}$ inclusive, is made up of four isoprene units arranged in pairs which are united in reverse order at C_{15} and $C_{15'}$, and may be abbreviated as *ipippipi* (*ip* denoting an isoprene unit). Lycopene may thus be written



The polyene chain is common to a large number of carotenoids, but the terminal groups may consist of substituted or unsubstituted rings of the α- or β-ionone type as below:



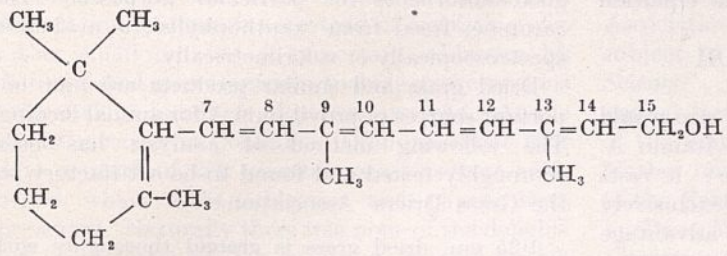
a *b* *c* *d* *e* *f* *g* *h*

Green leaves and other vegetable products contain α- and β-carotene and 'xanthophyll', a mixture of hydroxylated carotenoids, zeaxanthin and lutein predominating. Their functions in plant physiology are not yet understood, but owing to the connexion between carotene and vitamin A, the position concerning the role of carotenoids in the nutrition of animals is much less obscure.

Vitamin A from fish liver oils ($C_{20}H_{29}OH$) possesses a constitution which differs from one half of the symmetrical β-carotene molecule

* Based on papers by Dr. R. A. Morton "On the Constitution and Physiological Significance of Carotene and Allied Pigments", and W. M. Seaber, "On the Commercial Determination of Carotene and Allied Pigments with Special Reference to Dried Grass and other Leafy Materials", read at a joint meeting of the Society of Public Analysts and Other Analytical Chemists and the Food Group of the Society of Chemical Industry on February 7.

only by the addition of the elements of water :



The fact that green foodstuffs may cure avitaminosis A just as well as fish liver oils was explained when it was found that pure 'carotene' undergoes fission *in vivo* with formation of vitamin A.

The only carotenoids which act as precursors or provitamins A are those which possess intact one half of the β-carotene molecule. They include those shown in the accompanying table, echinonene and a few derivatives prepared *in vitro* from natural provitamins. There is no evidence that animals can synthesize either provitamins A or vitamin A *de novo*, or that the conversion of carotene to vitamin A is reversible.

Substance	Constitution	Occurrence
Lycopene	*a-ipippipi-a*	Ripe tomatoes
* α-Carotene	*b* ,, *c*	Red palm oil, mountain ash berries
* β-Carotene	*b* ,, *b*	Carrots, leaves, etc.
* γ-Carotene	*b* ,, *a*	Leaves of lily-of-the-valley
* Kryptoxanthin	*b* ,, *d*	Yellow maize
Zeaxanthin	*d* ,, *d*	Maize, egg yolk, leaves
Lutein	*d* ,, *e*	Grass, green leaves
* Myxoanthin	*b* ,, *g*	Algæ, especially blue-green
* Aphanin	*b* ,, *f*	algæ
Rubixanthin	*d* ,, *a*	
Astaxanthin	*h* ,, *h*	Crustacea

* Provitamins A.

The animal body contains only small quantities of carotenoids, and is not equipped to assimilate large doses. Carotene utilization is optimal when minimal doses are fed in oil solution, and the transport of carotene through the intestinal wall is conditional on normal fat absorption. The site of the conversion of carotene to vitamin A is generally held to be the liver ; certainly the liver is the main storage depot for the vitamin. In most species there is a normal level of concentration of vitamin A—and of carotenoid—in the blood. Carotenoids are also found in the pigmented layer of the eye and in yellow bone marrow.

Milk contains both vitamin A and carotenoids (largely β-carotene) and for a given species the total vitamin A activity of normal milk tends to be fairly constant, but in domesticated animals there are interesting variations with breed. Thus Holstein and Ayrshire cows yield milk with little carotene but more vitamin A, whereas Guernseys give a cream more deeply coloured by carotene but less rich in vitamin A. The new-born possess very low liver reserves of vitamin A, and it is significant that colostrum may possess vitamin A activity one hundred times that of normal milk. Human colostrum is two or three times as potent as early milk, which in turn is five or ten times as rich as the later milk.

The earliest sign of shortage of vitamin A or provitamin A is defective low-intensity vision. Visual purple, the photosensitive substance of the rods, may be obtained from retinas ; it is a conjugated protein from which vitamin A can be separated. Faulty dark adaptation is due to delayed regeneration of visual purple, and in the majority of subjects can be remedied by supplementing the diet with vitamin A or carotene. In order to prevent night blindness in cattle, sheep, pigs, rats and horses, Guilbert finds that either some 25–30 μgm./kgm. body weight (1 μgm. = 10^{-6} gm.) of β-carotene or 6–8 μgm./kgm. of vitamin A is needed daily.

Outspoken vitamin A deficiency is characterized by widespread atrophy of epithelial structures and often by xerophthalmia, but retardation of growth (weight) is the criterion most readily amenable to quantitative interpretation.

The diet of the majority of town dwellers shows inadequate vitamin A activity, especially during the winter months. It is also certain that most winter milk from stall-fed cattle is inferior to summer milk. Artificially dried grass is superior to hay both in respect of protein and provitamin A content, and its value as a feeding stuff has been established in many well-controlled experiments. The addition of vitamins A and D to margarine is a valuable way of alleviating vitamin deficiency, but the problem of utilizing the available resources to the best advantage and of increasing the supply to meet the known needs has not been solved. That it is necessary and possible to do so cannot be doubted, nor that the cost of effective action would be a small fraction of the cost of inaction.

This raises the point of the relative efficiency of carotene and vitamin A. The accepted unit of vitamin A activity is that exerted by 0·6 μgm. of pure β-carotene, so that the pure substance has a potency of $1{\cdot}66 \times 10^6$ I.U./gm. (by definition). Vitamin A, according to the best available data, has a potency near $3{\cdot}0–3{\cdot}3 \times 10^6$ I.U./gm., whereas all provitamins other than β-carotene have an activity near $0{\cdot}83 \times 10^6$ I.U./gm. These figures apply to rats receiving minimal doses.

There is urgent need for more research on the relative efficiencies of provitamins and vitamin A

at the level needed to convert a marginal diet into an optimal diet.

The commonly accepted view that the equation

$$\underset{\beta\text{-carotene}}{C_{40}H_{56}} \xrightarrow{2H_2O} 2C_{20}H_{29}OH$$

corresponds with a process occurring *in vivo* would lead to $1{\cdot}56 \times 10^6$ I.U./gm. for pure vitamin A. This is not in accord with experience; it rests upon the assumption that fission occurs exclusively at C15—15′ double bond, and its only advantage is that it agrees with the superiority of β-carotene over other provitamins. Unsymmetrical fission is more plausible and an equation

$$\underset{\beta\text{-carotene}}{C_{40}H_{56}} \rightarrow C_{20}H_{29}OH + \text{decomposition products}$$

is in closer harmony with the observed potency of vitamin A.

Vitamin A is estimated spectroscopically by utilizing the absorption maximum at 325 mμ. There is at present no reason to justify changing the accepted conversion factor, namely:

$$E^{1\%}_{1\text{cm.}}\ 325\ \text{m}\mu,\ 1 = 1{,}600\ \text{I.U./gm.}$$

The estimation of carotene in dried grass and similar materials involves extraction of the pigments, preparation of non-saponifiable extracts and a phase separation (that is, partition between petrol ether and 90 per cent methyl alcohol). The provitamins appear in the hydrocarbon solvent and the xanthophyllic compounds are eliminated in the aqueous methyl alcohol. Chromatographic adsorption permits a finer separation of individual carotenoids, specially prepared alumina, lime, calcium carbonate, magnesia and soda ash being good absorbents for particular purposes. The carotene, freed from 'xanthophylls', is evaluated spectroscopically or colorimetrically.

Dried grass and similar products are now important sources of provitamin A for animal feeding. The following method of analysis has been thoroughly tested and found to be satisfactory by the Grass Driers' Association:

0·25 gm. dried grass is ground thoroughly with sharp silver sand (5 gm.) and the mixture is treated with a mixture of acetone (15 ml.) and petrol ether (45 ml.) in a continuous drip extractor for at least 1 hour. The cooled extract is transferred to a separating funnel using a little petrol for washing in, and 30 per cent methyl alcoholic potash (5 ml.) is added. Vigorous shaking for two to five minutes is followed by addition of water (200 ml.). Carotene remains in the petrol, and after washing with water (200 ml.) the 'xanthophylls' are removed by shaking the petrol ether three times with 90 per cent methyl alcohol. The petrol layer is retained and made up to known volume. A solution of potassium dichromate(0·025 per cent) is colorimetrically equivalent to a solution of β-carotene containing 0·158 mgm. per 100 ml. petrol ether.

The estimation of carotene is complicated by the presence in the petrol ether fraction of a variable amount of an *X*-substance, which may be eliminated by filtering through a short column of alumina after adding 3 per cent of acetone. A yellow impurity is adsorbed but the carotene is carried through. Dr. Kon has confirmed the observation that the percentage of this contaminant increases in dried grass on storage.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COLUMBUS MEETING

BY DR. F. R. MOULTON, PERMANENT SECRETARY OF THE AMERICAN ASSOCIATION

IN many respects the American Association for the Advancement of Science is similar to the British Association, which served as a model for its organization and early development. It is the great democratic scientific organization of America (using the word in the geographical, not the national, sense), including in its interests all of science and its applications and relations to society. During a period of rapid increase in specialization and the organization of special scientific societies, it has served as an integrating agency. The breadth of its scope and the number of its members, now exceeding 20,000, make its voice more and more the voice of science in America.

In certain respects, however, the American Association differs from the British Association. Perhaps the least important is that it holds two meetings each year, the annual meeting during the Christmas holiday week (this year December 27—January 2, inclusive) and another meeting in the summer, usually the latter part of June. In addition, because of the large area of America, it has two geographical divisions, the Pacific Division and the Southwestern Division, each of which holds one meeting each year. A greater difference between the two associations is in the nature of their programmes. Before stating this difference, I wish to point out that many special scientific societies and organizations, at present 174 of them, are affiliated with the American Association, meet

with it at their option, and have representation on its Council, its supreme governing body. As a consequence of this organization, the American Association programmes, instead of consisting of a rather small number of important addresses by distinguished men of science, include many sessions before which hundreds of papers are read. At the recent meeting in Columbus, Ohio, in about four days a total of 259 scientific sessions were held, before which 2,154 addresses and papers were presented. Naturally there was none of the delightful leisureliness of the meetings of the British Association.

Although many, probably most of the 2,154 papers presented at the Columbus meeting were of no considerable importance, yet a considerable number were distinguished. As an example, I may refer to the paper by I. I. Rabi on "Radio Frequency Spectra of Atoms and Molecules", for which the Thousand Dollar Prize of the Association was awarded. Dr. Rabi not only discovered radiations from atoms of much lower frequency than hitherto known, but also devised a method of determining their properties although they are far too feeble to be detected by any of the devices previously in use. It is not possible to pick out from the hundreds of other papers—75 in physics, 44 in chemistry, 56 in astronomy, more than 300 in the zoological sciences, more than 350 in the botanical sciences, an equal number in genetics and other general biological sciences, 67 in the medical sciences, 310 in agricultural science—a few for special comment without injustice to many others.

On the whole, the best part of the programme from the point of view of direct contributions to science was the symposia, often organized and presented by several sections and societies in co-operation. These symposia were on such subjects as "Applications of Mathematics to the Earth Sciences", "Photosynthesis", "Fifty Years of Entomological Progress", "Speciation", "Effects of Science upon Human Beings" and "Blood, Heart and Circulation". The Association has published in book form the most important of the symposia presented at its meetings during the past three years.

Perhaps the foregoing paragraphs might lead the reader to conclude that the programmes of the American Association do not include the general sessions which are so characteristic of meetings of the British Association. The American Association has such general sessions, often of distinction, but relatively to the remainder of its programme they are much less important than those of the British Association. In addition to the address of the retiring president of the Association, there are two regular evening general sessions, one under the auspices of the Society of the Sigma Xi, an honorary scientific society, and one under the auspices of the Phi Beta Kappa, an honorary scholarship society. The retiring president of the Association, Dr. Wesley C. Mitchell, chose for the subject of his address "The Public Relations of Science" [see NATURE, Feb. 10, p. 207]. The annual lecture under the auspices of the Society of the Sigma Xi was delivered by Dr. Kirtley F. Mather on "The Future of Man as an Inhabitant of the Earth". The Phi Beta Kappa address was by Dean Marjorie Hope Nicolson on "Science and Literature".

This year saw the initiation of two new general sessions, one under the auspices of the Honor Society of Phi Kappa Phi and the other under the arrangement between the British Association and the American Association for exchange lectures on alternate years. The former was delivered by Dr. Isaiah Bowman, president of the Johns Hopkins University, whose subject was "Who is Responsible for Peace ?" As British men of science will recall, Dr. Bowman was invited by the officers of the British Association to deliver at its meeting last September the first of the British and American Association Lectures.

Although the first lecture by a British man of science under the arrangement was not due until next June, the arrival of Dr. Julian S. Huxley in America just before the Columbus meeting presented an opportunity that could not be neglected. He was invited to deliver the first lecture by a British scientific worker and accepted the invitation. His subject was "Science, War and Reconstruction". In referring to this brilliant address in my report of the meeting, I wrote as follows :

"The address of Dr. Huxley illustrated the scientific ideals of impartiality, justice and altruism, not simply as ideals without immediate applications but as ideals that are urgently needed at this hour. Obviously there is now a tide in the affairs of scientists that taken at its flood may enable them to make the greatest contribution to the progress of mankind in the history of the world, but neglected may leave them in the position of having provided the bark on which civilization will drift back into the darkness from whence it came. It is gratifying that so many addresses and programs of the association and its affiliated societies gave concrete evidence of a deep feeling of responsibility of scientists to society. These responsibilities include also the more fundamental one of laying foundations for an organization of society based on the essential nature of man ; and they include the still deeper one of deriving from the laws of the inanimate and animate universes about us and within us a basis for ethics whose authority for acceptance shall be in our own hearts."

OBITUARIES

Prof. Alfred Wohl

PROF. ALFRED WOHL died in Stockholm on December 25, 1939, at the age of seventy-six years. He was born on October 3, 1863, at Graudenz and received his early training at the Universities of Heidelberg and Berlin. He obtained his doctorate in 1886 at the University of Berlin, working under the supervision of Prof. A. W. von Hoffman, and spent the next two years in the Laboratorium des Vereins für Rübenzuckerindustrie, Berlin. In 1891 he became *Privat-dozent* in Emil Fischer's laboratory in the University of Berlin, and in 1904 was appointed director of the Laboratory for Organic Chemistry and Technology at the Technische Hochschüle, Danzig, a post which he held until he retired on reaching his seventieth birthday in 1933.

During a period of almost fifty years uninterrupted research, Wohl made many important contributions to both organic and physical chemistry. His early connexion with the sugar industry probably laid the foundation for his deep interest in this branch of organic chemistry. We owe to him methods for the degradation of sugars, the preparation of the optically active glyceraldehyde and much of our early knowledge of fermentation enzymes. He also devised methods of making artificial honey which are still in use to-day, and during the War of 1914–18 produced an economical process for growing yeast.

In other branches of organic chemistry, Wohl carried out the synthesis and investigation of many important compounds such as phenylhydroxylamine, the semi-aldehyde of malonic acid, malic and tartaric dialdehydes, lactic acid aldehyde, the acetal of methyl glyoxal, and the preparation of glyoxal by the interesting method of the ozonization of acetylene. He also showed that nitrobenzene reacts with potash to give nitrophenol.

One of Wohl's outstanding achievements was the demonstration of the wide applicability of vanadium pentoxide as an oxidation catalyst; by its use he carried out the oxidation of naphthalene to phthalic anhydride and of anthracene to anthraquinone, and thus opened a new path to the cheap production of intermediates for the dyestuffs industry.

Wohl always showed a fervent interest in the theoretical aspects of organic chemistry, and developed a theory of chemical reactivity based on Michael's theory of primary association of reaction spots and on the polarity of linkages. Much of his work was devoted to the substantiation of these ideas and in this respect he made special studies of the reactivity of bromacetamide, hydrazonium compounds, and of the Friedel-Crafts synthesis. His interest in theory extended to physical chemistry and his most important contribution in this field was the formulation of an equation of state for gases, based upon a simple modification of van der Waals' equation. He also published a series of papers in the *Berichte* on methods of analysis of gases. In developing these methods, he devised a new type of glass tap and also a means of producing vacua suitable for low-pressure distillations by the use of charcoal cooled by liquid air and an ordinary filter-pump.

Wohl was a man of outstanding personality and an enthusiastic, ardent, and inspiring teacher. He spared no effort to help his students, and during term it was his daily practice to gather them together in small groups in the laboratory and discuss with them their research problems.

Many honours were conferred on Wohl. He held the office of president in the Deutsche Chemische Gesellschaft in 1933 and was given the honorary degree of Dr.Ing. of the Technische Hochschüle, Hanover, in 1928, and Dr.Agr. of the Landwirtschaftliche Hochschüle, Berlin, in 1931.

Although he retired in 1933, he carried on experimental work until 1938, and in his last years developed a process for the manufacture of pulp from fibrous vegetable materials.

Mr. R. A. Smith

WE regret to record the death, at the age of sixty-six years, of Mr. Reginald A. Smith, formerly keeper of the Department of British and Medieval Antiquities of the British Museum, which took place at Colchester on January 13.

Reginald Allender Smith was born in 1873 and educated at Christ's Hospital and University College, Oxford. In 1898 he was appointed to the staff of the British Museum in the Department of Ethnography and British and Medieval Antiquities, as it then was, of which Charles Hercules Read was at that time keeper. Smith was assigned to the archæological collections, of which he became keeper in 1927, after the ethnographical collections had become a distinct department. He retired in 1938.

Smith was fortunate both in his chief and in the nature of his duties—the care and arrangement of the prehistoric and early historic collections of antiquities of the Museum. By his association with Read he was trained in that appreciation of the significance of form and technique in which his chief was pre-eminent, while his care for, and arrangement of, the collections committed to his charge developed to the full his capabilities of scientific precision in observation and interpretation of detail which enabled him during a period of nearly forty years to make to the advancement of archæological studies a contribution which was no less valuable than it was individual, and, indeed, unique.

A variety of circumstances combined to afford Smith the opportunity to attain the position which he afterwards held in the archæological world. Of these, one of the most influential was the part assigned to him in carrying out the policy initiated

early in his career at the Museum of issuing guides to the archæological collections, of which the first, on the Stone Age, appeared in 1902. Smith was mainly or solely responsible for the valuable guides, both in the original and in the revised editions, to the Stone, Bronze, and Iron Ages collections as well as to those of the Romano-British and Anglo-Saxon periods.

The preparation of these guides demanded an intimate and detailed knowledge and understanding of the characteristics of each individual specimen in the collections in relation to general typology as well as to the development of theoretical reconstruction in prehistoric and early historic studies. An even broader view was demanded in Smith's contribution of archæological chapters to early volumes of the "Victoria History of the Counties of England", which had commenced publication also early in Smith's career.

This thorough grounding in knowledge of the detailed evidence bearing upon British archæology proved of enormous service to scientific studies when Smith in 1908 joined the Council of the Society of Antiquaries of London, and afterwards became its honorary secretary and then its director, an office which he held for many years. Through the ramifications of the Society's many activities he was in close touch with archæological research in the field throughout Britain as well as on the Continent. Not only did he himself make many valuable contributions to archæological literature in its technical periodicals—his most considerable publication was an exhaustive illustrated catalogue of the Sturge collection of stone implements—but also he came to be widely recognized as, in a sense, a court of final appeal on the value and significance of any new discovery, or any fresh evidence bearing on previously ascertained facts in the prehistoric field of Britain. In the records of archæological discovery of the last twenty years, no name, with the possible exception of that of the Abbé Breuil, is more frequently quoted as responsible for an authoritative and final opinion than that of Reginald Smith.

Mr. G. L. Bates

MR. G. L. BATES, who died on January 31, was born in the State of Illinois in 1863. He was the eldest son of a large family, and inherited his love of natural history from his mother. He was educated at Galesburg and Chicago, and it was his father's wish that he should enter the Church. However, he had a great desire to travel and study Nature, and he persuaded his father to send him to West Africa in 1895. His first years were spent in Gabon and the French Congo, and later he settled in the former German colony of Cameroon.

In 1896 Bates began to send collections to the British Museum, and up to 1928 there was a steady stream of specimens in all groups. Though primarily an ornithologist, Bates did not confine his collecting to birds, and he had the reputation as a very successful collector of reptiles, discovering some sixty-two new species, including *Rana goliath* and *Trichobatrachus robustus*, the curious hairy frog. In mammals, too, he made many discoveries, and his specimens of plants and fishes are models of careful collecting. From 1923 onwards he made many expeditions to different parts of West Africa, including a trip to the Southern Sahara, where he made some interesting observations on the affinities of the Saharan avifauna. Later he undertook the study of Arabian birds, and in 1934 paid a visit to Mr. H. St. J. Philby at Jedda.

Apart from his expeditions, Bates will always be remembered for his papers on the reversed underwing coverts of birds, and his study of the genus Smithornis. In this last he proved by anatomical evidence that the genus had nothing to do with the normal Passeres. This was confirmed later by P. R. Lowe, who demonstrated that the true position was in the Asiatic Eurylæmidæ. Perhaps Bates's most important contribution to ornithology was on the "Geographical Variation within the Limits of West Africa", in which he showed that these variations, whether in colour or size, fall within certain rules. In 1930 he published a useful little "Handbook of the Birds of West Africa".

Bates's shy and retiring nature was increased by long residence alone, but nevertheless, no one was more ready to help others, and he will be missed by many. In the late autumn he underwent a serious operation from which he never fully recovered.

N. B. KINNEAR.

Prof. Fritz de Quervain

PROF. FRITZ DE QUERVAIN, an eminent Swiss surgeon, who died last month at the age of seventy-one years, was born at Sion, the capital of the Valais Canton, on May 4, 1868. He received his medical education in Bern, where he was assistant to Kronecker the physiologist from 1889 until 1891 and to Langhans the pathologist from 1891 until 1892, when he qualified. For the next two years he was assistant in Kocher's surgical clinic, and then entered on a surgical practice at Chaux-de-Fonds, where he became director of the surgical clinic in 1897. In 1902 he returned to Bern, where he remained until 1909, when he was appointed professor of surgery in the Basle faculty of medicine, and finally in 1918 occupied the corresponding chair at Bern.

WE regret to announce the following deaths :

Lieut.-Colonel J. A. Amyot, C.M.G., lately Canadian deputy minister of pensions and national health, formerly professor of hygiene in the University of Toronto, aged seventy-two years.

Colonel R. E. B. Crompton, C.B., F.R.S., a pioneer in electrical engineering and mechanical road traction, on February 15, aged ninety-four years.

Mr. H. G. Newth, lecturer in zoology in the University of Birmingham, on February 17.

Prof. C. Tangl, director of the Institute of Experimental Physics, University of Budapest, on December 10, aged seventy-one years.

NEWS AND VIEWS

Waynflete Professor of Physiology, Oxford

ANNOUNCEMENT has been made of the appointment of Dr. E. G. T. Liddell, of Trinity College, Oxford, to the Waynflete chair of physiology in the University of Oxford, which has been vacant since last autumn owing to the death of Prof. J. Mellanby. Dr. Liddell graduated in medicine from Oxford and St. Thomas's Hospital, and returned to the University as assistant in physiology in 1921. He collaborated in much of the later work of Sir Charles Sherrington, including the studies on the stretch reflex, the publication of the "Reflex Activity of the Spinal Cord", and the revised second edition of "Practical Exercises in Mammalian Physiology". He was thus intimately associated with the Sherrington School. His particular interest has naturally been the physiology of the nervous system, and his more independent published papers have been concerned with studies on the knee-jerk, physiology of the cerebellum and spinal cord. He has also published work on the experimental production of high blood pressure in animals. Latterly he has elaborated a technique for study of the postural reactions in the limbs of the intact animal over a long period of time, thus exploring the effects of lesions of the spinal cord and corpus striatum by operative means. He has made himself an authority on this particular branch of the subject, hitherto neglected in Great Britain.

Prof. Liddell was elected fellow of the Royal Society last year. As fellow of Trinity College, Oxford, since 1921, he has gained a wide reputation as tutor and will be greatly missed in this sphere of university life. His long experience as examiner and tutor, his wide interests and thoughtful outlook, all combine to make him unusually well suited to the chair, and we wish him every success.

Guthrie Lecturer of the Physical Society

THE twenty-fourth Guthrie Lecture of the Physical Society will be delivered at 5.30 on February 26 at the Royal Institution by Prof. P. M. S. Blackett, professor of physics in the University of Manchester. The subject of the lecture is "Cosmic Rays: Recent Developments". Prof. Blackett served with the Royal Navy in 1914–19, having previously been at the Royal Naval Colleges at Osborne and Dartmouth. After the War he exchanged a naval for a scientific career and went up to Magdalene College, Cambridge. In the Cavendish Laboratory he began work with the Wilson cloud chamber, a technique of research to which he has remained faithful. His work during 1923–1933 was concerned with the alpha particle. He showed that alpha particles make nuclear collisions in which energy and momentum are very accurately conserved, but he also investigated collisions resulting in nuclear disintegration, and showed, for the first time, that in a Rutherford disintegration of the nitrogen nucleus the alpha particle is absorbed and a proton liberated.

In 1932 Blackett developed the counter-controlled cloud-chamber device—a method of using the cloud chamber in which the expansion is initiated by the passage of the particle to be photographed. This has proved to be a most valuable instrument. This work led immediately to the detailed study of cosmic ray particles; and Blackett and Occhialini found, almost at the same time as Anderson, that positively charged particles of electronic mass occur in the cosmic rays. With Chadwick and Occhialini, Blackett showed the formation of positrons by the passage of hard gamma rays through lead. Since that time Blackett has concentrated almost entirely on the subject of cosmic rays. He has initiated investigations at Cambridge, at London (Birkbeck College) and at Manchester; indeed most of the experimental work on cosmic rays in Great Britain has been inspired by him more or less directly. His own work has been chiefly concerned with the energy spectrum of the particles, which he has investigated by means of a very refined cloud chamber in a strong magnetic field.

Prof. D. R. R. Burt

MR. DAVID R. R. BURT, who has just been made professor of zoology in University College, Colombo, has had charge of his department since 1924, and has raised it from small beginnings to a school of more than a hundred students. Prof. Burt is a graduate of St. Andrews, and was at one time an assistant to Sir D'Arcy Thompson; he also worked under Hans Przibram in Vienna. He has studied, among other things, the very numerous cestode parasites of the Ceylon fauna. Some years ago he devised, and described in NATURE, a method of anatomical injection with rubber-latex which has great advantages and has come into everyday use, especially in America.

Centenary of Sir Hiram Maxim

AMONG the great mechanical inventors of last century, none was known to a wider public than Sir Hiram Maxim, who was born on February 25, a century ago. When he came to Europe in 1881 to attend the Paris Exhibition, he was the engineer of the first electric light company in the United States, but was known to few in Great Britain. He had, however, already taken out a goodly number of patents, had invented a gas-making machine for lighting buildings and had done much original work on the incandescent electric lamp, dynamos, regulators, boiler plant and suchlike. When on the Continent, his attention was attracted to the subject of machine-guns. His countrymen Gatling, Gardner, and Hotchkiss had all invented machine-guns, and so had the Swedish engineer Nordenfelt. None of their guns, however, had proved entirely satisfactory.

In Paris Maxim drew the design of his gun, and his original gun was made in a workshop at 57A Hatton

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NATURE

SUPPLEMENT

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SHORT REVIEWS

Biology

(1) Bacteriology
For Medical Students and Practitioners. By Prof. A. D. Gardner. (Oxford Medical Publications.) Second edition. Pp. viii+274. (London: Oxford University Press, 1938.) 6*s*. net.

(2) The Microscope Made Easy
By A. Laurence Wells. Pp. 182. (London and New York: Frederick Warne and Co., Ltd., 1938.) 3*s*. 6*d*. net.

(1) PROF. GARDNER has managed to include in this small book a surprising amount of information on bacteriology, which is adequate for the medical practitioner who desires to keep abreast of advances in the subject, as well as being detailed enough for the medical student, with some supplementary reading. The matter is well presented and readable, singularly free from errors, and well up to date. Apart from the descriptions of the pathogenic micro-organisms and their effects, such subjects as immunity and antibody-antigen reactions, agglutination and anaphylaxis, and bacterial variation, are particularly well done, and the author has managed to include short sections on disinfection and the bacteriology of water and milk. The additional chapter on viruses in this second edition gives an excellent general account of the subject, together with sections on microscopical visibility and the bacteriophage. This is a book that can be cordially recommended.

(2) Mr. Wells's book, as its title implies, is a simple guide to elementary microscopy. The descriptions are easy to follow, and accounts are given of the microscope, and how to examine and mount a number of objects—crystals, pond life, diatoms, etc. The book contains several plates which satisfactorily illustrate and name a number of the objects mentioned in the text. The beginner without previous knowledge of microscopy will find it a useful first book on the subject. R. T. H.

The Fauna of British India, including Ceylon and Burma
Edited by Lt.-Col. R. B. S. Sewell. (Published under the Patronage of the Secretary of State for India.) Butterflies. Vol. 1. By G. Talbot. Pp. xxix+600+3 plates. (London: Taylor and Francis, Ltd., 1939.) 35*s*.

SINCE the publication of Bingham's volumes in the Fauna of India series in 1905 and 1907, knowledge of Indian butterflies has progressed very considerably. The issue of new volumes on these insects is, therefore, justified. In the present book there is a general and rather elementary introduction to certain aspects of the subject as a whole. External characters, variation, mimicry and distribution are dilated upon in this chapter: the rest of the volume is devoted to accounts of the species belonging to the families Papilionidæ and Pieridæ and, whenever possible, descriptions of the early stages are included.

The present work is uniform with the other volumes in the series and maintains the standard already established by its predecessors. It is a book which all who wish to know about Indian butterflies will need to consult. Some time will evidently elapse before the work is brought to completion by subsequent volumes, since only about one seventh of the recognized species are dealt with in the present contribution.

The Structure of Economic Plants
By Prof. Herman E. Hayward. Pp. x+674. (New York: The Macmillan Company, 1938.) 22*s*. net.

THIS volume is an outgrowth of the author's courses in plant anatomy at the University of Chicago. It is divided into two parts, the first dealing with general plant anatomy, and the second with the structure of a selection of plants of economic value. These are chosen partly for their economic importance, partly as typical representatives of the various families, and partly for their anatomical

complexity. Fruit crops are omitted, as the author plans a second volume devoted especially to them.

Part 1, consisting of 109 pages, is an excellent condensed introduction to vegetable anatomy. In Part 2, the structure of the selected crops is treated in detail and full references to literature are given. It is, in effect, a series of monographs, and should prove very valuable to any research worker who requires an account of the basic anatomical structure of the plant he is dealing with. A special feature is the number of diagrams showing the course of vascular bundles in stems and other structures. Throughout the book the copious illustrations are, with one or two exceptions, clear and well drawn.

In matters not purely anatomical, the author's high standard is not always maintained. For example, in the discussion of the hybrid origin of 'Grimm' and other variegated alfalfas, the important genetical work of Urban (1877) and others, which puts this origin beyond doubt, is not mentioned. In the glossary, phylogeny is defined as "the developmental history of a race rather than an individual"; it would surely be preferable to substitute a broader term, such as 'group', for 'race', which has a too restricted connotation.

L'Acide ascorbique dans la cellule et les tissus

Par Prof. A. Giroud. (Protoplasma-Monographien, Band 16.) Pp. vi+187. (Berlin: Gebrüder Borntraeger, 1938.) 12 gold marks.

IN this monograph—the sixteenth of the well-known "Protoplasma" series—Prof. A. Giroud develops, from an account of his own and other histochemical studies on the distribution of ascorbic acid in plant and animal cells, an interesting general discussion of the biological function of the vitamin. Although his treatment is sometimes rather speculative and often superficial, it provides a highly stimulating review of the large literature that has grown up since Szent-Györgi announced the discovery of 'hexuronic acid' ten years ago. It well repays reading. J. C. D.

Chemistry

A History of Chemistry

By Dr. F. J. Moore. Revision prepared by Prof. William T. Hall. (International Chemical Series.) Third edition. Pp. xxi+447. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 20*s*.

IN this revised edition of a well-known and valued work, the account of the earlier period has been greatly extended and new material has been added in most parts of the text. A valuable feature of the book is the attention given to American chemists; it is not generally known, for example, that Crafts was an American, although much of his work was done in France. The history is brought down to recent times, although some of the sections dealing with atomic structure are now in need of revision, and the statement on p. 406 as to the possible future use of the electron theory in organic chemistry needs rewording, in view of the extensive applications which have been made in this field. The text is very accurate and very few slips have been noted; among these is the statement on p. 337 that Mitscherlich was Russian, and the name Rausch on p. 429 for Ruark. The book is most attractively written and displays a truly philosophical outlook throughout; the new edition may be cordially recommended both to students and also the general reader. The large number of interesting illustrations should be specially mentioned.

Hand- und Jahrbuch der chemischen Physik

Herausgegeben von A. Eucken und K. L. Wolf. Band 10, Abschnitt 3: Starkeffekt, von B. Mrowka; Elektrischer Kerr-Effekt (Elektrische Doppelbrechung), von H. A. Stuart. Pp. 110+vi. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 12 gold marks.

THE first twenty-six pages are devoted to the Stark effect. This brief article will prove useful alike to physicists and physical chemists. It is written in a clear, straightforward style. After dealing with the Stark effect of hydrogen atoms and helium ions, consideration is given to the Stark effect of helium atoms, of atoms with more than two circum-nuclear electrons, and of molecules. The article concludes with a treatment of the relationship between the Stark effect and other phenomena.

All who are interested or engaged in problems of molecular structure will welcome Dr. Stuart's capable summary of the electro-optical effect first observed by Kerr in 1875 and named after him. A discussion of the theoretical aspects, occupying twelve pages, is followed by an account of the methods used in the investigation of the effect. Various factors which influence the effect are discussed and the magnitude of the influence of each is indicated. The last thirty pages illustrate the application of Kerr effect data to problems of molecular structure. Tables of selected reliable data and an extensive bibliography are given.

Both articles are treated in a clear, competent manner and can be recommended to all interested in these topics.

Inorganic Chemistry

By Fritz Ephraim. Third English edition. By Dr. P. C. L. Thorne and Dr. A. M. Ward. Pp. xii+912. (London and Edinburgh: Gurney and Jackson, 1939.) 28*s*. net.

IN preparing the new edition of this well-known book, the editors have made a number of useful additions covering recent work and have revised several parts of the text. There are still some parts of the old text which should be removed, as they are in contradiction with the new material. The point of view is more modern than was the case in previous editions, particularly in the sections dealing with co-ordination compounds, and the book is certain to maintain its well-deserved popularity with advanced students. It provides a very good survey of modern inorganic chemistry in a reasonable compass, and the references to the literature will enable

both teachers and students to amplify the information on any particular subject. The printing and lay-out are very good and the book is pleasing in appearance ; the price is very reasonable.

Geography and Travel

Transport in Many Lands

By W. Robert Foran. Pp. 260. (London and New York : Frederick Warne and Co. Ltd., 1939.) 7*s*. 6*d*. net.

MR. FORAN'S "Transport in Many Lands" is not, as its title may seem to suggest, a systematic account of the various methods of transport practised by different peoples, but to the general reader it will probably prove more entertaining. It is a record of personal experience and observation, more especially in the indulgence of a personal preference for animal transport, in the course of some forty years of travel in many of the remoter quarters of the globe. The elephant holds pride of place, both as a worker in the teak forests of the East, and as an impressive member of the pageantry of eastern princes. Some of the instances of its intelligence when logging timber are indeed, as the author describes them, almost 'uncanny'. Next to the elephant comes the camel, which as Mr. Foran points out, when discussing ancient trade routes, is one of the most ancient forms of animal transport on an economic scale employed by man. One of the most surprising uses, to which the author has put it, is as a mount for polo in Egypt. Apparently the experience was enjoyable. Following on the llama in South America and yak in Tibet, Mr. Foran deals with pack animals, the horse, mule and donkey, and then reindeer, oxen, and dogs, concluding with a chapter devoted to some of the strange vehicles and methods of transport he has seen, in which the power of man himself is harnessed. It is perhaps scarcely necessary to point out in reference to Mr. Foran's account of the reindeer that the Samoyedes and Ostiak of Siberia are not Eskimo.

In his forty years of observation Mr. Foran has witnessed a vast extension of European methods of transport among backward peoples in the use of the car and the bicycle. Nevertheless he shows how, under the influence of environment and tradition, old-fashioned methods still in many regions maintain their vitality, and usually for good reason.

L'Asie centrale soviétique et le Kazakhstan

Par Charles Steber. Pp. 302. (Paris : Éditions Sociales Internationales, 1939.) 35 francs.

THE part of Central Asia formerly known vaguely as Russian Turkestan and now comprising several autonomous republics of the Soviet Union is little known and is treated mainly in books which lack recent information. For the main part, it is an area of vast and somewhat arid plains extending southward from Siberia and eastward from the European plain, but it comprises also the mountainous little explored area in which lie much of the Pamirs and allied ranges. Formerly it was a land of sparse population and nomadic tribes, but all that is changing. Soviet influence has begun to develop its resources on a large scale. Irrigation, where possible, has led to agriculture, and the cotton output, not to say its manufacture, is already considerable. Public works, roads, railways and schools have been built, and even in the remoter mountain areas Russian influence is spreading. The author of this small but informative volume gives a clear record of the land and its progress, although his physical introduction is somewhat brief. There are simple but adequate maps and many references to authorities.

Geology

Elements of Geology

With Reference to North America. By Prof. William J. Miller. Second edition. Pp. x+524. (London : Chapman and Hall, Ltd., 1939.) 21*s*. net.

ALTHOUGH prepared primarily for American students, Prof. Miller's text-book is written in such a simple and interesting style and is so well illustrated that it should have a wide appeal. Indeed, the author arouses interest in the science at the outset, for he takes the novel course of describing, in his opening chapter, the evidence for upward and downward movements of the earth's crust and the phenomena of earthquakes—both subjects not too remote from everyday life. Thence he leads the reader to the study of minerals and rocks, weathering, rock-structure, and the work of rivers, glaciers, wind, the sea, underground water, and volcanoes. The development of scenery is also simply described. Having regard to the vast accumulation of data relating to these subjects, every author of a text-book must decide what to omit : and here Prof. Miller's selection seems to have been judicious.

The second half of the volume is concerned with historical geology and, except for the penultimate chapter on Cenozoic life, has reference only to North America. Dull stratigraphical details are avoided so far as possible and full use is made of palæogeographical maps. The section on early man in the chapter on Cenozoic life has necessarily, however, been largely compiled from the records found in the Old World, and here the author is rather less happy in his summary than elsewhere in the book. A study of articles recently published in NATURE would afford him material help, and the author might find it worth while to seek the assistance of some geological and archæological friends in Europe in wending his way through the tangle of conflicting accounts of the history of man. The volume is of such quality as to justify the effort.

Ground Water

By Prof. C. F. Tolman. Pp. xvii+593. (New York and London : McGraw-Hill Book Co., Inc., 1937.) 36*s*.

THIS book makes a notable addition to the literature of ground-water hydrology. The author assumes the reader to possess an elementary knowledge of geology and of hydraulic engineering,

and the introductory historical chapter mentions the importance of co-operation between geologist and engineer in the study of sub-surface waters. Chapter ii states the general principles controlling the occurrence and behaviour of ground-water, with terms defined, and is intended to provide a summary suitable for the lawyer preparing litigation on the subject; numerous page-references are given in the index under the general heading 'Litigation'. Chapters follow with a detailed discussion of rainfall, porosity, soils, flow of ground-water, and the water-table, the last containing a 24-page appendix on prospecting for water by geophysical methods, contributed by C. A. Heiland.

Selected references to literature (mainly American) are given at the end of each chapter. Water in fractures, artesian supplies, wells, oil-field fluids, and springs form the subjects of further sections. The last two chapters deal respectively with quantitative methods of measurement (with extracts from publications by O. E. Meinzer) and the distribution of underground water in the United States and the Hawaiian Islands. The book is illustrated by 189 good text-figures; most of the water-table contour maps in Chapter ix lack a statement of scale, which would have been helpful in estimating water-table gradients. There is a useful glossary of more than a hundred terms and a generous index.

Mathematics

An Introduction to Modern Statistical Methods

By Paul R. Rider. Pp. ix+220. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 13*s*. 6*d*. net.

THIS text-book on statistical methods is intended for the student who is interested in applications, but who at the same time, while not aiming at a complete knowledge of the underlying mathematical theory, would like to get a grasp of the main principles and formulæ. It is thus introductory both to theory and application, and although the discussion sometimes seems more fragmentary than one would wish, the author has welded the two aspects together into a fairly unified course.

The statistical concepts of frequency distributions, averages and moments, regression, and correlation, are first explained, before sampling and significance problems are dealt with. After a chapter on the binomial and normal distributions, the author then discusses the use of "Student's" and the χ^2 distributions, before concluding with the general principles of analysis of variance and experimental design. Statistical tables required for significance tests are included at the end of the book, and appended to each chapter is a useful collection of examples. It should be noted that in his discussion of the χ^2 test of goodness of fit (p. 108), the author omits to warn the reader of the necessity for *efficient* estimation of unknown parameters; in fact, the whole problem of estimation, even for an introductory text-book of this kind, seems scarcely adequately discussed. M. S. B.

An Introduction to the Theory of Functions of a Real Variable

By S. Verblunsky. Pp. xi+170. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 12*s*. 6*d*. net.

TO the ordinary mathematical student, geometrical illustrations in a text-book on analysis are a relief and an inspiration; to the purists the use of figures is a weakness. They demand that the theory shall be based on arithmetical considerations alone. Mr. Verblunsky's treatise completely satisfies this demand. For the student of analysis who is already acquainted with the subject, a careful reading of this book should be a useful discipline in careful and logical statement. For the usual type of honours student a course of this kind would, we fear, be disastrous.

The volume starts at the beginning of the subject—with the positive integers—and leads on by carefully graduated steps to the study of functions, sequences, derivatives, limits and integrals, closing with a chapter on infinite series. There are numerous illustrative examples, most of them fully worked out; but no sets of examples for practice are provided.

Mr. Verblunsky's exposition is, in the main, clear, concise and accurate. We deprecate, however, his method of introducing irrational numbers. This he bases on the following "Postulate of the Continuum". If, for every n,

$$a_n \leqq a_{n+1} \leqq a_n + (\tfrac{1}{2})^n,$$

then there is just one number ξ such that, for every n,

$$a_n \leqq \xi \leqq a_n + (\tfrac{1}{2})^{n-1}.$$

This postulate is flung at the reader with practically no explanation or discussion. The effect on the beginner is bound to be bewildering. If the book is to be used as a text-book it will be necessary for the teacher to lead up to the postulate by some sort of explanatory introduction.

Medical Science

Medical Entomology

With Special Reference to the Health and Well-being of Man and Animals. By Prof. William B. Herms. Third edition, based on the book known as "Medical and Veterinary Entomology". Pp. xx+582. (New York: The Macmillan Company, 1939.) 24*s*. net.

WITH the present volume, and those by Matheson and by Riley and Johannsen, the student of medical entomology is very well catered for in North America. Prof. Herms has, in this book, brought out a complete revision of his "Medical and Veterinary Entomology", the second edition of which appeared in 1923. Since that time an enormous amount of information has accumulated. Its sifting and compression, necessitated in a book of this kind, is no light task, and Prof. Herms has accomplished the feat with notable success.

All the more important diseases and other affections of man, and of domestic animals, in which insects and arachnids are implicated as carriers or as

causative agents, come in for discussion. In addition to six chapters of a more or less general character, some fourteen chapters are devoted to insects in relation to disease, two chapters to arachnids in the same connexion, together with a chapter on venomous and urticarial arthropods and a final one dealing with the utilization of arthropods in medical practice.

Written in a clear, terse style, a great deal of valuable information is compressed in rather fewer than 600 pages. Prof. Herms's book can be confidently recommended as an up-to-date guide to its subject.

The Genuine Works of Hippocrates

Translated from the Greek by Dr. Francis Adams. Pp. ix+384+8 plates. (London: Baillière, Tindall and Cox, 1939.) 13*s*. 6*d*.

THIS volume appears to be a reproduction in book form of Francis Adams' translation for the Sydenham Society in 1849, which Dr. Emerson Crosby Kelly, the editor, had already published in *Medical Classics* for September, October and November, 1838. It contains the following works of Hippocrates which Adams regarded as genuine: The Oath, On Ancient Medicine, On Airs, Waters and Places, On the Prognostics, On Regimen in Acute Diseases, First and Third Books of the Epidemics, On Injuries of the Head, On the Surgery, On Fractures, On the Articulations, Mochlicus, Aphorisms, the Law, On Ulcers, On Fistulæ, On Hæmorrhoids, and On the Sacred Disease. The present edition has the advantage over the Sydenham Society's publication in consisting of only one volume instead of two, but this has been effected by the omission of (1) Adams's Preliminary Discourse, which deals with the life of Hippocrates, his disquisition on the authorship of the different treatises attributed to Hippocrates, and the physical philosophy of the ancients, (2) Adams's introductions to the various treatises contained in the volume, and (3) almost all the footnotes as well as a considerable number of the entries of the index. The present edition, therefore, will be more acceptable to the general reader than to the medical historian, who will miss the learned commentaries of one of the most famous authorities in classical Greek medicine.

Miscellany

The Official Year Book of the Scientific and Learned Societies of Great Britain and Ireland

With a Record of Publications issued during Session 1938–1939. Compiled from Official sources. Fifty-sixth annual issue. Pp. vii+175. (London: Charles Griffin and Co., Ltd., 1939.) 10*s*.

IN spite of the dislocation of the work of scientific and learned societies by the War, the publishers state in their preface to this useful reference book that they hope to continue to produce it. Indeed, in view of present difficulties, it is a matter for congratulation that the book has appeared so promptly, and that no increase has been made in the price. The volume is slightly larger than last year's issue, and contains the usual information relating to the addresses, publications and other activities of scientific and learned institutions, including such official bodies as the Department of Scientific and Industrial Research. In many cases the bodies referred to will no doubt have war-time addresses, but it may be assumed that correspondence addressed to their permanent homes will eventually reach them.

The Theory and Practice of General Science

By H. S. Shelton. Pp. 123. (London: Thomas Murby and Co., 1939.) 3*s*. 6*d*. net.

MR. SHELTON'S book is written chiefly in support of a detailed syllabus of general science, which he has arranged in the form of topics, and it may be said at once that the syllabus is a good one. He himself seems to be in no doubt about it, for he writes: "To those who desire to found a course of general science, it can be said quite simply and clearly: Here it is for the first time in a simple, intelligible and coherent form". Mr. Shelton is severely critical of all other syllabuses of general science, especially those which have recently been compiled by the Science Masters' Association. He seems, however, to have misunderstood their aim, which was not to mark the end of thought, but to display a content of teaching material which masters could employ in arranging their own schemes of work. For this purpose, the form in which the S.M.A. printed its material is more useful than Mr. Shelton's, since it can be adapted more easily to special circumstances.

Outlines of the History of Architecture

Part 4: Modern Architecture, with particular reference to the United States. By Prof. Rexford Newcomb. Pp. xv+318. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 20*s*. net.

IN the history of architecture class at the University of Illinois, Prof. Rexford Newcomb found it necessary to devise means whereby both lecturer and students could make full use of their opportunities. In these courses, which are largely presented by the illustrated lecture method, the students were compelled to write almost continuously in a darkened room, and much of the consequent distraction from the subject itself was obviated by supplying them with mimeographed sheets giving bibliographies, references, class assignments and directions—in fact, all the routine notes the writing down of which has no exercise value. From these sheets this very unusual book has been developed, and the author has done well to preserve and publish the valuable digest of the facts and examples on which his lectures were based. The fourth volume of the series is concerned with modern architecture—say from the beginning of the eighteenth century—and while American architecture is more freely referred to, historical, bibliographic and other data are collated from France, Great Britain, Germany, the Low Countries and Scandinavia.

Physics

Electricity and Magnetism

An Introduction to the Mathematical Theory. By Prof. John B. Whitehead. (Electrical Engineering Texts.) Pp. xi+221. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 19*s*. 9*d*.

THE professor of electrical engineering of the Johns Hopkins University has written a compact introduction to electricity and magnetism in which stress is laid on the physical and mathematical theories. The historical order is adopted, and the first six chapters are concerned with electrostatics. A single chapter on magnetism is followed by chapters on electrodynamics and electromagnetism, and the electrical units receive special attention. The chapters on alternating currents are of value and deserve mention, as they include an elementary account of modern methods of computation. Finally, a brief description is given of the theory of conduction in gases. To condense so much into little more than two hundred pages is a noteworthy feat, and the author is to be congratulated on his presentation of the subject.

Matter, Motion and Electricity

A Modern Approach to General Physics. By Henry De Wolf Smyth and Prof. Charles Wilbur Ufford. Pp. xiii+648. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 25*s*.

UNIVERSITY teachers of physics who are not fettered by examination requirements and can plan their own courses will find this stimulating volume suggestive and helpful. Designed for a first-year course at Princeton, the book does not profess to cover the whole range of physics; but it deals with subjects related to the great theme of atomic and molecular constitution. It will therefore appeal to the chemist as well as to the eager student who wishes to plunge at once into the latest results of modern research on the properties of matter and of electricity. The advantages of the practical electrical units are so great that the authors have been led to adopt from the outset the M.K.S. (metre-kilogram-second) system of units.

Cosmic Rays

Three Lectures, being the revision of the 1936 Page-Barbour Lectures of the University of Virginia and the 1937 John Joly Lectures of Trinity College, Dublin. By R. A. Millikan. Pp. viii+134+22 plates. (Cambridge: At the University Press, 1939.) 8*s*. 6*d*. net.

THE first and perhaps the most important lecture is of a general character, in which, together with an account of the historical development of the subject, Millikan provides an answer to the often recurring question: What good are cosmic rays? He discusses the supreme social importance of abstract scientific knowledge, first in its applications to everyday life, although these may be delayed for generations, secondly in providing the example of a network of established fact to such subjects as economics, politics, etc.

The second lecture is an account of the various particles—positive and negative electrons, protons, photons and mesotrons, and of their discovery. It is noteworthy that throughout the book there is no mention of the instability of the mesotron, nor except in a footnote of its theoretical importance.

The last and longest lecture is a study of the latitude effects, both at sea-level and high in the atmosphere. It is valuable in giving in one place a full account of all the work of Millikan and his collaborators in this field, but is somewhat confusing reading, especially to those unfamiliar with the subject, as the historical development is given in detail. All the misconceptions, difficulties and mistakes of the past are treated with equal emphasis as the extent of our present knowledge.

Psychology

General Psychology

By J. P. Guilford. Pp. xii+630. (London: Chapman and Hall, Ltd., 1939.) 18*s*. net.

THIS book is divided into six parts. The first contains a discussion, on traditional lines, of the scope of the subject and a brief outline of the nervous system. A thorough and highly satisfactory section follows dealing with sensory activities and the processes of attention. The chapters on vision and hearing are noteworthy. The remainder of the book deals with the following topics: motivation of behaviour; acquiring new adjustments; symbolic activity, that is, images, concepts and language; and individual differences in ability and personality. The weakest chapters are those on human personality, which do not reach the standard set by the rest of the work.

The book is designed as an introductory experimental text, and each chapter concludes with a series of questions planned to test the student's grasp of the chapter. There are numerous diagrams and graphs, and the material is presented with clarity and simplicity. The student of psychology in Great Britain will welcome this interesting and up-to-date exposition of his subject.

The Mind of the Bees

By Julien Françon. Translated by H. Eltringham. Pp. xi+146. (London: Methuen and Co., Ltd., 1939.) 6*s*. net.

THIS little book is a reliable translation of "L'Esprit des Abeilles," the author of which is an original investigator and a good observer. His work has been carried out on foraging bees and not on bees within the hive. He appears, however, to under-estimate the importance played of odours in bee-behaviour, and claims that the first-comer communicates the location of a food source to the other foragers, who are thus enabled to find it. These and many other observations are carried out in a scientific manner, but the deductions made therefrom are more open to criticism. In spite of whatever defects the book may have, it is suggestive and well worth reading.

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Garden, London. In it Maxim used the force of the explosion to work the breech mechanism, and for the first time produced a fully automatic gun. The Maxim Gun Company was formed in 1884 and soon it was supplying guns to many armies. In the 'nineties Maxim began his experiments with steam-driven 'captive' flying machines, on which he spent many thousands of pounds. He knew he was trying to achieve something thought impossible, and if he had little success he at least brought the subject of aeronautics into the limelight. Scores of distinguished men, including King Edward VII, then Prince of Wales, visited Baldwyns Park in Kent and rode on Maxim's machine.

Like Edison, Maxim had but little schooling, but became a first-class mechanic and pored over such books as Ure's "Dictionary of the Arts". In middle life a short handsome man of great strength, he was as self-reliant as Ericsson and as fruitful in ideas as Trevithick and Bessemer. Traditional views were nothing to him, and, though he made himself familiar with what others had done, he looked at every problem in his own original way. He was born in the State of Maine, U.S.A., but after his visit to Europe he made his home in England, became a naturalized British subject, and in 1901 was knighted. He died on November 24, 1916, and was buried in Norwood Cemetery.

William Smith

AT a meeting of the Geological Society of London on January 17, Dr. L. R. Cox, of the British Museum (Natural History), delivered a lecture on the life and work of William Smith, the Father of English geology. The subject was chosen for two reasons, one being that this was the session of the Society nearest to the centenary of Smith's death, and the second that Dr. Cox had recently had an opportunity of studying Smith's original notes, diaries and letters, which have not hitherto been made public. These MSS. have apparently lain unexamined at Oxford for many years, presumably since the death of John Phillips, Smith's nephew, who until his death in 1874 occupied the chair of geology there. They were recently discovered in Oxford in a packing-case by Prof. J. A. Douglas, the present occupier of the chair, and through his courtesy they have since been examined systematically by Dr. Cox. They are now catalogued and housed in a specially built cabinet presented by Dr. K. S. Sandford and Mr. H. A. Sandford.

There are many gaps and obscure passages in the existing records of Smith's life, and these manuscripts throw a flood of light on the activities of this great geologist. Apart from the outstanding importance of his contributions to geological science, Smith lived during the heroic age of geology. The MSS. have therefore a more than personal interest, and should contribute materially to the history of the science during this period. The only existing biography of Smith, Phillip's "Memoirs of William Smith, LL.D.", has long been out of print and is almost unprocurable. With the new material at his disposal, there is every reason for Dr. Cox to prepare a full-dress account of the life and work of so worthy a subject, and it is to be hoped that its publication may not be unduly delayed.

Treasury Grant to Universities

IT has been decided to maintain the Government Grant to the Universities and Colleges at the existing level, namely, £2,149,000. In reply to a question in the House of Commons on February 20, Sir John Simon said: "The Government are fully conscious of the vital part played by the universities in the life of the community, and of the importance of maintaining the standards of university education as far as possible in the strained conditions of war. Moreover the universities are making an essential contribution to the national effort at the present time in supplying personnel of the educational standards necessary for many national services, as well as in affording more direct assistance to a number of Government Departments by means of particular researches, the provision of specialized technical equipment in laboratories, and in other ways. I have satisfied myself, after considering the representations of the Vice-Chancellors and the results of a survey of university finance carried out at my request by the University Grants Committee, that the maintenance during the coming financial year of the present provision is necessary if the universities are to continue to make their contribution to the national effort, and the Government therefore earnestly hope that local authorities will take similar action."

British and French Scientific Co-operation

IN connexion with the recent visit of the French scientific delegation, Capt. D. F. Plugge, chairman of the Parliamentary and Science Committee, asked the Minister of Supply what arrangements had been made for regular liaison between French scientific representatives and the Advisory Council on Scientific Research and Technical Development. Mr. Burgin made the following written reply: "Regular liaison between the Advisory Council referred to and French scientific representatives is effected through the Mission Scientifique Franco-Britannique, which has a permanent Secretary resident in London, who will shortly be located in the Ministry of Supply. The Mission has contact with the whole of the French war-time scientific organization. There is, in addition, a direct link between the Ministry of Supply and the French Ministère de l'Armement, which can be used by the Advisory Council for matters relating to scientific inventions, in the form of a Ministry of Supply officer who has been appointed liaison officer in the French Ministère and will shortly take up his duties in Paris."

Physics in War

A SERIES of public lectures on the "Background to Present-Day Problems" has been arranged in the University of Birmingham. The second lecture in this series was given by Prof. M. L. E. Oliphant, Poynting professor of physics in the University. His

subject was "Physics in War". Prof. Oliphant stressed the value of academic science, which in present circumstances can be turned to practical use. Future development of industry depends on the academic development of science, which in Great Britain is conducted only in the universities. It is therefore essential that the country should encourage academic research in science if we are to keep any sort of supremacy in industry. So far, the War has been almost entirely a physicists' war, waged with weapons depending for their operation on knowledge gained by physicists.

Prof. Oliphant referred to the great value of the pioneer work done by Dr. Lanchester in aviation, to the work of Sir William Bragg and Lord Rutherford on the detection of submarines, and to the development of the high-class optical industry. 'Wireless' is proving to be the fundamental controlling factor in the present War, and perhaps, when it is over, the public will realize how great is the work done by physicists in this field. The control of the magnetic mine presents no difficulties to the physicist. Scientific and technical men sometimes complain that they have not been given any job, and that their talents are not being used. Some of this criticism is justified, Prof. Oliphant said, because in England there is a tendency to allow administrative offices to be filled only by persons with non-technical qualifications. He deplored the conclusion that is sometimes reached that because a man has technical qualifications he cannot discharge administrative duties.

Censoring Scientific Journals

IT is announced that, at the request of Sir Walter Monckton, director-general of the Press and Censorship Bureau, Sir William Bragg, as president of the Royal Society, has undertaken the formation of a scientific panel to assist the bureau in arranging the censorship of papers in scientific journals. The following have agreed to serve on the panel: Prof. C. R. Harington (biochemistry), Prof. V. H. Blackman (botany and agriculture), Prof. A. C. Egerton (chemistry), Dr. H. L. Guy (engineering sciences), Prof. P. G. H. Boswell (geology), Prof. S. Chapman (mathematics), Dr. C. H. Desch (metallurgy), Dr. C. G. Darwin (physics), Prof. A. V. Hill (physiology), Prof. F. C. Bartlett (psychology), Prof. W. W. C. Topley (bacteriology and pathology), Prof. M. Greenwood (statistics), Sir Guy Marshall (zoology).

Animals and Plants of Use to Man

THE British Museum (Natural History) is now open to the public on Saturdays and Sundays from 1 p.m. until 4 p.m. A special exhibition has been arranged in the Shell Gallery to show the animal and plant sources from which some useful commodities come. This is too vast a field for the exhibition to be an exhaustive one, consequently only selected exhibits, illustrating commodities which lend themselves to attractive demonstration, are shown. These include the sources of certain textiles like linen, cotton, silk and rayon; plant and animal dyes used in commerce; the colouring matter and ingredients of cosmetics; the sources of leathers and of bristles for brushes; the plants and animals which produce oil in large enough quantities for it to be valuable to mankind; and some of the uses of moulds and mushrooms. Several of the cases have a war-time interest; for example, animals of use in war, margarine, bacon pigs, pests of stored food. The object of the exhibition is to show the sources of certain commodities, and not to give a detailed explanation with examples of how the raw materials are worked up into the finished products.

Discovery of a Royal Tomb in Egypt

A FURTHER discovery reported from San-el Hagar, the ancient Tanis, in the Nile Delta, promises results of even greater interest than those anticipated from the examination of the remarkable gold and silver sarcophagus discovered on this site by Prof. E. Montet, of the University of Strasbourg, in March of last year (see NATURE, **143**, 512 and 552). When Prof. Montet returned to Egypt about a month ago to reopen his season's work on the tombs of the Twenty-first and Twenty-second Dynasties on this site, he proposed to examine the sarcophagus which had been left unopened. The cartouche of Pharaoh Psussenes, identified with Sheshonk, had led to the attribution of the sarcophagus to that monarch; but in the course of the work of further examination, another tomb, it is reported (*The Times*, February 20) has been brought to light, which is thought to be the royal tomb, while the gold and silver sarcophagus is now said to be that of a royal priest. The newly discovered tomb contains a huge granite sarcophagus and a profusion of funerary ornaments. These consist for the most part of gold vessels, and include a gold cup in the form of a lotus, which is said to be of great beauty. This is the first royal tomb of the period (*c.* 1100–1000 B.C.) to be discovered; and it is of enhanced importance as belonging to a phase of Egyptian dynastic history of which archæologically too little is known.

Statistical Methods and Ethnographical Observations

A NUMBER of attempts have been made from time to time to introduce statistical methods of analysis in the study of ethnographical facts, but certain obvious difficulties, more especially the artificial abstraction and the divorce of so complex an entity as an ethnographical fact from its cultural context, as a rule have militated against extended and continued application of these methods. Anthropologists, therefore, have watched with considerable interest the work of the Culture Element Survey of Native North-West America of the University of California, of which Prof. A. L. Kroeber is director. This survey was initiated as a result of an attempt to apply statistical methods of analysis to the recorded ethnographical data concerning the Indians of California by S. Klimek, who went to the University in 1933 as a Rockefeller Fellow.

The Survey has now become the most considerable example extant of the application of statistical technique to ethnographical observation. Prof.

Kroeber, in a progress report covering the work of the Survey to April, 1939 (*Anthropological Records*, 1 : 7, Culture Element Distributions, 11, 1939, University of California Press), records that between 1934 and 1938 twenty trips to indigenous groups of peoples were made by 13 different observers, who brought back 279 filled-in lists of elements. In these there are now at least half a million of particularized and localized items of cultural fact, or if the supplemental notes are included, the number may well be nearer a million. Although several monographs already have been published, the great bulk of this material awaits computation. Not only does this task seem beyond human capability as a practical method of comparative ethnographic study, but also Prof. Kroeber now records that experience in the field, as well as in the study, counsels a reversal of method, at least to a major degree, in a return to the observational records of the more orthodox ethnographer.

Anglo Soviet Journal

THIS new journal has been started with the purpose of supplying "the more scientifically skilled and specialized workers in the British Commonwealth with a regular flow of information, accurate and reliable, on the progress and developments that are being realized in the U.S.S.R., in their own field, the field which they understand best". Very wisely the first issue is largely devoted to accounts of exhibitions, particularly of the great Agricultural Exhibition held in Moscow last summer, which was unquestionably the most magnificent effort of its kind the world has ever seen. Dictatorships are based on propaganda, and the Russians are the acknowledged leaders of the world in this new art. The design of the Exhibition was coherent and logical: the products of each region were brought together into separate pavilions, and each of the chief products had also its own special arrangements for show. The architecture was impressive and striking: no one could possibly forget the huge statue at the gate or the tower just inside, or the beauty of some of the pavilions.

The visitors included parties of peasants, some in picturesque local costume from all parts of the Union; many of them saw their own photographs hung up as good workers who had achieved more labour days than their fellows. More attention was paid to records than to average performances. Special notice was given to the effort of two farm workers, Okhota and Chalova, in getting forty-one tons of sugar beet per acre (the average for England and Wales is about ten tons). How far the Exhibition reflects actual performance in the countryside cannot be determined, as no detailed statistics of yield or total production have been published so far as we know since 1935, though there are some figures for the bumper year of 1937: but that is not the question. A forecast is given of the results anticipated from the proposed Trans-Volga irrigation scheme which, if it matures, and is free from too much complication of water-logging and salt, should produce food in a region where but little is grown now.

France's Colonial Problems

IN an address on "The Establishment of an Imperial Economy" (*Bull. Soc. d'Encouragement pour l'Industrie Nationale*, October 1939), M. E. du Vivier de Streel discusses the dependence of France on her colonial resources. He stresses the importance of science and technology in colonial development and the necessity of placing larger resources at the disposal of scientific organizations and technical men for the investigation of colonial problems, whether in improvement of agriculture, the prevention or control of disease, or the opening up of mineral resources. Such work should not be left precariously at the mercy of any local drive for economy. M. du Vivier de Streel refers also to the importance of population questions, education and a policy of public works, but while covering briefly much the same ground as the "African Survey" of Lord Hailey, he makes no reference to that outstanding work.

Studentship for Psychical Research

TRINITY COLLEGE, Cambridge, has established a studentship for the study of psychical research, out of a bequest left to the College for that purpose by Mr. F. D. Perrott as a memorial to F. W. H. Myers. Psychical research is defined, for this purpose, as "the investigation of mental or physical phenomena which seem *prima facie* to suggest (*a*) the existence of supernormal powers of cognition or action in human beings in their present life, or (*b*) the persistence of the human mind after bodily death". The studentship is open to any person who shall have completed his or her twenty-first year at the time when the election takes place. The studentship is tenable for one year, but a student may be re-elected once, but not more than once. The studentship will be of such value, not exceeding £300, as the electors may award after considering the nature of the research which the candidate proposes to undertake. Further information can be obtained from Prof. C. D. Broad, Trinity College, Cambridge.

January Earthquakes Registered at Kew

DURING January 1940 thirteen earthquakes were well registered by the seismographs at Kew Observatory. The largest of these were on January 6 at 14h. 23m. 2s. and January 17 at 1h. 33m. 24s., though a doubtful phase preceded this at 29m. 35s. This latter shock was registered at De Bilt (Holland) at 33m. 16s. G.C.T., and the shock of January 26 was also well observed there. The United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association has determined the epicentre of the earthquake of January 6 to have been lat. 22° S., long. 170° E. with initial time 14h. 3·4m. G.C.T. This determination was based on observations of seismograms obtained at Georgetown, Sitka, Apia, Honolulu, Pasadena, Fordham, San Juan and Manila. The provisional epicentre was in a well-known seismic zone of the Pacific Ocean to the east of the island of New Caledonia. The earthquake of January 17 was found by the same authority on the basis of

reports from nineteen observatories to have been provisionally centred at lat. 17° N., long. 148° E., and to have had initial time 1h. 14m. 53s. G.C.T. This epicentre was in the Pacific Ocean to the east of Zealandia Bank (Marianas Islands).

The Night Sky in March

THE time of the spring equinox is March 20 18h. when the sun enters the sign Aries. The moon is new on March 9 and full on March 23. Lunar conjunctions with the planets occur as follows: March 11d. 8h., Jupiter: 12d. 14h., Saturn: 12d. 23h., Venus: 14d. 0h., Mars. It will be seen from these times that the grouping of the bright planets is still a conspicuous feature of the western sky after sunset, although Jupiter is being lost to view as the month proceeds. On March 8d. 14h., Venus is in conjunction with Saturn, and on March 26d. 14h. with Uranus. Mars is in conjunction with Uranus on March 16. Neptune is in opposition on March 14, the distance from the earth being 2,716 million miles. The constellations of bright stars associated with winter evenings are now well westwards when the sky darkens after sunset. The regions of the sky which follows—Leo, Virgo, Ursa Major and Bootes—though less spectacular to the unaided eye, are of great interest on account of the rich fields of extra-galactic nebulæ. With small or moderate optical aid, there is also a number of interesting double stars well worth examining, including Castor (separation of components 3·6″), γ Leonis (4·0″), ξ Ursæ Majoris (1·7″), γ Virginis (5·7″), ζ Ursæ Majoris (14″) and ζ Herculis (1·1″). The last binary has a period of about 35 years and was discovered in 1782 by Sir William Herschel; the greatest separation of its components is $1\frac{1}{2}$″. Under favourable conditions the Zodiacal Light may be seen after sunset during this month. On fine evenings when the moon is absent, it is also worth while looking for auroras, for in March occurs one of the semi-yearly peaks in auroræ frequency. [All times are given in Universal Time; subtract 1 hour from Summer Time.]

Announcements

THE University of Oxford has decided to confer the honorary degree of D.Sc. on Dr. E. V. Appleton, formerly Wheatstone professor of physics at King's College, London, and Jacksonian professor of natural philosophy in the University of Cambridge. Dr. Appleton is now secretary of the Department of Scientific and Industrial Research.

PROF. A. L. MELLANBY will deliver the Thomas Lowe Gray Lecture of the Institution of Mechanical Engineers on March 15, at 6 p.m. The title of the lecture will be "Fifty Years of Marine Engineering".

THE Herbert Jackson Prize for 1939 of the L.M.S. Railway has been awarded to Mr. H. I. Andrews, of the Engineering Section, Research Department, Derby, for his paper entitled "The Development of a Refrigerating Machine for Use on Trains".

THE council of the Institution of Naval Architects has awarded the Premium of the Institution for the year 1939 to Mr. A. Nicholls, for his paper "The All-Welded Hull Construction of H.M.S. *Seagull*. The Wakeham Prize for 1939 has been awarded to Mr. A. Emerson, for his paper "The Effect of Shape of Bow on Ship Resistance (Part 2)".

DR. WARFIELD T. LONGCOPE, Baltimore, has been elected president of the board of directors of the Rockefeller Institute of Medical Research in succession to the late Dr. Charles R. Stockard.

THE Alfred Denker Foundation Prize for 1939 has been awarded by the German Otorhinolaryngological Society to Dr. Lotar v. Hofmann, of Vienna, for a work on the influence of diseases of the ear and upper respiratory tract on the development of the infant and young child.

THE Committee of the Physiological Society which was planning the Seventeenth International Congress of Physiology at Oxford in August 1941 under the presidency of Sir Charles Sherrington has decided, with regret, that the Congress must be postponed. Arrangements for the future will be made in consultation with the Permanent International Committee.

THE Central Association for Mental Welfare, in co-operation with the University Extension and Tutorial Classes Council, will, if sufficient applications are received, hold a course on mental deficiency at the London School of Hygiene, Keppel Street, W.C.1, from April 8 to 20. The lecturers will include Dr. A. F. Tredgold, Dr. Henry Herd and Miss Lucy Fildes. Further information can be obtained from Miss Evelyn Fox, c/o University Extension Department, at the School of Hygiene.

A RESEARCH scholarship of the value of £250 a year and tenable for two years has been founded by the Wrought Light Alloys Development Association to encourage and facilitate research in the application of light alloys to ship construction. The scholarship will be administered by a committee of the Institution of Naval Architects, and it is hoped to make the first award in September 1940. Full particulars of entry, which closes on July 31, can be obtained from the Secretary, Institution of Naval Architects, 10 Upper Belgrave Street, London, S.W.1.

A PRIZE of £20 with a diploma is awarded annually by the Council of the Royal Asiatic Society for an essay on some selected subject. The object is to encourage interest in the history and civilization of the East among non-Asiatics. In order to increase the basis of interest, the Council has decided to offer alternative subjects for the next competition. The two subjects are: (i) "Compare briefly the British, French and Dutch Systems of Administration in the East"; (ii) "The Development of Modern Turkish Literature". An essay on either subject may be submitted, and must be in the hands of the secretary at 74 Grosvenor Street, W., by October 1 next.

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.

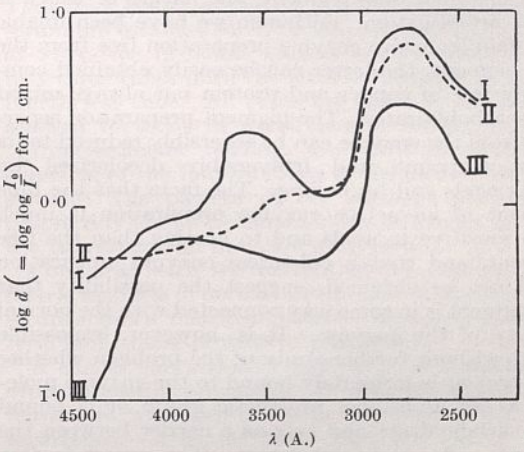
NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 308. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Photo-Oxides of Carcinogenic Hydrocarbons

IN a recent note under the above title[1], Prof. J. W. Cook described a number of water-insoluble peroxidic photo-oxides derived from carcinogenic hydrocarbons. Experiments made in Cambridge during the past year indicate that a photochemical oxidation product, which is different in character both from those prepared by Cook and from the alkali-soluble materials prepared by Boyland, can be obtained from 3 : 4-benzpyrene under suitable conditions. 10 c.c. of a 0·1 per cent solution of the hydrocarbon in benzene (B.D.H., 'Specially Pure') is irradiated for one hour in an open Petri dish placed three inches below a neon-sensitized mercury lamp of the type described by Melville[2], nearly all the energy radiated from which is concentrated in the 2536 A. resonance line. The remaining benzene is quickly evaporated off in a current of air, and the dry residue is extracted with 10 c.c. of glass-distilled water or with weak alkali (*M.*/500 $NaHCO_3$) and filtered. The resulting solution is colourless—unlike the solid residue—and its absorption spectrum, I, contains two very well-defined bands, with maxima of intensity at about 3600 A. and 2760 A. respectively. When the aqueous solution is allowed to stand, the band at 3600 A. disappears, while that at 2760 A. becomes less intense, in the course of 3–4 hours, II. The spectrum is not of the dihydroanthracene type such as is that, for example, of the water-soluble endosuccinate derivative of 1 : 2 : 5 : 6-dibenzanthracene. It indicates, however, that a labile water-soluble photo-oxidation product can be prepared from 3 : 4-benzpyrene, even though this compound gives no photo-oxide of the peroxidic type. Schulman and Rideal[3] have shown that the labile constituent of the aqueous solution can be adsorbed readily on to protein monolayers. These observations may be correlated and compared with the experiments on the photodynamic activity of the hydrocarbons described by Mottram[4].

Benzene, irradiated under identical conditions, yields a small quantity of an oily residue which dissolves freely in water to give a clear yellow-coloured solution. The absorption spectrum of this solution, III, also contains a well-defined band at 2760 A.; but this is now associated with a very wide band the maximum of which is at about 3950 A., and the absorption curve passes through a *minimum* at 3600 A. This material cannot be identified with any of the usual impurities in benzene. The same result was obtained with highly purified specimens (i) obtained from the Bureau d'Etalons Physico-Chimiques in Brussels; (ii) prepared by the method described by Lowry and Allsopp[5]; and (iii) from B.D.H., 'Specially Pure', as used for the irradiation of 3 : 4-benzpyrene.

In preliminary experiments, embryonic chick heart has been grown for two passages (4–6 days) in a medium composed of fowl plasma and chick embryo extract to which had been added either (*a*) the aqueous extract from irradiated 3 : 4-benzpyrene, or (*b*) the aqueous extract from irradiated benzene. A high percentage of the mitotic cells in series (*a*) was abnormal, and prophase was prolonged, as compared with control cultures or with series (*b*).



(I am indebted to Dr. A. Glücksmann for making the cytological examination of these cultures.) It is concluded that the labile product from 3 : 4-benzpyrene may have high biological activity, and experiments to isolate the substance, to elucidate its chemical and biological nature and to determine the part played by the benzene solvent in its production, are in progress.

I am also indebted to Prof. E. K. Rideal and to Dr. H. B. Fell for much valuable advice and assistance.

C. B. ALLSOPP.

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and Strangeways Research Laboratory,
Cambridge.
Jan. 29.

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Some Properties of Laccase from the Latex of Lacquer Trees

WE have previously shown[1] that laccase, the oxidizing enzyme present in the latex of the Indo-Chinese lacquer tree (*Rhus succedanea*), is a copper-protein compound. Our purest preparation of this enzyme, which catalyses the oxidation of polyphenols and diamines, contained 0·154 per cent copper and 6·45 per cent nitrogen, corresponding to about 45 per cent protein. The remaining fraction of the preparation was composed of a polysaccharide. This preparation had a strong blue colour which disappeared reversibly on the addition of reducing substances or substrates and irreversibly on heating the enzyme to about 60° C. or acidifying it.

It was, however, impossible to ascertain whether this deep blue colour was due to a special combination between the copper and the enzyme protein or to a colouring substance present in our preparations.

In order to determine the relationship between the colour and the enzyme we have made an attempt to obtain and study this enzyme from other sources such as the latexes of the Japanese and Burmese lacquer trees (*Rhus vernicifera* and *Melanorrhœa usitata*). As a result of this study we are now able to state that the laccases obtained from all three sources are copper-protein compounds and that the blue colour of all these enzyme preparations is not due to the copper but to the presence in these preparations of a blue pigment, the nature of which is under investigation. Although we have been unable to obtain an active enzyme preparation free from the blue pigment, the latter can be easily obtained completely free of copper and protein but always mixed with carbohydrates. The pigment preparation separated from the enzyme can be reversibly reduced to its leuco compound and irreversibly decolorized by strong acids and by boiling. The facts that the blue pigment of an active enzyme preparation is much more sensitive to acids and to heating than the free pigment, and that a colourless enzyme preparation could not be obtained, suggest the possibility that the pigment is in some way connected with the normal activity of the enzyme. It is, however, impossible to say without further study of the problem whether the pigment is intimately bound to the enzyme molecule as an additional prosthetic group or is bound to a carbohydrate and acts as a carrier between the enzyme and certain substrates. The purest laccase preparation we have so far obtained contains 0·24 per cent copper and is still of a deep blue colour.

Although laccase shows a very wide range of activity, extending to a great variety of *ortho-* and *para-*phenols, diamines and aminophenols, it does not catalyse the oxidation of monophenols such as *p*-cresol. This peculiar property of laccase preparations suggested at first that these preparations are devoid of an additional factor essential for this reaction and present in crude extracts of mushrooms or potatoes. It was, however, a matter of some surprise to us to find that the addition of such crude extracts to laccase preparation not only fails to reactivate it in relation to *p*-cresol, but also that the crude extract itself in presence of laccase loses its ability to catalyse the oxidation of this monophenol.

This peculiar inhibitory property of laccase preparations can only be ascribed to laccase itself and not to some additional factor present in the preparation. In fact, this property is not affected by dialysis, it is absent in blue pigment preparations devoid of laccase and it disappears from laccase preparation on boiling or after any other treatment which destroys the enzyme.

D. KEILIN.
T. MANN.

Molteno Institute,
University of Cambridge.
Feb. 2.

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Inactivation of Prolactin by Treatment with Phenyl *Iso*cyanate

PHENYL ureido derivatives of serum albumin peptone[1], plastein[2], and native proteins[3], have been prepared by treatment with phenyl *iso*cyanate. This reaction is eminently suitable for masking the free amino groups of protein molecules without doing further damage, since the reaction conditions are very mild (0° C. and *p*H 8). Hopkins and Wormall[3] concluded that phenyl *iso*cyanate reacts only with the free amino groups of the lysine components of the protein molecules.

In view of reports that prolactin, the anterior pituitary hormone which stimulates the pigeon crop-gland, can be inactivated by acetylation with ketene[4], and treatment with nitrous acid[5], we were led to compare the crop-stimulating activity of prolactin with that of its phenyl ureido derivative.

Phenyl ureido prolactin was prepared by treating a solution of purified prolactin from ox pituitary with phenyl *iso*cyanate at *p*H 8 and 0°, diphenyl urea from excess phenyl *iso*cyanate being removed by centrifuging. The pigeon crop-gland stimulating activities of this and a control solution were estimated by Rowlands'[6] systemic method.

Test liquid	No. of birds	No. of daily injections	Volume injected (ml.)	Mean $\frac{\text{crop wt.} \times 100}{\text{body wt.}}$
Prolactin	9	6	1	1·12
Phenyl ureido prolactin	10	6	1	0·45

The results in the accompanying table show that destruction of the free amino groups by reaction with phenyl *iso*cyanate has resulted in a very marked loss of activity. The percentage inhibition (see Folley[7]) was approximately 87. The observations of Evans and his co-workers[4,5], that the crop-stimulating activity of prolactin depends on the presence in the molecule of free amino groups, appear therefore to be confirmed. These experiments are being continued.

A. C. BOTTOMLEY.
S. J. FOLLEY.

National Institute for Research in Dairying,
Shinfield, Reading.
Jan. 30.

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Hyperprothrombinæmia During Pregnancy

THE determination of prothrombin in blood plasma acquired especial importance after the discovery[1] of vitamin K, which is known to play a certain part in the formation of prothrombin. During my researches on the normal and pathological variations of prothrombin I have found the concentration of prothrombin in pregnant women to be remarkably high, a condition not formerly known.

The determination of prothrombin in plasma has been carried out according to a method recently indicated by me[2]. My method differs from those of others in that the prothrombin is determined in relation to a standard prothrombin solution. It has proved justifiable to take the blood plasma of the investigator as a standard solution. By means of this method the prothrombin values of 104 normal persons of both sexes have been determined. If the average value is put at 100, the distribution has been found to range from 82 to 118 with a standard deviation of 6·58.

The results of the determinations of prothrombin in pregnant women are seen in the accompanying table. The figures indicate the average prothrombin value in the women examined.

Month of pregnancy	Number of subjects	Average prothrombin value
1–2	7	105
2–3	8	111
3–4	7	123
4–5	5	136
5–6	4	149
6–7	7	146
7–8	5	152
8–9	27	169

It is apparent from this table that the average prothrombin values of all pregnant women examined after the third month of pregnancy are considerably higher than the average value of the normal material and exceed the highest values observed in the latter. The figures indicate a steady rise from the third month until the end of pregnancy.

One month after delivery, normal prothrombin values are found.

The significance of hyperprothrombinæmia in pregnant women will be further elaborated in a forthcoming publication.

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Jan. 24.

[1] Dam, H., *Biochem. J.*, **29**, No. 6, 1273 (1935).
[2] Thordarson, O., *Nordisk Medicin*, No. 3 (1940).

Interferometric Serum Test for Cancer

A PRACTICAL optical test of the blood serum that appears to prove of assistance in the early diagnosis and prognosis of cancer is here described, the validity of which has been ascertained in a few hundred clinical cases.

The test involves the measurement of the densities of a certain number of samples of the person's blood serum, by the use of an interferometer. The density to be determined is the result of interaction between an extract of cancer cells and the serum under examination.

Previous studies leading up to the test were those of Dr. Ernest Freund and G. Kaminer[1], F. Neuberg and A. Waterman[2], further refined by Drs. R. Willheim and K. Stern[3]. The first four investigators claimed to have established the following facts: A lysis of cancer cells takes place in the blood serum of non-cancerous persons. Serum of cancerous persons has not only no lytic substance but even a substance which protects cancer cells from destruction.

Willheim and Stern, however, stated that a diagnosis of carcinoma could not be made merely by determining the presence or absence of any specific cancer-destroying substance. They postulated the existence of cancer-destroying and cancer-protecting chemical principles in the serum, the difference in the balance of which determined whether or not a serum could be clinically associated with carcinoma.

It seemed that a surer and simpler diagnostic reaction should be obtained by using an extract of human cancer cells instead of the whole cells. An alcoholic extract of carcinoma of the breast, because of its convenience of freedom from infection, was prepared to serve as the testing agent. Four test tubes are set up. Into each of these is pipetted the same amount of cancer extract, 0·05 c.c. Next, the serum to be tested is added in each tube in increasing amounts, 0·05, 0·25, 0·5 and 1·0 c.c. respectively. Thus four grades of dilution of the extract with the serum are established. The tubes are then incubated at 37° C. for 12 hours. Serum is then added to the first three tubes until the level is the same as for the fourth test tube. All tubes are carefully shaken and allowed to settle in a refrigerator for six hours.

Interferometer readings are made to obtain the densities of the four dilutions of the extract with the serum. The pattern of the readings plotted out graphically shows a characteristic difference between the cancerous and non-cancerous sera.

Compared with the pattern of the four interferometric readings of normal serum, that of the cancerous serum shows a 'disturbed balance' between the cancer-lytic and cancer-protective properties.

A cancer curve slowly changes to a normal curve after successful operation. It changes again from a normal to a cancer curve in the earliest stages of recurrence. A cancer curve does not change post-operatively if metastases have already taken place or are about to take place elsewhere in the body.

The test reaction failed to appear when serum of a pregnant woman or of a person with tuberculosis, syphilis or numerous other diseases was used. However, as was to be expected, fever and intensive X-ray treatments influenced the serum so as to make the test uncertain. Extract of normal organs, for example, fibroid tissue, failed to show any reaction.

This preliminary report deals with 325 cancer cases in which the test was proved to be 96 per cent correct. Altogether 575 cases have been tested.

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[1] Freund and Kaminer, *Wiener Klin. Woch.*, **34**, 378 (1910).
[2] Waterman, A., *Biochem. Z.*, **188**, 65 (1927).
[3] Willheim and Stern, *Biochem. Z.*, **239**, 473 (1931).

A Vacuum Core-Sampler for Deep-Sea Sediments

FEW geophysical problems have such important bearings as that of sampling undisturbed sediment cores of great length from ocean deeps. Questions pertaining to the permanence of ocean basins or their subsidence, to continental drift, to climatic changes and to variations in volcanic activity, etc., can best be answered through studies of the stratigraphy of deep-sea sediments, sampled in the manner just indicated. Recently, Dr. Piggot of the Carnegie Institution of Washington has obtained cores from the north-west Atlantic bottom approaching 3 m. in length, by projecting the sampler into the sediment by means of an explosive charge.

According to a scheme advanced by one of us at the meeting of the International Council in 1933, the hydrostatic pressure prevailing at great depths has been utilized for forcing a tube-sampler down into the sediment. The first instrument, constructed during last summer in the workshop of this Institute and put to practical tests in the fall of the same year, consisted of a 2 m. length of steel tubing, 2 in. wide, closed at its upper end and having a water-tight piston at its lower end, released by trigger action as soon as it touched the sediment surface. The air was pumped out of the tube before immersion, so that the piston, followed by a column of sediment, was able to move up to the upper end without compressing any air behind it, which might otherwise expand and push out the core on hauling up the sampler to the surface. The tests made with this first sampler proved the release to function well, and the tube was filled with sediment; but at depths exceeding 150 m. the shock due to the impact from the piston proved too severe for the steel bolts securing the lid to the upper end of the tube. Moreover, the looser kinds of sediments were sucked into the tube, before it had time to descend completely into the sediment.

A modified instrument was accordingly constructed with a cylindrical container of much wider bore attached to the upper end of the tube. The container is evacuated, whereas the tube itself is completely filled with water which, after the release, is free to enter the container through a nozzle of a more or less narrow bore, according to the depth in which the sample is to be taken. Thus the rate at which the tube sinks into the sediment can be made practically equal to the rate at which the sediment core mounts into the tube. Tests with this new sampler made at depths down to 240 m. have been entirely successful, cores of lengths varying between 160 cm. and 200 cm. being readily obtained. Markings on the outside of the tube proved the sampler to have sunk into the sediment to a depth agreeing to within a few centimetres with the length of the core. A deep-sea sampler with a larger spherical container and a tube 6 metres in length is now being constructed and gives hope of obtaining cores of approximately the same length from depths of 4,000 m. or more.

With all types of samplers hitherto used, including that of Dr. Piggot, the friction against the inside of the tube prevents cores of equal length to the depth of immersion in the sediment being sampled (see Pratje's recent experiences in the Baltic). With the vacuum sampler this friction is counteracted by suction, properly regulated, so that the core will give a true picture of the undisturbed stratification of the sediment. Moreover, since the force pressing the tube down into the sediment increases with the bore of the tube, and with the depth of water, it should be possible to obtain cores of still greater thickness and length, say 10 m. if not even more, by means of this sampler. The instrument will be described in greater detail in a coming issue of *Meddelanden fran Oceanografiska Institutet i Göteborg*.

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[1] *Ann. Hydrographie*, 213 (1939).

The α, β Transformation of Quartz

Sir C. V. Raman and T. M. K. Nedungadi have discussed in NATURE of January 27 a remarkable series of photographs showing the spectrum of monochromatic light scattered in a quartz crystal at various temperatures up to 530° C., not far from the transition point at 575° C. Their results are of special interest to me because they serve to confirm my opinion that, at any transition temperature (including the melting point), some kind of resonance occurs between two frequencies which characterize the two phases concerned. In other words, the transition takes place when there is close agreement between a frequency characteristic of the first phase and another frequency characteristic of the second phase. Since resonance may occur when this agreement is not quite exact, an explanation is possible of the fact that for many substances the 'setting' point is not quite the same as the 'fusion' point.

In the experiments on quartz, the authors state that "the 220 cm.$^{-1}$ line behaves in an exceptional way, spreading out greatly towards the exciting line and becoming a weak diffuse band as the transition temperature is approached. On the other hand, the other intense lines [including 132 and 468 cm.$^{-1}$] having both larger and smaller frequency shifts continue to be easily visible, though appreciably broadened and displaced". They infer that the binding forces corresponding to the line 220 cm.$^{-1}$ diminish rapidly with rising temperature, and also that the increasing excitation of this particular mode of vibration and the resulting deformation of the atomic arrangement are in a special measure responsible for the changes in the physical properties of the crystal, as well as for inducing the transformation from the α to the β form.

So far as I am aware, there is no information available as to the characteristic frequency of β-quartz save that which is obtainable from the Sutherland-Lindemann formula

$$\nu = \frac{3{\cdot}08 \times 10^{12}}{V^{1/3}} \sqrt{\frac{T}{M}},$$

where T is the absolute temperature of the melting point, M is the molecular weight, and V is the molecular volume. Assuming that T is 2,053° K., and the density is 2·65, the calculated frequency is $3{\cdot}63 \times 10^{12}$ sec.$^{-1}$, corresponding to 212 cm.$^{-1}$, and thus supports the hypothesis put forward.

For some time I have been examining the effect of substituting the absolute value of a transition point for T in the melting point formula, and have obtained interesting results. Taking 848° K. as the transformation temperature of α, β-quartz, the corresponding frequency is $4{\cdot}09 \times 10^{12}$ sec.$^{-1}$ or 136 cm.$^{-1}$. This is very nearly the same as the Raman line 132 cm.$^{-1}$.

The two suggestions which I wish to emphasize are these: (1) the occurrence of a transformation is associated with some kind of resonance between approximately equal frequencies characteristic of the phases concerned; (2) the applicability of the Sutherland-Lindemann melting point formula to the transition point.

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Chemical Action of γ-Radiation from ^{80}Br

DURING the course of an investigation into the exchange of radiobromine between a number of organic and inorganic bromides, it has been observed that with certain of the latter, for example, aluminium bromide, and a wide variety of organic bromides, a complete exchange of all the bromine atoms in the system takes place very quickly at room temperature. With many other inorganic bromides, however, there is apparently no exchange, but an *extraction* of the 18-min. ^{80}Br isotope from the radioactive organic bromide.

For example, if inactive antimony tribromide be dissolved in radioactive ethyl bromide several hours after the preparation of the latter, that is, when all the 18-min. isotope originally present has decayed, and immediately after the dissolution the ethyl bromide be volatilized away *in vacuo*, the residue of antimony tribromide is found to be strongly radioactive, with a half life of 18 min., the 4·5- and 36-hour periods being found in the condensed ethyl bromide.

That is, the antimony tribromide has made a selective extraction of the short-lived radiobromine isomer which has grown from, and is in transient equilibrium with, the parent 4·5-hour ^{80}Br. This result is to be attributed to a form of intramolecular photo-dissociation of the ethyl bromide by the internal conversion of the γ-ray which, as Snell[1], Abelson[2] and others have shown, is emitted by the bromine nucleus during the isomeric transition. A similar extraction was observed with arsenic tribromide, phosphorus pentabromide and, though the amount extracted was less, with crystals of mercuric bromide and of potassium bromide, and with metallic silver, mercury and even gold. In each case the radiobromine extracted was almost pure 18-min. ^{80}Br, the 'tail' to the decay curve due to the longer-lived isotopes being very small—generally less than 1 per cent of the total initial activity.

Segré, Halford and Seaborg[3] obtained a partial separation of the radiobromine isotopes by the precipitation of silver bromide from an aqueous methyl alcoholic solution of radioactive *tert*-butyl bromide, and DeVault and Libby[4] obtained a more complete separation by the precipitation of silver bromide from a radioactive bromate solution. These authors attributed the separation to a chemical activation of the molecule containing the bromine, by the recoil from an internal conversion electron. LeRoux, Lu and Sugden[5] have also found that a greater proportion of the 18-min. isomer than of the 4·5-hour isomer can be extracted by aniline from neutron irradiated ethylene dibromide, or by water from a benzene solution of a radioactive alkyl bromide, and offer as explanation[6] that the soft γ-ray gives a recoil which can only activate, but not disrupt, the C–Br bond.

The present results indicate, however, at all events in the case of ethyl bromide, that the process is not simply a matter of supplying an extra activation energy (over that received spontaneously by thermal agitation) to an otherwise exothermic reaction, since the removal of a bromine atom or ion from an ethyl bromide molecule by arsenic tribromide or mercuric bromide, for example, is endothermic by a very large amount.

Moreover, the mechanical recoil of the bromine nucleus from the γ-ray or from a conversion electron cannot be a major factor in these reactions. Siday[7] has shown that the energy of this γ-ray emitted during the transition is about 43,000 e.v. The energy of recoil of the comparatively heavy bromine nucleus from such a γ-ray is about 286 cal./mol., which is less than the energy of thermal agitation of the molecule at room temperature. The internal conversion of this γ-ray results in the expulsion of conversion electrons, the recoil from which will be greater than from the γ-ray, but even with 100 per cent efficiency of recoil would be less than 7 kcal./mol. Such an additional energy would accelerate the hydrolysis of an alkyl bromide, but could not bring about the present results. These suggest that a bromine atom or ion is broken completely away from the ethyl bromide molecule before reaction, a process requiring about 60 kcal./mol. if the disruption is into neutral fragments, and rather more for disruption into ions (much of the additional energy required to form the ions is recovered as solvation energy when the process takes place in solution).

It appears more probable, therefore, that the C–Br bond is broken immediately following the nuclear transition, not by mechanical recoil of the bromine atom, but by a process involving any one of a series of excited molecular states which are produced during the gradual settling down of the bromine atom after the start of the internal conversion. That is, the molecule is broken up, not merely activated, by a process which is more in the nature of a photo-dissociation brought about by intramolecular quanta.

All these reactions were carried out with anhydrous materials at room temperature, the ethyl bromide being volatilized away *in vacuo* ($\sim 10^{-3}$ mm. mercury), at or below room temperature and condensed by liquid air. The radiobromine was converted into AgBr, the activity of which was measured with a Lauritsen type quartz fibre electroscope.

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Effect of Temperature on Lubricant Films

THE friction apparatus developed by Bowden and Leben[1,2] has shown that when clean steel surfaces slide on one another, the motion is not smooth but proceeds in a series of irregular jerks. This apparatus has also been used for comparing the lubricating properties of various substances. With the high loads and low speeds employed, the conditions which obtain correspond to boundary lubrication. Experiments show that when a non-polar lubricant such as medicinal paraffin oil is used, the motion still proceeds in stick-slips, though the average value of the friction is lower than for the dry surfaces. Certain long-chain fatty acids and small quantities of these acids in a non-polar oil will, however, cause continuous sliding[1,3]. This property has been used to detect the oxidation of non-polar oils on heating. The original oil gives a jerky motion; when a certain amount of oxidation has occurred the motion becomes smooth. The rate of this oxidation becomes appreciable with most oils at temperatures above 150° C. and the change in the frictional behaviour is irreversible on subsequent cooling[3].

Some recent work on commercial oils giving smooth sliding on steel surfaces at room temperature has revealed a new effect. As the surface is warmed (to temperatures usually ranging between 40° C. and 80° C.) stick-slips set in, which increase in size with temperature and decrease as the temperature is reduced. Provided the heating has not been sufficient to cause appreciable oxidation of the lubricant, this effect is reversible. Subsidiary experiments have shown that it is not due to any change of viscosity with temperature, and the effect is to be attributed to a desorption or disorientation of the lubricant film. These results indicate that *in those cases where boundary lubrication occurs*, a lubricant which behaves well at room temperature (that is, which gives smooth sliding) may have poor lubricating properties at quite moderate temperatures of the running parts. The temperature at which this reversible effect occurs will be a measure of the strength with which the lubricant film adheres to the surface; the higher the temperature the more strongly is the film adsorbed on the surface. It is possible by such means to compare different lubricants in this respect.

Experiments have also been carried out with pure fatty acids, and similar effects have been observed, though the temperature at which stick-slips commence is appreciably higher than the values given above and increases slightly with the chain length of the acid.

These observations are of importance in any general consideration of the effect of temperature on the behaviour of adsorbed films.

I am indebted to the Asiatic Petroleum Company for permission to publish this work, which was carried out in their laboratories.

D. TABOR.

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[3] Bowden, Leben and Tabor, *Trans. Faraday Soc.*, **35**, 900–904 (1939).

Points from Foregoing Letters

C. B. Allsopp has found that photo-oxidation products of 3 : 4-benzpyrene, which can be extracted with water or dilute alkali, possess characteristic absorption spectra. The unstable extracted material, which was shown by Schulman and Rideal to react strongly with protein monolayers, is found to produce a high percentage of abnormal mitotic cells in embryonic chick heart tissue cultures.

After examining the oxidizing enzymes, named laccases, obtained from the latex of the Indo-Chinese, Japanese and Burmese lacquer trees, D. Keilin and T. Mann conclude that they are all copper-protein compounds containing a blue pigment the nature of which is under investigation.

A. C. Bottomley and S. J. Folley find that the pigeon crop stimulating activity of the anterior pituitary hormone prolactin disappears when the free amino groups react with phenyl *iso*cyanate.

O. Thordarson finds that the prothrombin content of the blood plasma of pregnant women is higher than normal. A steady rise occurs from the third month of pregnancy until delivery; normal values are found again one month after delivery.

It is claimed by M. W. Mettenleiter that the density of blood serum incubated with an alcoholic extract of carcinoma of the breast, can be used as a test for cancer. When the observations are plotted, a characteristic difference between cancerous and non-cancerous sera is observed; this difference disappears after successful treatment and reappears with recurrence. The test fails in cases of pregnancy and of certain diseases.

The experimental results of Raman and Nedungadi on the α, β transformation of quartz are reviewed by Prof. H. S. Allen. Two suggestions are put forward: (1) at any transition temperature (including the melting point) some kind of resonance occurs between two approximately equal frequencies characteristic of the phases concerned; (2) the Sutherland-Lindemann melting point formula may be applied to the transition point.

Experiments on the exchange of radiobromine between organic and inorganic bromides are described by F. Fairbrother. The radiobromine with a half-life of 18 min. can be separated almost completely from the others by extraction of a radioactive organic bromide with certain inorganic bromides and metals. Since the energy of mechanical recoil, from the γ-ray emitted during the isomeric transition of ^{80}Br, or from its conversion electrons, is too small to break the C–Br bond or to bring about the observed reactions, these are attributed to a fission of the bond by an intramolecular photo-dissociation.

Using the stick-slip friction apparatus developed by Bowden and Leben, D. Tabor finds that certain lubricants giving smooth sliding on steel at room temperature give stick-slip motion when heated to moderate temperatures. This effect is reversible with temperature and has been observed with pure fatty acids. It is attributed to a desorption or disorientation of the lubricant film.

RESEARCH ITEMS

Facial Deformity in Anthropomorphic Pottery

IT is pointed out by R. N. Salaman that in any considerable collection of Chimu Peruvian pottery there will be found among the anthropomorphic pots examples in which some peculiar deformity of mouth or nose or both occur (*J. Roy. Anthrop. Inst.*, **69**, 1; 1939). Several different explanations have been put forward. Distinct groups may be recognized, namely, those which depict abnormal localized obesity, those in which the face is distorted as a result of facial paralysis, and those in which the mutilation is induced and associated with some representation, however conventionalized, of the potato. The potato was regarded as controlled by a spirit which was strengthened by blood libations effected by the act of mutilation. This mutilation consisted in the abscission of the upper lip, and often the lower as well and the removal of the soft parts of the nose. The effect was a startling display of teeth and a cavernous mouth, the explanation being that the Peruvians regarded a potato eye as a mouth, which indeed it resembles in the Peruvian varieties more closely than an eye. A pot of the proto-Chimu period from Chimbote shows the symbolism complete. It depicts a human figure built up from a single potato tuber, in which the end of the nose and the central portion of the upper lip are removed, while on the body are displayed potato eyes from each of which are growing several slender sprouts. In the left hand the figure holds a digging stick. A large number of the pots for funerary purposes exhibit facial deformities which might be illustrative of some disease process, such as, it is suggested, the *uta* disease due to an infection with the protozoan *Leishmania brasiliensis* in various stages, after surgical treatment and after death. The reason or reasons underlying the frequent representation by the ancient Peruvians of maimed and mutilated figures remain obscure.

Moulting in Snakes

A SHORT paper by Robert M. Stabler, reporting upon twenty-one snakes observed for periods ranging from 11 to 47 months, adds to the somewhat meagre knowledge about this habit (*Copeia*, 227; 1939). The snakes belonged to seven different genera and fourteen species, and yet they showed similarity in the frequency of sloughing when account was taken of the periods of reduced activity, and when observations were confined to individuals which fed readily and were perfectly healthy. Continuous observations showed apparent dissimilarity; thus in 47 months one specimen of *Agkistrodon piscivorus* sloughed fifteen times, while another sloughed three times in 12 months, and one individual of *Elaphe o. obsoleta* only twice in 12 months, the average periods between sloughs in these cases being respectively, 3·1, 4, and 6 months. But all the snakes were kept in a room not specially heated, and it was found that when winter temperatures fell as low as 40° F. a state of pseudo-hibernation or 'rest period' was induced, during which the snakes lay motionless for days, took food sparingly, and sloughed rarely. This period, extending from about October to April, averaged 6·4 months in the year. When the rest periods, which were carefully recorded, were omitted from the computation, the sloughing in the three cases mentioned took place respectively at intervals of 1·3, 2·3, and 1·2 months. In all the snakes the periods were somewhat similar, generally ranging around about 1·5 months.

Translocation in the Somatic Tissue

L. V. MORGAN reports the finding of two salivary gland nuclei with a reciprocal translocation between the right arms of chromosome 2 and of chromosome 3 of *Drosophila melanogaster* (*Genetics*, **24**, 747–752; 1940). The interchange must have occurred in the last or in a very late division in the nucleus of a somatic cell before the full number of cells of the salivary gland was attained. The discovery is of importance in showing that reciprocal translocations, like mutation, or crossing-over, may occur during mitosis as well as during meiosis.

Genetical Investigation in Neurospora

Neurospora tetrasperma normally has four spores per ascus, and differs in this respect from *Neurospora sitophylla*, which forms eight spores per ascus. One culture of *N. tetrasperma* was found by B. O. Dodge (*J. Hered.*, **30**, 467–474; 1939) to form ascocarps which contained aborting and sterile asci. About 10 per cent of the ascocarps occasionally contained a fertile ascus, with usually eight not four ascospores. If these eight spores were cultured, those that germinate again produced 4-spored asci. On the other hand, a binuclear spore sometimes found in an ascus would give aborting ascocarps with an occasional 8-spored ascus, as in the original culture. It would seem that this culture of *N. tetrasperma* produced eight spores, half of which carry *E*, a lethal which prevents germination. As a result of segregation at the second division for both sex factors, *Aa* and the lethal *Ee*, a large spore may contain *AE* and *ae* in the two nuclei, and can germinate and give rise to ascocarps. Many of these will abort, but some will contain 8-spored asci, since *E* affects the nuclear distribution and spindle mechanism at spore formation.

Separation of Amino-Acids in Protein Digests

AN interesting new method of protein analysis is outlined by R. L. M. Synge (*Biochem. J.*, **33**, 1913, 1918, 1924 and 1931; 1939). The amino-acids in a digest are acetylated and then extracted with chloroform in a continuous liquid extractor. The partition coefficients of these acetylated amino-acids between chloroform and water vary so widely that separation into groups is readily accomplished, for example, acetyl-1-phenylalanine is soluble and *N* acetyl-1-hydroxyproline almost insoluble in chloroform. Subsequent benzoylation of hydroxy groups, however, produces derivatives easily soluble in chloroform such as *N*-acetyl-*O*-benzoyl-1-hydroxyproline and hydroxy-amino-acids can thus be readily separated from other amino-acids. Fractionation of hydroxyamino-acids from each other may be carried out by preparing their *N*-acetyl-*O*-methyl derivatives, which have very different chloroform-water partition coefficients.

Solvent Effect on Solubility

THE solubilities of barium iodate, silver acetate and silver sulphate in dioxane-water mixtures at 25° over the complete range of solvent mixtures have been determined by T. W. Davis, J. E. Ricci and C. G. Sauter (*J. Amer. Chem. Soc.*, **61**, 3274; 1939). This corresponds with a variation of dielectric constant of 2·10 to 78·55 (the widest so far reported in solubility work), and the results have been treated in the light of the interionic attraction theory and Born's theory of solvent interaction, in which the free energy of charging spheres of radius r in a medium of dielectric constant D is set equal to $Z^2e^2/2Dr$, where Z is the ionic valency and e the charge on the electron. This equation, even when corrected for interionic effects, fails to account for the variation of solubility with solvent, the predicted solubility in each case being too low. An empirical result, that the mean activity coefficient of an electrolyte in saturated solution is almost independent of the dielectric constant of the medium, is pointed out. The test of the Born equation applied was to determine whether the value of a, the effective ionic diameter, remained constant from one medium to another and was related to the solubility and dielectric constant according to an equation made up by combining Born's equation with the Debye-Hückel equation containing the simple correction for ionic diameter. This was not found to be the case. The questions of a changing with solvent and incomplete ionization of solute (for example, with barium iodate) are to some extent considered by the authors, but not the use of a more accurate equation for activity coefficients than the Debye-Hückel equation.

Chaulmoogra Oils

CHAULMOOGRA is the native name of the oil expressed from the seeds of the fruit of the *Taraktogenos kurzii*, and it has been used for centuries in Burma and India in the treatment of leprosy. The tree is widely distributed in Burma and is also found in Thailand (Siam), eastern Bengal and Assam. The gathering of the seeds is dangerous on account of wild animals, and as the fruit is no longer fresh when gathered the oil is of poor quality and is often adulterated. The name 'chaulmoogra' is also applied to any oil containing chaulmoogric acid, such as *Hydnocarpus wightiana* and *H. anthelmintica*. The latter occurs abundantly in Thailand, Cambodia, Cochin China and Laos, and has been successfully cultivated in Hawaii and the Belgian Congo; its seeds form an article of export to China, where they are known as Ta-fung-chi or Ta-feng-tzu. *T. kurzii* has also been acclimatized to Brazil. H. I. Cole and H. T. Cardoso (*J. Amer. Chem. Soc.*, **61**, 3442; 1939) find that chaulmoogra oil (from *T. kurzii*) keeps for years if expressed from dried fresh seeds and not from old seeds, and is non-irritating upon injection. They give the first quantitative analyses of oils from *H. anthelmintica* and *T. kurzii*, finding that they contain hydnocarpic, chaulmoogric, gorlic, oleic and palmitic acids as well as small amounts of lower homologues of hydnocarpic acid. They also give the physical and analytical characteristics of five chaulmoogra oils. One of these (from *O. echinata*) contained no hydnocarpic acid but was very rich in chaulmoogric acid. The true chaulmoogra oil contained the highest percentage of gorlic acid.

Prehistoric Copper

AT a meeting of the Newcomen Society held at the Iron and Steel Institute on February 14, Mr. H. H. Coghlan read a paper on "Prehistoric Copper and Some Experiments in Smelting". Native copper, he said, occurs as thin plates, or in massive form in crevices in the rocks. The latter form is very intractable to work, and it was the former that prehistoric man used for making such things as needles, awls, beads and chisels. These were made by cold-working. As to the discovery of the processes of tempering, melting and smelting, Mr. Coghlan thought that at some early date, say about 5000 B.C., small objects were made by hammering; then when tempering was discovered and understood, larger objects were made, followed by, first, the discovery of smelting, and then of melting. The discovery of the process of smelting from ore must have been accidental. Some thought it was due to ore melting in a camp fire. To test this theory, the author made experiments trying to reproduce the conditions likely to have obtained, but the result was negative. Taking the green carbonate malachite, he had subjected it to the heat of a charcoal fire, but all he obtained was black oxide of copper. The result led him to try smelting the ore in an arrangement in which the conditions were such as existed in the ancient pottery kiln, and in this experiment he obtained metallic copper in the form of well-shaped crystals. Mr. Coghlan concluded by discussing the problem of how malachite may have been used in connexion with pottery.

Constants of the Star-Streams

W. M. Smart and T. R. Tannahill have utilized the photographic proper motions of 18,323 stars in the zone −40° to −52° for the determination of the constants of the star-streams (*Mon. Not. Roy. Astro. Soc.*, **100**, 1; November 1939). The results of the analysis according to the two-stream theory are as follows:

	Drift i	Drift ii
R.A. of apex	88·0° ± 1·4°	303·6° ± 9·5°
Dec. of apex	−8·5 ± 0·6	−75·0 ± 13·5
Space velocities of drifts	1·463 ± 0·035	0·650 ± 0·035

The probable errors are small in the case of Drift i but they are not very satisfactory in the case of Drift ii. The vertex of the star-streaming is R.A. 271·5° ± 1·6°, Dec. −14·5° ± 2·0°, or, in galactic co-ordinates, long. 343·2° ± 1·0°, lat. −0·5° ± 1·7°. The vertex derived from the Cape proper motions is seen to lie on the galactic equatorial plane, but the longitude exceeds that derived by other methods by 16°, though it is almost exactly the same as Jackson's value. The equatorial co-ordinates of the solar apex are R.A. 265·1°, Dec. +26·1°; solar speed 0·879 astronomical unit. From the values of the stream-constants the ellipsoidal constants are calculated, and the results are compared with those obtained by Jackson from his analysis of the proper motions according to the ellipsoidal hypothesis. Those obtained by the first method are $G_0 = 334{\cdot}6° \pm 1{\cdot}2°$, $K/H = 0{\cdot}705 \pm 0{\cdot}002$, and the corresponding values found by Jackson are 343·6° and 0·59°; G_0 denotes the longitude of the vertex and K/H is the ratio of the minor axis to the major axis of the velocity ellipsoid. The authors show that a very close agreement between the two values derived by such dissimilar methods is not to be expected.

GLUTAMIC ACID OF PROTEINS

THE recent claim of Kögl and Erxleben[1] that the proteins of malignant tissues are partially racemized was based largely on the observation that the hydrolysates of such proteins, unlike those derived from normal tissues, contained glutamic acid which showed evidence of racemization, in some cases to a high degree. In our preliminary communication[2] we directed attention to the fact that we had been able to isolate the normal, unracemized, *l* (+) glutamic acid hydrochloride in good yield from three different samples of malignant tissue protein material, and suggested that a more extensive investigation was needed before Kögl and Erxleben's claim could be admitted. In reply, these latter workers[3], *inter alia*, produced evidence which they believed to show that our modified Foreman[4] method of analysis was unsuitable for demonstrating the presence of any racemized glutamic acid in protein hydrolysates, because the calcium salt of this acid is more soluble in 90 per cent alcohol than is that of the natural *l* (+) antipode, and also because the racemic hydrochloride is more soluble in either concentrated or 20 per cent hydrochloric acid than is that of the natural product.

Our own investigations have now led us to conclusions that are still at variance with those of Kögl and Erxleben, and a paper giving full details of our work has been submitted for publication in the *Biochemical Journal*. The points to which we wish to direct attention in this communication are as follow:

(1) The calcium salts of both the racemic and the *l* (+) glutamic acids are equally insoluble in 90 per cent alcohol, and the fact that our modified Foreman method of analysis is applicable to hydrolysates containing large amounts of the racemic acid follows from the data for the wheat protein gliadin given in the accompanying table.

Protein material	Method of analysis	Glutamic acid isolated		Yield of *d*(−) glutamic acid as per cent of protein
		Yield as per cent of protein	Percentage racemization	
Normal ox heart	Foreman	11·93	2·7	0·16
Normal calf lung	Foreman	8·70	1·8	0·08
Grafted sarcomata from mice	Foreman	8·34	2·7	0·11
Metastases from liver of a woman with carcinoma of colon (E.B.)	Foreman	10·28	4	0·22
Metastases from liver of a man with carcinoma of bronchus (W.V.)	Foreman	10·25	2·8	0·165
,,	Cuprous oxide: First crop	0·44	63·4	0·14
	Second crop	2·39	1	—
Gliadin	Direct as hydrochloride, followed by Foreman analysis	33·53	nil	—
		9·55	46	2·21

(2) When the method is applied to hydrolysates containing only a small amount of the racemized acid, the first two or three crops of hydrochloride isolated will consist almost exclusively of the *l* (+) antipode, and it is necessary to search the mother liquors to obtain evidence for the racemized product. What we believe to be well-nigh quantitative glutamic acid analyses of three malignant tumour and of two normal tissue protein preparations are given in the table. In all five cases the yield of total glutamic acid is high, but that of the unnatural *d* (−) antipode is very low, and there is no apparent differentiation between the two types of tissues. It is clear from these results that our failure to demonstrate the presence of the racemized acid in our earlier tumour analyses was due to the fact that the natural *l* (+) antipode was present in large excess.

(3) The above-mentioned results are not in keeping with those of Kögl and Erxleben. The latter workers, using the Dakin butyl alcohol procedure, have in two instances isolated products showing a high degree (80 per cent; 89 per cent) of racemization in yields that indicate 4·16 per cent and 3·69 per cent respectively of the *d* (−) antipode in terms of protein material taken for analysis. Nevertheless, in the majority of their analyses they have used the shorter, cuprous oxide, method of Abderhalden and Fuchs[5], and whereas from normal tissue materials the products isolated in yields of from 1·65 per cent to 5·0 per cent showed the normal rotation, those obtained from malignant tumour materials, in yields sometimes as low as 0·34 per cent, always showed a high degree of racemization (20–85 per cent). Because they had shown that the hydrochloride of the racemic acid was more soluble in concentrated hydrochloric acid than that of the natural antipode, they have assumed that the glutamic acid they failed to isolate from the hydrolysate would be racemized to at least the same degree, and have accordingly interpreted their results as showing the presence of the *d* (−) antipode in amounts comparable with those obtained from the two samples of malignant tissue mentioned above.

That this is not a valid interpretation follows from the results given in the table, which show that under the conditions of these cuprous oxide analyses the racemic glutamic acid hydrochloride may be preferentially salted out, even when the *l* (+) glutamic acid is present in very large excess. In the case quoted, the first crop by the cuprous oxide procedure, obtained in only 0·44 per cent yield, showed 63·4 per cent racemization, yet the companion Foreman analysis, which gave an overall yield of 10·25 per cent, showed only 2·8 per cent racemization.

These findings explain the apparently conflicting results recorded in the recent literature[6] and show that the interpretation of Kögl and Erxleben's cuprous oxide analyses must be based on the *yield* of the product isolated and not on its *percentage racemization*. A review of their data on this basis suggests that, except in three cases, the amount of *d* (−) glutamic acid present in the various malignant tumour hydrolysates was of the same order (0·5 per cent) as we ourselves have obtained from both malignant and normal tissue material, and much less than we have obtained from seed proteins, such as gliadin and edestin. We have, moreover, isolated

partially racemized aspartic acid from the hydrolysates of both types of animal tissue protein, and are thus led to conclude that racemization of amino acids is not a characteristic of malignancy.

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[1] Kögl and Erxleben, *Z. physiol. Chem.*, **258**, 57 (1939).
[2] Chibnall, Rees, Tristram, Williams and Boyland, NATURE, **144**, 71 (1939).
[3] Kögl and Erxleben, *Z. physiol. Chem.*, **261**, 154 (1939); Kögl and Erxleben, NATURE, **144**, 111 (1939); Kögl, Erxleben and Akkerman, *Z. physiol. Chem.*, **261**, 141 (1939).
[4] Foreman, *Biochem. J.*, **8**, 463 (1914).
[5] Abderhalden and Fuchs, *Z. physiol. Chem.*, **57**, 339 (1908).
[6] Arnow and Opsahl, *Science*, **90**, 257 (1939); Graff, *J. Biol. Chem.*, **130**, 13 (1939); White and White, *J. Biol. Chem.*, **130**, 435 (1939).

IN 1939, Kögl and Erxleben[1] reported the isolation from tumour proteins of amino-acids of the *d*-series, chiefly *d*-glutamic acid, and developed a new theory of the origin of malignant tumours based on the view that malignant growth depends upon the alteration of the proteins in tumour cells owing to the inclusion of racemized amino-acids. Chibnall *et al.*[2] failed to detect the unnatural form of glutamic acid in hydrolysates from tumour proteins. Graff[3] was also unable to reproduce Kögl's results. According to Kögl[4], the failure of these authors to obtain *d*-glutamic acid was due to the fact that they used a different method for its isolation. White and White[5] and Arnow[6] confirmed the results of Kögl in a small number of experiments, but Dittmar[7], who followed Kögl's technique for the isolation of glutamic acid, failed to detect the *d*-form of this acid in proteins from the growing parts of different types of sarcoma, though he was able to establish racemization of glutamic acid in the proteins from necrotic malignant tissue.

I have isolated glutamic acid from normal and malignant tissues by the method described by Kögl, due notice being taken of the technical details stated in his second paper. The experimental results are summarized in the accompanying table. As seen from these data, partial racemization of glutamic acid has been observed in a few cases in malignant tumours. In the majority of the tumours, however, no 'unnatural' glutamic acid was present. The extent of the possible loss of the *d*-form in the course of the isolation procedure was ascertained in an experiment in which 100 mgm. racemic glutamic acid were added to the hydrolysate from 5 gm. of dry muscle proteins. From this material 670 mgm. glutamic acid were obtained, with an amino nitrogen content of 7·51 per cent and 27·5° specific rotation. Thus 42·8 mgm. have been recovered from the 50 mgm. of *d*-glutamic acid added to the muscle protein hydrolysate. Further, we have recrystallized from 20 per cent hydrochloric acid 200 mgm. of a glutamic acid mixture with $[\alpha]_D = +24°$ made from 150 mgm. *d*-acid and 50 mgm. of the racemate. Upon recrystallization we obtained 174 mgm. glutamic acid with $[\alpha]_D = +25°$. These values show that the percentage of *d*-form lost in the course of isolation and purification of glutamic acid from protein hydrolysates by Kögl's method is low.

Our experimental data justify the conclusion that the presence of *d*(−) glutamic acid in tumour proteins is not a regular phenomenon attending malignant growth. Our present aim is to investigate the causes of the presence of *d*-glutamic acid in the hydrolysates from certain tumours. The data at our disposal for the present give no reason to associate this phenomenon with bacterial activity in the necrotized parts of the tumours, as suggested by Dittmar.

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Dec. 29.

[1] Kögl, F., and Erxleben, H., *Z. physiol. Chem.*, **258**, 57; **231**, 154, (1939).
[2] Chibnall, A. C., Rees, M. W., Tristram, G. R., Williams, E. F., and Boyland, E., NATURE, **144**, 71 (1939).
[3] Graff, *J. Biol. Chem.*, **130**, 13 (1939).
[4] Kögl, F., Erxleben, H., and Akkermann, A., *Z. physiol. Chem.*, **261**, 141 (1939).
[5] White, I., and White, M., *J. Biol. Chem.*, **130**, 435 (1939).
[6] Arnow and Opsahl, *Science*, **90**, 257 (1939).
[7] Dittmar, *Z. Krebsforsch.*, **49**, N. 4 (1939).

GLUTAMIC ACID FROM NORMAL AND MALIGNANT TISSUES.

Source of tissue	$[\alpha]_D$	Amino-nitrogen (per cent)	Weight of hydrolysed material (gm.)	Amount of isolated glutamic acid (mgm.)	Notes
Normal rabbit's muscle	+ 31·50°	7·51	—	—	
,, ,, blood	+ 31·0	7·31	—	—	
Muscle from rabbit affected with Brown-Pearce carcinoma	+ 31·0	7·3	—	—	
Blood from rabbit affected with Brown-Pearce carcinoma	+ 31·3	7·76	—	—	
Brown-Pearce carcinoma	+ 26·5	7·67	67	180	No visible necrosis
,, ,, ,,	+ 31·0	7·8	63	215	,, ,, ,,
,, ,, ,,	+ 31·5	7·31	60	185	,, ,, ,,
,, ,, ,,	+ 31·0	7·4	62	335	Slight necrosis
Rous chicken sarcoma	+ 27·0	7·31	28	90	No visible necrosis
Krichevsky-Sinelnikow rat sarcoma	+ 31·5	7·34	40	150	,, ,, ,,
Methylcholanthrene sarcoma (rat)	+ 22·0	7·53	20	130	,, ,, ,,
,, ,, ,,	+ 31·5	7·45	26	98	,, ,, ,,
Liver of rats painted with *o*-amino-azotoluene	+ 31·5	7·6	—	—	

RELEVANT to the discussion which has taken place recently between Chibnall[1] and Kögl and Erxleben[2,3] are some facts which I have accumulated in an analysis of gliadin. Kögl and Erxleben find that the glutamic acid derived from the proteins of malignant tissue is partially racemized and suggest that this might be a characteristic of such proteins. Chibnall found tumour proteins to contain the bulk of their

glutamic acid in the ordinary active form with $[\alpha]_D + 31{\cdot}6°$ in 9 per cent hydrochloric acid, and he thought that any racemization was incidental to the methods employed in its isolation. The work described here indicates that a vegetable protein such as gliadin also contains part of its glutamic acid in a racemic form, and that it is probably a general characteristic of proteins and not of special significance for the proteins of tumours.

600 gm. air dry protein (91·6 gm. nitrogen) were hydrolysed for thirty-six hours with 30 per cent sulphuric acid, the acid removed with baryta, and the barium salts of the dicarboxylates precipitated by adding 3 vols. of 95 per cent alcohol. This precipitate was dissolved in dilute hydrochloric acid, freed from barium, and saturated with hydrochloric acid gas. Five crops of glutamic acid hydrochloride were precipitated, with characteristics as shown in the accompanying table.

It was thought that this might be the derivative obtained from *d-l*-glutamic acid and so a sample of *l*(+)-glutamic acid was racemized by boiling a 0·4 *M*. solution in normal caustic soda for 130 hours until the specific rotation was zero. The free amino-acid was isolated, but still yielded the 3 : 5 dinitrobenzoyl derivative m.p. 104°.

It is thus not 3 : 5 dinitrobenzoyl *d-l*-glutamic acid.

The free acid is only sparingly soluble in hot water, and its equivalent weight by titration against standard baryta is 144. The copper salt is easily soluble in water and it sets to a glass on evaporation. Its rate of ring closure at *p*H 4 to form pyrrolidonecarboxylic acid is almost identical with that of known glutamic acid. On oxidation with free hypochlorous acid it yields succinic acid. All these factors confirm the belief that it is a glutamic acid.

Samples of the 3 : 5 dinitrobenzoyl compounds,

TOTAL NITROGEN PRECIPITATED AS DICARBOXYLATES 24·6 GM.

Crop	Wt.	m.p.	Wt. as free glut. acid	% N	% Cl	Rotation 4% aq. soln.	Gm. N in fraction	m.p. of 3 : 5 dinitrobenzoyl. deriv.	Yield of deriv.
1	225·0 gm.	207°	181·0 gm.	7·55	19·40	+ 25·0°	17·0	104°	40·0%
2	15·0 gm.	203°	12·1 gm.	7·40	19·48	+ 20·8°	1·0	104°	40·0%
3	7·5 gm.	203°	6·0 gm.	7·43	19·5	+ 19·1°	0·55	104°	39·4%
4	7·0 gm.	202°	5·6 gm.	7·40	19·4	+ 24·0°	0·53	104°	38·1%
5	3·0 gm.	175°	2·4 gm.	7·45	19·3	+ 5·8°	0·23	203°	51·6%
	Isolated in subsequent fractions		6·0 gm.				19·31 gm. 0·59 gm.N.	104° 203°	3·0% 58·0%

All five fractions were converted to 3 : 5 dinitrobenzoyl derivatives with the results indicated—the first four fractions yielding a derivative having m.p. 104°; the last crop a 203° m.p. derivative. Both derivatives analyse as for 3 : 5 dinitrobenzoyl glutamic acid, but the 104° derivative crystallizes with one molecule of water, whereas the 203° derivative is anhydrous.

The mother liquors from the precipitation of glutamic acid hydrochloride (4·4 gm. nitrogen) were reprecipitated with baryta and alcohol, giving a precipitate (2·34 gm. nitrogen) and a filtrate (2·02 gm. nitrogen of which 0·55 gm. nitrogen was present as NH_3). The precipitate was freed from barium, converted to copper salt to separate aspartic acid and then subjected to Dakin's treatment in order to see if any hydroxyglutamic acid was present. None was found, but the silver precipitate and the silver filtrate together yielded another 6 gm. of a glutamic acid which gave a 3 : 5 dinitrobenzoyl derivative, m.p. 203° (≡ 0·57 gm. nitrogen).

The copper aspartate which looked a homogeneous blue crystalline mass was also examined, and from it by crystallization there was obtained 2·35 gm. of glutamic acid and 2·25 gm. aspartic acid. It would thus appear as if the copper salt were a double salt of copper aspartate and copper glutamate (1 : 1), as the 4·86 gm. of amino-acid obtained from it would require to be in the ratio 2·55 gm. glutamic acid : 2·31 gm. aspartic acid. This glutamic acid also yielded a 3 : 5 dinitrobenzoyl derivative m.p. 203°.

There is thus the curious fact that the first four fractions of glutamic hydrochloride yield a 3 : 5 dinitrobenzoyl derivative which crystallizes with 1 H_2O and has m.p. 104°. Fraction 5, however, yields a derivative, crystallizing without water, m.p. 203°, and all the subsequent fractions yield the 203° m.p. derivative.

m.p.'s 104° and 203°, were next hydrolysed by heating in a sealed tube at 120° for eight hours. The specific rotations determined in micro-polarimeter tubes indicated that the 104° derivative yielded an amino-acid having $[\alpha]_D$ in 9 per cent hydrochloric acid + 13·5°; whereas the 203° derivative gave an amino-acid with $[\alpha]_D - 2°$. As the rotation observed was only −0·14° in a somewhat cloudy solution, it might well be that the solution was inactive.

The amino-acids obtained by hydrolysis of the 3 : 5 dinitrobenzoyl compounds were re-benzoylated, and this time both yielded the derivative m.p. 203°.

It appears to me that the probable explanation of these facts is that the glutamic acid obtained by hydrolysis of the protein contains, besides *l*(+)-glutamic acid, some racemic glutamic acid; and as *d-l*-glutamic acid yields the derivative m.p. 104°, this racemic acid is probably not an artefact but a definite hydrolysis product. It is important to remember that this *d-l*-glutamic acid received violent treatment (boiling for 130 hours with normal sodium hydroxide) in comparison with that accorded to the natural glutamic acid. However, to complete the investigation a study of the equilibrium conditions for the reaction

$$d\text{-}l \text{ (mixt.)} \rightleftharpoons \text{racemic (compd.)}$$

is being undertaken both for glutamic acid itself and for its 3 : 5 dinitrobenzoyl derivatives.

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[1] NATURE, **144**, 71 (1939).
[2] *Z. physiol. Chem.*, **258**, 57 (1939).
[3] NATURE, **144**, 111 (1939).

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX

ANNUAL REPORT

THE Association of Special Libraries and Information Bureaux arranged to hold its sixteenth annual conference at University College, Nottingham, during September 15–18, 1939. Owing to the War, the meeting did not take place, but a report including the papers which were to have been presented together with the Council's report on the year's work of A.S.L.I.B. 1938–39 and a report of the fourteenth annual general meeting held on November 24, 1939, has now been issued*. The report indicates that the membership stands at 334 as against 325 in the previous year, and the financial position continues to restrict the activities of the Association. One hundred and eight translators are now registered, but this service is not nearly so widely used as it should be. At the annual meeting, the chairman emphasized that under war conditions the need for a clearing house for information is accentuated and the Council aims at keeping the work of the Association going as normally as possible.

Of particular interest to scientific workers are the papers dealing with "Thesis Literature" by Colonel Luxmoore Newcombe, of the National Central Library, Mr. Watson Davis and M. Julian Cain. Colonel Newcombe, dealing with the accessibility of British university thesis literature, emphasizes the need for more information about such theses, to which we have no adequate guide. The accessibility of theses for consultation or loan is discussed and some details are given of existing catalogues in university libraries and the collections of foreign theses in such libraries. Colonel Newcombe also discusses the feasibility of compiling and publishing a national guide to these theses, as well as the advisability of each university filing in its library two copies of each unpublished thesis accepted for any degree. The compilation of such a catalogue of unpublished theses in each university library, and the collection in one library, possibly the National Central Library, of copies of published foreign theses, which would be available for loan, also require consideration.

Mr. Watson Davis, in his paper dealing with the accessibility of the thesis literature of the United States, emphasizes the service which the American Documentation Institute is able to offer for obtaining American dissertations on microfilm in co-operation with the libraries and institutions concerned. M. Julian Cain's notes on thesis literature in France describe the centralization of such theses in the Library of the University of Paris (Sorbonne). A complete set is sent to each university library in France annually and to all foreign libraries participating in the exchange scheme.

A paper by G. S. Fulcher discusses the value of author's abstracts as an aid to documentation and advocates the extension of this system, preferably through some organization such as the International Federation of Documentation. Dr. L. A. Sayce contributes a paper on microphotography in 1939 in which he refers to the research work proceeding at King's College, Newcastle-on-Tyne, and the need for a central library, preferably in London, to take the lead in Britain by establishing a well-equipped micro-copying bureau.

Papers of more general interest are those in which Sir Harry Lindsay describes the work of the Imperial Institute as an information centre ; Mr. Guy Pocock describes the libraries and information bureau of the British Broadcasting Corporation, and Mr. Thomas Baird discusses the cinema and the information services, in which he emphasizes the important educational work the cinema could render in wartime conditions, notably in evacuation problems.

* Report of the Proceedings of the Sixteenth Conference, organized to be held at Nottingham University College, September 15th to 18th, 1939. Pp. 92. (London : A.S.L.I.B., 1939.) 5*s*.

LEVEL MEASUREMENT AND CONTROL

AN important class of instruments among those required for scientific purposes as well as for the many accurate measurements which are now an essential feature in industrial and engineering undertakings is that which is designed for indicating, recording and controlling liquid levels. Many devices have been adopted for these purposes, one being the employment of compressed air which is arranged to be slowly discharged through an open tube the end of which is submerged in the liquid. As the head of liquid above the open end varies, so does the pressure of air, thus giving an indication of the level. Instruments of this type are suitable for almost any fluid and give single or multi-point readings, or they may be adapted for continuous records. Where the provision or use of an air supply presents difficulty or is undesirable for special reasons, depth indicators and level recorders may be of the self-contained pressure bulb type. The bulb is installed at the zero of the level to be measured and is connected by tubing to the instrument, which may be at any desired height above or below the liquid and at any reasonable distance from it.

For tanks the mercury column can be conveniently employed, and a precision type of instrument based on this principle is capable of an overall accuracy of 0·005 of an inch of mercury. Instruments for level and depth alarm or control are of pneumatic or electrical types and, at maximum or minimum or both, they operate bells, klaxon horns or pilot lights to give warning or regulate a diaphragm control valve so as to maintain any desired level. The

pneumatic principle can be applied also to measure the specific gravity of liquids of variable density by two standpipes connected to a differential pressure indicator or recorder. In a list recently issued, Messrs. Negretti and Zambra, who have wide experience in the manufacture of instruments of these types among many others, have supplemented the illustrations with accessory schedules and diagrams showing how the several models are employed and connected under different conditions of service. More than a catalogue, it is thus a handbook for the reference of those responsible for the selection and installation of level measuring instruments.

THE PUBLIC HEALTH IN WAR-TIME*

IN every war of which we have records the wastage from disease has outnumbered many times the losses from killed and wounded. Figures from the War of 1914–18 support this statement, as well as the experience of the Walcheren expedition and the Crimean campaign.

Military and civil authorities are both interested in the maintenance of the public health in war-time. Military and civilian health authorities successfully co-operated in this respect during the War of 1914–18, and similar arrangements have been made in the present war.

While indirect war consequences, such as alterations in diet, excess of work and worry and the pandemic of influenza (1918–19), contributed to increased rates of mortality among civilians in the War of 1914–18, the record of civil public health was good on the whole. The population increased and the infant mortality rate was lowered. It must be remembered that that War saw the beginnings of those personal health services which have done so much to improve the health of the community; for example, the School Medical Service (1907), the Insurance Medical Service (1912), the Tuberculosis, Maternity and Child Welfare and Venereal Disease Services. It is a harder task in the present War to maintain the health services at the high level they have reached. In addition, unprecedented demands have been made on the national health services. The central health authority has become a more important arm of defence, and has had to organize an emergency medical service, in itself a stupendous task, and an evacuation scheme for school children, expectant mothers young children and other priority classes of the population.

An account of the emergency medical service and of the medical problems of the evacuation scheme was also given.

Certain criticisms of the evacuation scheme were discussed. It was emphasized that the Public Health and School Medical Services should not be blamed for departures from the normal standards of cleanliness and conduct found in certain of the evacuees. The root cause of these conditions lies in the home. They mean that slum clearance has not yet gone far enough, that low standards of living still persist, and that the lessons taught in the school and clinic sometimes fail to reach the older generation.

It was suggested that the policy of preparing for casualties and of evacuation may have played no inconsiderable part in the present freedom of Great Britain from enemy air raids.

Reference was made to certain diseases—deficiency diseases, tuberculosis, venereal diseases, influenza, infectious diseases, cerebrospinal fever—which are the objects of special concern in this War. The civilian arm has yet to receive its baptism of fire. If that stern ordeal comes, it will endeavour to keep the flag of national health flying in the storm of war as zealously as it did in the sunshine of peace.

* Substance of a Chadwick Public Lecture delivered on February 20 by Sir Arthur MacNalty, K.C.B., Chief Medical Officer of the Ministry of Health.

HAULAGE PRECAUTIONS IN MINES

OF the deaths caused by haulage accidents in mines, the fact that over a period of eight years nearly 25 per cent were due to runaway tubs is sufficiently serious to indicate this as a subject demanding inquiry. One of the lines of research undertaken in this connexion was to determine the relative degree of effectiveness of the different types of backstay which are used as one means of arresting potential runaways. The backstay, which is known by several local names, is a strong steel bar which trails along the rail track at the rear of the string of tubs, its function being to dig into the track if the train tends to run back. Frequently its action is ineffective, and this led to one line of research being directed by the Department of Mines towards ascertaining the chief causes of the failures and the ways and means of preventing them by improving the design of this simple safeguard. The results of this investigation have now been published under the title "Backstays for use in Mines" (Safety in Mines Research Board Paper No. 103. H.M. Stationery Office. 1*s.* net), which describes all the steps taken and results obtained and makes available to the coal mining industry the conclusions reached.

Representative types of backstays having been obtained from several coalfields, these were examined for variations in design. They were classified in four groups, the classification mainly depending on the method of attachment to the tub. In other respects very marked differences were noted; length varied from 23 to 42 inches and weight from 9¾ to 72 lb. They were subjected to a number of tests under conditions simulating those which might actually

occur when tubs are on an incline, such as allowing tubs to run back for some feet before the stay is free to operate, or being bumped into by a runaway. The results of the several tests are recorded in relation to the four different groups of the original classification. From these it was possible to draw conclusions as to a suitable mode of attachment, safe limits of length, weight and cross-section and general construction. It is interesting to note that the ideal length is about that of the longest stay examined and its weight should be about 40 lb.

The metallurgical and mechanical tests of the materials used in the sample stays showed that they have usually been made of soft steel and therefore have been relatively weak and easily bent. The report recommends that high quality steel should be used, preferably 1·5 per cent manganese steel as previously suggested for colliery haulage drawgear.

In addition to the details of the investigation, the paper gives the analysis of the problem in relation to different numbers of tubs on various inclines. The formulæ published should be of considerable assistance in checking the sizes required under any given conditions.

TRANSVERSE DISTRIBUTION OF HORMONES IN PLANTS

By E. D. Brain

"THE relation between various types of hormone distribution is the internal regulating mechanism of a plant." This conception underlies the theory of the transverse reactions of plants which Georg Borgström discusses in a recent publication[1]. He emphasizes the physiological importance of transverse hormone distribution in relation to polar transport. Starting from the discovery that treatment with ethylene upset the normal transport of auxins and caused a transverse flow out of the phloem into the surrounding tissue with consequent swelling of the cells, Borgström studied various natural conditions which produced similar effects. He found that light of short wave-lengths, high humidity, high and low temperature, action of specific chemical substances, mechanical stimulation of the phloem and the age of the plant organ were factors which influenced the direction of auxin distribution, by diverting the normal polar stream into transverse channels with resulting reaction in the plant. Among these "transverse reactions" of the plant he classes tropistic growth responses, the light-growth reaction, secondary growth, root formation, root contraction, water transport, fruit development and leaf fall. He also discusses various other physiological and morphological problems in the light of his theory and suggests that the transverse distribution of hormones is responsible for various ecological types; the strength of the reaction being governed by the extent to which normal growth is upset by the transverse effect.

It is impossible to discuss here the numerous applications of the transverse theory, but I propose to deal with Borgström's interpretation of the mechanisms of photo- and geo-tropism, which is in some way illustrated by my own work on geotropism[2]. According to Borgström, light induces lateral hormone transport which increases the transverse growth of cells of the cortex and retards their elongation on the light side of the stem. Histological studies by various workers have endorsed this, and Borgström's measurements for cells of the cortex in Pisum stems and Lupinus and Helianthus hypocotyls, when submitted to unilateral illumination, show marked increase in width and decrease in length on the illuminated side. A transverse growth effect is therefore included in the mechanism of phototropic curvature. What has been termed as increased sensitivity in the dark can also be explained as the normal elongation proceeding without interference from transverse light effects. A study of geotropically curved stems shows increased width of cells on the lower side, accompanied by elongation due to the accumulated auxin from the transverse effect of gravity. In the root the same distribution takes place but, since auxin inhibits growth, the lower side is retarded and positive curvature results. In my investigations on the growth of plants for prolonged periods on a klinostat, I have found histological changes which indicate the resultant of processes which would normally produce curvature. In hypocotyls of *Lupinus albus*, marked increase in the radial walls of the cortical cells was noted, and in radicles, cells of the cortex were much shorter in longitudinal section but only slightly smaller in transverse section. It appears as if radial extension is the predominant factor in negative curvature of the stem, whereas in roots the inhibition is more in the longitudinal direction. Reaction of shoots and roots is different and it seems doubtful if the transverse effect can be so complete an explanation of positive geotropism as Borgström suggests.

Besides seedlings, flowers and leaves of *Narcissus pseudo-narcissus* and fronds of *Asplenium bulbiferum* were grown on the klinostat. In Narcissus flowers no bend in the receptacle occurs on the klinostat but, at the stage when the bud bends normally, changes occur in the outer layer of cells. The difference in length of the dorsal and ventral halves of curved flower stalks has been explained by Zollikofer[3] as being due to the unequal elastic pressure of the two halves, as a result of unequal growth hormone distribution. On the klinostat the normally unequal distribution would be equalized and alteration in the elastic pressure might result, causing the tangential stretching of cells which are compressed when bending occurs normally. It is significant that these changes coincide with a maximum development of statoliths in the receptacle, which points to the possibility of some link between the statolith apparatus and the bending mechanism.

In Narcissus leaves the epidermal cells are shorter and there is a greater number of stomates on both the inner and outer surfaces of the leaves grown on the klinostat. The cells of the cortex of *Asplenium bulbiferum* fronds are much wider radially

and shorter on the klinostat than in upright plants. On the klinostat there is less sclerenchyma formed. The walls of the sclerenchymatous cells are much thinner and the cells are half as long and more than twice as wide as in upright fronds. Heyn[4] has shown that geotropic stimulus causes changes in the plasticity of cell walls as a result of auxin redistribution. In this case the continual transverse auxin supply prevents the cells ageing and losing their plasticity, and the formation of sclerenchyma is retarded. In all cases examined, no difference was found in the distribution of starch and statoliths in plants on the klinostat. Borgström questions the idea of the statolith mechanism and geotropic reaction being causally related. He considers that it is the transverse distribution of auxin caused by gravity which increases the mobility of the starch grains and facilitates their falling, at the same time inducing differential growth of longitudinal and transverse cell walls. From experiments with onion and oat roots he shows that auxin activates diastatic processes and accelerates the transformation of starch into sugar, and he assumes that it is a transverse distribution of auxin which causes the disappearance of starch from developing tissues, making sugar available for growth purposes. Should this be so, one would expect to find that an artificially induced transverse distribution would change the distribution of starch in klinostat plants.

It is clear that a change in the direction of auxin distribution may alter the plasticity of cell walls and lead to definite changes in plant tissues. The possible applications of this theory offer wide scope to the research worker in many problems of plant physiology and morphology.

[1] Borgström, Georg, "The Transverse Reactions of Plants: Outlines of a New Interpretation of the Significance of Growth Hormones for Life-Processes in Plants". Pp. 230. (Lund: C. W. K. Gleerup; Copenhagen: Ejnar Munksgaard; London: Williams and Norgate, Ltd., 1939.) 6.00 kr.
[2] Brain, E. D., *New Phytol.*, **38**, 3 (1939).
[3] Zollikofer, C., *Ber. deutsch. Bot. Ges.*, **53**, 152–157 (1935)
[4] Heyn, A. N. J., *Jb. wiss. Bot.*, **79**, 753–787 (1934).

THE SCATTERING OF WAVES IN RADIO TRANSMISSION

FOR many years past, the mode of propagation of radio waves through the ionosphere has been studied intensively by mathematicians, physicists and radio communication engineers. It is now well known that all long-distance communication takes place by deflection of the waves in one or other of the ionized regions of the atmosphere, and furthermore that, depending upon the density of ionization of any particular region, there is a maximum frequency of the waves which will be deflected and above which the waves penetrate the region and are not returned to the earth. This critical penetration frequency increases with the angle of incidence of the waves on the ionosphere. Thus, while the general features of long-distance radio transmission can be interpreted in terms of a simple ray treatment of the waves passing from the earth up to the ionosphere and back to the earth, there is a minimum distance from the sending station at which signals can be received by this mode of propagation. This 'skip' zone or distance, as it is termed, is naturally subject to diurnal and seasonal variations, as well as to the actual frequency used in the transmission.

Although all normal commercial communication takes place by the transmission of waves to ranges beyond the skip zone, it has been known for some time that, inside this zone, signals may be received more or less spasmodically, these signals being very irregular and subject to large variations in both intensity and direction of arrival at the receiving station. This type of reception has been interpreted as being due to the scattering of waves from local irregular portions or clouds in the ionosphere, where the intensity of ionization is such as to give rise to a diffuse reflection of the waves in all directions.

In a paper read before the Wireless Section of the Institution of Electrical Engineers on February 7, Mr. T. L. Eckersley presented an analysis of the effect of scattering in radio transmission. The earliest experimental evidence of scattering was obtained from observations at Chelmsford in 1927, when the short-wave beam stations were first opened. In general, such scattered signals within the skip zone gave no definite bearing indication on a direction-finder unless the sending aerial emitted a directive beam, in which case the apparent direction of travel of the waves was approximately the opposite to that in which the beam of rays was projected. In later work, it has been possible to measure the time delay of the scattered signals in relation to the ground or direct ray, and also in some instances to the normal echoes received after one or two reflections from the *F* region of the ionosphere. The scattered echoes are of relatively low intensity and thus only become suitable for quantitative observation when a high-power transmitter is available, and the use of a pulse modulation makes possible the measurement of the time of arrival of the individual echoes.

Photographic records demonstrated by Mr. Eckersley showed that the scattered echoes have a moderately well-defined minimum time of arrival, but beyond this, the received echoes are spread over a considerable period in an irregular manner. A complete investigation of the phenomena showed that the cause of such scattering lies in momentary irregularities and small clouds in the *E* region of the ionosphere. Since the wave frequencies employed were generally much greater than the critical frequency of the *E* region, the path of transmission from the sender involved penetration of this region, reflection at the higher *F* region, followed by scattering from the upper side of the *E* region, and so by a second reflection from the *F* region back to the receiving station on the ground. The time delays of the echoes fits in with this explanation, and the fact that the average intensity of the scattered signals varies approximately as the fourth power of the wavelength is in accordance with the scattering coefficient of ionic clouds in the *E* region.

The effect of scattering is of major importance in the analysis of long-distance radio transmission phenomena, and the results of the investigation described in the paper referred to do much to increase our knowledge of the subject and our understanding of the mechanism by which the scattering is produced.

R. L. S-R.

SEVENTY YEARS AGO

NATURE, vol. 1, February 24, 1870

The Minister of Public Instruction

REFERENCE is made in a leading article to the Education Bill, the first reading of which was taken in the House of Commons "last week". The reception given to the Bill suggests that a Minister of Public Instruction will shortly be appointed.

"Such a Minister should, we think, take charge of the whole range of natural knowledge in all matters in which the State in any way intervenes to advance such knowledge. We understand the comprehensive term natural knowledge to include Education, Science, the Fine Arts, and Music. . . . The Education branch would include the national system of compulsory primary education about to be established, public schools, universities. . . . The Science branch would include all establishments, in receipt of Government assistance, in which Science is taught as a special study; all those in which scientific observations or investigations are conducted under State auspices, and all museums in which natural objects are displayed for scientific purposes. . . . The first step towards organizing this branch of knowledge must be by collecting facts and opinions relating to it. This step can only be taken through the agency of a Royal Commission instructed to give the widest possible scope to its inquiries into everything relating to both Instruction and Investigation in Science."

"A DEPUTATION consisting of Earl Fortescue, the Right Hon. C. B. Adderley, Dr. Farr and others, had an interview with Mr. Shaw-Lefevre at the Board of Trade on Saturday to recommend the legislation of metric weights and measures in the Post Office, and the legal substitution of metric weights for the troy weight which the Standard Commissioners propose to abolish."

"WE have to record the decease of Mr. J. F. Sowerby, so well-known in connection with the illustration of botanical works, especially the new edition of the English Flora, edited by Mr. J. Boswell-Syme, now nearly completed."

"A METHOD of protecting iron from atmospheric influences has been proposed by Messrs. Macmillan and Macgregor, of Dumbarton and Glasgow. They bring melted sulphur into contact with the cold metallic surface to be coated. The sulphur chills and sets into a hard, thin, protecting cover."

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

RESIDENT HEADMISTRESS of the Royal Masonic School for Girls, Rickmansworth Park—The Secretary, Royal Masonic Institution for Girls, 31 Great Queen Street, Kingsway, W.C.2 (March 1).

CHIEF CHEMICAL INSPECTOR, Chemical Inspection Department, Royal Arsenal, Woolwich—The Ministry of Supply (S.E.3.B.), The Adelphi, W.C.2 (quoting Appts. 021/S.E.3.B.) (March 4).

LECTURER IN BACTERIOLOGY, Royal Veterinary College, and RESEARCH ASSISTANT in the Research Institute in Animal Pathology—The Bursar, Royal Veterinary College, The University, Reading (March 9).

HEADMISTRESS of the County School for Girls, Gravesend—W. A. Clench, Bank Chambers, Windmill Street, Gravesend (March 11).

PROFESSOR OF MECHANICAL ENGINEERING—The Secretary, The University, Birmingham (April 20).

PART-TIME TEACHER IN CHEMISTRY—The Head of the Department of Chemistry and Biology, The Polytechnic, Regent Street, W.1.

CIVILIAN WIRELESS INSTRUCTORS at the Electrical and Wireless Schools, Royal Air Force—The Under-Secretary of State (S.5.D.), Air Ministry, Adastral House, Kingsway, W.C.2.

ASSISTANT MECHANICAL ENGINEERS for the Electrical Branch, Public Works Department of the Government of Nigeria—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9067).

MECHANICAL AND ELECTRICAL ENGINEER for the Public Works Department of the Government of the Gold Coast—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9120).

TWO ASSISTANT ENGINEERS—The Engineer, Nene Catchment Board, Priestgate, Peterborough.

TEMPORARY FORECASTERS, Grade II (Male) in the Meteorological Office—The Under-Secretary of State, S.2.B.(Met.), Department Q.A., Air Ministry, Adastral House, Kingsway, W.C.2.

HEADMASTER of the Sydney Grammar School, Sydney, New South Wales—The Agent-General for New South Wales, 125 Strand, W.C.2, or The Secretary to the Trustees, Sydney Grammar School, Sydney.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Royal Commission on the Distribution of the Industrial Population. Report. (Cmd. 6153.) Pp. x+320. (London: H.M. Stationery Office.) 5*s*. net. [62

University of Leeds: Department of Coal Gas and Fuel Industries, with Metallurgy. Report of the Livesey Professor (D. T. A. Townend) for the Session 1938–39. Pp. 18. (Leeds: The University.) [72

Mines Department. Eighteenth Annual Report of the Secretary for Mines for the Year ended 31st December 1938, and the Thirty-first Annual Report of H.M. Inspector of Mines for the same Period, with a Statistical Appendix to both Reports. Pp. xx+271. (London: H.M. Stationery Office.) 4*s*. net. [72

Father and the Family. Pp. 12. (London: National Baby Welfare Council.) 2*d*. [82

Mines Department. Report of the Committee on the Emergency Conversion of Motor Vehicles to Producer Gas. Pp. 27+2 plates. (London: H.M. Stationery Office.) 9*d*. net. [82

Tenth Annual Reports of the National Radium Trust and Radium Commission, 1938–1939. (Cmd. 6161.) Pp. 30. (London: H.M. Stationery Office.) 6*d*. net. [92

Smoke Abatement in Wartime. Pp. 12. (Epsom: National Smoke Abatement Society.) [92

Transactions of the Zoological Society of London. Vol. 24, Part 7: The Mammals of the North Cameroons Forest Area; being the Results of the Percy Sladen Expedition to the Mamfe Division of the British Cameroons. By Ivan T. Sanderson. Pp. 623–726+22 plates. (London: Longmans, Green and Co., Ltd.) 50*s*. [122

Other Countries

Smithsonian Miscellaneous Collections. Vol. 99, No. 1: Sketches by Paul Kane in the Indian Country, 1845–1848. By David I. Bushnell, Jr. (Publication 3553.) Pp. ii+25. (Washington, D.C.: Smithsonian Institution.) [12

Proceedings of the United States National Museum. Vol. 87, No. 3075: A Taxonomic Study of Neotropical Beetles of the Family Mordellidæ, with Descriptions of New Species. By Eugene Ray. Pp. 271–314. (Washington, D.C.: Government Printing Office.) [22

Report of the Danish Biological Station to the Ministry of Agriculture and Fisheries. 43, 1938: On the Migrations and the Racial Character of the Plaice. By Erik M. Poulsen. Pp. 80. (Copenhagen: C. A. Reitzel.) [62

New Zealand State Forest Service. Misc. Series No. 1: Forestry in New Zealand. Pp. 24. (Welington: Government Printer.) [62

Gold Coast Colony. Report on the Gold Coast Survey for the Year April 1938 to March 1939. Pp. 10. (Accra: Government Printing Department; London: Crown Agents for the Colonies.) 1*s*. [62

Field Experiments on Sugar-Cane in Trinidad. Annual Report for 1939. By P. E. Turner. (Published by the Sugar-Cane Investigation Committee.) Pp. 262. (Trinidad: Government Printing Office.) [62

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 204: Flax in Egypt. Part 1: Research and Culture. By Dr. M. A. El Kilany. Pp. 4+32+10 plates. P.T. 3. Bulletin No. 215: Jute and Kindred Fibres in Egypt—Research and Culture. By Dr. M. A. El Kilany. Pp. 6+22+12 plates. P.T. 3. (Cairo: Government Press.) [122

Publications of the South African Institute for Medical Research. No. 45: A Study of Experimental Tissue Reactions following Intravenous Injections of Silica and other Dusts. By F. W. Simson and Dr. A. Sutherland Strachan. Pp. 95–122+25 plates. (Johannesburg: South African Institute for Medical Research.) [122

Annals of the New York Academy of Sciences. Vol. 39, Art. 4: American Cities and States; Variation and Correlation in Institutions, Activities, and the Personal Qualities of the Residents. By Edward L. Thorndike. Pp. 213–298. (New York: New York Academy of Sciences.) [122

Field Museum of Natural History. Anthropological Series, Vol. 31, No. 1: Anthropometric Observations on the Eskimos and Indians of Labrador. By T. Dale Stewart. Material and Data collected by William Duncan Strong. (Publication 462.) Pp. 164+16 plates. (Chicago: Field Museum of Natural History.) 1.75 dollars. [122

OFFICIAL ANNOUNCEMENTS

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A Course of ten lectures on PROBABILITY THEORY IN RELATION TO STATISTICS will be given by Professor H. Levy, D.Sc., F.R.S.E., in the Royal College of Science, Imperial Institute Road, South Kensington, S.W.7, commencing Wednesday, February 28, at 2.15.

The Course is free to Internal Students of the University, on application to the Registrar; for others a fee of one guinea will be charged. All applications should be made to the Registrar, Imperial College, South Kensington, S.W.7.

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METEOROLOGICAL OFFICE

Applications are invited for appointment as Temporary Forecasters, Grade II (Male), in the Meteorological Office. Candidates must be between 23 and 35 years of age.

Candidates must have reached their 23rd birthday but not their 35th birthday on January 1, 1940. Candidates must pass a Science Degree, preferably with physics, or applied mathematics, or meteorology. The possession of an Honours degree will be an advantage.

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Candidates should apply for an application form by post card to the Under Secretary of State, S.2.B. (Met), Department Q.A., Air Ministry, Adastral House, Kingsway, W.C.2.

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Further particulars may be obtained from:

C. G. BURTON,
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The University,
Birmingham.
February 1940.

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