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"To the solid ground
Of nature trusts the Mind that builds for aye."—WORDSWORTH.

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Vol. 145 SATURDAY, JANUARY 13, 1940 No. 3663

UTILIZATION OF SCIENTIFIC MAN-POWER

THE concern which has recently found expression as to the position of science in the war effort of Great Britain, and the extent to which the services of scientific workers are being utilized, is evidence that the importance of this contribution is recognized far beyond the ranks of scientific workers themselves. The apparent tardiness with which the maximum contribution of science is being developed in the war-time effort of Great Britain has caused much questioning, and it is to be hoped that the activities of the newly appointed Advisory Council on Scientific Research and Technical Development will quickly overcome at least some of the obstacles which have appeared.

Political and Economic Planning (P E P) published a year ago an admirable broadsheet on "Man-Power Policy" in which four principles were laid down as essential and suggestions made for giving effect to them. It has now published a review of the present situation and its relation to economic policy under the title "Industrial Man-Power", in which the effect of expansion and contraction in industry in war-time is considered. The table showing the changes which have occurred in certain industries between 1923 and 1938 in Great Britain and Northern Ireland suggests that the great 'dilution' problem of the War of 1914–18 may be of much less importance to-day, since there now exists a range of metal trades already staffed for munitions, without the need to create them afresh.

This factor particularly affects the position of women, and it is accordingly unlikely, in view of the work already carried out under the Industrial Health Research Board and the National Institute of Industrial Psychology, that the grave social problems arising out of physical difficulties through the industrial employment of women will recur. The chief reason for alarm indeed appears to lie in the tendency of the Government to dispense with the Factories Act. The recent report of the Industrial Health Research Board recalls that its work was born of the experience of the War of 1914–18, but there are signs that scientific workers must bestir themselves if that entirely new attitude towards the study of working conditions and industrial welfare is to be preserved under the stress of the present war.

In industry as in civil defence, there is already evidence that the over-working of men and women has begun, and there are no signs of a consistent and well-understood policy in granting permission to work overtime. Equally it is important to conserve our limited resources of skilled labour by training, on a sufficient scale, fresh recruits for the less skilled operations. A scientific policy, which will keep alive the protective machinery and handle such problems before they become serious enough to damage health and efficiency, demands the co-operation of scientific workers as much as the prosecution of fresh research in these fields.

The difficulties experienced at the moment, however, are chiefly of a special and local character. There is some difficulty in spreading the available skilled workers evenly over the field, especially among the new munitions and aircraft factories. Social difficulties also attend the provision of the non-factory groups with work in munition factories. The dangers and opportunities in bringing many of these unorganized workers into official organizations are immense. Again, the labour requirements of several large industries, such as the textile groups, depend very much on policy, particularly export policy, and for this reason lack of a clear

economic policy on the part of the Government is being held responsible for the rise in unemployment.

The P E P broadsheet forecasts a considerable scarcity of male labour in the coal-mining, shipbuilding and other heavy industries, rather than in the munitions industries, and stresses the fundamental changes in the whole structure of British society since the War of 1914-18 in relation to the industrial sources of man-power for the forces. A much greater proportion of the population is engaged in selling goods or performing personal services, and the entire non-factory working-class is larger in relation to the rest of the population. Of the non-factory groups, a much larger proportion are now employees rather than employers or workers on their own account. The distributive trades, personal services, and other non-factory trades and occupations are regarded as important sources of personnel for the fighting services and civil defence.

The change in the framework of labour relations involves, for a thorough study of the man-power problem, a survey of the changes in organization, and the broadsheet comments on the great "civil service" which has grown up in industry, represented by thousands of paid officials, hundreds of joint committees and slow-moving democratic machinery. Smooth adaptation of labour relations to war problems as they arise will depend on whether such constitutions reveal latent elasticity or become too brittle to bear the strain.

The value of the National Register as a basis for the scientific use of man-power does not require stressing here. The P E P broadsheet refers particularly to the Central Register of scientific, technical, professional or higher administrative workers, which is already being used by Government Departments and by firms engaged on work of national importance. Much unemployment still exists, however, among highly trained technical workers, particularly graduates in chemistry and other sciences, and even among professional workers such as architects, whose services would be expected to be in demand in numerous problems involved in civil defence and evacuation. A special section of the Central Register has been formed of those in this position, but the preservation of their abilities would seem to require a considerable extension of research programmes, even if such activity has no immediate connexion with war. So far as chemists are concerned, the establishment by the Chemical Society of an Advisory Research Council already provides a means for pooling suggestions for research and bringing them before those engaged in research in the universities and colleges.

Something more is required than improvements in placing methods. Formulation of a really adequate programme of work and its adoption by the Government could scarcely fail to secure the efficient and adequate use of the available scientific personnel and the disappearance of unemployment from the scientific register.

Certain suggestions were made by Sir William Bragg in his presidential address at the anniversary meeting of the Royal Society (see NATURE, Dec. 9, 1939, p. 953). Sir William Bragg suggested that a Ministry of Science would be too formal and rigid for immediate needs and that personal and elastic methods of using knowledge were the most successful. We might well be content to bring science as a whole into close relation with government as a whole by attaching a central authority of science to the central authority of the country. The immediate application of science in any department of national affairs should be made from within that department, not from without, and the real need is for means of ensuring that the Government is able to rely on and make use of the whole range of scientific knowledge.

The value of the Royal Society as a consultative body, so strongly urged by Sir William Bragg, will be endorsed by all scientific workers, most of whom will agree that the Government could well utilize these services much more widely and fully. It is, however, the evidence of a bureaucratic outlook, indicated by the interruption of important research as a result of evacuation or other exigencies and the neglect to provide alternative accommodation, that has occasioned misgivings in the minds of scientific workers. The Advisory Research Council of the Chemical Society appears to be the first organized attempt to mobilize the research resources of the country at the universities or elsewhere, and it may be hoped that the new Advisory Council will extend the process quickly and effectively.

In the meantime scientific workers might well follow the lead of Prof. J. D. Bernal, who at the recent annual council meeting of the Association of Scientific Workers alluded to a number of scientific problems which would appear to have been overlooked in the present situation. Suggestions for investigation should not be restricted to any one field. Prof. Bernal himself referred to

the need for a scientific study of 'black-out' psychology and the effects of the 'black-out' on the temperament of the community. Similarly, problems of health and hygiene raised by evacuation and other changes await investigation.

Besides the suggestion and initiation of lines of investigation, the maximum development of our scientific effort in war demands an immense educational effort, and whatever central body is established will require to have under careful consideration the propaganda of science. Science cannot be used to the best advantage without the co-operation of the whole public. The stimulation of public interest in science is of vital importance to public efficiency and technical morale, and incidentally should provide a check on the bureaucratic tendencies which have been causing concern in some quarters.

The educational aspect is of importance from another point of view also. There is perhaps the danger that in the mobilization of scientific effort and resources in support of our cause, there may be further disposition to blame science for some of the evils of war. Propaganda of the type we have indicated should do more than prevent such misunderstanding. By promoting that full understanding and sympathy which are essential in the highest technical achievements, they should also prepare the way for science to make its full contribution, undisturbed by the demands of war, to the advancement of knowledge and the enrichment of human living.

VICTORIAN SOCIALISM

The New World Order

Whether it is Attainable, How it can be Attained, and What Sort of World a World at Peace will have to be. By H. G. Wells. Pp. 192. (London : Martin Secker and Warburg, Ltd., 1940.) 6*s*. net.

"FEW human beings," says Mr. Wells in his new book, "are able to change their primary ideas after the middle thirties. They get fixed in them and drive before them no more intelligently than animals before their innate impulses." Here he does himself a great injustice. We used to wonder what panacea he would discover next. He was sure to advocate it in a brilliant and stimulating manner.

But the time comes to all of us—it came to me long ago—when our minds stiffen, and we become, as a Frenchman unkindly said, the comedians of our early convictions. The hardships of his early life have permanently embittered Mr. Wells against the class in which his genius has placed him. He sees Red when he thinks of them, and exults in the destitution which he hopes awaits them.

So, since he is far too well-informed to be a Bolshevik, he has nailed his colours to that waterlogged derelict, Fabian collectivism. We have only to make a clean sweep of emulation, ambition, love of private ownership, patriotism and pugnacity, and we shall all be as happy, progressive and intelligent as a flock of sheep. That is always the way with Utopians. Abolish all the strongest passions and instincts of human nature, and a terminal state of blessedness, an earthly paradise, will be reached.

It is pathetic to look at the row of deserted idols which we used to worship in the last century : Liberalism, Democracy, Human Perfectibility, Socialism, Communism—there are few any more to do them reverence. Liberalism, which might sweep the suburbs with the Gladstonian creed of peace and retrenchment, is content to limp feebly after Labour, and has paid the penalty. Democracy is still a fetish in America, where it means anything, from an attribute of the Deity to a method of therapeutics, except what it really is, a not very successful experiment in government. "Uric acid," I read in a New York medical journal, "is tottering on its throne. The triumphs of Democracy are not confined to politics." Elsewhere it is merely accepted from inertia, or from fear of something worse. No institution has lost in prestige so much as the House of Commons. Who now reads the dreary debates, which are not expected to turn a single vote ? (Democracy as a form of society—equality of consideration—is a different matter ; some other name ought to be found for it.) As for human perfectibility, nobody any longer believes in a law of progress. The fact of progress in the past—for example, in the eighteenth and nineteenth centuries—cannot be denied. But in the future ? We began with faith, we went on with hope ; now there is nothing left but charity.

Socialism has never recovered from giving birth to its misbegotten brat Communism. There was such a thing as Social Democracy, though Socialism and Democracy are fundamentally incompatible. Nothing could be more ignominious than the total collapse of the Social Democrats in Italy and

Germany at the first impact of Fascism. The Bolsheviks found that the Social Democrats had not got the true milk of the word, and helped in their overthrow. Mussolini and Hitler were quick to observe the signs of the times.

Communism is also practically dead. It exists in the U.S.S.R. only for export; the Government of the Soviet Republic is pure Fascism or State capitalism. It would be difficult to name any prediction of Marx that has not been falsified by history; but the most significant of all his miscalculations was that after the success of the social revolution the State would "wither away". Instead of withering away, the State in Russia is omnipotent, the most brutal and searching tyranny that the world has ever known. Communism at home is now the creed of a few *enragés* and armchair doctrinaires, and of callow boys and girls at Oxford, Cambridge and the London School of Economics.

The total failure of the prophecy that the State under Soviet Socialism would wither away is important because it affects other kinds of socialism. The inevitable result of collectivism is to deprive the citizen of all liberty, and to put him at the mercy of a horde of ignorant, indolent and insolent Jacks-in-office, who take their orders from above. This is the crucial difference between State-socialism and democracy. The bureaucracy under socialism must take their orders from above. Mr. Wells wishes his citizens to be free to speak their minds; but your bureaucrat cannot stand criticism, and will know well enough how to gag it. Mr. Wells's Gestapo are to be "sturdy and assertive". There is no fear of their being anything else.

State-capitalism can make out a plausible case for itself. But apart from the difficulty of finding skilled administrators who are willing to give their best for a very small salary (in the U.S.S.R. differential salaries are as steeply graded as in England) in the absence of competition it is most unlikely that the infinitely complicated affairs of a great industrial community would be competently handled by State officials. Such experience as is available is very discouraging to the advocates of that favourite Fabian slogan, 'a planned economy'.

I entirely agree with Mr. Wells's detestation of the new idol which has dethroned the fetishes of the Victorians—frenzied nationalism. The deification of the State is indeed a monstrous and Satanic form of idolatry. It is at present the strongest force in the world, though it must be said to the credit of the democratic countries that it has made few converts in England, France or the United States. It unfortunately commands the allegiance of some of the best as well as the worst elements in the totalitarian countries, and is therefore the greatest danger that European civilization has ever had to meet. Nevertheless, to speak of the possible "extinction of mankind" (p. 18) is surely a violent exaggeration. The worst that can happen to Europe, if we persist in what are really civil wars, waged with greater fury than the old wars of religion, is that we may be plunged into another 'dark age', which we may hope would not last six hundred years, like the welter of barbarism which followed the downfall of Græco-Roman civilization. But America and the British Dominions would survive and hand down the torch. Count Keyserling, in his "Révolution Mondiale", unaccountably forgot the not unimportant part of the human race who speak English. For I do not think that even Great Britain will either cease to exist or relapse into savagery.

I also agree with the author about the ruinous folly of the present war; but perhaps at present the less said the better on that subject.

One protest I must make in conclusion. I am not supposed to be very fond of the Roman Catholic Church, but I deprecate Mr. Wells's very harsh words about that institution. Catholicism is certainly anti-revolutionary. With its unequalled experience of human nature, that Church knows that revolutions always lead to reactions, and achieve very little at a terrible cost of human suffering. But it preserves some valuable traditions which are in some danger of being lost, including a philosophy which is far superior to modern systems. I am specially distressed to read what Mr. Wells says about Spain. I cannot understand how any decent person can deny that the Nationalists were justified in taking arms against those devils in human shape, the Spanish Reds, who, fighting under the 'hammer and sickle', and under orders from Moscow, butchered three hundred thousand men and women, a hundred thousand in Madrid alone, in an attempt to extirpate whole classes of the population. It is difficult to forget what an American eye-witness saw in the town of Ronda, near Malaga. The Reds impaled on stakes all the male inhabitants who belonged to the middle class, and while they were dying in agony compelled them to watch their wives and daughters being first violated and then burnt alive. There are scores of similar horrors equally well authenticated.

Although Mr. Wells's Utopia seems to me utterly unrealizable, no one can read the book without admiration for his earnest longing for a new and better world. As Plato said of his Republic, the type of the perfect State is laid up in heaven, and we need not inquire too curiously whether it is likely to be realized on earth. The obstacles are human sin and folly, and we shall soon have sharp enough lessons to cure all but the incurable.

W. R. INGE.

TERRESTRIAL MAGNETISM AND ELECTRICITY

Physics of the Earth, 8:
Terrestrial Magnetism and Electricity
Edited by J. A. Fleming. Contributors: J. Bartels, L. V. Berkner, J. A. Fleming, O. H. Gish, H. D. Harradon, C. A. Heiland, E. O. Hulburt, H. F. Johnston, H. E. McComb, A. G. McNish, W. J. Rooney, B. F. J. Schonland, O. W. Torreson, L. Vegard. Pp. xii + 794. (New York and London: McGraw-Hill Book Company, Inc., 1939.) 52*s*. 6*d*.

INTEREST in geophysics is widespread in the United States of America to a degree paralleled nowhere else. This still young community, now in the first flush of vigorous scientific maturity, is from practical motives actively exploring the hidden riches of its land; it is also energetically studying the land, the sea, and the air, from purely intellectual motives. One consequence is that America possesses, in the American Geophysical Union, the largest geophysical society in the world; this Union publishes an extensive and many-sided annual report, but not, as yet, any general geophysical journal. America is, however, the home of the only existing journal devoted solely to terrestrial magnetism and electricity; and the only research institution which pursues all branches of this department of geophysics, from a world-wide point of view, is also American. It is therefore fitting that the volume under review, which is probably the largest general work ever published on the subject, should come to us from across the Atlantic. It will give a valuable stimulus and help to the study of the earth's magnetism and electricity, publications on which have hitherto been rather inaccessible to workers in other fields. The volume is one of a series of reports on geophysics prepared under the auspices of the U.S. National Research Council, with which the American Geophysical Union is associated.

The book is not a systematic treatise on its subject (and there remains a need for such a treatise); it is a collective work by fourteen authors, under the editorship of Dr. J. A. Fleming, director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington —who himself, in the first chapter, on "The Earth's Magnetism and Magnetic Surveys", gives a general introduction to this, the larger of the two subjects with which the book deals. These two subjects are in fact not very intimately related to one another, and the four 'electrical' chapters—on "Atmospheric Electricity" (iv, Gish), "Instruments used in Observations of Atmospheric Electricity" (v, Torreson), "Earth-Currents" (vi, Rooney), and "Thunder-clouds, Shower-clouds and their Electrical Effects" (xii, Schonland)—might well have appeared as a separate volume; these chapters are excellently written in a systematic expository style, and almost constitute a treatise on terrestrial electricity, though of course this subject offers scope for a more detailed treatment. With their bibliography, these four chapters occupy about a quarter of the book.

No fewer than a hundred pages are devoted to a bibliographical chapter (xiii, Harradon); this is a valuable part of the book, because one of the difficulties in this, as in some other branches of geophysics, is that the original data and observations are for the most part not published in the scientific journals which have wide currency throughout the world; often they appear in separate publications or in observatory reports—the introductions or appendixes of which sometimes contain important discussions of the data, not to be found elsewhere. Moreover, owing to the border-line character of the subject (lying as it does between physics, astronomy, meteorology, geology and geography), together with the fact that there is only one journal expressly devoted to it, its current literature is scattered over an exceptionally wide collection of periodicals. Hence such a bibliography forms, as the editor states, "a most valuable research tool".

The remaining two thirds of the book includes two main groups of chapters, much more closely linked together than might appear at first sight. There are the more strictly magnetic chapters, including (with the first, already mentioned), "Magnetic Instruments" (ii, Johnston, Fleming and McComb), "Magnetic Prospecting" (iii, Heiland), "On Causes of the Earth's Magnetism and its Changes" (vii, McNish) and "Some Problems of Terrestrial Magnetism and Electricity" (viii, Bartels); and there are three chapters relating to the upper atmosphere, including one with that title (x, Hulburt), one on "Radio Exploration of the Earth's Outer Atmosphere" (ix, Berkner), and one on the "Aurora Polaris and the Upper Atmosphere" (xi, Vegard).

Workers on the many topics with which the book deals will recognize the authority of the writers who contribute the several chapters. With the exception of Chapter iii, the outlook of the book is more towards the purely scientific than the important practical aspects of the subject; it

may be said to be directed to the initiation or enlightenment of physicists (and perhaps also astrophysicists) in one of the oldest of the modern sciences, which still confronts us with the mystery of Gilbert's great discovery that the earth is itself a magnet, and the but little less mysterious secular variation of the magnetic field. Apart from this, the exciting and complex problems of the subject are concerned mainly with the atmosphere ; there is the semi-meteorological problem of the maintenance of the earth's negative surface charge, and the group of problems associated with the action of the sun upon the earth—for it is the sun which causes and controls the inconstant daily magnetic variation, the irregularly occurring magnetic storms and the associated auroras, and also the recently discovered group of terrestrial phenomena linked with eruptions in the solar chromosphere—radio fading and brief magnetic disturbances. The moon also, through the lunar tide which it produces in our atmosphere, plays a small but interesting part in causing the magnetic variations.

All these subjects are discussed in an interesting and authoritative way in this book, and if the voices are not always in unison, this is but a token of the need for more observation and more thought to illuminate dark questions. It is to be hoped and expected that many among the readers of this book will be led to take a share in making these "rough places plain".

S. CHAPMAN.

THE SOYA BEAN

Le soja et les industries du soja

Produits alimentaires, huile de soja, lécithine végétale, caséine végétale. Par A. Matagrin. Pp. x + 390. (Paris : Gauthier-Villars, 1939.) 60 francs.

IT is well known that the soya bean (*Glycine soja*) is one of the most valuable of cultivated crops, and this comprehensive account is of value, particularly at the present crisis, because of the numerous by-products that are obtainable from this particular plant. It is in fact one of the world's indispensable commodities.

The author records with considerable success the whole range from the cultivation of the bean to the manufacture of the latest form of by-product. In an account of the history and origin of the crop, it is pointed out that the home of the plant is eastern Asia, and in particular, Manchuria, Japan and China, from which regions, for many years, the main supply for the markets of the world was obtained. It is natural that other countries, with an eye to the valuable nature of the crop, should have endeavoured to establish it into their agricultural systems, and the most successful so far has been the United States. Here after years of trial and experiment, success has been attained in breeding types suitable to the climatic conditions, and the output of which now rivals in extent that of the Far East. In the detailed account that is given of the many attempts that have been made to establish the crop, it is noted that although the crop is stated to be adaptable and capable of growing from the equator to 50° S. and 60° N. respectively, yet success has, in the main, only been achieved on a grand scale in those countries possessing a temperate or sub-tropical climate.

In view of its great nutritive value, due to its high oil and protein content, there is little doubt that if the crop could be established in the tropics it would be of great value, not only because it is a valuable export crop which could be sold for cash and would, therefore, widen this field, which is so often held by cotton alone at present, but also on account of its food value. To the many who are now interested in the nutrition drive that is taking place in the British colonies its value is obvious ; but it is not an easy crop to grow in the tropics. The number of varieties as indicated by the author is very great, but he brings out clearly that each variety has been evolved to meet particular types of soil and climatic conditions, and that each will usually only be found in a comparatively circumscribed area where it can enjoy these particular conditions.

The United States introduced numerous varieties and undertook prolonged selection before types suitable to American conditions were obtained. The trade demands a large round bean of a white or light colour, but unfortunately such experiments as have been made in the tropics indicate that the type of soya that grows best is one of a darker colour with a smaller and flatter bean. There is no doubt that much plant-breeding work will be needed before types really suited to the tropics can be evolved, although there is evidence that success will ultimately be obtained. Another difficulty is the short viability of the seed under tropical conditions. For this reason it is not always easy to obtain an even stand, with the result that disappointing crops are often reaped,

although individual plants may often be excellent heavy bearers. The causes of this rapid loss in viability will, therefore, need to be studied and systems of storage, within the means of the peasant, evolved. Temperature is one contributing factor, as seed stored at about 60° F. keeps its viability well. It is probable that moisture content may be another factor as a natural corollary.

Another difficulty that will have to be faced is ignorance of the most attractive ways to prepare it for human consumption. Not the least valuable part of this book is the account given by the author of the different dishes that are prepared in various countries, and a campaign to educate the grower into the cooking of the bean will probably have to accompany any attempt to introduce it into his cropping system. The problem of inoculating the seed will also need to be faced, as it appears obvious that good crops cannot usually be obtained unless the right inoculum is present. This problem should not be difficult of solution, however, once a commencement has been made, as soil from an inoculated field can be used to extend the system.

Nearly half the book is devoted to accounts of the commercial products of the bean, particular attention being paid to the processes involved in the refining of the oil and its numerous uses, to the preparation of lecithin and the manufacture of vegetable casein, the demand for which has expanded greatly in recent years.

The volume is well arranged, but it is hoped that in a future edition an index will be added.

G. EVANS.

MYTHS AND MAGIC IN JAMAICA AND HAITI

Voodoo Gods

An Inquiry into Native Myths and Magic in Jamaica and Haiti. By Zora Hurston. Pp. x+290+24 plates. (London: J. M. Dent and Sons, Ltd., 1939.) 15*s*. net.

OBEAH in Jamaica and Voodoo in Haiti, as secret cults of the Negro, have both aroused considerable curiosity, mostly morbid. The literature relating to them is extensive, but more remarkable for its sensational statements than its ability to carry conviction as to its truth or accuracy of observation. It is, in fact, with a few notable exceptions, based on hearsay. Miss Hurston's knowledge of both cults has at least been acquired, to a great extent, at first hand; and her book is the work of a trained and experienced observer. As a member of the race she was qualified to take part in the ceremonial as an initiate, while as a pupil of Prof. Franz Boas she was able to grasp its significance as the manifestation of a form of religious belief, and view it with detachment.

Miss Hurston gives the two cults of Obeah and Voodoo their social setting in her accounts of the Negro community in Jamaica and of society and politics in the Black Republic of Haiti. The high lights of Haitian history are reached in revolution and massacre, more especially in the earlier years of the present century, leading up to occupation by the United States in 1915. The occupation lasted for nineteen years. Notwithstanding this story of bloodshed and corruption, the author sees in the recent growth of a young intelligentsia, which is making its mark in public life, the possibility of a future regeneration. There are indications of the growth of a national consciousness and of a decrease in the degree of cultural dependence on France.

In this movement towards cultural and national independence of white influence, it is thought by some, strangely enough, that Voodoo will play its part. This may seem surprising, in view of the fact that it has been usual to look upon Voodoo solely as an influence for evil, rather than as a form of spiritual belief, which could hold its own in the long run against one of the more highly organized religions, such as Christianity. This may be due to prejudice; and it has to be conceded that under the influence of the negro temperament, even Christianity itself may assume strange forms. At the same time the popular and darker view of Voodoo may not be entirely accurate.

Miss Hurston attributes much of the sensationalism which has become almost inseparable from accounts of Voodoo to a failure to understand its symbolism. Thus she maintains that the reverence accorded to the gods of the Negro in the guise of the Roman Catholic saints 'done over in black', the prominence of the snake in their cults, the erotic rites and the magical dances, and the like, are all parts of an elaborate system of symbolism, which has been, but should not be, taken at face value. Voodoo, in fact, is neither snake worship nor magic mixed up with fetichism, sacrifice and other of the more repulsive erotic and necrophilic practices of wizardry, but an organized body of pagan belief with an African pantheon.

The gods of the Haitian pantheon to a great extent are localized, and a spirit of great power

in its own home may be unknown beyond a radius of fifty miles. Nevertheless some of the gods are reverenced generally; Damballa, for example, whose signature is the snake, and the goddess of love, whose position in relation to Voodoo as a fertility cult is indicated not only by the fact that she has no children, and is implacable to women, but also in that every man in Haiti is regarded as her husband. It is significant that two types of gods or spirits are recognized—the Rada or Arada, who are the good gods, to whom only pigeons and chickens are sacrificed, and the Petro, the more powerful and evil gods, who can, however, be made to do good things. To them are offered pigs, goats, sheep, cows and dogs, and even on occasion dead bodies from the tombs. The Rada are said to have been brought with the Negroes from Guinea or Dahomey; the Rada came from the Congo.

This brief mention of one feature only in Voodoo belief does less than justice to a remarkable record, which will repay close study by those who wish to understand the mentality which underlies what has been the most remarkable experiment in self-government of the black races, on their own initiative, of modern times.

HABITS AND HABITATS OF TROUT

Trout Streams

Conditions that Determine their Productivity and Suggestions for Stream and Lake Management. By Dr. Paul R. Needham. Pp. x+233. (Ithaca, N.Y.: Comstock Publishing Co., Inc., 1938.) 3 dollars.

THIS book is an attempt to place in the hands of anglers, sportsmen, and aquatic biologists, trustworthy information relating to trout and streams in which they live.

The author is well qualified by years of experience to undertake such a work and has done it very well, not only using his own researches into stream problems but also that of many workers in his own country and in other lands where trout streams abound. The opening chapter deals largely with the various kinds of trout to be found in North America in both streams and lakes, dealing also with the habits of the different fish, followed by the chemical and physical conditions of trout streams in general and how such factors as temperature, transparency, oxygen content, and river bed play their part.

The importance of biological indicators as evidences of pollution as against that of chemical analysis is stressed—a line which is advocated in Great Britain. A very well illustrated chapter deals with trout stream animals which serve as food for trout, and should prove very useful to aquatic biologists, while it cannot fail to attract the angler with very little interest in stream organisms apart from fish. The line drawings and photographs are very clear and the tables show evidence of much work in collecting the data.

An interesting point to which attention is directed is the large numbers of land insects which are taken by trout at certain times of the year; the probable reason for this is well discussed. A very large number of stomach contents have been examined to obtain the information, and so far as streams in the central area of New York State go, the author points out the amounts of foods fall in the following percentages: caddis flies, two-winged insects and may flies, 66 per cent taken in the order stated, beetles fourth (6·6 per cent of total), spring tails, leaf hoppers, ants, bees and wasps furnish 3–6 per cent of the total, with other foods about 1 per cent, made up of crayfish, shrimps, grasshoppers, stone flies, true bugs and earthworms.

The distribution of the food in streams is dealt with under the heading of the physical conditions of the bed of the stream, stream flow and depth. The methods to be adopted in taking a census of the stream animals is described and is much on the lines adopted by workers in other countries. Stocking, propagation, and protection find a place in the book, followed by the management of trout waters gained by experience in many States.

A very useful appendix deals with the numbers and sizes of fish it is wise to introduce into streams where restocking is done, taking into account size of stream and available natural foods. Outlines are given of stream surveys and how the information should be recorded to be of use for comparison with later surveys or with those of other rivers.

There is a very extensive bibliography, which should prove very useful to those seeking fuller information on the points dealt with. The book is very well illustrated with photographs of weir fishing pools and the like, making it very attractive to the non-technical reader as well as the scientific investigator. It also gives an insight into the extent of the investigations undertaken by workers across the sea, and being written by one who, in addition to being a scientific investigator is also an angler, links up the two sides of the questions that arise.

W. RUSHTON.

CHEMISTRY FOR INTERMEDIATE EXAMINATIONS

(1) General and Inorganic Chemistry
By Dr. P. J. Durrant. Pp. x+ 547. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1939.) 8*s*.

(2) A College Course of Inorganic Chemistry
By Prof. J. R. Partington. Pp. x+ 658. (London: Macmillan and Co., Ltd., 1939.) 8*s*. 6*d*.

(3) Intermediate Chemistry, Inorganic and Physical
By Dr. Frederick Prescott. Pp. viii + 828. (London: University Tutorial Press, Ltd., 1939.) 12*s*. 6*d*.

THE number of chemistry text-books is becoming greater every year, and because of their number, the final selection of a suitable book is becoming increasingly difficult. During the last few years, the needs of those taking intermediate science examinations and university entrance scholarships have received special attention, and here are three new books catering for their requirements.

(1) Of the people who write text-books, the one who obtains the deepest insight into the student mind is not the teacher (who may, in fact, be very ignorant of its contents) but the examiner. He, more than any other, is familiar with the facts which are absorbed, and the heresies which persist. Dr. P. J. Durrant is not without experience as an examiner, consequently something exceptional was to be expected, and expectation has not been disappointed. The book he has written is an admirable one, and the reviewer can fully endorse the report of the publishers' reader that "the book has originality and vitality of presentation and gives a balanced and cultural appraisal of a difficult subject". Not only is this so, but the type, headings, spacing and arrangement of the text are excellent and make an immediate appeal to the eye.

The outlook is modern, Bohr's theory of atomic structure and the electronic theory of valency are introduced at an early stage, and are used as a basis for the explanation of chemical theory. The scope of the book is not limited to the syllabus of any particular examination, and it would take the student through his first year at the university. The less common elements are omitted, and only compounds of definite technical or theoretical interest are included. The only important omission is a chapter on radioactivity, which might, with advantage, have been included. Errors are extremely rare: the quantum shells (p. 116) are presumably those of uranium, where the *P* shell contains 12 not 13 electrons, and *catronic* (p. 297) is an obvious misprint.

(2) Prof. J. R. Partington's "Text-Book of Inorganic Chemistry" first appeared in 1921 and is now in its fifth edition. Successive editions have grown in size with the passing of time, until it is now too comprehensive for 'inter.-science' students. His "College Course of Inorganic Chemistry" is intended to meet the needs of the latter, especially those rather older students who are beginners, as well as younger pupils.

Although the plan and method of the "Text-Book" have naturally served as a foundation for the smaller work, much of the text has been rewritten and rearranged. Nevertheless, the familiar and successful "Partington" method is obvious throughout. The historical approach has been retained, special attention being given to the physical chemistry required at this stage, and although designed only as an intermediate text-book, it contains a very considerable amount of information and details of industrial processes.

Opinions differ as to how soon the student should begin to use and appreciate the significance of electronic formulæ. The modern tendency is to introduce them early and even to abandon the classical 'structural formulæ' entirely. The fact that here the former are sparingly used, and the latter largely retained, gives the book a somewhat old-fashioned appearance which might not entirely satisfy a modern teacher. This is the only criticism of the book, which well maintains the high "Partington" standard.

(3) Dr. F. Prescott's "Intermediate Chemistry" is described as "an entirely new book, a well-planned course of Inorganic and Physical Chemistry, based on modern ideas associated with the inter-related domains of Physics and Chemistry". The plan and balance of the book are good, but the contents are of very uneven quality, and the proof-reading has been entirely inadequate. A perusal of the book revealed twenty-one incorrect equations (and there may be more, for a systematic search was not made), many incorrect formulæ, and small errors in the text. All these mistakes are obvious and would be detected by the dullest student.

The section on the structure of the atomic nucleus and the occurrence of isotopes (pp. 252–4) contains the following sequence of statements: (*a*) the nucleus consists of protons, or particles of positive electricity, and, in most cases, electrons, the protons always being in excess; (*b*) the

atomic number corresponds to the net positive charge on the nucleus; (*c*) the mass number (atomic weight) is equal to the number of protons in the nucleus; (*d*) the difference between the mass number and the atomic number is attributed to neutrons in the nucleus; (*e*) neutrons are particles with a mass nearly that of a proton; (*f*) the neutrons, being of negligible mass, may be disregarded. The table (p. 253) which gives the atomic structure of a number of selected elements does not mention the neutron, which, considering its (apparently) uncertain properties, is perhaps just as well.

'Partington' and 'Durrant' are widely contrasting books, complementary rather than competitive. Partington is historical, somewhat discursive, and (at least once) reminiscent (p. 433). Durrant is non-historical, logical, modern, and provides much tabulated information, of which Partington (p. vii) disapproves. The teacher may choose according to his tastes. J. N. SUGDEN.

BIOGEOGRAPHY IN THE U.S.S.R.

(1) Zoogeography
By I. I. Puzanov. Pp. 360 + 32. (Moscow: State Publication Office of the Commissariat for Education, 1938.) 7·80 roubles.

(2) Zoogeography of the Ukrainian Socialist Soviet Republic
By M. Sharleman. Pp. 234 +1. (Kiev: Ukrainian Academy of Sciences, 1937.) 6·60 roubles.

(3) Vegetation of the World
(Plant Geography, vol. 3.) By A. P. Il'inskij. Pp. 458. (Botanical Institute of the Academy of Sciences, Moscow-Leningrad, 1937.) 10 roubles.

ALTHOUGH the three books referred to above by no means exhaust the most important biogeographical publications that have appeared in the Soviet Union during the last few years, they deserve special notice for various reasons.

(1) Prof. Puzanov's book on zoogeography is of interest as an attempt to produce a text-book in this subject, which is still taught in too few universities, one of the reasons being the lack of suitable books for students. A brief introduction dealing with the aims and methods of zoogeography and giving a concise history of the science is followed by two general parts. The first presents a lucid discussion of the ecological principles of zoogeography; the second deals with dynamics of faunas from a geological aspect. This difficult problem is dealt with in a very clear manner, without superfluous detail, while avoiding undue simplification. The third, and the main, part of the book is devoted to regional zoogeography, that is, to descriptions of the faunas of various regions. These descriptions are based mostly on vertebrate animals, but whenever possible some data on insects, etc., are also given. A feature of the book is the abundance of very well-executed (but poorly reproduced) original illustrations of numerous animals mentioned in the text. There are even three plates in colour, but their standard is low.

On the whole, the book undoubtedly represents a very successful approach to a university text-book of zoogeography, which is as yet lacking in any language, in spite of a seriously felt need for one.

(2) Sharleman's book on the zoogeography of the Ukraine is an original treatise on the regional distribution of vertebrates of that country in connexion with their ecology and geological history. The book is written in the Ukrainian language, but Russian and English summaries are appended, while a complete list of species showing their distribution by districts, and a very full bibliography should make it very valuable for workers on the Palæarctic fauna.

(3) The book on the vegetation of the world by Il'inskij is published as the third (and concluding, but first published) volume of a series, the other two of which deal with plant geography and plant ecology respectively. The general part of the book is very brief—because the two other volumes just referred to should supply the introductory knowledge to the present one, which contains descriptions of types of vegetation by continents and natural regions. Most of the descriptions are clear, concise, based on up-to-date information and illustrated by well-reproduced photographs. All this goes to make a good text-book that should be very useful, particularly to geography students.

Indeed, it can be said that geography departments in Soviet universities are particularly fortunate in having modern text-books in both branches of biogeography, by Puzanov on animals and by Il'inskij on vegetation. The appearance of similar text-books in English would go a long way towards introducing biogeography into British and American universities, where this science is suffering from undeserved neglect. B. P. UVAROV.

MARGARINE

By Prof. J. C. Drummond,
University of London

Early History

IT is unlike the French to be unmindful of a son of their country who has rendered notable service in so important a matter as food, yet I am not aware that the achievement of Mège-Mouries is commemorated in France by a public monument or inscription or even by a street name. Equally surprising is the scanty information supplied by biographical works of reference about that most ingenious inventor. Perhaps we can attribute this to the lack of sympathy one would expect from a nation which appreciates above all other things good food and good cooks, towards one who hoped to pass off the greasy and rather unpalatable products of his laboratory as butter. Whatever the reason for such neglect, the fact remains that the French might well be proud to claim the inventor who made possible one of the greatest food industries of our time.

It is often erroneously believed that Mège-Mouries set out to concoct a substitute for butter. It is true that he was stimulated by the desire of the Victualling Department of the French Navy to find such a substitute ; but he himself was more ambitious. He attempted to produce butter itself, and that by a series of laboratory treatments that he thought would reproduce exactly the changes by which he believed body fat to be converted into milk fat in the animal body. His laborious process, in which beef fat was digested at blood heat, first with macerated sheep's stomach and then with chopped cow's udder and milk, actually gave him nothing more unusual than the softer portion of the original fat, carrying, presumably, some traces of a milky flavour. Nevertheless, in the early days he was quite satisfied that he had made butter. Others, less optimistic, were content to believe that he had solved the problem of preparing an edible substitute for butter, and for this achievement he was honoured in 1870 by Napoleon III.

Had it not been for the Franco-Prussian War, it is probable that France would have led the world in the technical development of the new process. As it happened, the opportunity was seized in the United States and in Holland. In a remarkably short time factories were springing up in these countries for the manufacture of what was then called 'butterine'. It was soon found that Mège-Mouries's complicated digestion was quite unnecessary, and that all it was necessary to do was to mix as thoroughly as possible with skimmed milk, preferably slightly sour, a fat of the appropriate melting point. On separating the fat again it was found to have acquired a buttery taste. It could then be 'worked', salted and coloured to taste.

Manufacture in Great Britain lagged far behind in the seventies. So far as can be judged from the contemporary press, the home-produced material was, moreover, of very inferior quality. Most of it was made in small, dirty, 'back-street' premises under highly insanitary conditions. To a large extent it was knowledge of these facts that gave 'butterine' so bad a reputation at that time. The English public was ready to believe any fantastic yarn about the doubtful nature of the fats used by the manufacturers, and they also suspected, often with more reason, that a good deal of the despised stuff was employed as an adulterant for butter. The passing of the Margarine Act in 1887 did something to allay uneasiness ; nevertheless, the reputation of the new food remained an unsavoury one for a good many years.

Improvements in Manufacture

Then in 1889, Otto Monsted opened the first up-to-date factory in Great Britain. The pioneers were faced with a truly formidable task. Prejudice against margarine was at that time shared by rich and poor alike, and opposition from certain other trades, particularly the dairy industry, was vigorous and none too scrupulous. The product Monsted turned out was made from that fraction of beef fat which is known as 'oleo' or 'premier jus'. It was, in fact, a highly digestible fat possessing a calorific value equivalent to that of ordinary butter and, what was of great importance although unknown at the time, its vitamin A, and probably also its vitamin D, content was by no means negligible. It is probable that its nutritive value was not far below that of ordinary 'average' butter ; but it is difficult to make a proper estimate because it is a curious fact that an extensive modern literature on the vitamin contents of foods does not give us any information as to the A and D value of the common edible body fats such as those of beef or mutton.

By comparison with our modern margarines these primitive materials were undoubtedly very crude. They were inclined to be unpleasantly

greasy, to stick to the knife, and to spread in a manner unattractive to those used to butter. Moreover, they often had a 'fatty' taste and smell which many people disliked.

No problem has given the margarine manufacturers more trouble than that of producing a texture resembling that of dairy butter. The introduction about 1890 into margarine manufacture of vegetable oils suitable for blending with 'oleo' helped them to some extent; but it was not until some years of the new century had passed that their fortunes turned. By this time the small producer was dropping out of the picture and with him many brands of dubious quality which had served to keep alive an unenviable reputation. To an ever-increasing extent manufacture was passing into the hands of large commercial organizations guided by directorates not only anxious to provide the consumer with an article of high quality, but also prepared to spend very large sums of money on scientific and technical research to that end. One by one the problems were attacked and solved. Care in the selection of oils for blending; improved methods of emulsifying the mixture with pretreated separated milk; controlled crystallization of the final product to get the right 'grain'; special precautions to be taken in 'working' a mixture differing in many subtle characteristics from butter; such knowledge, gained by patient and costly research, brought about remarkable improvements in respect of that almost indefinable but all-important character of texture. Chemists, biochemists and bacteriologists collaborated to select the appropriate bacterial flora which would produce in the separated milk just the right blend of substances necessary to impart to the margarine that elusive 'butter flavour'. Others ingeniously prepared chemical flavouring substances to serve the same end.

Another important milestone was the introduction of 'hardened' vegetable and animal fats.

Such have been the labours that have gone to produce the high quality of the popular butter substitute we know to-day.

Vitamin Reinforcements

The period of the War of 1914–18 is very important in the history of margarine. At that time most authorities on dietetics regarded margarine as a reasonably good substitute for butter, because it was well digested and for all practical purposes provided the same heat-producing power. It was one of the cheaper forms of energy.

During the latter part of the War, however, the importance of the fat-soluble vitamins, discovered a few years before, gradually came to be recognized. The nutritive worth of edible fats could no longer be assessed solely in terms of digestibility and energy equivalents. It was necessary to ascertain whether they would also provide the newly discovered constituents. Butter was found to contain them. On the other hand, most of the vegetable oils and fats then being used more and more extensively in margarine manufacture, as well as the hardened fats which had come into use soon after 1910, were found to be defective in this respect. Following up the obvious line these observations indicated, the late Prof. W. D. Halliburton and I examined a number of typical margarines and found that their nutritive value for the growing animal was determined by the vitamin contents of the constituent oils and fats. Margarines prepared almost solely from beef 'oleo' appeared to be as nutritive as butter, whereas the vegetable oil margarines, in spite of being excellently assimilated, did not supply the fat-soluble 'growth-promoting' factors needed by the young animal.

These observations made little impression on the margarine industry at the time. Such reaction as there was consisted of frank scepticism. Some people challenged the conclusion that vegetable oil margarines were devoid of vitamins by directing attention to the fact that milk, which in a vague sort of way was thought to be one of the richest sources of the accessory factors, was employed in the manufacture of the products. Others refused to acknowledge that experiments on rats could have any bearing on human nutrition. Others, again, argued that such small differences in composition of a single article of diet could scarcely be of any practical significance. Nearly ten years passed before serious attention was given to the matter. Then, at last, the margarine manufacturers moved. Many of the earlier attempts to raise the nutritive value of their products by the addition of vitamin preparations were failures. For the most part they were attempting to employ materials and concentrates prepared from cod liver oil. It was not a difficult matter to add sufficient of such supplements to bring the vitamin value of margarine up to that of an 'average' butter; but it was found that such additions almost invariably ruined the flavour and palatability besides materially increasing the cost.

The first real progress was made after the discovery of the method for preparing pure crystalline vitamin D_2 from ergosterol. It then became possible to raise the antirachitic value of a margarine at a very slight cost without affecting edibility in the slightest. To confer on margarine a vitamin D activity of 30 units per ounce, it was necessary to add only one ounce of vitamin D_2 (calciferol) to 120 tons of margarine. What was next required was a cheap and effective source of

vitamin A. It was found in one of the by-products of the whaling industry operating in Antarctic waters. Like other mammals, the whale stores considerable amounts of vitamin A group in its liver, though on the other hand it has curiously small reserves of D. The development of the factory-ship organization in the far southern waters made available large quantities of whale liver fat. It had the advantage not only of being valuable as a source of A but also of yielding material which could be employed without impairing the flavour of the finished margarine. By employing this supplement and at the same time adding artificially prepared vitamin D, the production of a satisfactory 'vitaminized' margarine for the ordinary market was achieved. Brands prepared with such additions first came on the market about six years ago. Not unexpectedly, they aroused a good deal of hostility from the butter industry, and there have been sharp controversies between the rival interests. With the many and widely differing aspects of these controversies we cannot be concerned here. Suffice it to say that in one country at least a rather bitter trade war has been terminated by a government-inspired 'gentleman's agreement' to 'live and let live'.

More recently, success has rewarded efforts to prepare from fish liver oils concentrates of A and D suitable for adding to margarine. They are prepared from liver oils of very high initial potency. So small an addition is required that the palatability of the final product is unaffected, and, what is so important, the cost is almost negligible.

Margarine in the Nation's Diet

It is very important, particularly at a time like the present, to try to get such a valuable foodstuff as margarine into proper perspective with the diet of the nation. In 1938, a year in which butter was, generally speaking, cheap, the weighted average consumption per head of the population of Great Britain was 7·6 oz. a week, while the corresponding figure for margarine was 2·3 oz. Even the people classified in the poorest category of the population purchased, on an average, 4·5 oz. of butter per head per week.

If we take, as a peace-time basis for our argument, 10 oz. per week as a rough and ready estimate of the consumption of butter and margarine by the people of Great Britain in 1938, and if we also assume that the whole supply had the same vitamin content as an 'average' butter, we find a weekly intake of, approximately, 5,500 units of A and 150 units of D. Had the whole ten ounces been an 'average' vitamin-reinforced margarine, the intake of A would have been somewhat less, whereas the D supply might have been nearly twice as large. In either event, these quantities approximate more closely to the requirements of the individual for one day than to those for a whole week.

In other words, the 'average' individual is more dependent on milk, eggs, green vegetables, etc., than on butter and 'vitaminized' margarine for vitamins A and D.

It is very important to remember, therefore, that the consumption of these alternative sources of fat-soluble vitamins is pitifully small among the poorer sections of the community. Under such conditions the question of the vitamin content of margarine assumes greater importance.

A consumption of 4·5 oz. of butter weekly—which is slightly more than the official ration—together with the balance of 5·5 oz.—assuming once again a total intake of 10 oz.—in the form of a 'non-vitaminized' margarine, would provide a mere 2,500 units of A and 70 of D. That is scarcely a conspicuous contribution to what the body requires. Such figures signify that a good proportion of the poorer people were receiving insufficient of these two vitamins under the relatively good conditions prevailing in 1938. There is evidence from other sources that this was so.

The deficiency was, of course, very much more serious at the end of the War of 1914–18, when rationing restricted weekly supplies to 1 oz. of butter and 4 oz. of margarine, none of the latter being 'vitaminized'. From these foods the individual could count on little more than 550 units of A and 15 units of D in a week—about one tenth of an adult's daily needs!

With rationing of butter in force, and having in mind the limited purchasing power of the poorer sections of the community, the desirability of enriching all margarines with vitamins A and D supplements must appear obvious.

At the present time a large proportion of the margarine sold over retail counters is so enriched. Unfortunately, there does not appear to be uniformity between the various brands, although for the purpose of general estimates such as have been made in this article, the content of an 'average' vitaminized product can be taken as 450 units of A and 30 units of D per ounce. A weekly supplement to the butter ration of 6 oz. of reinforced margarine could be regarded, therefore, as adding some 2,700 units of A and 180 units of D to the diet. It is certainly nothing to boast about; but one must remember how valuable is every unit where poverty diets well below the marginal nutritional level are concerned.

It will not be possible to plead ignorance this time if vitamin deficiency is allowed to be responsible for a decline in general health such as occurred during the years of 1914–18.

TOWN'S REFUSE AS A SOURCE OF SOIL ORGANIC MATTER

By Dr. E. H. Tripp

ALTHOUGH animal and vegetable wastes have been used as manure for untold ages, and their good effect on soil fertility has never been in doubt, chemists and microbiologists would be the first to confess that there are many gaps in our knowledge of their modes of action. To take farmyard manure—still without a rival—we know the value of the plant foods it contains, and its remarkable power, after decomposition, of promoting and conserving the granular structure of the top soil, thereby making it porous to air, absorptive and retentive of moisture. How this physical effect is brought about is still largely a matter of hypothesis ; and generally speaking, we know nothing of the sequence of changes that follow the incorporation of farmyard manure with the top soil.

The solution of such questions would help in determining beforehand the possibly beneficial action of many other organic substances that are or might be available to eke out our diminishing supplies of farmyard and stable manures. At the present time, when it is planned to convert millions of acres of inferior grassland into arable, the provision of additional supplies of humus-forming material becomes exceptionally important.

A potential source of supply of organic manure is the refuse of cities and large towns that is now carted away and dumped on to waste land or into the sea. The composition and production of such refuse have, *inter alia*, been investigated by a sub-committee of the Institute of Public Cleansing, and reported upon by H. Edridge (1937). Samples of the refuse collected from 485,894 houses, with 2·082 million people, contained an average of 13·23 per cent of vegetable and putrescible matter, corresponding to more than one million tons of such matter contained in the estimated total of 8·3 million tons for the entire annual output of the United Kingdom. The percentage of organic matter in the refuse varied considerably with the class of dwelling ; that from artisans was 9·96, from the middle class 15·33, and from the 'better' class 16·62. Paper averaged 14 29 per cent, and rags 1·89 per cent.

The question arises, therefore, whether such refuse can be used as an organic manure, either directly or after processing. As criteria of suitability the main considerations are : contents of nitrogen, cellulose and lignin, and rate of decomposition in the soil. Although little work has been done in these directions, a few practical men have been forestalling scientific inquiry. The Corporation of St. Albans, Herts, is producing material that is reported to have given good results on neighbouring farm land, and the Royal Borough of Kensington is disposing of all its refuse to a private company that is converting it into an organic manure in a plant designed to treat 250 tons a day, situated at Wood Lane, London, W. A similar plant is to be in operation at Harrow early in 1940. The process is simple : grosser solids like metal containers, glass, and paper are picked out by hand on moving belts ; the material is crushed, sprayed with a culture of nitrogen-fixing bacteria, and then allowed to ferment, aerobically and anaerobically, for sixteen days in large chambers. The product has little odour, and is a coarse brown powder containing about 30 per cent of organic matter (with about 1 per cent of nitrogen), 40 per cent of inorganic solids, and 30 per cent of moisture.

Large-scale replicated experiments to determine its manurial value were undertaken by the Rothamsted Experimental Station on a wide variety of soils at Rothamsted on kale, Woburn on sugar-beet, Tunstall (Suffolk) and Siddlesham (Sussex) on potatoes, and at High Halstow (Kent) on mangolds. The treated town's refuse (termed 'Hyganic') was compared with farmyard manure, rape-dust, and sulphate of ammonia in single and double doses. The chief interest lies in the comparison with farmyard manure at Rothamsted where, on an equal nitrogen basis, 'Hyganic' proved superior three times out of four ; and at Woburn where, although the differences in terms of sugar per acre were not statistically significant, there was an advantage of 3 cwt. per acre of sugar in favour of 'Hyganic' when double dressings (1·6 cwt. nitrogen per acre) were applied. The value of the nitrogen in the manure was found to be nearly equal to one half that in sulphate of ammonia.

The results apply to the year of application only (residual effects were not examined), but they show that the organic matter in the town's refuse decomposes quickly, rendering the contained nitrogen readily available. The relatively rapid decomposition in the soil may well be associated with the beneficial effect on soil texture, which has been observed by market-gardeners and others, thus supporting Geltzer's generalization that the rate of decomposition of organic matter in a soil is directly related to the stability of the larger soil-aggregates that determine a good tilth.

MAGNETISM AND THE STRUCTURE OF MATTER*

By Dr. Kathleen Lonsdale
Royal Institution, London

THE first attempts at an explanation of magnetic phenomena were mainly concerned with the problem of action at a distance, but later the centre of interest shifted to the mechanism within the magnetized body which came into action under the influence of the external field. After the discovery by Oersted of the magnetic effect of an electric current, Ampère suggested in 1825 that a hypothesis of molecular currents might explain induced and permanent magnetization. At the time, only ferromagnetic phenomena were known, but the design of powerful electromagnets enabled Faraday to make the fundamental discovery that all matter is affected to a greater or less degree in a magnetic field. There are two broad types of behaviour: diamagnetic substances tend to move from the stronger to the weaker part of a non-uniform field and to set their longest dimension at right angles to the lines of force; paramagnetic substances move from the weaker to the stronger part of a field and set their length along the lines of force. Faraday showed that the resultant flux (lines of force per square centimetre) within a diamagnetic body must be less, while the flux within a paramagnetic body must be greater, than that in the external field. That means that the induced magnetization within a diamagnetic body opposes the inducing field, while that within a paramagnetic body reinforces the field.

Weber suggested in 1854 that if electric currents could exist within molecules, then substances might be divided into two classes according as to whether their molecules had a resultant magnetic moment due to circulating currents or not. Only the former could show paramagnetism. This is the basis of the Langevin theory. The atom is now known to be built up of particles of a certain mass and charge, the velocity and distribution of which can be varied under certain conditions. Magnetism is a property of these ultimate particles, because a moving charged particle is equivalent to a current in a circuit and therefore possesses a magnetic moment.

Diamagnetism

Diamagnetism is due to induced currents within the atom, these induced currents taking the form of a modification of the existing motion of the electrons. The orbits precess about the field direction, and this extra electronic motion gives rise to a magnetic moment the value of which depends on the field strength, the electronic mass and charge, and the projected areas of the electronic orbits. The gram atomic susceptibility (ratio of the intensity of magnetization per gram atom to the inducing field) is entirely governed therefore by the distribution of electron density in the atom. All atoms show diamagnetism, but unless the resultant angular momentum of the atom is zero in the absence of a field, paramagnetism or ferromagnetism will also be present and the diamagnetism is relatively unimportant.

The susceptibilities of the inert gases have been measured and compared with those calculated from spectroscopic knowledge of the electron density distribution. Other atoms or groups of atoms may attain zero resultant angular momentum in three principal ways. In *ionic compounds* the component atoms may give or accept electrons, so that the external shells of each are completed. This occurs, for example, in the alkali halides. The susceptibilities of such polar compounds are additive, but when the compounds are dissolved in water, only dilute solutions show additivity. In concentrated solutions the ions not only depolymerize the water, but also form hydrates and other complexes. The electronic structure both of the ions and of the water molecules is deformed, with a consequent change of susceptibility. The structures of light and heavy water and of water of crystallization are also being studied by measurements of susceptibility.

In *homopolar compounds* the atoms share electrons, thus completing their electron shells or pairing off their odd electron spins. The diatomic molecules H_2, Cl_2, Br_2, etc., are diamagnetic because the electron spin of one atom is antiparallel to that of the other. In O_2, however, the electron spins are parallel, giving rise to a strong paramagnetism. Nearly all organic compounds are diamagnetic, and Pascal has shown that their molecular susceptibilities obey an additive rule $\chi_M = \Sigma\chi_A + \lambda$, where λ is a factor which makes allowance for the different kinds of valency bonds. This rule can be used for the determination of chemical constitution in doubtful cases, and for the study of polymerization. Complex compounds are frequently diamagnetic because the effective atomic number of the complex group is equal to that of an inert gas, but this alone is not a sufficient criterion. The state of the electrons taking part in the formation of chemical bonds.

* Substance of a special course of lectures for students, given at the Royal Institution on November 29, December 6 and 13, 1939.

is important. Measurements of susceptibility are now being used to investigate the constituents of natural products, including blood.

In *metallic compounds* the valency electrons become free electrons having a small resultant paramagnetism, while the positive metallic ions will be diamagnetic if their outer shell is closed. Thus many metals are weakly paramagnetic or diamagnetic. In some semi-metals such as bismuth, antimony and graphitic carbon, the binding electrons are not really free; their energy states bear a definite relation to the crystal structure and this results in high diamagnetism and large anisotropy, both of which disappear on melting or can be radically changed by the solution in the solid of small quantities of other elements.

Normally, diamagnetism is independent of temperature and of change of state, but a metal which becomes superconducting at very low temperatures always becomes also strongly diamagnetic. Except for a very small surface region, no flux can penetrate an ideal superconductor, the permeability being zero throughout the interior of the metal and changing from zero to unity in a region of about 1000 A. width below the surface. The supercurrent, which exists only in this surface region, is according to the theory of London a stationary current dependent upon the presence of a magnetic field, similar to that in a large diamagnetic atom. In wires, films or particles of dimensions comparable with 1000 A., the susceptibility is only a fraction of that of the bulk superconductor. Slater has suggested a molecular model for the theory of London on the basis of semi-bound electrons with very large wave-functions, and explains the 'threshold field' as that value at which the Larmor precession energy becomes comparable with the 'atomic' energy.

In aromatic organic compounds there are electrons which occupy large plane orbits, and this results in a large molecular anisotropy. From the principal susceptibilities of single crystals of such substances, it is sometimes possible to determine the orientations of the molecules, or if the crystal structure is known to deduce the electron distribution in the molecule.

PARAMAGNETISM AND FERROMAGNETISM

Any atom or ion will be paramagnetic that does not succeed in completing its outer shell or in pairing off its electrons. The inner closed shells contribute only to a correcting diamagnetism. The resultant magnetic moment of the atom is measured in Bohr magnetons (μ_B) and is dependent upon the motion and distribution of the odd electrons, that is, upon their momenta. Electrons can have orbital (L) and spin (S) momenta, which combine to give a resultant angular momentum (J). All of these are quantized, that is, they can only have certain values. The angle between the resultant angular momentum and the magnetic field direction can also only have $(2J + 1)$ discrete values. The gyromagnetic ratio, which is the ratio of angular momentum to magnetic moment, is $2m/e$ for orbital motion, m/e for spin motion and $2m/ge$ for the whole atom, where g, the Landé splitting factor, is dependent only on L, S and J.

In the Gerlach-Stern experiment a stream of free atoms from an electric oven passes through an inhomogeneous magnetic field and is received on a cold glass plate, the vapour pressure in the apparatus being low so that no collisions take place. Paramagnetic atoms will be both orientated and deflected, giving $(2J + 1)$ separate traces, the separation of which depends upon g. Hence the one experiment gives both angular momentum and magnetic moment of free atoms. Data so obtained agree well with those determined from spectroscopic measurements. A modification of the method can give the spin momentum and magnetic moment of the nucleus. Even for large atoms containing many protons and neutrons the largest nuclear spin observed is 9/2, indicating that the nucleus itself may have a shell structure, only uncompensated particles contributing to the resultant momentum. The magnetic moment of the proton is 2·85 nuclear magnetons ($\mu_N = \frac{1}{1840}\mu_B$), from which it appears that the proton itself may not be a single particle.

When the effective magnetic moments of bulk substances containing paramagnetic ions are measured, it is found that the rare earth salts give results which agree well with theory, whereas salts of the transition series have susceptibilities considerably lower than theoretical values. This is due to quenching of the orbital moments in the latter by electric fields due to neighbouring atoms; this effect may introduce asymmetry in the case of crystalline fields. The incomplete group in rare earth ions is largely shielded from such interaction by an outer completed shell.

Paramagnetic saturation can only be approached at very low temperatures using enormous fields and substances of large magnetic moment. At ordinary temperatures the susceptibility varies inversely with absolute temperature (Curie's law) or with the excess temperature above a critical value θ (Curie-Weiss law). In the latter case it appears as if, within the substance, there were an extra field adding to the effect of the external field. This inner field is much too large to be of purely magnetic origin and is attributed to exchange interaction between electrons of neighbouring atoms.

Below the Curie point, θ, it is possible for a spontaneous magnetization to exist in certain cases

even in the absence of an external field. This magnetization, which varies from complete saturation at 0° A. to zero at the Curie point, is identified with the 'saturation' intensity of ferromagnetic substances appropriate to each temperature. Above their Curie points, all ferromagnetic substances are paramagnetic and obey the Curie-Weiss law. The intrinsic magnetization of a ferromagnetic is uniform in direction only throughout small regions or domains the average size of which is about 10^{-8} c.c., containing some 10^{15} atoms. The directions of magnetization of the various domains may be random and their resultant nil, but a small field is usually sufficient to align moments of individual domains. Single crystals have certain axes of easy magnetization which would appear to be the natural directions of spontaneous magnetization. Measurements of the gyromagnetic ratio prove that the elementary magnetic carrier is the electron spin. Heisenberg showed that intrinsic fields of the right order of size could arise from exchange interaction between electron spins. The condition for a large-scale alignment of spins is that the ratio of the distance between neighbouring atoms to the radius of the energy shell in which uncompensated electron spins exist shall lie within certain limits. The ratio has the right value for iron, cobalt, nickel, and for some of the rare earth metals; chromium and manganese lie just outside the range, but certain compounds and alloys containing these elements (notably the Heusler alloys) are ferromagnetic.

The first few atoms of an impurity do not markedly affect polycrystalline ferromagnetic materials, but if the number of dissolved atoms becomes larger than the number of domains, then even very small percentages of carbon, oxygen or sulphur can greatly lower permeability and increase hysteresis. The addition of silicon has the effect of causing these impurities to crystallize out in forms in which they are relatively less harmful. Much work has been done on the technical side in these directions, and in the preparation of 'soft' and 'hard' magnetic materials. Recent X-ray work has revealed why it is that alloys prepared under certain conditions of heat treatment make excellent permanent magnet material.

OBITUARY

Mr. Wilfred Trotter, F.R.S.

IN the recent autumn the Royal Society has suffered the loss of both of its fellows whose work lay in surgery, Harvey Cushing of America, who died on October 7, 1939, and Wilfred Trotter of London, who died on November 25 at the age of sixty-seven. Each had done conspicuous work in the surgery of the brain, approaching their problems with physiological thought, and Cushing's name will always be remembered for the studies by himself and his pupils on the pituitary gland and on the microscopic structure of brain tumours in reference to their ways of malignant growth. He was a pioneer in cerebral surgery in America, and his supreme powers both as an operator and as a scientific thinker soon gathered around him at Harvard a school of workers who will assuredly maintain the energetic influence left by Harvey Cushing's mind. The possibility of this broadly based success was a reward of the changes deliberately planned in American universities in order to enable a leader in medicine or surgery to receive all such laboratory and other advantages as a professor of physiology would expect in his department for the progress of scientific work and teaching.

Trotter was too early in England for such an opportunity, and much of his life was perforce spent in individualistic effort as a consulting surgeon. At University College Hospital he inherited the field of Sir Victor Horsley's work and soon proved himself to be a master of the surgery of the brain and of the thyroid gland. He wrote a general analysis of the physiological processes involved in cerebral concussion which influenced surgical thought widely. A new approach to the difficult tumours of the pharynx was devised by him, and in this and equally in all the familiar operations of surgery he worked with such technical perfection and delicate care of every detail for the welfare of both wound and patient that none could surpass his results. Practice as a London consultant grew rapidly, and from 1932 onwards Trotter had the honour of being sergeant surgeon in succession to three kings of England. But at that zenith of individual success he made a choice which to ordinary ambition seemed utterly paradoxical. His health was becoming unequal to the fullest strain of work, and so about 1934 he withdrew, not from unpaid hospital duties at his medical school, but from all private practice. He wished, while he still could, to teach the young men.

Trotter's influence on those around him at University College Hospital had at all times been profound. The fine lines of his face and the quiet perfection of everything said or done by him were united with a keenness of intellect that was stirringly eager to aid the minds of others and never stood aloof. His method was like that ascribed to Socrates, a conversation in which he would relentlessly, yet never with discourtesy or overbearing force, compel those sharing it to think afresh, to see

through time-worn phrases, and to discover the foundations, if any, of their beliefs. Any question would serve him for the method—surgical, medical, ethical, or artistic ; and a light irony would always keep the talk at human levels. He seemed to have realized completely the old precept "Know thyself", and through that discipline to have gained the power to influence the minds of all others.

Trotter's intense interest in the human mind inspired the first as well as what chanced to be the last of his publications ("Has the Intellect a Function ?", *Lancet* ; June 24, 1939). In 1905, when demonstrator of anatomy at his medical school and waiting in the hope of appointment to the surgical staff, he produced none of the conventional apprentice papers in surgery but wrote for the *Sociological Review* an illuminating article on herd instinct. This was enlarged and republished in 1915 as a small book analysing the mentalities of nations then at war. Describing himself in it as a biological psychologist, he sought to compare with objective detachment the workings of the mind and of instinct in man and in animals, and he found associated with the gregariousness of man and of many creatures a powerful herd instinct that could be used to explain much in human behaviour.

But his surgical training and his exact sense of scientific values made Trotter reluctant for speculation that could not be tested by observation, and his later writings on such questions were those of a wise philosopher surveying the world of medicine rather than of a formal psychologist. The question of pain often occupied his thoughts, and during the earlier period when he had some leisure for experimental work he published in the *Journal of Physiology*, 1909, an important series of observations made with Morriston Davies on the nature of the sensations found during restoration of function of various skin nerves that had been deliberately cut in themselves. This work was done to test the generalization as to the existence of separate epicritic and protopathic nerves that Head and Rivers had made upon one experiment. Afterwards Trotter himself suggested a most attractive generalization, that pain arose when body tissues were in contact with naked and uninsulated nerve fibres ; but then he had no leisure to test his view experimentally nor pupils to whom he could give the problem.

For a period, 1935–37, that was too brief and too late for work of his own, Trotter accepted the post of director of the Surgical Unit at University College Hospital as a temporary successor on the retirement of Prof. Choyce, because he regarded the welfare of such departments as of the highest value to a medical school. His eminence as a surgeon naturally gave him a seat for many years on the Council of the Royal College of Surgeons. He also served clinical science by his membership of the Medical Research Council during 1929–1933 ; and he was twice chosen for the Council of the Royal Society, on the second occasion being named as a vice-president. Trotter never avoided committee work, for he was eager to guide practical progress. But he cared little to popularize his name in general surgery, and the writings by which he became more widely known in the medical world were his short papers and addresses on the general theme of medical science. They gave his message of the need for clear thinking. But few men have the power to think as penetratingly as Trotter could always do, or to state their thoughts with such clearness and perfection of language.

T. R. E.

WE regret to announce the following deaths :

Mr. W. A. S. Calder, president of the Institute of Chemistry, on January 6.

Dr. W. B. Worthington, formerly engineer-in-chief of the Midland Railway, president of the Institution of Civil Engineers during 1921–22, on December 29, aged eighty-five years.

NEWS AND VIEWS

Margarine

Now that rationing of certain articles of diet has begun in Great Britain, interest is naturally being concentrated on substitute foodstuffs. In the recent past, margarine has not enjoyed much popularity, even among the poorer people of the country. This has been due partly to a not too savoury history and partly, no doubt, to ignorance of its constitution and dietetic value. Present-day brands of margarine cannot be considered in any way *Ersatz* butter, but will, once prejudice has been eliminated by experience, prove complementary to the adequate amount of butter allowed under the present rationing scheme. At present, margarine is not being rationed ; therefore until it becomes necessary to ration cooking fats, its greatest value lies in eking out our butter supplies.

The plain statement of facts about margarine in an article beginning on p. 53 of this issue of NATURE, by Prof. J. C. Drummond, should do much to allay suspicion of, and counteract ill-founded prejudice against, this important commodity. Prof. Drummond has been University professor of biochemistry in University College, London, since 1922, and his deep practical knowledge of biochemical and physiological problems is now being utilized by the Ministry of Food, to which he is attached. His account of the early history and later improvements of manufacture of margarine will be read with interest, while the description of vitamin reinforcements should convince those still sceptical that margarine is a valuable article of food not only from the point of view of nutrition but also from that of health.

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Sir John Reith, Minister of Information

SIR JOHN REITH, chairman of Imperial Airways, Ltd., has been appointed Minister of Information in succession to Lord Macmillan; the way is thus open to bring into the House of Commons the minister in charge of a department the working of which has been severely criticized ever since it began to function on the outbreak of war. Sir John is perhaps better known as the director-general during 1927–38 of the British Broadcasting Corporation, having been managing director of the British Broadcasting Company which preceded it. Hence he was largely responsible for the guidance and development of the broadcasting service of Great Britain in its early and critical days, when its functions were ill-defined and its merits as a vehicle of entertainment, of news and of education for the masses were much debated.

Before he became associated with broadcasting, Sir John was for a short period general manager of the well-known engineering firm, Wm. Beardmore and Co., Ltd. This followed Government posts in charge of munition contracts after and during the War of 1914–18, in which he served with the Royal Engineers. Sir John is an engineer by profession, having passed through the Royal Technical College, Glasgow, and served a five-years engineering apprenticeship in Glasgow. He is a member of the Institution of Civil Engineers. While his professional knowledge was no doubt of service during his eleven years with the B.B.C., it was his forceful character and administrative ability which were outstanding; these, with his experience of public affairs and the Press, will be invaluable assets in the chief of a young department which is capable of making invaluable contributions to the influence and prestige of Great Britain and to the morale of the people at home.

The British Association

THE General Committee and the Council of the British Association held a joint meeting last week, at which Sir Albert Seward, the retiring president, handed over the chair of the Association to his successor, Sir Richard Gregory. It was reported that, by agreement between the authorities at Newcastle and the general officers of the Association, arrangements for the meeting of the Association which had been appointed to take place in that city next September were in abeyance, and that a meeting there was not contemplated, save in the event of an early peace.

The Committee of the Association therefore proceeded to a discussion of the desirability and possibilities of a meeting being held, in some modified form, and in some other place. As to desirability, there was general agreement; as to possibilities and places, various suggestions were put forward, and in the upshot the general officers were instructed to make the best arrangements they can for some sort of an abbreviated meeting. Whether as part of such a meeting, or independently, the potential activities of the Division for the Social and International Relations of Science will be taken into consideration. No action has been taken to appoint new sectional officers for the year; but the general officers were instructed to consult those who held such offices last year, and any others whose advice and help would be appropriate.

Scientific Workers and the Armed Forces

THE Ministry of Labour and National Service announces that the operation of the Schedule of Reserved Occupations is being relaxed to enable men at or above the age of reservation in scientific occupations to volunteer in approved cases for service in the Forces. Such men have previously been able to join the Forces in their professional capacity, and the present relaxation of the schedule is designed to enable those whose services are not required in a professional capacity in the Forces or as civilians to volunteer for other forms of service. To secure that scientific workers shall not be withdrawn from civil work to the detriment of the national interest, and that an adequate reserve of scientific workers is maintained for essential services, the Scientific Research Committee of the Central Register Advisory Council will consider applications from volunteers with the view of ensuring that relaxation is granted only in suitable cases. Any reserved scientific worker who wishes to volunteer should apply to the Ministry of Labour and National Service (National Service Department), Montagu House, Whitehall, S.W.1.

Scientific Workers and the War

A SYMPOSIUM, organized by the Faculty of Science of Marx House, Clerkenwell Green, London, E.C.1, was held during the week-end of December 30–31, the title of the meeting being "The Position of Science and Scientists in the War Situation". No adequate assessment of the effect of the war is possible without some knowledge of the economic background, and this was afforded by Maurice Dobb in a paper entitled "The Economics of War Capitalism". It was with this background that the meeting held a discussion on the effects of the war on university research and education, opened by Prof. H. Levy. It was argued that the cost of the social services would be cut, and in this respect, the maintenance of the universities on the present scale would be regarded as an unnecessary luxury, with adverse effects on staff, students, and standards of education. Mr. Roscoe Clarke, in discussing the scientific social services, showed that the incidence of the same problems has been felt in the medical services. The emergency medical schemes have cut right across the normal medical services, already dislocated by the evacuation of schoolchildren. Prof. J. D. Bernal, in the concluding paper, dealt with the status of the man of science. The historical role of science in the development of capitalism was analysed, and the effect of the functions of the scientific worker on his status discussed; at the present time, the existing system cannot use to the full the science it has itself brought into being.

The general tone of the discussion as a whole was that scientific workers are more and more

beginning to feel dissatisfied with the role of science and its present applications to human welfare, and that a material change, if not a complete break, will have to be made with the present economic system before science can be fully utilized. Concern at the insecurity of their own position in the immediate future is leading scientific workers to the view that a new type of scientific organization, based on the experience of the trade unions in the defence of the economic and cultural interests of large masses of the population, is becoming necessary.

The Earthquake in Turkey

As the railway between Sivas and the ruins of Erzinjan has now been repaired, it is possible to add a few more details concerning the Erzinjan earthquake of December 27, 1939 (see NATURE of Jan. 6, p. 13). From Ankara to Sivas and Tokat the damage has been done chiefly to the old and badly constructed buildings made from inferior material, whilst the better ferro-concrete public buildings of recent construction have escaped with cracks and minor damage; but from Tokat and Sivas to Erzinjan there has been practically complete destruction of old and new. The only 'oasis' of lesser damage thus far recorded has been at Kemah near Erzinjan, where some buildings still stand, though 548 buildings were wrecked and nearly 150 casualties caused. It appears probable that Kemah was built on more solid rock than the other towns in the area of approximately 15,000 square miles affected.

In the mountainous district between Amasya and Tokat there are ground fissures 12 yards wide, out of which are said to issue smoke and sulphur fumes and also jets of boiling water. There is as yet no direct news of some five hundred villages to the east of Erzinjan, although efforts are being made to reach them through a countryside covered to a depth of 12 ft. in snow. At Niksar, a rock pinnacle fell on the town, doing much damage, and there were few survivors in this place or in fourteen of the neighbouring villages, whilst on the Black Sea coast the towns of Kerasun and Ordu are reported to have suffered the greatest damage.

At Kew Observatory the first waves to arrive did so at 0h. 3m. 26s. G.M.T. and the maxima exceeded the limits of registration, the ground movement being greater than one millimeter in amplitude. Several severe after-shocks have occurred as well as hundreds of smaller ones. On January 1 there were seven severe after-shocks at Erzinjan, and a violent shock at 7 a.m. local time at Bergama in the west of Turkey. On January 2 at Yozgad there was a strong shock and 190 houses collapsed, though no casualties are reported. The after-shocks appear now to be decreasing in strength and number. Although the after-shock of January 1 was at Bergama, it is yet uncertain whether the floods in the Brusa and Smyrna districts of Turkey and in the Bilecik Valley (River Sakaria) had anything to do with changes in topography attendant on the earthquakes, nor whether the Kemal Pasha Dams and numerous river bridges were destroyed by the shocks or by the floodwaters, but if the meteorological conditions in the area did not cause the floods, they certainly enhanced them considerably.

Other Recent Earthquakes

ON December 21, San José (Costa Rica) suffered the most severe earthquake it has known since 1923. Buildings were cracked, including the cathedral, though no casualties are reported. The shock was recorded at Manila, at De Bilt (Holland), where the *P* wave arrived at 21h. 7m. 10s. G.M.T., and at Kew, where the first of three shocks in rapid succession arrived at 21h. 6m. 51s. G.M.T., the maximum ground amplitude at Kew being 0·42 mm. On December 22, considerable damage is reported to have been caused by earthquake shocks in Costa Rica, though no loss of life or other casualties are reported. These shocks were possibly after-shocks of the earthquake which rocked San José on December 21.

On December 22 also severe earthquake shocks were experienced in the South Sea islands of Molucca. On December 23 and 24 earthquakes and landslides, which were probably caused by the earthquakes, occurred in Java in the East Indies. In addition to the Anatolian earthquake of December 27, further shocks were registered at Kew Observatory on December 25 (2), December 28 and December 29. Further news concerning all these shocks is awaited from the areas concerned and from other seismological observatories. On January 2, early in the day, an earthquake shock was perceptible on the Ionian Island of Zante (Greece), though no damage or loss of life has been reported.

Potatoes in War-time

POTATOES are one of the most valuable sources of human and animal food in war-time, and it is of the greatest national importance that both the acreage devoted to this crop shall be increased and that the maximum yields shall be obtained. Questions of quality, colour and shape must now take second place and yield be the all-important aim of the grower. The National Institute of Agricultural Botany, Cambridge, has just issued a war-time edition of its Farmer's Leaflet No. 3, in which useful information to this end is supplied. Emphasis is laid on the necessity for using healthy seed, as otherwise attention to cultivation, manuring, etc., is of little value. A number of varieties are recommended for both early and main crops; but it is pointed out that to lift potatoes in an unripe condition is an unwarranted waste of tonnage in a time of emergency. As regards choice of varieties, most of those commonly grown are still recommended, but King Edward should be replaced by a heavier cropping kind such as Arran Banner, Arran Consul, Kerr's Pink, Majestic or Redskin.

The use of unsaleable potatoes for animal feeding is the subject of "Growmore" Leaflet No. 10, issued by the Ministry of Agriculture. All potatoes, whether to be used raw or cooked, should be washed before feeding, or digestive trouble may result. Raw potatoes

can be used safely in moderation for cattle, dairy cows and sheep; but they are not suitable for young stock, horses or pigs. Cooked potatoes, however, can be successfully fed to pigs of all ages, and a table of suitable quantities is provided. Potato and potato and green fodder silage are other useful ways of utilizing waste tubers, particularly if some of them are slightly diseased, and simple methods for preserving them in this way are described. Nutritious food of a feeding value equivalent to about a quarter of its weight of barley meal, and suitable for sheep, cattle and pigs, can thus be produced.

Johann Friedrich Blumenbach (1752-1840)

JOHANN FRIEDRICH BLUMENBACH, a pioneer in anthropology and craniology, was born on May 11, 1752, at Gotha. He studied medicine at Jena under Soemmering and qualified in 1776 at Göttingen, where he was appointed extraordinary professor of the practice of medicine in the following year and full professor in 1778. In his thesis entitled "De generis humani varietate nativa" (1776), which according to Garrison is the starting point of modern ethnology, he based his classification of mankind upon the shape of the skull and the facial configuration as well as on the colour of the skin. As the result of his craniological investigations, he divided the human race into five great families: the Caucasian or white race, the Mongolian or yellow, the Malayan or brown, the Negro or black, and the American or red.

Blumenbach was a voluminous writer. His principal work, which was published in 1790–1820, was entitled "Decades 1–6 collectiones suae craniorum diversarum gentium illustratæ". He was also the author of "Handbuch der Naturgeschichte" (1779–80), "Ueber der Bildungstrieb und das Zeugungsgeschäft" (1781), "Institutiones physiologicæ" (1787), "Beiträge zur Naturgeschichte" (1790–1811), and "Handbuch der vergleichenden Anatomie" (1805). He was also the editor of "Medicinische Bibliothek" from 1785 until 1795, and contributed many articles to periodical literature. He was a fellow of the Royal Society, member of the Royal Academy of Sciences of Paris, and the recipient of many other honours at home and abroad. He died on January 18, 1840.

Neanderthal Man in Central Asia

A PRELIMINARY account of the discovery of skeletal remains of Neanderthal man in Central Asia is given by Dr. Aleš Hrdlička through the Smithsonian Institution of Washington. The remains—the skull of a child, with the lower jaw and all the teeth, and some of the bones of the skeleton in a fragmentary state—were found by Dr. A. Nokladnikov in a cave of the Gissar Mountains of Siberia. The discovery is of special importance, as not only is this the first example of Neanderthal man to be recorded from Central Asia, but it is also the farthest extension of the type eastward hitherto known. With the exception of the finds in Palestine, all previous specimens have been found in Europe. Dr. Hrdlička, who has had an opportunity of examining the material while on a visit to Siberia recently, regards it as one of the most important discoveries in anthropology of the last two decades, and further as lending support to his view that there is an overlap in skull pattern between Sinanthropus and Neanderthal man.

In an account of the find which Dr. Hrdlička received at first hand from those who were responsible for the discovery, it was stated that the cave deposits contained many splintered bones of deer, leopards, wild horses, goats, boars, marmots and birds. Many of these showed evidence of having been used in the manufacture of stone implements. Most of these implements were made of local limestone, but the finest were of jasper. Good material for implement-making, however, was scarce. Typical Mousterian scrapers and small pointed implements, chipped on one side, were associated with the animal bones, and both were in relation to fire-places. The human skeletal remains were imbedded in a sterile underlying stratum. An interesting feature of their disposal was that they were encircled by five pairs of goat horns, of which three were still united.

Psychology of the Initiate

An interesting sidelight is thrown on certain changes in mentality taking place after initiation by an examination of two series of drawings made by an Australian aboriginal boy, which have been recorded and reproduced by C. P. Mountford, acting ethnologist of the South Australian Museum (*Records S. Austral. Mus.*, **6**, 2; 1939). The subject was one of two interpreters accompanying an anthropological expedition of the University of Adelaide to the Warburton Ranges of Western Australia in 1935. At the time of his engagement it was understood that he was a full initiate; but when an investigation of aboriginal art was being made, it was noted that when drawings of a secret character were being made by tribesmen, they were carefully concealed on his approach. His own drawings in the first series invariably represented objects of, or known to, European civilization.

This fact, coupled with his failure as an interpreter, led to inquiry, when it was found that initiation of the man had not been completed. Though circumcized, he had not been subincized, and consequently in all matters affecting tribal ritual he was virtually ostracized, while his behaviour consorted with that of younger members of the tribe. Full initiation, which was then carried out, induced a remarkable change in his outlook, behaviour, and what from one point of view was of greater moment, in the attitude of other members of the group. The youth assumed the attitude and behaviour of a senior of the tribe; he was no longer prevented from seeing ceremonial drawings and taking part in ritualistic discussions, while, it is interesting to note, his own drawings now depicted the ceremonial designs associated with, or recording tribal traditions. The author's comment is significant. He points out how any interference with tribal ritual by outside influence may prove an effectual bar to association with tribal society, while still not securing an admission to any real participation in white civilization. The lesson is instructive.

Supposed Risso's Grampus in the Mersey

THE importance that authorities in tidal districts be acquainted with the fact that, under an arrangement made some few years ago, all large cetaceans stranded on the shores of Great Britain should be offered to the British Museum before any decision is made to dispose of them, is well borne out by the unfortunate destruction of a rare cetacean recently stranded in the Mersey. The flood tide of December 10, stranded a large cetacean in the Mersey at Widnes, and various unofficial reports circulated suggested it to be a porpoise, dolphin, or killer whale. Immediately upon discovering that no local museum or university had been informed of the rarity, the Merseyside Naturalists' Association went to considerable trouble to collect all available evidence and photographs and to interview all people who had handled the specimen. Through some misunderstanding, it appears that although the customs authorities had told the transporter company who recovered the whale that any scientifically interested body could have it, the Upper Mersey Conservators took possession of the carcass the day following its stranding, cut it up into pieces and returned it to the river from one of their vessels.

Evidence which was gathered by the Merseyside Naturalists' Association strongly suggests that the animal was a Risso's grampus (*Grampus griseus*), of which there is no previous Lancashire or Cheshire record. The report of evidence it collected gives: Length, 11 ft. 2 in.; upper parts: dark grey, almost black, blotched and streaked plainly with greyish-white, dorsal fin broad and high; head: no teeth in upper jaw; lower jaw with a few rather blunt teeth spaced about 0·75 in. apart; lower jaw a shade shorter than upper jaw; whitish tinge to muzzle and greyish tinge to head; head large and swollen like that of pilot whale; underparts white, smooth; flippers long, narrow and pointed; tail flukes narrow. No scientific measurements had been taken owing to the surprising and unannounced destruction of the carcass, but a photograph taken by a local man had been secured. The specimen was still alive and blowing when stranded and roped.

The Meteorological Office

THE recently issued report of the Director of the Meteorological Office for the year ending March 31, 1939 (H.M. Stationery Office. 9*d*. net), is largely occupied with a description of changes of organization arising from the rapid expansion of the Office, due mainly to the expansion of the Royal Air Force; it contains also an account of the methods adopted for dealing with routine requirements of the different services and of civil aviation. For these reasons a more careful perusal of the report is necessary than has generally been the case in the past in order to find items of purely scientific interest, although, it is curious to note, the decision was made during the period under review to make organized research a part of the normal work of the Office, instead of leaving research to individual enterprise on the part of the scientific staff.

The most important instrumental problem that has been pursued has been the development of the *radio-sonde* method of measuring the pressure, temperature and humidity of the atmosphere up to heights of 10 miles or more. The apparatus arrived at has been developed in collaboration with the National Physical Laboratory. It is carried by a free balloon, and transmits radio signals which are modulated in a manner dependent on the physical state of the atmosphere with which the balloon is surrounded at the moment. Fifty ascents were made, in most of which a Dines meteorograph was attached so that a check on the indications of the radio transmitter was available eventually on those occasions when the instruments were recovered. Much time was spent in trying to eliminate various sources of error that were encountered. Trials of a radio method of measurement of winds at great heights were continued, the method consisting of observations by two distant radio direction finding stations of the position of a small radio transmitter carried by a balloon. The main difficulty arose from the deflection of the radio signals by surface objects, which necessitated elaborate calibration. During the year under review the use of the cloud searchlight for rapid determination of cloud height at night was greatly extended. Improved specifications for pilot balloons were considered, with the view of avoiding the rapid deterioration experienced in hot climates, also improved methods of storage.

Terminal Velocities

DR. HERBERT CHATLEY prepared a paper on 'terminal velocities' for delivery to the Junior Institution of Engineers on October 13. It is now published in the December issue of the *Journal* of the Institution. In many engineering and physical problems of the present day, the question often arises as to the maximum velocity developed when a body falls in a fluid medium. To give a rough idea of the terminal velocities, Dr. Chatley compares the impact velocity of a stream-lined aerial bomb and the speed with which the finest clay suspensions settle in water. Between these speeds he considers the landing speed of parachutes, the fall of rain or oil-drops, the vertical current speeds necessary in coal dust or grain elevators, the suspension of sand or silt in rivers, and the settlement of dust particles in a room.

When an elevated body is released, it falls earthwards according to the law of gravitation. As it proceeds, the resistance of the air or water increases up to a definite value, namely, when this resistance equals the weight of the body. When this happens, the velocity remains constant and is called the terminal velocity. A sand particle one micron in diameter has a terminal velocity in water of about 0·001 mm. per second; in air it is about ninety times as great. One of the most useful applications of the terminal velocity is in the computation of the power required to sustain bodies when placed in a current of fluid. For example, in the elevation of grain from a hopper or ship's hold to a level somewhat above the receiver, out of which it flows to a second container (say, 50 feet

lift), modern plants consume about 0·8 h.p. hour per ton. This represents a very low efficiency. In a vertical pipe a fluid ascends more quickly than a suspended material, their relative velocity being the 'terminal velocity' in this case.

A Zinc 'Famine'

ACCORDING to the *Electrical Contractor and Retailer* an idea was current a short time ago that a shortage of zinc was responsible for the recent famine in torch-batteries. This is not the case as there was plenty of zinc in Great Britain and the torch-battery famine was due entirely to the overwhelming Government and public demand for these accessories—and quite naturally so. When a large number of people suddenly resolve to carry flash-lamps, something like a temporary famine is unavoidable. During the life of an ordinary dry battery possibly five per cent of the zinc is consumed and so about 95 per cent of the zinc used for this service is thrown away. It looks as if we were surrounded by an appalling waste in various directions. Notice, for example, the packing of tobacco and cigarettes for domestic use in 'tins' and then visualize the waste of iron and tin thereby involved. Many of these tins are also provided with substantial rubber seals, all of which are used once and then thrown away. It would be of interest if somebody considered whether this waste is serious or not, and if it is, then investigate how the saving could be effected.

Training Physicists

DURING the last six years there has been much discussion in the United States as to the most suitable training for physicists who are required in industry, and the conclusions come to have been summarized in these columns. In general, the training then available was considered to provide a superficial acquaintance with the latest developments of quantum theory and of atomic disintegration rather than a fundamental knowledge of the older physics. Criticisms of the same type were made in the May issue of *Metals and Alloys* this year and were quoted in the July issue of the *Journal of Scientific Instruments*.

In the November issue of the *Journal*, two physicists in the research department of a cable works in Great Britain point out that the criticism applies equally well to the training the universities of Great Britain provide, and that in consequence industrialists are reluctant to employ physicists. They think that the position would be improved if the universities provided some training in applied physics and supplemented it by visits to works and by practical experience in works during vacations.

Fused All-Glass Cells

MESSRS. TINTOMETER LTD., of Salisbury, announce the manufacture of a range of fused all-glass cells suitable for holding liquids for colorimetry, photometry, polarimetry and other purposes. The construction of the standard type consists of a body of a single bend of glass with faces of clear glass sintered to it. This avoids the use of the usual cements, which often break down under the attack of alkalis and other solvents. It is claimed that the accuracy of the thickness is within $\pm 4 \times 10^{-3}$ in. for cells of one inch or less; moreover, examination shows that distortion of the faces in the sintering process has been very largely avoided. Beside the standard types, hollow cubes, prisms, rectangular cells, double light-filter cells, and 'blood' cells are also being manufactured. It appears that these products will form a useful addition to the range of such articles manufactured in Great Britain.

Rhodes Scholars

THE "Statement of the Rhodes Scholarships" for the academic year 1938–39 shows that 68 scholars began their English experience, while 188 were in residence. Among the subjects covered, natural science and medicine with 45 representatives, and jurisprudence and the Modern Greats school with 38 each are easily the most popular. Agriculture, forestry and music have solitary devotees. The record is good on the whole in academic distinctions, and includes several names well known in sport and athletics. The list of books published by men of the foundation is long. The Rhodes scholars include a dean of Christ Church and a regius professor of medicine. They come to England with previous academic training and at an age more advanced than that of the average undergraduate. The question whether this discrepancy is advisable has been the subject of considerable comment.

Scientific Research in India

THE progress of research in India can be followed by the help of the *Indian Science Abstracts*, which is an annotated bibliography arranged by subjects. Some of these bear closely on the economic development of the country, and their principal interest is local rather than general. Part 1 for the year 1937 covers mathematics, physics, geology and botany (National Institute of Sciences of India, September 1939). Mathematics has 86 papers, five of which deal with Indian geodesical problems, physics has 189, only a dozen of which deal with local meteorological or geophysical subjects; geology has 316 and botany 286, dealing almost exclusively with Indian problems.

Alchemical Manuscripts

VOLUME 6 of *Osiris*, dedicated to Prof. Bidez, contains his portrait and a bibliography of his publications. The rest of the volume of 844 pages consists of a "Catalogue of Latin and Vernacular Alchemical Manuscripts in the United States and Canada" by W. J. Wilson, of the Library of Congress, Washington. After a brief but very interesting general introduction, the text consists of detailed and annotated analyses of 79 manuscripts, with 41 facsimile figures. The dates of the manuscripts range from the thirteenth to the nineteenth centuries. Many of them contain collections of recipes. There is a very full index (pages 690–844). The work is thorough and reaches a high standard of scholarship;

it is a notable addition to the literature of a subject which has recently attracted a good deal of attention, namely, the history of alchemy.

Early Works on Medicine and Science

WE have received from Messrs. Goldschmidt and Co., Ltd., 45 Old Bond Street, W.1, their Catalogue No. 53 listing rare early works on medicine and science. Pride of place is occupied by a good and large copy in vellum of the first edition of William Harvey's "De Motu Cordis" (1628), and also a copy of the rare third edition of the same work. A complete set of Conrad Gesner's "Natural History" (1551), three of Kepler's important works, a work by Joseph Black on alkalis (1770) and William Withering's "An Account of the Foxglove" are also to be noted. A number of less rare though none the less important books and tracts by Erasmus Darwin, Euler, Faraday, Fayrer, Fraunhofer, Stephen Hales, Mendeléeff, Pasteur, Lister, Fox Talbot and many others are also listed.

Medical and Scientific Lending Library

PART 2 of the new edition of the "Catalogue of Lewis's Medical and Scientific Lending Library", revised to the end of 1937, has now been issued (London: H. K. Lewis and Co., Ltd., 136 Gower Street, W.C.1. 16*s*. net; to subscribers, 8*s*.). It contains the classified index of the subject-matter of the books, with the names of their authors, upon medical and scientific subjects contained in Lewis's Library. An extensive subject is subdivided to facilitate reference; for example, chemistry has eleven, and agriculture thirteen, sub-headings. The date of publication is given, and a note is frequently added to indicate the scope of the work. It will be appreciated what a large number of works is listed when it is mentioned that the text occupies 156 pages, each with three columns and each column containing authors' names of some 30–45 works. The catalogue should therefore prove a very useful general guide to medical and scientific books.

Big Sunspots

A BIG group of sunspots, originating about January 1 and growing rapidly, crossed the sun's central meridian on January 5 and reached the west limb on January 12. Between January 2 and 4, the area increased tenfold and measured 1,300 millionths of the sun's hemisphere on the latter date. Still expanding on January 5, the spots were clearly seen with the naked eye through the morning mist. In structure, the group was a typical stream with leader and follower spots and subsidiary spots in between. This group is the largest since last September, and indicates that, although the maximum of the 11-year cycle is past, the sun is still generally active.

Royal Institution Discourses

THE following Friday Evening Discourses have been arranged by the Royal Institution to be delivered before Easter. The discourses begin at 5 o'clock: January 19, Sir Leonard Woolley, "The Latest Excavations at Atchana in North Syria"; January 26, Sir Noel Ashbridge, "Long Distance Broadcasting"; February 9, Prof. L. C. Martin, "Ultra-Violet and Electron Microscopy"; February 16, Sir William Bragg, "Physics in War-time"; March 1, Lord Eustace Percy, "Peace-making after War: Past History and Future Problems"; March 8, Sir William Bragg, "Experiments from the Researches of Sir James Dewar"; March 15, Sir Frederick Keeble, "Agriculture and National Well-being".

Announcements

THE Harrison Lectureship Medal of the Pharmaceutical Society will be awarded to Mr. A. D. Powell at a meeting on January 9 at 7.30, when Mr. Powell will deliver the Harrison Memorial Lecture entitled "Drug Standards: their Development and Application".

THE next monthly meeting of the British Institute of Radiology will be held in the Reid-Knox Hall on January 19, at 2 p.m., when the following lectures will be delivered: Silvanus Thompson Memorial Lecture entitled "The Irradiation of Liquids", by Prof. F. L. Hopwood; Mackenzie Davidson Memorial Lecture entitled "Maternal Mortality and Radiology", by Dr. L. A. Rowden.

THE Friends of the National Libraries decided at their annual meeting to continue their activities during the War. Acquisitions during the year included a number of early and rare books on science presented to the Science Library at South Kensington, a volume of drawings by the architect, Edward Blore, of country houses and other buildings, given to the Royal Institute of British Architects, and the purchase of a collection of papers belonging to the publishing business of Robert Cadell, Stoneham and Houlston.

THE Paris Academy of Medicine has awarded the Jansen Prize to Prof. A. Bessemans, pro-rector of the University of Ghent, for his work on spirochætes.

THE Albert Brachet Prize of 12,000 francs is awarded every three years for the best work on embryology published during this period in English, French, Dutch, German or Italian. Further information can be obtained from the Secrétarie perpétuel de l'Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, Palais des Académies, Brussels.

THE Emergency Executive Committee of the International Congress of Mathematicians has decided definitely to postpone until some more favourable date the Congress which was to have been held in Cambridge in September 1940.

A EURASIAN YOUTH MOVEMENT has been launched in Singapore with a scheme to uphold and improve the social, moral, physical and intellectual welfare of the Eurasian youth when they leave school.

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. 73. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Anisotropy of Cellulose Sheet

IN view of the results just published by Spence[1] on the optical anisotropy of films prepared from various esterified celluloses, it may be of interest to record some recent measurements on 'Cellophane' (regenerated cellulose) sheet.

This material is observed to be optically bi-axial, the axes lying in the plane defined by the direction of extrusion and the normal to the sheet. The measurements made in this laboratory are not, as in Spence's case, direct measurements of birefringence, but are observations of the two principal refractive indexes in the plane of the sheet, and of the optic axial angle. From these the refractive index normal to the sheet and the birefringence have been calculated. Numerical results for two batches of material are given in the accompanying table, where θ is the angle between one optic axis and the normal to the sheet; n_γ is refractive index for electric vector along extrusion direction; n_β is refractive index for electric vector in plane of sheet at right angles to extrusion direction; and n_α is refractive index for electric vector along normal to sheet.

		θ	n_γ (obs.)	n_β (obs.)	n_α (calc.)	$(n_\alpha - n_\gamma) \times 10^5$
Acid and water-washed sheet	Wetted	43·0°	1·413	1·408	1·403	−1000
	Air-dry	45·7°	1·534	1·526	1·519	−1500
Sheet undried during manufacture	Wet	56·5°	1·382	1·377	1·374	− 800
	Freely dried	57·6°	1·531	1·521	1·517	−1400
	Stretched and dried	72·3°	1·535	1·521	1·520	−1500

For ready comparison with Spence's birefringence figures, the values for $(n_\alpha - n_\gamma)$ are given in the same units as used by him although, owing to the method by which the figures were obtained, they cannot have the same accuracy as his. They are not inconsistent, however, with the values to be expected—by extrapolation to zero acetyl content—from Spence's figures obtained on sheets prepared from cellulose acetylated to different extents.

It may be observed that, while the 'slow ray direction' and the direction of extrusion or stress are coincident in the regenerated cellulose sheet, Spence found them (with one exception) to be at right angles in sheets made from cellulose esters with various acyl groups. Moreover, in cellulose sheet, increase of the stress along the direction of extrusion leads to increase in the negative value of $(n_\alpha - n_\gamma)$, in contrast again to the behaviour of the esters.

These differences are probably to be ascribed to the absence of acyl side chains in regenerated cellulose, since any 'selective' orientation that may be induced by stress will presumably have less effect on n_α and n_β in cellulose than in its esters. The values of n_α and n_γ in the material examined are nevertheless both increased by stress, while n_β remains remarkably constant.

D. G. DRUMMOND.

Photochemical Department,
British Cotton Industry
Research Association,
Manchester.
Dec. 8.

[1] Spence, J., *J. Phys. Chem.*, **43**, 865 (1939).

Heat Conductivity of Rubber at Low Temperatures

WHILST examining the possibilities of applying rubber in low-temperature work, we were hampered by the lack of available data of its physical properties at low temperatures. We were quite aware of the difficulties to be expected in making accurate measurements in that temperature region, and this applies specially to the heat conductivity in which we were particularly interested. In order to obtain at least an estimate of the order of magnitude, we carried out some measurements of the heat conductivity of commercial rubber (tyre rubber, North British) at room temperature and the temperature of liquid air.

We used (1) the standard method (heat transmission through a thin sheet) at both temperatures with a small vacuum apparatus which had a circular cross-section of about 7 cm.²; the specimen had a thickness of 0·9 mm.; (2) we checked the low-temperature measurement by the following method: a bag of the same rubber was immersed in liquid oxygen and filled with liquid nitrogen. The rate of evaporation of the nitrogen was measured and, together with the dimensions of the bag, allowed of an independent determination of the heat conductivity. The mean values obtained by both methods are as follow:

T	293°K.	83°K.
cal./sec.cm.°K.	0·00055	(1) 0·000018
		(2) 0·000010

This considerable drop in the heat conductivity to, say, one fortieth from room to liquid air temperature does not seem to be confined to this particular rubber, as other specimens which we subjected to rough measurements show a similar behaviour.

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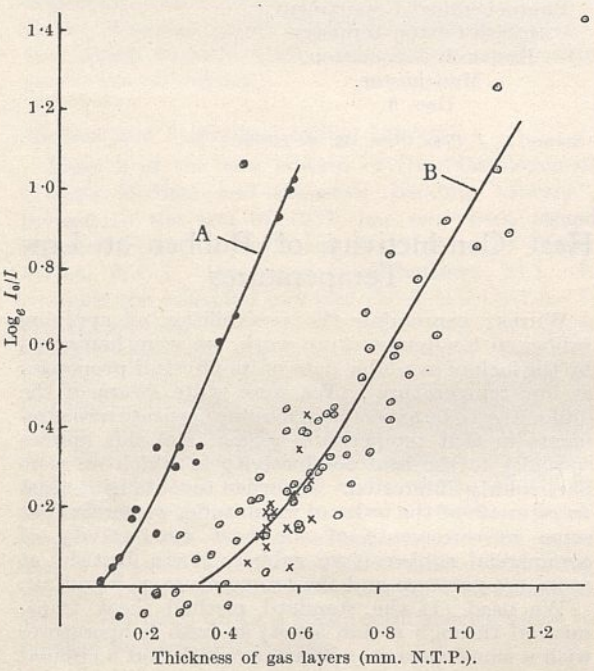
Dec. 18.

Absorption of Hydrogen Lyman Radiation by Atmospheric Gases

THE absorption of the hydrogen resonance line at 1215·7 A. has been investigated to obtain more exact information bearing on the theory of the production of short-wave radio fadeouts by solar eruptions[1]. The following results have been obtained:

(1) Nitrogen is transparent in layers up to 3·2 mm. thick (N.T.P.), in agreement with the early observations of Hopfield[2] and more recent measurements by Preston[3].

(2) Exact measurements on water vapour were difficult, but more than half the incident radiation is absorbed in a layer about 0·05 mm. thick. This agrees with Preston's observations.



●, oxygen; ⊙, air (energy in disruptive charge, 6 watts); ×, air (energy in disruptive charge, 3 watts).

(3) The absorption in oxygen and air was found to be much heavier than was expected from previous work. In the region where absorption commences, the densities of the parts of the hydrogen line in the absorption spectrum and the check spectrum without absorber, which was put on the same film, were compared directly as an approximate measure of the absorption. Lack of the characteristic curves for the emulsion should not cause serious errors in the comparison of nearly equal densities.

In the accompanying figure, Curve *A* shows the absorption of molecular oxygen in layers up to 0·6 mm. thick (N.T.P.). The ordinates are $\log_e I_0/I$ (I_0 being the unabsorbed and I the absorbed intensity); in the usual formula for mass absorption, $\log_e I_0/I = \mu x + c$. Since absorption appears to start only when there is a minimum gas layer amounting to about 0·10 mm., then c is not, in this case, zero. In addition, the absorption coefficient, μ, may not be constant for small values of the absorption.

Curve *B* shows the absorption in air. Several points falling below the axis of zero absorption indicate the possible magnitude of individual errors, and the general scatter of observations makes it difficult to define the absorption curve accurately. Its slope, however, is not constant, and again, there is no absorption until a minimum layer of gas is present. This minimum appears to be between 0·30 and 0·40 mm. (N.T.P.) and is not exactly five times the minimum in oxygen. For the strong bands at 1140, 1245 and 1450 A. absorption is clearly apparent in the least amounts of gas used for observations on 1215·7A.

The absorption coefficients given for oxygen and air by Preston are about fifty times less. In the present case the absorbing gases were pure to within three parts in a thousand, and, in addition, water vapour, the most powerful absorber, was ruled out as an unobserved impurity by check experiments with saturated nitrogen. It is possible that Preston's observations were in error owing to serious dissociation of the oxygen in his apparatus (cf. the difficulties experienced by Ladenburg and van Voorhis[4]). In the present case reduction to half the energy dissipated in the discharge caused no observable difference in the absorption measurements, showing that dissociation of the oxygen was negligible.

With a fixed absorption path the pressure is varied in order to change the thickness of the absorbing layer, and it would appear from the two curves, therefore, that the partial pressure of the oxygen in the spectrograph is the factor determining the onset of absorption. This minimum pressure is about 0·04 mm. If absorption of 1215·7 A. is only possible when an oxygen molecule is in a slightly perturbed state owing to its collision with another oxygen molecule, the absorption coefficient should vary as the square of the pressure until the population density of absorbing molecules is constant. In oxygen at very high pressures, Shalow and Steiner[5] have found absorption bands which behave in this way, and attributed by them to the temporary formation of O_2–O_2 molecules.

If λ 1215·7 is emitted from the sun, no absorption will take place until it reaches levels in the upper atmosphere where the partial pressure of molecular oxygen is about 0·04 mm. (about 80 km.), except for attenuation due to the small amount of water-vapour above this height. According to the shape of the 'tail' of the absorption curve, the radiation would be absorbed more or less rapidly in dissociating oxygen molecules and producing ionization according to the process previously suggested[1]. The resultant ionized layer would perhaps correspond to that found by Budden, Ratcliffe and Wilkes[6].

This work has been made possible through a grant for research made by the Commonwealth Government.

S. E. WILLIAMS.

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Nov. 30.

[1] Martyn, Munro, Higgs and Williams, NATURE, **140**, 603 (1937).
[2] Hopfield, *Phys. Rev.*, **20**, 573 (1922).
[3] Preston, *Phys. Rev.*, **55**, 1125, 1939 (abstract only). An attempt to communicate with Mr. Preston privately regarding the discrepancy was unsuccessful.
[4] Ladenburg and van Voorhis, *Phys. Rev.*, **43**, 315 (1933).
[5] Shalow and Steiner, *Z. Phys.*, **99**, 137 (1936).
[6] Budden, Ratcliffe and Wilkes, *Proc. Roy. Soc.*, A, **171**, 188 (1939).

Does the Mesotron Obey Bose-Einstein or Fermi-Dirac Statistics?

WHETHER the mesotron obeys Bose-Einstein or Fermi-Dirac statistics is closely associated with what one assumes regarding the nature of the field, emission and absorption of which by the heavy particle is responsible for the interaction between elementary nuclear particles. If the field be a one-particle field, as postulated by Yukawa[1], the mesotron obeys Bose-Einstein statistics, and has a spin equal to unity (All momenta are expressed in units of $\hbar$.) However, in view of the fact that all known elementary particles obey Fermi-Dirac statistics and possess a spin $\frac{1}{2}$, one is rather reluctant to accept, unless experimental evidence points that way, that the mesotron obeys Bose-Einstein statistics and has a spin equal to unity. If we could suppose that the field involved is a two-particle field instead of a one-particle one, Fermi-Dirac statistics and a spin of $\frac{1}{2}$ could be attributed to the particle concerned. So we suppose that the mesotron is emitted or absorbed by a heavy particle always in conjunction with a neutrino or an antineutrino. In symbols

$$P \rightleftarrows N + \eta^+ + n^- \qquad (1)$$
$$N \rightleftarrows P + \eta^- + n^+$$

where N and P stand for a neutron and a proton respectively, n^-, n^+ for a neutrino and an antineutrino, and η^-, η^+ for the negative and the positive mesotron, which now obey Fermi-Dirac statistics and possess a spin of $\frac{1}{2}$.

If we start with a neutron and a proton at $\vec{r}_1$ and $\vec{r}_2$ respectively, processes (1) obviously lead in the second approximation of the perturbation theory to an exchange interaction between the nuclear particles. If we suppose that the spin of the heavy particle is not affected during (1), the exchange force is purely a Heisenberg force; if, on the other hand, the spin of the heavy particle is reversed during (1), we get a purely Majorana force, so that the correct spin dependence of nuclear forces is obtained by choosing for the interaction between the heavy particles and the mesotron-neutrino field a form which combines the above two.

The forces between like particles, which are known[2] to be of the same order of magnitude, for anti-parallel spins at least, as the force between unlike particles, can likewise be explained by introducing the neutral counterpart of the mesotron.

The phenomenon of β-decay can be fitted into this theory if it is assumed that the mesotron disintegrates into a β-particle and a γ quantum; so that the emission of a β-decay particle during a β-decay is accompanied not by a neutrino alone, as on Fermi's theory, but also by a γ quantum. This departure from Fermi's theory should enable us to explain in a more satisfactory way the energy distribution curve for the β-particle transformation.

Detailed calculations will be published elsewhere.

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[1] Yukawa, *Proc. Phys. Math. Soc. Japan*, 1748 (1935).

[2] Tuve, Hafstadt and Heydenburg, *Phys. Rev.*, **50**, 806 (1936); **53** 239 (1938)

Interpretation of Nebular Red-Shifts

IN a recent communication[1], M. E. J. Gheury de Bray discusses the possibility of explaining the red-shifts by assuming that the velocity of light (c_T) is constant throughout the universe at any given time but decreases with time (T).

This hypothesis implies the assumption (*a*) that the atomic frequencies remain constant throughout space and time and may therefore be used as clocks (atomic clock 'AC') for time measurements; (*b*) that measuring rods, other than light years (which contract with a decrease of c_T), can be found. For such measuring rods we may now choose the distances of *the material points* (for example, the nebulæ) in the universe, as according to the hypothesis the universe neither expands nor contracts. Such measuring rods we call 'material rods' ('MR').

It shall be shown here that the proffered hypothesis, based on the measuring system $AC + MR$, is one of three alternative ways of formulating the hypothesis of the expanding universe.

The following clocks and measuring rods can be taken as basis of a measuring system for cosmological purposes:

(*a*) Clocks	(*b*) Measuring rods
AC (atomic clocks); *or*	MR (material rods); *or*
LC (light-clocks: the time taken by light over a given distance—c is here assumed as constant).	LR (light-rods, for example, light years: the distance covered by light in a given time—c is here assumed as constant)

Only the following three combinations of these clocks and measuring rods can be taken as basis of a measuring system: $AC + MR$, which is the basis of Mr. Gheury de Bray's hypothesis; $AC + LR$, a basis which leads to the expansion theory of the red-shifts, and $LC + MR$, which leads to what Milne[2] calls 'dynamical time scale', and to the 'speeding up' theory of the red-shifts.

($AC + LR$). The theory of the expanding universe states that the distances between material points, measured in LR, increase; in other words, it maintains an increase of MR against LR. This leads to the recession of distant nebulæ and to the Doppler effect. The identity of the frequencies of characteristic spectral lines throughout the universe (atomic clocks) is thereby assumed; the measuring system of the theory is thus the $AC + LR$-system. In tracing back the recessive movements it is found that $1{\cdot}86 \times 10^9$ years ago the size of the universe was zero. Thus an absolute scale of time T (based on the atomic clock) is assumed in which the unit is the (atomic) year and the *present value* of T is $T_P = 1{\cdot}86 \times 10^9$. (This 'age of the world' is confirmed by other measurements based on atomic radioactivity clocks.)

($AC + MR$). The above statement that MR increases if measured in LR is equivalent to saying that LR decreases if measured in MR. If MR is chosen and the clocks are not changed, the system $AC + MR$ is adopted. The decrease of LR means a decrease of the velocity of light (measured in MR). This permits an explanation of the red-shift of old light, since c_T was greater at the time $T - \triangle T$ when it was emitted and therefore $\lambda_{T-\triangle T}$ is longer than λ_T.

($LC + MR$). There is a third way to express the same facts. If we allow the light a longer time for its voyage, by defining our clocks in such a manner that they are slowing down as compared with the atomic clocks, then the decrease of c can be made to disappear. In other words, we adopt a new time scale τ in which the atomic frequencies throughout

the universe are speeding up; this explains the red-shift of old light.

The three alternative ways of expressing things agree in regard to the observable effects they describe. All predict the red-shift of old (distant) light. All therefore also predict a violet shift of characteristic spectral lines in the course of time to come (in $AC + LR$, that is, in the expansion theory, this has to be explained by an expansion of the spectroscope's grating). The three theories are logically equivalent, and therefore do not describe alternative *facts*, but the same facts in alternative *languages*. (To ask whether 'in reality' the universe expands, or c decreases, or the frequencies speed up, is not more legitimate than, when prices of goods fall throughout the economic system, to ask whether 'in reality' the value of money has increased or the value of the goods has decreased.) Nevertheless, the $AC + MR$-language seems to offer a particularly simple mathematical treatment and, furthermore, an *observational approach* to Milne's 'dynamical' time scale. It shall therefore be briefly examined.

In $AC + MR$, where characteristic atomic frequencies are assumed constant and c_T depends in some way upon T,

$$(1) \qquad (d\lambda/\lambda)_{T+\triangle T} = (\triangle c_T/T)_{T+\triangle T};$$

on the other hand, the observatlonal law of red-shifts (velocity-distance relation) can be written:

$$(2) \qquad (d\lambda/\lambda)_{T_P-\triangle T} = (\triangle T/T)_P,$$

if the 'apparent distance' in light years, calculated on observed luminosities, is identified with $\triangle T$. From (1) and (2) we get

$$(3) \qquad (\triangle c_T/\triangle T)_P = (dc_T/dT)_P = -(c_T/T)_P.$$

Generalizing this and integrating we get the law of the decrease of c:

$$(4) \qquad c_T = c_P T_P/T.$$

If we proceed from $AC + MR$ to $LC + MR$, we have to introduce a time scale τ so that $c_\tau = c_P =$ constant. In order to get the general formula for $d\tau/dT$, we make use of (4), which can now be written as

$$(5) \qquad d\tau/dT = c_T/c_\tau = c_T/c_P = T_P/T;$$

integrating and choosing $\tau_P = 0$ (Milne chooses $\tau_P = T_P$), we arrive at

$$(6) \qquad \tau = T_P \log(T_\tau/T_P),$$

which is essentially Milne's formula $(A)^2$; the index 'τ' in 'T_τ' indicates the value of T at the instant τ of the τ-scale. Equivalent to (6) is $T_\tau = T_P e^{\tau/T_P}$. From this and (5) we get the law of the 'speeding up' of characteristic frequencies when measured in $LC + MR$, that is, on the τ-scale:

$$(7) \qquad \nu_\tau = \nu_P dT_\tau/d\tau = \nu_P e^{\tau/T_P},$$

and from this and $c_\tau = c_P$ we get, corresponding to (2), the law of red and violet shifts in the form

$$(8) \qquad (d\lambda/\lambda)_{\tau+\triangle\tau} = -\triangle e^{\tau/T_P}/e^{\tau/T_P} = -\triangle T_\tau/T_\tau.$$

In the above deduction we have identified the 'apparent distance' (calculated on observed luminosities, that is, energy densities ρ, and not corrected for departures) with $\triangle T$. Thus our assumption regarding ρ is that it measures the square of the *time* $\triangle T$ the light travels, which in $AC + MR$ cannot be identified with the ('real') *distance* r; for as the light was quicker when it was emitted, $r > \triangle T$. If the usual assumption that ρ measures not $(\triangle T)^2$ but r^2 is upheld, our deductions would have to be altered and we would neither get (4) nor its equivalent (6), that is, Milne's scale of τ. Vice versa, if our assumption regarding ρ is upheld and if we consequently arrive in $LC + MR$ at Milne's τ-scale, in which $r = \triangle\tau$, then neither r^2 nor $(\triangle\tau)^2$ can be taken as being measured by ρ. Whether this behaviour of ρ in τ can be deduced *a priori* in Milne's theory I do not know. But available *empirical* data seem to speak at least not against our assumption that $(\triangle T)^2$—which is smaller than r^2—is a measure of ρ, for "present evidence points to observed luminosities (ρ) decreasing with distance *not even quite as rapidly* as we should expect. . . ."[3].

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Nov. 27.

[1] NATURE, **144**, 285 (1939).
[2] Milne, E. A., *Proc. Roy. Soc.*, A, **158**, 327.
[3] Schroedinger, E., NATURE, **144**, 593 (1939).

"The Relationship between Pithecanthropus and Sinanthropus"

THE article by Dr. G. H. R. von Koenigswald and Prof. F. Weidenreich on the relationship between Pithecanthropus and Sinanthropus in NATURE of December 2 is eminently satisfactory to those anatomists who have not been able to understand why these two hominids should ever have been separated generically. Probably my colleague, Dr. S. Zuckerman, was the first to express doubt on the justification for this distinction, in an essay on Sinanthropus[1], and I have on more than one occasion urged that the Peking hominid is but a Chinese variant of Pithecanthropus[2].

While for some years Prof. Weidenreich, with his first-hand knowledge of the Chinese fossils, has been insisting on their supposed distinctive characters, and has put forward the thesis that they represent an early type of man still more primitive than Pithecanthropus, he now agrees not only that Pithecanthropus and Sinanthropus "are related to each other in the same way as two different races of present mankind", but also that in some significant characteristics Pithecanthropus is the more primitive of the two. If these conclusions are accepted (as they certainly should be) it now becomes necessary finally to discard the generic term Sinanthropus. The Chinese fossils should logically be referred to the species *Pithecanthropus erectus*, or, if it should be thought more desirable as a temporary convenience for purposes of reference, they might be conceded a specific distinction with the name *Pithecanthropus pekinensis*.

The article of Dr. von Koenigswald and Prof. Weidenreich raises again the whole question of the validity of the morphological evidence upon which physical anthropologists often seem to depend for their taxonomic conclusions. For example, the authors use the remarkable argument that, because the femora ascribed to Pithecanthropus of Java show a marked degree of platymeria such as is not found in the femora of 'Sinanthropus', therefore they probably do not belong to Pithecanthropus. This statement would provide a pretty exercise in logical

analysis. A similar process of reasoning would also lead to the conclusion that, because a femur excavated from a Neolithic barrow shows more platymeria than the femur of a modern Englishman, therefore it cannot belong to *Homo sapiens*! In any event, an acquaintance with recent literature might have informed the authors of a short, but not unimportant, paper by the late Dr. Dudley Buxton on platymeria and platycnemia[3] in which evidence is adduced in support of the thesis that these characters may have a nutritional basis, and no racial significance.

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Oxford. Dec. 17.

[1] *Eugenics Rev.*, **24** (1931).
[2] *Man*, 60 (April 1937); *Modern Quarterly*, 115 (April 1939); Presidential Address, Section H, British Association, 1939.
[3] *J. Anat.*, **73**, 31 (1938–39).

Influence of the Geology of the Virgin Islands on Local Agricultural Practices

WITH the exception of Anegada, Santa Cruz, and part of Virgin Gorda, the Virgin Islands are hilly and rugged. There is in most cases a long narrow backbone rising to about 1,000 ft. with numerous lateral spurs sloping steeply to the sea. Owing to centuries of cultivation and charcoal burning, there is no virgin forest. The predominant vegetation is dense secondary bush in various stages of seral development. Many of the hills are stark naked, while others exhibit a sparse retrogressive xerophytic vegetation.

According to Earle[1] and Hardy[2], the islands are largely composed of enormously thick dynametamorphosed sedimentary tuffs lifted up from the ocean bed by volcanic forces. To quote Earle: "The effect of these dynamic forces has been to lift the sedimentary beds bodily on end into a highly inclined position without obliterating the original stratification. These stratified metamorphic beds which cover by far the greater part of the presidency invariably strike East and West, which fact is doubtless responsible for the alignment of the islands in that general direction. They always dip very steeply, varying from 45° to 90° South and averaging 70°."

The tops of these highly inclined beds have frayed off and are scattered down the slopes in the form of flags of various sizes mixed with soil derived from them. This soil ranges from gravel to loam. The surface is thickly covered with denuded and weathered fragments. Such land at first sight appears extremely inhospitable. Yet owing to the scarcity of flat land, most of the cultivation is done on these talus slopes, which offer certain unique advantages.

After felling the secondary forest, the first step in the preparation of the land is the separation of flags from the soil. The disposal of the flags presents a problem which is easiest solved by placing them in rows along the contours. This is a common practice among the peasants. A few more alert individuals have made better use of the peculiar advantages to hand and have gone in for stone terracing out and out. Needless to say, all manner of terracing is seen, from the primitive arranging of stones in rows to admirable terraces.

To conclude, it will be seen that much of the land in the Virgin Islands can be stone terraced by the peasant himself at no cost apart from his labour. So far as I am aware, no inducement is offered to peasants in the British Virgin Islands to undertake such permanent improvement of their land.

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[1] Earle, K. W., "The Geology of the British Virgin Islands", *Geol. Mag.*, **61**, No. 722 (August 1924).
[2] Hardy, F., "Notes on the Geology and Soils of the British West Indies", Imp. Coll. Trop. Agric., Trinidad (1938).

Dioximaleic Acid Oxidase Action of Peroxidases

Banga and Szent-Györgyi[1] recently described a new enzyme, dioximaleic acid oxidase, which catalyses the aerobic oxidation of dioximaleic acid to the corresponding diketo acid.

It was shown in a previous paper[2] that hydrogen peroxide must play an important part in the mechanism of the ferment, because catalase inhibits the reaction between oxygen, ferment and dioximaleic acid completely.

We have undertaken preparations and purifications of the dioximaleic acid oxidases from different plant sources, such as *Rumex acetosa*, *Fraxinus excelsior*, *Prunus Padus*, *Syringa vulgaris* (leaves); horse-radish roots and cauliflower. Many different purification methods were used, as fractional precipitations with salts and organic solvents, absorptions, electrophoretic experiments and others. The removal of impurities by precipitation with lead acetate was especially successful in many cases. Thus the activity of the cauliflower juice was increased in one operation eight thousand times. Very high degrees of activity were obtained, that is, 40,000 c.mm. of oxygen per minute per mgm. of ferment from horse-radish. The

starting materials showed activities of 1 to 10. All of the purified preparations showed the typical peroxidase spectrum, 645, 550 and 500 mμ[3].

The ratio dioximaleic acid oxidase/purpurogallin number always remained practically constant in spite of all our attempts to separate the two activities from one another. Moreover, this ratio was nearly constant, whatever the source of the ferments. The purpurogallin number of the most active preparation from horse-radish was 900. The hæmatin content agreed with the figures of Elliott and Keilin[4]. Heavy metals other than iron were practically absent.

Determinations of the inhibitory effect of various reagents revealed remarkable differences between the dioximaleic acid and the purpurogallin tests. Hydrocyanic acid inhibits completely in the latter, incompletely and irregularly in the former. We think this irregularity, noticed first by Banga and Szent-Györgyi, must be connected with a strongly stimulating effect of hydrocyanic acid on the autoxidation of the dioximaleic acid with the subsequent formation of hydrogen of peroxides, which we have observed. Fluoride and azide inhibit in both tests though not to equal degrees, copper salts only in the dioximaleic acid test. Carbon monoxide inhibits only in the dioximaleic acid test. This inhibition is sensitive to light.

Heating ferment solutions to different temperatures caused qualitatively parallel inactivation in both tests.

The results mentioned indicated that the dioximaleic acid oxidase was a hæmin protein. Experiments with pure cytochrome *c* confirmed this conclusion[5]. We found previously[2] that cytochrome *c* + 2 γ of Mn^{++} were able to catalyse the oxidation of the dioximaleic acid.

We now find that manganese produces hydrogen peroxide by stimulating the autoxidation of the substrate. (Fe^{++}-ions, but not Cu^{++}, Cr^{+++}, Ni^{++} and Co^{++}, stimulate the autoxidation, but practically no hydrogen peroxide remains in the solution, as it is removed by a secondary, peroxidatic reaction between Fe^{+++}, hydrogen peroxide and dioximaleic acid.) Thus the manganese can be entirely replaced by the addition of a small amount of hydrogen peroxide. The hydrogen peroxide, which does not disappear during the reaction, seems to take part as well in the reduction of the Fe^{+++} as in the oxidation of the Fe^{++}. Analogous mechanisms have been proposed for the catalase[6]. The cytochrome remains mainly reduced until all of the substrate is oxidized. Then the cytochrome is immediately oxidized and partly destroyed by the hydrogen peroxide. Manganese or hydrogen peroxide can be replaced by hydrocyanic acid, which stimulates the hydrogen peroxide production and does not inhibit the reaction because cytochrome *c* gives no compounds with hydrocyanic acid at this *p*H. We have here interesting examples of hydrogen peroxide maintaining, or hydrocyanic acid stimulating, a hæmin protein catalysis.

On the basis of the experiments described above, the possibility was considered that the natural dioximaleic and oxidase could be identical with the peroxidase. However, its manner of reaction in the dioximaleic acid and in the purpurogallin test might be different. In the latter the peroxidase is supposed to remain all the time in its ferric state[3]. In the former, on the contrary, we were able to demonstrate the reduction of the ferric to the ferrous state. If solutions of peroxidase preparations plus dioximaleic acid are shaken with air the colour turns from brown to red with absorption bands appearing at 580 and 545 mμ, belonging to the Fe^{+++}-hydrogen peroxide-peroxidase II[3] or to a hypothetical Fe^{++}-oxygen-peroxidase, or to a mixture of both. If the air is rapidly replaced by carbon monoxide the bands of the Fe^{++}-carbon monoxide-peroxidase (578,543) appear. Thus a valency change, ferric $\rightleftarrows$ ferrous, is involved in the reaction of the ferment with dioximaleic acid, but not with hydrogen peroxide plus pyrogallol.

The differences found in the experiments with inhibitory substances thus may be explained, and there is no sufficient reason for the assumption that the dioximaleic acid oxidase and the peroxidase are different ferments. Our results give an example of a ferment, acting in a different manner with different substrates. They also show that the characterization of ferments exclusively on the basis of the effect of inhibitory reagents may lead to mistakes. Differences may be due to the substrates and not to the ferments themselves. Finally, the dioximaleic acid is remarkable because it allows the peroxidase to produce the necessary hydrogen peroxide spontaneously. A detailed report will be published elsewhere.

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Dec. 7.

[1] Banga and Szent-Györgyi, *Z. physiol. Chem.*, **255**, 57 (1938).
[2] Theorell and Swedin, *Naturwiss.*, **27**, 95 (1939).
[3] Keilin and Hartree, *Proc. Roy. Soc.*, B, **122**, 119 (1937).
[4] Elliott and Keilin, *Proc. Roy. Soc.*, B, **114**, 210 (1934).
[5] Theorell and Åkesson, *Science*, **90**, 67 (1939).
[6] Weiss and Weil-Malherbe, NATURE, **144**, 866 (1939); with further literature references.

Diurnal Rhythms in the Axolotl Larva and in Drosophila

DURING spring and summer of this year, I made some experiments with the intention of throwing light on the physiological mechanism of diurnal activity rhythms. An account of some of the main results follows. It is hoped to publish full details of the experiments at a later date.

The motor activity of axolotl larvæ was recorded by means of a simple actograph. The animals were kept in a shallow layer of water. Their activity caused movements of the water surface, which were recorded on a slowly moving smoked drum, by means of a float connected with a light lever.

The larvæ showed a pronounced diurnal rhythm, under normal conditions of alternating daylight and darkness, being more active at night. If the larvæ were put in continual darkness, the rhythm persisted. If, however, they were subjected to alternating illumination and darkness, so controlled that the illumination phase was made later and later by gradual stages, the rhythm could be reversed. The animals were then active during the real day (this was by now the dark phase) and quiet at night (the artifically lighted phase). Evidently, the rhythm is primarily determined by light; but there is also an inherent rhythm revealed by the persistence of activity cycles in continual darkness.

I was unable to detect any diurnal activity rhythm in metamorphosed individuals.

Hypophysectomized larvæ are active by night and quiet by day, like normal ones; but only so long as the normal illumination cycle acts upon them. In continual darkness, the distribution in time of their activity at once becomes quite irregular. Thyroidectomy does not interfere with the activity rhythm. It appears then that the hypophysis plays an important part in the inherent rhythm revealed by normal animals kept in darkness.

The interrelations of internal and external factors in determining diurnal rhythms were also studied in Drosophila. Here a 'hatching rhythm' appears. Under normal lighting conditions, most of the adult flies emerge from the pupa in the hours just before sunrise. The interval between consecutive 'emergence peaks' is always twenty-four hours, whatever the temperature, and it appears that light is the primary controlling factor. If the culture is transferred to continual darkness, the rhythm continues unmodified at medium temperatures. At low temperatures the intervals are slightly lengthened, at high temperatures shortened.

By altering the temperature, the intervals between emergence peaks were varied between $2\frac{1}{2}$ days and 16 hours. The 'inherent rhythm' revealed by the persistence of emergence maxima in darkness is therefore sensitive to temperature. It appears to have a temperature coefficient obeying van't Hoff's rule.

If a culture is kept from the first in continual darkness, no hatching rhythm appears. The rate of emergence is affected by temperature; less flies than usual emerge during and just after a rise, and more during and after a fall. However, temperature change does not induce a persisting rhythm. Light, on the other hand, can induce such a rhythm. One single illumination period, provided that it lasts for at least 4 hours, induces a 24-hours rhythm in a culture kept beforehand and afterwards in continual darkness. The temperature relations of the rhythm thus induced are as follows: (1) whatever the temperature at the time of illumination, the rhythm has a period of 24 hours, provided that the temperature does not afterwards change; (2) subsequent change has the usual effect (lower temperature slows, while higher temperature hastens, the rhythm). The fact that a 24-hour rhythm can be induced by a single illumination period, independently of temperature, is remarkable and the nature of the factors ensuring that the induced rhythm shall have a period of 24 hours remains, for the present, obscure.

The experiments were carried out in the Department of Zoology, University College, London. I wish to thank Prof. D. M. S. Watson for kindly allowing me to work in his Department, Mr. C. P. Wells for much helpfulness, and Mr. N. H. Howes for allowing me to use his intact and operated axolotls.

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Points from Foregoing Letters

REGENERATED cellulose sheet is shown by D. G. Drummond to be birefringent in a way which might reasonably be expected from extrapolation of Spence's results for sheets made from cellulose esters. The relative unimportance of side-chain orientation in cellulose itself results in a generally greater birefringence and a change in the 'slow ray direction' as compared with the ester films. Numerical results for regenerated cellulose sheets are given.

A. Schallamach finds that the heat conductivity of commercial rubber at the temperature of liquid air is about one fortieth of that at room temperature.

S. E. Williams has examined the absorption of the hydrogen line at 1215·7 A. in nitrogen, water vapour, oxygen and air. Nitrogen is transparent and water vapour absorbs very strongly. Oxygen and air absorb much more strongly than has previously been believed. No absorption appears to occur until the partial pressure of oxygen is about 0·04 mm., and the absorption coefficient varies in the lower part of the absorption range. If the emission of 1215·7 is responsible for short-wave fadeouts, the radiation will penetrate to about 80 km. before it is absorbed in producing ionization.

Making the assumption that the field responsible for the interaction between elementary nuclear particles is a two-particle field, so that a mesotron is always emitted or absorbed in conjunction with a neutrino or antineutrino, P. L. Kapur states that it is possible to derive the forces between the particles and to explain the phenomenon of β-disintegration.

That the three theories (1) the universe expands, (2) c decreases, (3) atomic frequencies speed up, are all equivalent and must not be looked upon as alternative explanations is stressed by K. R. Popper. The systems of measurements underlying these theories are compared and an observational approach to Milne's 'dynamical' time is mentioned. It is asked whether in (2) and (3), luminosities do not decrease with time (measured in frequencies) instead of distance.

Now that it is admitted that Sinanthropus is but a variant of the Pithecanthropus type, W. E. Le Gros Clark suggests that the generic term Sinanthropus should be discarded. The Peking fossils should be referred to the species *Pithecanthropus erectus*, or at the most they might be conceded a specific distinction with the name *Pithecanthropus pekinensis*. The argument that the femora ascribed to Pithecanthropus of Java do not really belong to this genus has no logical basis.

F. A. Squire states that, owing to geological peculiarities, the soils of the Virgin Islands are composed largely of flags. This makes stone terracing a practical, inexpensive proposition.

B. Swedin and H. Theorell have extracted and investigated the ferment recently described as new and called dioximaleic acid oxidase by Banga and Szent-Györgyi. From their observations, Swedin and Theorell conclude that this ferment is a hæmin protein and that it can act in a different manner with different substrates. They finally conclude that there is not sufficient reason for the assumption that the dioximaleic acid oxidase and the peroxidase are different ferments.

H. Kalmus describes experiments on the physiology of diurnal rhythms in axolotl larvæ and Drosophila, dealing with the relation between externally and internally determined rhythms, the action of light, temperature and endocrine factors.

RESEARCH ITEMS

Australian Shell Ornaments

A DETAILED study of shell ornaments in use by the aborigines over wide areas in Australia has been made by C. P. Mountford and Alison Harvey, ethnologists of the South Australian Museum (*Records S. Austral. Mus.*, **6**, 2, 1939). These shell ornaments fall into two divisions, one made from the baler shell (*Mela diadema*) and the second from the shell of the pearl oyster (*Meleagrina maxima*) and the smaller pearl shell (*Meleagrina margaritifera*). The pearl shell ornaments are found almost exclusively in western Australia, while with a few exceptions the baler shell ornament is limited to Queensland, Western Central Australia and north-eastern South Australia. The pearl shell ornaments are used for decoration and as objects of ceremonial importance. For the former purpose they are suspended from a belt back and front, while both men and women wear several down the back suspended from a necklace of human hair. In Central Australia the chief aspect of their magical purpose is their potence in charms for women and their healing properties. Various myths are woven round the pearl shell, and a particular chant is sung when the designs, which appear on them, are being engraved. The ornaments are oval in shape and vary from two to eight inches in length. The baler shell ornaments vary in use according to locality; but they may be used as ornaments or for ceremonial purposes. In west-central Queensland, for example, they are used for personal adornment or as a decoration on the haft of a spear-thrower. Among the Dieri, however, the shell ornament had great magical value and was closely connected with the circumcision ceremony, in which it was worn by the initiate as a chest ornament. The Dieri were also the only tribe using the shell for evil magic. In appearance the ornament was an ovate piece of white shell from two and a half inches to five inches long. Designs were engraved on the concave face and red ochre rubbed in. These shell ornaments were intended for male use only, but in certain circumstances, more or less ceremonial, women were allowed to handle or use them.

Scaphocephaly among Australian Aborigines

IN an examination of 2,000 skulls of Australian aborigines, Frank J. Fenner, honorary craniologist of the South Australian Museum, has found five cases of scaphocephaly (*Records S. Austral. Mus.*, **6**, 2; 1939). Two forms of scaphocephaly are recognized, of which one is descriptive of the form of skull characteristic of the Eskimo, and found among the Australian aborigines, and the second is pathological —a premature, probably fœtal, synostosis of the sagittal suture present in a very long narrow type of skull; this is a rare condition occurring in many races, European, Egyptian, Negroes, etc. The specimens here described belong to the second class. Premature closure may, of course, occur without any trace of scaphocephaly. Of the skulls examined three were adult (male) and two juvenile, 4–5 years and 6 years. Detailed observations and comparisons with such normal material as was available were made. In the result these observations would go to support the conclusion of Hamy that scaphocephaly is the result of the synostosis of the two parietal bones, that this synostosis is the result of a pathological process, probably inflammatory, and that the deformation occurs only when the fusion begins during intrauterine life at a time close to the commencement of the ossification of the cranial vault. In two of the skulls and in one described in 1867, fine vascular pores covering the surface of the bone gave evidence of a pathological condition. Three of the skulls examined showed a synostosis of the squamous suture, but of 1,200 normal aboriginal skulls, three only showed fusion of the squamous suture—all aged individuals. Probably this condition is here related to the sagittal synostosis and an outcome of the same underlying pathological cause.

Doubling the Chromosomes of Nicotiana

H. E. Warmke and A. F. Blakeslee (*J. Hered.*, **30**, 419–432; 1939) have successfully induced the doubling of chromosome numbers in *N. Sanderæ*, *N. Tabaccum* × *glutinosa*, and *N. glutinosa* × *N. sylvestris*, by treating with colchicine. Treatment of seed gave as high as 100 per cent tetraploids of *N. Sanderæ*. A new method of application by using an emulsion spray, consisting of stearic acid, morpholine and lanolin, has been found more efficacious than the water spray. It is noteworthy that mixtures of fertile and sterile flowers on one plant were not obtained from seed treatment, but the whole plant was either diploid or tetraploid in behaviour. On the other hand, stomatal size in these plants was not always correlated with fertility. This indicates that some of the plants may have been periclinal chimæras.

The Chrysanthemum Midge

A MINUTE, red, two-winged fly which produces small conical galls upon the leaves and stems of chrysanthemums has been recognized as a serious pest in the United States, and has appeared twice in Great Britain during the last decade. The present attack is, fortunately, somewhat limited, but Dr. H. F. Barnes has published a timely description of his studies of the insect (*J. Roy. Hort. Soc.*, **64**, Pt. 2; Nov. 1939). The midge, which has usually been recorded as *Diarthronomyia hypogœa*, infests commercial late-flowering chrysanthemums, but will not apparently spread to the earlier summer kinds, nor to common, closely related weeds. Five generations appear every year in cool greenhouses, but in heated structures there are eight. The length of time spent in each stage of the life-history appears to depend directly upon temperature, being generally shortened by summer heat. Severely infected plants do not flower. Consistent spraying or fumigation with nicotine provides a complete, though very expensive, control. The most effective prevention, however, is the cutting of infected shoots to ground-level, for the stool cuttings which emerge later from such plants are found to be free from the insects.

Larvæ of British Coleoptera

IN the *Entomologists' Monthly Magazine* of November and December, Dr. F. van Emden, of the Imperial Institute of Entomology, contributes the first of a series of articles on the larvæ of British Coleoptera (beetles). The object of these contributions is to provide keys to enable the larvæ of the

British members of the order to be recognized as reliably as possible, and the first of these articles deals with the family Cerambycidæ. The material upon which the account is based consists primarily of that available in the collections of the British Museum (Natural History). Important additions, however, were based upon the specimens obtained on loan from the Zoological Museum, Copenhagen. All the thirty-six genera of British Cerambycidæ are included in these keys. Seven of the genera, however, have their characters taken from literature, since no larval material was available. While it will obviously be a lengthy business in dealing with the larvæ of even the chief families of British Coleoptera, the present account is a good beginning, and we hope to see many other groups similarly treated by Dr. van Emden.

Control of the Bean Rust Fungus

A RUST disease of the bean is widely distributed in Lower and Middle Egypt, and its control has formed the subject of a study by Dr. A. F. El-Helaly (*Min. Agric. Egypt, Tech. and Sci. Serv. Bull.* 236, Govt. Press, Bulâq, Cairo, P.T. 4, 1939). Spraying with Bordeaux mixture of half per cent strength was found most effective, and yielded the significant net profit of from one to four Egyptian pounds per feddan. Chocolate spot, caused by *Botrytis fabæ*, was also controlled by the same treatment. Sulphur fungicides were tried, but were not found reliable against these particular parasites, and the Bordeaux treatment possessed the further advantage that no physiological check was administered to the foliage.

Vertical Air Currents

SCIENTIFIC Note No. 81 (7) of the India Meteorological Department, by K. P. Ramakrishnan, deals with vertical currents in the first few kilometres over Poona and their possible effect on the measures of upper winds made by pilot balloons assumed to rise at a known constant rate. The vertical currents were deduced from the height – time curves found for balloons by the tail method, which involves measurements of the angle subtended by a tail assumed to hang vertically beneath the balloon, with the aid of a special graticule in the pilot balloon theodolite. The method is probably accurate enough for the purpose of revealing vertical currents of the strength of those often observed at Poona in the hot season. A more serious source of error in computing the vertical currents arose from the assumption that the differences between the observed rate of ascent (V) and the rates given by the standard formula $V = q\frac{L^{1/2}}{(L+W)^{1/3}}$, where q is a constant for a particular size of balloon, L is free lift and W is weight of balloon, are measures of the vertical currents. Actually, the rate of ascent of a balloon is affected by its shape, which is never truly spherical, and, to judge from the performance of the 100-gm. Dewey and Almy balloon, by other factors not yet understood, for with this balloon, so far as observations have been made at the Meteorological Office, the rate of ascent varies roughly as $\frac{L}{(L+W)^{2/3}}$, and not as the square root of that quantity, as is implied by the standard formula. Such sources of error probably do not invalidate two of the conclusions reached by Ramakrishnan; first, that the rate of ascent of a balloon for a given lift and weight is far more variable in the afternoon than in the morning at Poona, and that this is due to the greater magnitude of the vertical currents in the afternoon, and secondly that a method of obtaining upper winds that involves the assumption of a constant rate of ascent of the balloon is thoroughly unreliable in a tropical climate like that of India. The values of vertical velocity found were mostly between 3 km. and 5 km./hour in the afternoon, and occasionally reached 10 km./hour.

Geography of Egypt

A VOLUME entitled "Contributions to the Geography of Egypt", written by J. Ball (Cairo: Government Press. 10*s.* 6*d.*), may be regarded as a comprehensive study of most aspects of the Nile and contains a great deal of new matter as well as facts that are scattered in various publications. Apart from the treatment of the physical aspects of the Nile basin and water, the Faiyum depression is the subject of a lengthy study. Much has already been written on this lake. Dr. Ball points out that the absence of Pliocene deposits proves that the depression cannot have been in existence in those times. The numerous lacustrine deposits of later ages show that a lake of varying height must have existed from early Pleistocene times to the present day, and since there can have been no erosional deepening of the depression while the lowest part was below the surface-level of the lake, its excavation must have been entirely accomplished between the end of the Pliocene and the beginning of the Pleistocene. But the Nile then flowed at much higher levels than to-day, so that its lateral stream could not have effected erosive action at such low levels. Thus, argues Dr. Ball, the Faiyum was hollowed out independently of the action of the Nile: some other agency must have been at work. He concludes that the depression is due to wind erosion in early Pleistocene times, and this theory is supported by what is known of the origin of other depressions in the Libyan plateau such as the oases of Kharga, Dakhla and Qattara.

Drainage of Southern Ireland

THE peculiar trellised pattern of the river system of southern Ireland has attracted considerable attention since Jukes postulated a superimposed origin from an elevated initial surface. Hull modified this hypothesis by invoking fault lines as controlling the right-angled deflections of the rivers. Austin Miller has re-examined the whole problem in a paper entitled "River Development in Southern Ireland" (*Proc. Roy. Irish Acad.*, **45**, Section B, No. 14). One of the most difficult features to explain is the failure of the subsequent at the expense of the consequent rivers in the completion of the pattern which might be expected to have led to the outflow of the Blackwater to Dungarvan Bay and the Lee to Youghal Bay. Conditions appear to favour this completion, for there has been rejuvenation since the present mouths were acquired that would provide the subsequents entering these two bays with the increase in gradient necessary for headward encroachment. Mr. Miller suggests that the explanation lies in the acquisition by the present estuaries of a volume of discharge, by a long process of captures, so much greater than that of their competitors that they have been able to excavate sufficiently rapidly through the hard ridges that attempt to bar their courses and so outrival the strike streams in spite of the softer rock over which the latter flow.

AIR TRANSPORT, INSECTS AND DISEASE

BY DR. A. D. IMMS, F.R.S.

MR. F. G. SAREL WHITFIELD has recently issued a comprehensive article on air transport, insects and disease (*Bull. Entomol. Res.*, **30**, 365–442; 1939). The discovery by Shannon in 1930 of the presence of *Anopheles gambiæ*, an insect native to Africa, in the city of Natal, Brazil, and its subsequent spread, directed special attention to the carriage of disease-bearing insects by aeroplanes. Whether *A. gambiæ* was actually transported in a surface vessel or in an aircraft will probably never be known, but, as the result of its entry and subsequent spread, more than 90 per cent of the population around Natal were infected with malaria in 1938. The indexes of malaria-infected mosquitoes are said to be the highest in the history of malaria. The introduction of *A. gambiæ* into South America seems to have had the disquieting results, just referred to, because possibly the native population has very little power of resistance to the African strain of the disease carried by the mosquito.

The situation as regards yellow fever is potentially far more serious than that concerning malaria. Shannon, Whitman and Franca in 1938 made a significant contribution to what is known of the vectors of yellow fever. They produced positive evidence of the mosquitoes *Aëdes leucocelænus* and *Hæmogogus capricorni* being concerned in the transmission of jungle yellow fever in Brazil. Until this discovery, evidence of any mosquito other than *Aëdes ægypti* being implicated in the transmission of yellow fever was furnished solely on the results of laboratory experimentation. The aspect of most importance with regard to aerial transport, arising out of recent research on yellow fever epidemiology, seems to be the discovery of vast areas in Africa and South America where the disease prevails in epidemic or endemic form. It is obviously of prime importance that aircraft operating within and from Africa and South America should be maintained free from all insects. Mr. Whitfield points out that the proposed reserve Empire war route across Africa to India and Australia will present an urgent problem in this connexion, and that it would be unwise to inaugurate such a service until the proper control of insects in aircraft has been achieved. In view also of the proved existence of considerable insect populations in the upper air, the question of the possibility of aircraft collecting insects while in flight arises. The ability of insects to survive air transit is another problem. *Aëdes ægypti*, for example, has been proved to be able to endure a journey of at least 9,580 miles in length and of 6½ days duration.

Diptera are overwhelmingly the commonest insects found in aircraft. Species of Musca are very frequent and also many kinds of mosquitoes. The control of insects in aircraft is a difficult subject. As Mr. Whitfield remarks, it involves the co-operation of the entomologist, the chemist and the engineer, an airline operating company and a commercial aircraft manufacturer. Such joint approach to the problem, he holds, is essential if progress is to be made. No adequate and reliable method of control of insects in aircraft has yet been devised: the problem of controlling insect invaders of aerodromes needs also the fullest attention. Little will be gained, the author adds, from further research upon insects found in aircraft—the real problem being the effective means for their destruction.

THE ROTHAMSTED EXPERIMENTAL STATION

BY E. J. ROBERTS

THE annual reports of the Rothamsted Experimental Station are of more than ordinary interest to farmers and research workers. The amount and variety of the fundamental investigations carried out in the laboratories, linked with the field work not only at the Rothamsted and Woburn farms, but also at a number of commercial farms scattered over England, give these reports a character and importance of their own. The improvements in the technique of field experimentation, evolved at the statistical department, have not only given more accuracy to the usual trials, but also have widened the scope of investigations by making it possible to detect small differences, and to measure, for example, the interaction effects of certain manures.

In the report for 1938*, published recently, an account is given of the experiments on wheat, including those on the continuous growing of this crop, and those on the value of leys, green manures, and fallows for preceding the wheat crop. The experiment on the continuous growing of wheat has now been in progress for nearly a hundred years, and it is interesting to note that the land has not become what might be termed 'wheat-sick'; the main difficulty has been in the suppression of weeds rather than in the actual growth of wheat. This conclusion is important at the present time. Why, it is asked, when these experiments prove clearly that wheat can be grown continuously on the same land, should difficulties arise when the crop is grown for a few years in succession on certain mechanized farms? An explanation is offered to the effect that the nature of the soil is responsible. Wheat is a heavy-land crop, and, on the heavy Broadbalk soil, the crop remains healthy; diseases and pests are present; but they do little damage. The lighter soils, however, especially the light chalky soils on which many mechanized farms are situated, are more liable to

* Rothamsted Experimental Station, Harpenden. Report for 1938. (Harpenden: Lawes Agricultural Trust.) 5s.

contain diseases, such as take-all, lodging diseases and others, and the crop suffers more heavily.

The effects of temporary leys, green manures, and fallows as preparation for wheat are also under investigation, and the field trials are combined with work in the chemistry department to follow seasonal changes in nitrates, ammonia, and readily decomposed crop residues in the soil; an attempt is made to trace the form in which available nitrogen is carried over from one year to another.

Sugar beet is the subject of extensive investigations carried out on a variety of soils, in conjunction with the sugar factories; the extent of these experiments may be judged from the fact that, in 1938, there were 38 experiments, with 1,360 plots. These experiments are mainly concerned with manurial responses in the various soil groups. The year 1938 was disappointing as regards this crop, the yield, expressed in terms of sugar, having been 12·5 cwt. per acre less than the average of the previous four years.

Other long-term experiments recorded are those on organic manuring by means of green crops, town refuse and straw. The question of organic manuring, and of the use of town refuse in particular, is of more than ordinary interest to-day. It is interesting to note that a prepared town refuse gave encouraging results in a comparison with sulphate of ammonia, dung and rape dust. The refuse gave rather higher yields than farmyard manure providing equal nitrogen in three out of four comparisons, and did almost as well as sulphate of ammonia providing half as much nitrogen.

Other sections of the report also contain much of interest, for example, those on the farm, and the report on fungus diseases at Rothamsted and at Woburn. Details are given of the experiments at outside centres. It is interesting to observe that in such experiments, which are designed at the Station, the degree of precision compares favourably with that in the experiments carried out at Rothamsted and Woburn.

ELECTRICITY SUPPLY IN AUSTRALIA AND NEW ZEALAND

THE rapid expansion in the practical applications of electricity in parts of Australia and New Zealand and the new problems to which it gives rise is well illustrated in the *Electrical Times* of November 23. In England we consider a 'County Council' as a body which has definite connexions with general public services as, for example, health, education, highways and the like. This is not the case at Sydney, New South Wales, where the 'Sydney County Council' was created in 1935, by a special Gas and Electricity Act, which enables it to assume ownership and control of the electricity department which up to that time had been in the hands of the City Municipal Council. This County Council has only five members, two of them elected by the City Municipal Council and the remaining three being shared by the municipal councils of thirty-two other townships. For election as a councillor, the candidate must be qualified by being eligible for alderm anship in one of these constituencies. This arrangement has points of similarity with that of our own Joint Electricity Authorities (J.E.A.). The Sydney County Council supplies electricity directly to the public in the city, thirty-two suburbs and for street lighting in the city. In addition it gives a bulk supply to fourteen other municipal authorities who do their own distribution, and to a company which distributes to two other municipal areas. The area throughout which a direct supply is given is about 150 sq. miles and its population is about 900,000. The 'bulk' areas are about 750 square miles and have about 150,000 inhabitants. Altogether the County Council supplies electricity over an area of approximately 900 sq. miles and having more than a million inhabitants.

The County Council co-operates with the railway department, which has a supply station of its own so as to level the output and so cheapen the cost. The interchange of energy between them is adjusted so as to be nearly equal at the end of each quarter. The main business of the County Council's Electricity Sales Branch is three-fold: first, to develop and advertise the use of electricity in commerce, industry and the home, secondly to sell electrical apparatus and thirdly to deal with contracts for large supplies of energy. The sale of apparatus, ranges, water-heating systems and wash-boilers is arranged for cash or on hire purchase. Instantaneous heaters are sold for cash only. The installation work is also sold by the Council. Two forms of merchandizing are employed. In one the Council buys the equipment and sells it to the consumer. In the other the Council sells the apparatus for the supplier on a commission basis. The basis of the Council's service policy is "make friends with the consumers. This is effected by the advisory service, which not only develops the use of electricity but keeps the consumers satisfied".

Reports from the New Zealand municipalities, which largely utilize hydro-electric power, show that there is considerable anxiety in both North and South Islands as to how to meet the coming winter loads. Deputations have approached the Government and pointed out the limitations of the hydro-electric power available and the urgent need of steam-driven plant to cope with the expected peak load of 1941. The general manager of Christchurch Electricity Department ends his report with these words: "The city of Christchurch is now so completely dependent upon electricity supply in its public services, which include sewerage and water pumping, that the electricity supply intimately concerns hygiene and health as well as the general public life". It looks as if in a few years' time these words would apply to many cities spread over the whole world.

The electrical engineer of Dunedin says that they cannot always count on getting the same ample supply of water-power every year. In severe frosts in winter time very little water-power may be available. The great demand for instantaneous water heaters for baths shifts the maximum load from the afternoon to the early morning. This makes it difficult to devise an equitable multi-tariff meter system which will charge the consumer most at times when the load is a maximum at the supply station.

PALÆOLITHIC MAN IN THE NORTH MIDLANDS

NOW that the text of Mr. A. Leslie Armstrong's Wilde Memorial Lecture is available in full (*Mem. and Proc. Manchester Lit. and Phil. Soc.* 1938–39, **83**, 1939. Separate, pp. 30, with plates. Price 1*s.*), the results of the investigations summarized in that lecture call for more extended notice than was possible at the time of its delivery on March 14 last (see NATURE, **143**, 512 ; 1939). As Mr. Armstrong pointed out, the North Midland area, that is, the Trent basin north of Leicester, has yielded evidence which now makes it possible to demonstrate on a stratigraphic showing the presence of man here during every stage of the palæolithic period more completely than for any other part of England.

An important consideration, which Mr. Armstrong emphasized in the opening of his lecture, was the constant oscillation in climatic and environmental conditions during the Ice Age, while at the same time he dwelt on the distinction worked out in detail by the Abbé Breuil between the core culture peoples associated with inter-glacial periods and the flake culture races associated with glacial periods. The changing environment not only brought about racial movement, but also necessitated cultural development and the elaboration of new types of implements, although with the setting in of less favourable conditions once more old and traditional types at times were revived.

Mr. Armstrong's evidence was drawn in part from recent explorations of the Trent Valley gravels, still in progress, in part from his now well-known investigations in Yorkshire and Derbyshire caves and on certain sites in Lincolnshire.

LOWER PALÆOLITHIC AGE

The first record of Lower Palæolithic implements in the Trent Valley was made in 1928 in a gravel pit at Burton. Further investigation by Mr. Armstrong and others has now shown that all the recognized forms of both the core and the flake industries from Pre-Chellean to Mousterian occur here. These finds come from three horizons of gravel, comprising two old river-terraces and a high-level glacial gravel. The main interest of the investigation, therefore, lies not merely in the occurrence of this range of types here, but also in the correlations which it has made it possible to attempt.

Recent investigation has also determined that the gravels, though they have been described as "Old Valley Gravels", are actually of sub-glacial origin. The low terrace comprises the infilling of an ancient valley of which the floor lies far beneath the bed of the Trent and through which that river has cut its channel. The most important deposits of the series are the high-level gravels, which mantle extensive areas on both sides of the valley. In the deposits three zones are distinguished, of which A, the oldest, in certain of the Hilton sections, rests upon bed-rock, the Kéuper marl, while in others it thins out until B rests on that rock. In other sections B and C zones, separated by a band of sand in gravel particles, alone are present.

As regards archæological content, artefacts found in Zone A *in situ* fall into two well-defined groups, of which the first, consisting of pre-Chellean, Chellean and a Levallois flake are patinated a deep chocolate-brown, heavily rolled and evidently derived from an earlier deposit ; while the second is patinated bluish-white and appears to be contemporary with the gravel. In the latter group were a typical Acheulean hand-axe, as well as a late Clactonian (or Tayacian) flake and two slightly rolled Levalloisian flake tools. The contents of Zone B, though less numerous, are the same as in A, but differ materially in condition. All are heavily rolled, but some Levallois and Clacton types are only slightly abraded. The patination suggests that the abraded artefacts are derived from Zone A.

Zone C exhibits extreme contortion, suggesting lateral pressure, or collapse under the influence of melting snow and ice. It has not yielded any Acheulean types, but two heavily rolled Clactonian and a Levalloisian flake, both only slightly abraded and, therefore, possibly contemporary with the gravels, have been found. The latter are important for correlation purposes.

For these conditions certain tentative interpretations are put forward by Mr. Armstrong. In the first place, he suggests that the co-existence here of core and flake may be due to the fact that they are not, as concluded by the Abbé Breuil, two distinctive cultures, but two techniques ; and in that event, while the flake industry was indeed almost exclusively employed by the ancestral Mousterian race, Acheulean and later peoples may have employed Clactonian and Levalloisian techniques where necessary or expedient. Secondly, that Zone A represents a deposit laid down at the end of the great Acheulean inter-glacial—possibly a remnant of the Little Eastern glaciation equated with Würm—which has been ploughed away and incorporated in Zone B. Thirdly, that Zones A and B respectively correspond with the two glacial phases separated by an interglacial phase, associated with a Mousterian (Late Clactonian or Tayacian or Micocquean in its earlier phase) observed in the Pin Hole section, Cresswell Crags. Fourthly, Zone C may be either a melt-out of Zone B, or a local re-advance of the ice after the B stage, or the final glaciation (Hessle) of the northern region.

MIDDLE PALÆOLITHIC AGE

In dealing with the Middle Palæolithic Age, Mr. Armstrong's evidence is chosen entirely from the cave explorations on which he has been engaged with the assistance of a Research Committee of the British Association for more than thirteen years. The Pin Hole Cave, Cresswell, has given a type cave section for Britain with occupation ranging from Mousterian I to the developed Aurignacian of the Upper Palæolithic which is preserved as an 'ancient monument'. The deposits consist of two beds of cave earth, of which the lower and earlier extends from Early Mousterian to the proto-Solutrean which with Aurignacian appears in the base of the upper bed.

As already mentioned, the lower deposit affords evidence of two glacial phases with a warm interglacial. If indeed these levels are correctly correlated with the Little Eastern glaciation and thus with Würm, this interglacial affords evidence of a North Midland retreat of the ice in relation to the Little Eastern which has not previously been recorded.

UPPER PALÆOLITHIC AGE

The highly significant evidence for the Upper Palæolithic period, drawn in part from cave deposits, in part from north Lincolnshire open sites, must here be dismissed in brief. Among the more interesting conclusions to which excavation has led, is the confirmation of the absence of any gap in continuity between Upper Palæolithic and Mesolithic, and at the close of the Aurignacian period the remarkable local variability in type of the elements of the culture. Two finds which must not be passed over are a fragment of mother-of-pearl skilfully shaped, possibly part of an amulet, and a cowrie shell, *Cyprea moneta*, from the Pin Hole Cave.

HEARING TESTS

IN the December number of the *Bell Laboratories Record*, Mr. H. C. Montgomery, of the Acoustical Research Department of the Bell Laboratories, discusses results obtained by subjecting many of the visitors at the World's Fairs to tests of the quality of their hearing. The records obtained enabled him to get nearly three-quarters of a million of records carried out in the same way.

The Bell system deals in hearing, and to get the best service it is important that it have available trustworthy data on the hearing characteristics of the American people. The tests are given in sound-proof rooms arranged to seat seven visitors, each partially screened from the others. Both the tests and the instructions are given through telephone receivers ; the visitor holds the receiver to his ear with one hand whilst he marks the results on a card with the other. Two types of tests are given, with separate booths for each. In one the visitor hears spoken words, which are two numbers, such as "eight-six". The numbers heard are written on the card, and each successive pair is at a lower volume. Twelve pairs of numerals are spoken at successively lower volumes ; and then the test is repeated with a different series. In the other type of test, the two numbers are replaced by pure musical tones, each tone being sounded from one to three times, and the listeners write down the number of times they hear the tone. Five tests, each consisting of nine sets of tones at successively lower volumes, are given. The first is a moderately low pitch, 440 cycles per second, which corresponds to *A* above middle *C* on the piano. Each following test is one octave higher in pitch and thus the hearing is tested at 440, 880, 1,760, 3,520 and 7,040 cycles.

At the San Francisco Exposition were three booths, one arranged for word tests, one for tone tests, and one that could be used for either. At New York eight booths were provided for each type of test. Only the tone tests were recorded. The word tests give only a check on one's ability to understand spoken words, while the tone test, by providing data at five frequencies over the most important part of the aural range, is more suitable for study and analysis. Before a record is made on the test card the attendant puts a mark on it to indicate whether the visitor is male or female, coloured or white, and to which of the five age groups the person belongs, the age groups extending in five groups between 10 and 60. The cards are then run through a Recordak machine which analyses the curves marked on them. The cards are then run through tabulating machines which analyse and sum up the data. The results of this survey indicate a definite falling in hearing acuity with age. This is in harmony with previous data, which indicate a definite falling off in hearing acuity with age, particularly noticeable at the higher frequencies. A rather remarkable fact is that at the low frequencies the falling off with age is less for men than for women, while at the higher frequencies it is less for women than for men. In the lowest age group the difference between men and women is small, but even here the advantage is slightly with the men at low frequencies and with the women at high frequencies. In the age group 50–59 years the difference becomes much more pronounced.

The curves show that for young ears and low frequencies, the tests are grouped fairly closely around the average. For older persons or higher frequencies, the distribution spreads and the number with average hearing becomes small ; most differ from the average in both directions and in varying degrees. The interpretation of the losses at various frequencies needs a specialist, since the evaluation of the effect on one's ability to hear in any particular band of frequencies is a function of many factors. It has been found that one's ability to understand speech can be determined from the average of his hearing losses at 440, 880 and 1,760 cycles per second as compared with good young ears. If this average is 25 db. (decibels), there may be some difficulty in hearing in auditoriums and churches, while if it is 45 db. there may be difficulty in hearing in direct conversation. Only if the hearing loss is as much as 65 db. will there ordinarily be much difficulty in hearing over the telephone.

By use of these figures, the tests indicate that about one out of twenty-five persons have difficulty in hearing in auditoriums ; one in 125 will have some difficulty in direct conversation ; and one in 400 over the telephone. Two out of five men between 50 and 59 will have a loss of at least 25 db. at 3,520 cycles, while only one in five women will have as great a loss at this frequency. It was found also that about one in 25 of the group from 10 to 19 had a loss of at least 25 db. at 7,040 cycles. This figure is important, because it has been found that young people with a hearing loss of this amount will often be found to become progressively worse in later years, but if remedial measures are taken immediately, impairment may be largely checked. No significant difference was found between the visitors to the Fairs who were resident in New York and those resident in San Francisco. The time of day at which each test was taken was marked on the card and permits a comparison of the results for different periods of the day. No consistent difference was found between early morning and late afternoon. There is thus no indication of any effect being produced in the hearing by fatigue.

SEVENTY YEARS AGO

NATURE, vol. 1, January 13, 1870

Government Aid to Science

ALFRED RUSSEL WALLACE, in a letter to the Editor, writes: "The public mind seems now to be going mad on the subject of education; the Government is obliged to give way to the clamour, and men of science seem inclined to seize the opportunity to get, if possible, some share of the public money. . . .

"Now, sir, I protest most earnestly against the application of public money to any of the above specified purposes, as radically vicious in principle, and as being in the present state of society a positive wrong. . . . I uphold national education, but I object absolutely to all sectional or class education; . . . The broad principle I go upon is this,—that the State has no moral right to apply funds raised by the taxation of all its members to any purpose which is not directly available for the benefit of all. . . . If we follow this principle, national education is not forbidden, whether given in schools supported by the State, or in museums, or galleries, or gardens, fairly distributed over the whole kingdom, and so regulated as to be equally available for the instruction and amusement of all classes of the community. But here a line must be drawn. The schools, the museums, the galleries, the gardens, must all alike be *popular* (that is, adapted for and capable of being fully used and enjoyed by the people at large), and must be developed by means of public money to such an extent only as is needful for the highest attainable *popular* instruction and benefit. All beyond this should be left to private munificence, to societies, or to the classes benefited, to supply."

A New Thames Subway

THE importance of geological data on the extent of the London Clay was emphasized in an article by J. Prestwich, F.R.S., on the second Thames subway. "The first to apply this knowledge was Mr. P. H. Barlow, C.E., F.R.S., who fixed upon a spot intermediate between London Bridge and Limehouse (where the thickness of London Clay must be about 80 ft.), and at a sufficient distance below London Bridge to render an underground passage of the Thames a work of great public utility. . . . The tunnel is 7 feet in diameter, and is formed by cast-iron tubing in lengths of 1½ feet each, each ring being composed of thin segments with a key piece. An iron shield, devised by Mr. Barlow, was pushed on in advance of the work. . . . The passage under the river will be made in an omnibus, by means, probably, of a stationary engine; and lifts on either side will take the passengers up and down [the shafts]." The tunnel, 1320 feet long, was begun on April 26, and finished on October 8, 1869, without a single fatal or even serious accident to any of the men employed. It is no longer in use.

On the Periodicities of the Solar Spots

"Messrs. De la Rue, Stewart, and Loewy have for some time past been engaged in investigations [at Kew Observatory], which . . . go to show that there is an intimate and, as yet, unexplained connection between the configuration of the planets and the position and number of the spots on the sun. This result, which at once seems to land us in a sort of modern astrology . . . is . . . questioned by many European astronomers". Accordingly, a digest is given of independent investigations carried out by Dr. Kirkwood and published in the *Proceedings of the American Philosophical Society*. Among his conclusions were that the theory "has been placed beyond reasonable doubt", and the "11-year cycle of spot variation is mainly dependent on the influence of Mercury".

THE oxy-hydrogen light is now largely used in Paris for illuminated advertisements and theatrical purposes. Carts with metal reservoirs containing the compressed oxygen for the supply of customers may be seen in the streets. At the Gaieté Theatre, which is one of the largest consumers, cylinders of magnesia or zirconia take the place of the lime cylinders ordinarily used for this light.

PROF. HELMHOLTZ, of Heidelberg, has been elected a corresponding member of the Physical Section of the Paris Academy of Sciences.

APPOINTMENTS VACANT

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

UNIVERSITY ASSISTANT IN BOTANY—The Secretary, The University, Aberdeen (January 20).

UNIVERSITY GRADUATE AS TEACHER OF ENGLISH for British-Peruvian Cultural Association, Lima—The British Council, 3 Hanover Street, W.1 (quoting 'Lima') (January 24).

LECTURER IN GEOGRAPHY in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (February 5).

LECTURER IN MECHANICAL ENGINEERING in the Witwatersrand Technical College, Johannesburg—Frank Ross and Co., 9 Fenchurch Avenue, E.C.3.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Scientific Proceedings of the Royal Dublin Society. Vol. 22 (N.S.), No. 18: On a Recent Bog-Flow in Powerscourt Mountain Townland, Co. Wicklow. By A. D. Delap and G. F. Mitchell. Pp. 195–198. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 6*d*. [2712

Board of Trade. Statistical Abstract for the British Empire for each of the Ten Years 1929 to 1938 (Trade and Commerce Section). Sixty-eighth Number. (Cmd. 6140.) Pp. xv+234. (London: H.M. Stationery Office.) 3*s*. 6*d*. net. [2712

Royal Meteorological Society. Bibliography of Meteorological Literature. Prepared by the Royal Meteorological Society with the collaboration of the Meteorological Office. Vol. 4, No. 7 (January–June 1939.) Pp. 351–414. (London: Royal Meteorological Society.) 2*s*. 6*d*. [2712

Other Countries

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 231: The Incidence of Contagious Abortion in Domestic Animals in Egypt. By Dr. Mohamed Ragheb Ahmed. Pp. 29. P.T. 4. Bulletin No. 236: Further Studies on the Control of Bean Rust, with some Reference to the Prevention of Chocolate Spot of Beans. By A. F. El-Helaly. Pp. 24. P.T.4. (Cairo: Government Press.) [2712

Meddelanden från Oceanografiska Institutet i Göteborg. 2 The Radioactivity of Seawater. By Ernst Föyn, Berta Karlik, Hans Pettersson and Elisabeth Rona. Pp. 44. 3: Large-scale Plankton Cultures. By Hans Pettersson, Fabius Gross and Friedrich Koczy. Pp. 25. (Göteborg: Elanders Boktryckeri A.-B.) [2712

Carnegie Corporation of New York. Report of the President and of the Treasurer for the Year ended September 30, 1939. Pp. 168. (New York: Carnegie Corporation of New York.) [2812

Catalogues, etc.

Pocket Diary for 1940. (Bonnybridge: John G. Stein and Co., Ltd.)

Desk Engagement Pad for 1940. (London: W. Edwards and Co.)

OFFICIAL ANNOUNCEMENTS

THE INSTITUTE of CHEMISTRY of GT. BRITAIN & IRELAND

(Founded 1877) (Incorporated by Royal Charter, 1885)

APPOINTMENTS REGISTER

A Register of Chemists (Fellows, Associates and Senior Registered Students) who are available for appointments or who are seeking to improve their positions, is kept at the office of the Institute. The facilities afforded by this Register are available (free) to Companies and Firms requiring the services of chemists, and to Universities, Colleges and Technical Schools requiring Teachers of Chemistry and Technology. A list of Laboratory Assistants is also available.

Particulars of the Regulations and Examinations of the Institute can be obtained (free), on application to the Registrar.

All communications to be addressed to The Registrar, the Institute of Chemistry, 30 Russell Square, London, W.C.1.

LEVERHULME RESEARCH FELLOWSHIPS

1940

Application is invited for (i) Fellowships or (ii) Grants in aid of research. The Fellowships or Grants are intended for senior workers who are prevented from carrying out research work by routine duties or pressure of other work. They are limited to British-born subjects normally resident in Great Britain. In exceptional circumstances the Trustees may waive the condition as to residence.

The Trustees are also prepared to consider applications from groups of workers engaged upon co-operative programmes of research—particularly from those engaged upon long-distance programmes or in Institutions in which the normal facilities for research have been curtailed by the War.

The duration of the awards will not normally extend over more than two years or less than three months, and the amount will depend on the nature of the research and the circumstances of the applicant.

Forms of application may be obtained from the Secretary, Dr. L. Haden Guest, M.C., M.P., Leverhulme Research Fellowships, Kingscote House, 1 Watergate, Blackfriars, London, E.C.4.

Applications must be received on or before March 1, 1940. Awards will be announced in July and will date from September 1, 1940.

SCOTTISH MARINE BIOLOGICAL ASSOCIATION

A good selection of Marine Animals and Algae can be supplied fresh or preserved.

Careful attention given to orders requiring special method of preservation.

Send your orders and inquiries to the DIRECTOR, Marine Station, Keppel Pier, Millport, Buteshire.

AIR MINISTRY

METEOROLOGICAL OFFICE

APPLICATIONS are invited for APPOINTMENT as TEMPORARY FORECASTERS, Grade II (Male), in the Meteorological Office. Candidates must be between 25 and 35 years of age.

Candidates must have reached their 25th birthday but not their 35th birthday on January 1, 1940. Candidates must possess a Science Degree, preferably with physics or applied mathematics or meteorology. The possession of an Honours Degree will be an advantage.

Remuneration will be by a fixed salary of £260 per annum. After a period of training entrants who have shown exceptional merit will be considered for promotion to the post of Temporary Forecaster, Grade I, at a fixed salary of £315 per annum.

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

UNIVERSITY OF CAPE TOWN

LECTURER IN GEOGRAPHY

Applications are invited for the post of Lecturer in the Department of Geography. The appointment will be for a period not exceeding three years and the salary will be at the rate of £400 per annum.

Applications must reach the Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, London, W.C.2 (from whom forms of application and a memorandum giving further particulars may be obtained), not later than February 5, 1940. Applicants, in addition to submitting copies of testimonials, must give the names of three referees.

UNIVERSITY OF ABERDEEN

APPOINTMENT OF A UNIVERSITY ASSISTANT IN BOTANY

Salary £250 12s. to £300 per annum, according to experience and qualifications.

Qualifications in Agricultural Botany will be a recommendation.

Applications, together with a full statement of qualifications and the name of at least three referees, should be sent not later than January 20, 1940, to the Secretary to the University, from whom further particulars may be obtained.

The University, Aberdeen. H. J. BUTCHART, *Secretary*.

The International Tin Research and Development

Council invites applications for the post of Research Assistant, to undertake work on the casting of bronzes. Candidates should have a degree in metallurgy and some research or works experience. Salary £300—(×£25)—£400. Applications should be received by the Secretary, The International Tin Research and Development Council, Fraser Road, Greenford, Middlesex, not later than January 27, 1940.

Scientific Intelligence Service. Reports and bibliographies of scientific literature—from a single abstract to a complete monograph. Current reports. Bibliographical researches. Any language. Accuracy and completeness. Chemistry, Biochemistry, Physics, Geology, Botany, Biology.—LEWKOWITSCH BIBLIOGRAPHICAL BUREAU, Barn House, Barn Hill, Wembley Park, Middx.; ARN 3956.

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