NATURE

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

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WAR-TIME CONSUMPTION AND RATIONING

TO the ordinary citizen, control and rationing are methods of maintaining equal division of limited supplies at reasonable prices; to the economist, considering the diversion of the maximum fraction of the national income to the purposes of war, they are methods of reducing civilian consumption; to the statesman they are a bit of both, with the maintenance of health and morale thrown in. The first chapter of the Report of the Economic Intelligence Service of the League of Nations considers the means by which civilian consumption can be reduced*. The last gives some idea of the effects of this reduction; in Great Britain the reduction of consumption provides 25 per cent of the war effort. In the intermediate chapters details are given of direct rationing in force in various countries.

The severity of the rationing of clothes varies. In Great Britain a man can get a woollen overcoat, a suit and a pair of shoes with one year's coupons. In Germany an overcoat requires more than one year's coupons and an overcoat and suit more than two. To obtain scarce goods (shoes and items containing a high proportion of wool, linen and cotton) a consumer in Germany has to prove his need for the articles. Non-perishable goods, such as vacuum cleaners and refrigerators, are durable and therefore not suitable for rationing. Consequently, their production has been cut down or stopped altogether. Until recently, this was the chief method by which consumption was limited in the United States. Food, drink and tobacco accounted for more than forty per cent of consumers' expenditure in Great Britain before the War; reduction of food consumption outside narrow limits has a serious effect on morale and health.

It is natural that the greater part of the report should be taken up with food rationing. The rations of twenty-one European countries are tabulated.

The food supply in Great Britain is much better than in any other belligerent country in Europe or in most of the neutral and occupied countries. Only in Great Britain, Switzerland, Eire and Portugal are bread and flour unrationed. Bread is rationed, but not potatoes, in Sweden, Denmark and, possibly, some other countries in eastern Europe. Meat is unrationed in Denmark and Eire; the meat ration in Great Britain is considerably higher than in the remaining countries. No milk is allowed to the ordinary consumer in Belgium, France, Germany, Holland, Norway and Poland. Heavy workers in Germany and workers in Britain who can eat in Class A canteens get double rations of meat and 50 per cent extra fat; but as the basic rations are higher in Great Britain, the British worker (provided that he has a canteen to go to) has the advantage.

The report draws a contrast between the flexibility of the British system and the rigidity of the German. In Germany, rations are fixed to allow for the needs

* League of Nations: Economic Intelligence Service. Wartime Rationing and Consumption. (Publication 1942, II, A.2.) Pp. 87. (Geneva: League of Nations; London: George Allen and Unwin, Ltd., 1942.) 3s. 6d.

of several different categories: children divided according to three age periods, three classes of workers. This difference of system is, however, merely a reflection of the difference of level of food supply in the two countries. In Great Britain we are still allowed to eat as much bread and flour as we want; there is no need to make special provision for those who expend extra energy. But, in Germany, the supply is not enough to meet the appetite, and the prior claims of manual workers and growing children are recognized; if the 'elastic' British system were introduced, the consumption would go up. It is good fortune, not judgment, that gives us the less rigid system. In Great Britain about 20 per cent more bread was eaten in 1941 than before the War. In those countries that ration bread and potatoes (which supply 40–70 per cent of the total energy of the diet) the calories derived from these two foodstuffs have gone down by 20–60 per cent.

In nine countries the foods that provide more than 90 per cent of the calories of the normal diets are rationed. As it is not possible to increase the energy value of the diet appreciably by expanding the consumption of the unrationed foods, a fair estimate can be formed of the total calorie value of the diet in these nine countries. The weighted average works out at 1,220 calories per head. In most of these countries the rations of children, down to six years old, are the same as those of adults. In the report, the number of calories per 'consumption unit' are calculated on the assumption that a typical family consists of man, wife and three children less than ten years old. However, the ratio of young children to adults is nowhere as high as this, and the calculations give a misleading estimate of the level of consumption by adults. Even in the early part of 1942 the normal consumers' rations of bread and flour in Germany were as low as in Berlin in September 1918 and the potato ration lower; the situation in Europe, as a whole, was at least as bad as in Germany at the end of that year. Also rations were cut down considerably between 1941 and 1942. As the chief cause of shortage of food on the Continent is reduction of the productivity of the soil it is probable that the shortage will become steadily worse. We may not be justified in prophesying the date of collapse of the Nazis; the extra rations of manual workers will do something to delay this, but we can be sure that, when that collapse occurs, want in Europe will be extreme. For the present we can do little to help our friends. The amount of grain allowed into Greece is a very small fraction of the amounts imported before the War, and the proposed allowance of relief for Belgium would supply only one ounce of dried milk per day to some two million children, pregnant and nursing women and invalids.

In due course the Allied troops will drive the Axis forces back through Europe. We are pledged to bring food with our armies. As it is, we have difficulties in maintaining the level of our own food supply. The Nazis will have cleared all stocks of food out of the liberated countries. We may find that we have millions of destitute people to feed while greater demands are made on our shipping for the transport of troops and supplies. Hundreds of millions of people in Europe will not be liberated until the Nazis are finally defeated. They will then need relief on a scale larger than in 1919. Two problems are inevitable: to find sufficient shipping to carry the necessary cereals and to find stocks of animal foods. To solve these problems it will be necessary to continue the control of production, transport and consumption until the economy of Europe is well on the way to recovery.

Will the need end when that time comes? The League of Nations Report suggests that rationing systems indicate the rise of a consumer's economy: "in spite of the necessary limitations imposed by war-time scarcity they contain the elements of a system in which consumption is guided, not so much by individual purchasing power, as by human wants". Such a consumer's economy is foreshadowed in the Atlantic Charter and the Four Freedoms of President Roosevelt; and more specifically in the Beveridge Report, in its unmutilated form. "Thus, the study of wartime consumption and rationing is relevant to the problems of the future."

POLITICAL AND ECONOMIC PLANNING

LONG before the outbreak of war, the body known as P E P (Political and Economic Planning) had established its reputation among fact-finding organizations studying the economic and social problems of modern society. Probably no other body in Great Britain has done quite so much to prove the possibility of an impartial approach to many large questions of social organization. There is nothing new in the contention that policy should be the outcome of research and knowledge. That has been urged by scientific workers for years. It is the core of their present criticism of the use of science by the Government in furtherance of the war effort, and it lies at the root of their claim that the scientific worker should not be debarred from administrative positions on the ground of his scientific qualifications when he shows that he possesses the requisite administrative ability.

The measure of the success of the P E P effort during the last twelve years, which has recently been reviewed in the two hundredth issue of its broadsheet, is shown in the extent to which collaboration has been made practicable over a wider territory in the social sciences among men and women of different political views, and also in the greater readiness to accept the discipline of inquiry and to follow the argument where it leads. The growing impatience at Government inaction over recent reports dealing with industrial and social reconstruction indeed testifies that there is now in Great Britain a much more general disposition to regard such methods of impartial inquiry and experiment as applicable in current matters of public concern and as the correct basis for policy, rather than political theories or party programmes.

Important as is this tendency, the system of group

consultation and investigation represented by Political and Economic Planning has a further advantage. It facilitates the pooling by specialists of their intellectual resources with those of their peers in other departments of study or knowledge, thereby fostering the creative thought which is our greatest need, and minimizing the risk that the services of the expert will not be invited or employed.

No one can read the brief summary of P E P activities set forth in this two hundredth broadsheet without realizing the wide range of problems, and the ramifications which call for the services of those who possess technical knowledge in every social or political plan. No schemes for reconstruction can hope for success in which this problem of securing the full contribution which the technical, scientific and other professional experts have to make collectively to social progress finds no solution. Unless that influence can be made effective, within the framework of a democratic system, on affairs that hitherto have been dominated by political parties, capital or labour, our hopes of progress are slight.

The leading ideas in the P E P approach are admirably set forth in the introductory paragraphs of the present report. Starting with emphasis on the value of the fact-finding attitude, the broadsheet points out that social measures are often impeded in our complex society, not so much by technical as by psychological obstacles arising out of ignorance, and these obstacles may often be removed by an impartial statement of the facts. A further fundamental aim of P E P has been to offset the sectionalism and specialization of modern society, which is so often the enemy of planning, by giving members of the general public, the administrator, the technician and the professional man or woman an opportunity to contribute, according to his capacity, to the solution of social and economic problems. By classifying problems to establish similarity or sequence, and by emphasizing, in tackling successive problems, patterns of ideas, the broadsheets have sought to forge a link between the social and economic organism of a technical age and Parliament or the Press.

In stressing the need for planning as an instrument for coping with the problems of a modern society and the failure of *laisser-faire*, P E P has always recognized that planning is no panacea. It has regarded itself as the exponent of a particular type of planning —the working together of a number of organizations for some consciously accepted end. Such evolutionary planning is regarded as the only means of escape from the intolerable restrictions upon individual liberty and freedom of choice which has resulted from the political and economic developments of recent years. The frank appeal which this broadsheet makes to those who are genuinely concerned at the outlook for liberty to set to work thinking and discussing how planning can be made the vehicle instead of the enemy of liberty is one which scientific workers especially should heed, and provides the right perspective in which to view, for example, the recent debates on the Beveridge Report. Success in evolutionary planning depends on the education of public opinion.

The investigations which P E P has conducted in particular fields, such as the productive apparatus, including industrial organization and the safeguarding of the public, industrial relations, agriculture, the planning of the use of land, the machinery of government, or of the social services, including retirement and education, nutrition and health, and again in the international field, such as international trade, where since the War P E P has revised its former decision to concentrate on domestic problems, have received notice from time to time in these columns. While in this way P E P's achievements may be familiar to scientific workers, its methods may be less generally known. P E P's main concern has been in the first place with the world outside the institutions of learning, and without discounting the fertilizing influence of theory, it is this world of experience that P E P has mainly attempted to tap. That there are now hundreds of organizations carrying out such investigations, whereas in 1931 only a few people were engaged in research of this kind, is clear evidence that the methods of practical research and group working that have been developed are of recognized value both in Britain and overseas.

Research is inevitably more complex in the social sciences than in the natural sciences. New techniques are required, of which this method of group research is one. The value of attaching a research secretary to discussion groups and of guiding research more fruitfully by the continued criticism of practical men and women have been demonstrated. Personal harmony and faith in the fact-finding approach are essential among the members of groups, and the best results have been achieved where members combine mastery of their subjects with a wide vision. A small number of laymen are usually members of each group, and outside experts have always been available for consultation. The executive committee watches the work of the individual groups and relates such work to the broad programme of P E P. The principle of anonymity is strictly preserved throughout.

There can be no two opinions as to the ability with which the P E P reports and broadsheets have laid clear the basic principles upon which decisions should be taken, and the directions in which further thinking and research are required as bases for policy.

The success already achieved not only entitles Political and Economic Planning to the goodwill and support of scientific workers in the future, but should also stimulate a wider and fuller contribution from them in the use of a technique of proved efficiency. We should not, indeed, make the mistake of assuming that the method is destined to eliminate Party politics. It may well assist in a new and more rational alignment of Parties and, by clarifying the issues and educating the electorate, give new vitality to the fundamental principles of representation and responsibility which a decade and a half of national or coalition government has overlaid, to the grave danger of democratic institutions. The fact that most of the tasks—social, economic and financial—before the nation are tasks of sheer organization which are eminently susceptible of the scientific and

practicable approach must not lead us to forget that in a democracy the action required to execute a policy must come from those to whom responsibility has been entrusted by representative institutions, and who are prepared at any moment to give way to others charged in like manner with the same responsibility.

WORLD REORGANIZATION

Phœnix

A Summary of the Inescapable Conditions of World Reorganization. By H. G. Wells. Pp. 192. (London : Martin Secker and Warburg, Ltd., 1942.) 8*s*. net.

WHETHER it be only an expression of the lust of the human race to live, or whether it be a rationalization of the mass of actual happenings of our times, the notion of the persistence of society is taken for granted by the great majority of us. The threat to civilization which the present upheaval is so often supposed to represent leaves most of us rather 'cold'. All the same, if we succeed in shaking ourselves out of that state of mental inertia to which, as a nation, we are specially prone, we see clearly enough that, when we emerge from this hurly-burly, we have but two alternatives before us : either we drift once more into a state of *laisser-faire*, 'lose the peace' and await the next cataclysm, or we organize on a world basis so as to make war impossible.

"Phœnix" presents us with "a summary of the inescapable conditions of world reorganization". We judge from the manner in which the conditions are presented that the author, despite his careful distinction between his hope and his faith, believes in the practicability of such re-organization and therefore in an escape from a further, and even more terrible, disaster. "There is good reason," he says, "for concluding that a rational reconstruction of the world . . . can still be attempted." Does the reader ask how ? The author reiterates the imperatives which a world revolution must obey : the establishment of an overriding federal world control of transport and inter-State communications, the federal conservation of world resources of all the federated States in accordance with a common fundamental law.

Having thus enunciated his imperatives clearly, the author, in true Wellsian fashion, takes the reader round his project "to view it from this point of view and that" in a series of interpolations which deal with the history of war, human temperaments and the place of money in the economic life. In the second part of the book the author returns to his aspects of the world revolution. He makes it clear that he is not thinking in terms of "bloody revolution" and an initial reign of terror. The Wells revolution is "the transformation of a going concern and not a fresh start". Revolution in the "bloody" sense is the antithesis of economy. "The institutions of to-morrow cannot be anything else than a clarified and emancipated adaptation of the institutions of to-day." The world revolution is a transformation by release. And again : "The . . . revolutionary movement can develop . . . at the higher level of the Open Conspiracy and the Candid Life." And there are things to be done *now* ; we must not wait until armistice is declared, or, if armistice be not the order of the day, until the moment of unconditional surrender. We must make the most strenuous efforts to reappropriate the material that has been socialized for greater collective efficiency during the War.

But as to the foundation of this reconstruction there is no attempt to escape the issue. "The fundamental issue of the world conflict is the banishment of mastery and ownership from the whole world." The citizen (in Great Britain at all events) must be a Party politician rather than a mere patriot and must throw his weight to the left. As for "federal supergovernment", we must sweep the idea to the winds ; quite effective machinery would be provided by special commissions to deal with settlements needed for the winding up of the War. These may be stretched out to become the effective administrative organizations of the world's affairs. We must aim at a system of federally co-operative world authorities with powers delegated to them by the existing Governments. And the ultimate pattern of society to be aimed at ? It cannot be, and it need not be, clearly predicted, but it may well be something larger and more satisfactory than hitherto achieved, even by equalitarian Soviet Russia, from the economic life of which ownership has been lifted. Soviet Russia is still crudely experimental, exhibiting an extreme ideological intolerance ; that draft no one should wish to stereotype. As for the Communist party in the West, it is "a yelping intervention and not an intermediary for the expansion of a common understanding".

So much for the imperatives of the world revolution, and so much for the machinery by which this revolution is to be effected. What of the personnel necessary for organizing its unity and its convergent activities ? What of the individuals upon whose selfless and determined efforts the attainment of the desideratum depends ? The author's answer lies in the Sankey Declaration of the Rights of Man, the universal acceptance of which is the paramount *sine qua non* for success. These "Rights" are the propaganda for the educational organization of the new world.

Mackenzie King recently expressed the view that if the new world order is not already on its way before the War is over, we may look for it in vain. This belief finds acceptance with the author of "Phœnix", as it does with many of us. To the question "Can science save civilization ?" the answer surely is, No. The salvation of society can only come through a change of heart in society itself. "The Kingdom of Heaven is within you." But as to whether there are enough men of good will to go round and to stand as a bulwark against the efforts that will certainly be made to force the world back into the slough of pre-war apathy, our seer gives no answer. How can he ? He has, in this book, performed the prophet's major task—he has stabbed our spirit wide awake. He has shown us clearly the inescapability of our position and he has also shown us what is necessary for our successful emergence from it.

In the presence of so weighty (to many of us) and so convincing an argument it is perhaps trivial to complain about the interruptions that tend to weaken its cogency. The reader surely knows his Wells sufficiently by now not to have his attention distracted unduly by digressions upon "why Generals deteriorate", "temperamental types" and "love in a new world". An edited Wells is unthinkable, and the reader can deal with these chapters separately. If he cannot, then he should forgive them to the man who writes such illuminating chapters as those on "re-education", "the protection of the consumer" and "the lay-out of the reorganized world". Both people

and the individuals get the rough side of the author's tongue now and again. Indeed, there are few, or no, soft words for anyone. To that also the reader is not unaccustomed. But the subject is a stark one and frills are, anyway, inappropriate. "Phœnix" lays bare for us our categorical imperative.

Horder.

ARABIA FELIX

In the High Yemen

By Dr. Hugh Scott. Pp. xix+260+115 plates. (London: John Murray, 1942.) 18*s*. net.

Ever since Niebuhr's remarkable scientific expedition to the Yemen in 1762–63, it has been recognized that to the biologist South-West Arabia holds a geographical position of great importance for questions relating to plant and animal distribution. For its varied and still largely unexplored confines, ranging from mountainous high altitudes with temperate conditions and abundant rain, to the tropical heat of the lower levels and coastal regions, are the meeting place and areas of overlap of the three great biogeographical regions: that of the Northern, the Oriental and the Ethiopian. Moreover, even now, nearing two hundred years since the plant collections of Niebuhr's botanist, Forskål, were made, published and finally reached the British Museum, the region has been so little investigated owing to political difficulty of access that Dr. Scott, in his most interesting book, can write of the 600-odd plants collected on his expedition that "in many cases no examples of these species from Arabia were received at the Museum from that time until we brought home fresh material in 1938".

The quest of Dr. Scott and his colleague Mr. Everard Britton, prolific though it proved in other incidental fields, was, however, primarily an entomological one; and in February 1941 appeared the first published instalment from the British Museum (Natural History) of the 27,000 insects they collected, which has already enriched science with new genera and many new species.

Dr. Scott is too good a naturalist to be content even in a generalized account of the expedition such as this book to omit scientific essentials underlying the wider aspects of the work. A succinct account is therefore given in Chapter 2 of the geological sequence of events in the region, leading up to the conclusion, "Though the separation of the South-West Arabian and Abyssinian highlands occurred after the remoter geological epochs, it took place quite long enough ago for some of the animals and plants on either side to have diverged in the course of evolution. We may therefore expect, and we do in certain cases find, closely related but slightly different representatives of the same groups on opposite sides of the Red Sea. Moreover the Red Sea rift has acted as a barrier to the distribution of some forms of life. For instance, the giant lobelias of the Tropical African mountains reach as far north as the Eritrean highlands, but are not found across the Red Sea in the Yemen. Conversely some European and Asiatic plants such as the iris reach as far as the Yemen but are not established on the African side. When our large collections have been studied in detail, it is hoped that a contribution will have been made towards solving these questions concerning the past history of this part of the earth, and the rate at which new species and varieties are evolved."

Scientific specialists mostly are, by nature and nurture, habitually observant people; and when, as in the case of Dr. Scott, this quality is combined with a sense of proportion it would be unfortunate, as is only too often the case, that the written record should be confined to the purely scientific results alone. This is doubly so in South Arabia, which has tended to become the 'copy' of now fairly numerous unofficial travellers, whose tales, ranging between extremes of gush or dislike, hold common ground in their disregard for objectivity.

Dr. Scott's book, a by-product of his real work, is a straightforward and quietly impersonal narrative of an expedition full both of diverse interest and thwarted hopes, in a setting of sometimes startling beauty, communicated to us in a long series of outstanding photographs. In particular the difficult panoramic snapshots, taken from stances on 8,000 or 9,000 ft. mountain tops, are descriptively magnificent. Wild-flower lovers, too, as well as wild-scenery lovers, will find alluring references to such flowers as pure white iris (which Dr. Scott suggests may have spread from its Mediterranean habitat owing to the Arab custom of planting it on graves), a yellow-blossomed lavender, orange gladiolus, and sweet white jasmine, as well as the homely wild rose and buttercup.

It had been the original intention to investigate especially the fauna and flora of altitudes above 9,000 ft. This programme was almost completely frustrated by the not unnatural suspicions of the Imam, of whom Dr. Scott writes with dispassionate understanding. Plans therefore had to be recast at Aden, and while permission even to enter the Yemen remained in suspense, an improvised, but in the event very profitable, expedition of some weeks was made in the freedom of the Amiri Highlands of the Western Aden Protectorate, mainly spent in camp on Jebel Jihaf at about 7,000 ft., or in the Wadi Tiban on the still forbidden Yemen frontier.

At an early stage in the narrative the present reviewer, remembering the unnecessary strain of the badly organized expedition to the Hadhramaut of which she was the archæological member, the same winter that Dr. Scott was in the Yemen, is filled with envy at the description of his three carefully chosen Somali servants, men of resource, ability and tact, who, moreover, spoke English as well as Arabic, and evidently eased many a trying situation, besides becoming valuable assistants in the work.

Finally, a grudging permit to enter the Yemen was obtained, and Dr. Scott and his colleague were enabled to spend three months in that near-forbidden land, though continually handicapped by strict surveillance, limitation of movement to specified areas, and refusal of permission to ascend mountains. Temporary escapes from the authorized paths enlivened the collecting. Maddening though such prohibitions must have been, Dr. Scott records much kindness and hospitality from the generality of Yemeni officials encountered; and in spite of all, much ground was really covered—such as the six-day journey from Ta'izz to San'a by the highland route, via Ibb and Yarim (where Forskål, who died there in 1763, probably from virulent malaria still prevalent, is buried), which has been traversed by less than half a dozen Englishmen.

Wherever he went, in town or countryside, Dr. Scott's powers of trained observation gathered harvests of diversified information scrupulously recounted. As a small example: his villagers sit, not

under trees, but under fig, tamarisk or some other named tree ; a seemingly trivial exactitude, but one which awakens in the memory of the reviewer the innumerable occasions in a Libyan desert oasis, when palæolithic man was found to have knapped his flints under the palæo-botanic remains of fig-trees preserved in travertines. 'Things', one might deduce, interest him more than 'people' ; yet there is no lack of human interest, and a racy account is given of the strange State procession of the Imam in San'a in an ancient hooded State-coach drawn by four horses ridden by liveried postilions, preceded by his personal bodyguard of dancing foot-soldiers brandishing aloft their curved daggers ; while behind followed his charger and an empty motor-car in case of need. An extra incongruity (to Western eyes alone) is added to the scene by the attendant who walked beside the coach whirling a gigantic 8-foot-wide umbrella.

In the final chapters Dr. Scott makes an audacious attempt to outline the still very speculative history, mainly undated, of ancient South Arabia. This is followed by a useful review of the more recent investigations on its racial composition by physical anthropologists. For this, owing to lack of published data by the Egyptian Expedition of 1936, led by Dr. Huzayyin, he has wisely drawn on Dr. Carleton Coon's "Races of Europe". The conclusions, which must be considered purely provisional until adequately long series of approximately dated ancient skulls have been obtained in controlled excavations, suggest to the reviewer a curious anthropological parallel to the biological situation which, as quoted above, has made South-West Arabia so valuable for evolutionary and distributional studies. For, inasmuch as Northern, Oriental and Ethiopian forms of fauna and flora find common ground there so, on the present findings (which are bound to be contested), does a branch of so-called Mediterranean man (that is, the typical brunettes of Nordic type on the high plateaux), Veddoid people (that is, with Ceylon Vedda affinities, mainly in the south and the Hadhramaut), and African negroids. The presence of other elements, including Jewish enclaves about which Dr. Scott gives interesting passages, adds complexity to an already over-complex question.

It is unfortunate that a delay of three years at the Oxford Press in the publication of the reviewer's results in the Hadhramaut should have introduced a small but not unimportant error in Dr. Scott's allusion to the short series of skulls there excavated. The evidence points towards a date of at least three or four centuries B.C., not, as stated, to the Christian era.

G. CATON-THOMPSON.

NATURE AND EARLY MAN IN IRELAND

The Irish Stone Age

Its Chronology, Development and Relationships. By Dr. Hallam L. Movius, Jr. Pp. xxiv+339+7 plates. (Cambridge : At the University Press, 1942.) 30*s*. net.

A MAJOR contribution to the advance of Irish archæology in the years before the War was made by the archæological expedition of the Harvard Irish Survey, directed by Dr. Hugh O'Neill Hencken, which between 1932 and 1936 excavated no less than fifteen ancient sites in Ireland, six of them—Kilgreany Cave in Co. Waterford and five sites in Northern Ireland—being of the Stone Age. These were excavated by Dr. Movius, assistant director of the expedition, and on that basis he has now, in this admirably produced volume, given us the first comprehensive and systematic modern account of the Irish Stone Age cultures, and the chronology and character of their natural environment. Its importance is very far from being confined to Irish archæology. The first part deals with the Late Glacial and Early Post-Glacial chronology of all Northern and North-Western Europe, and the second, in which the earliest known human settlement in Ireland is shown to be Mesolithic of the Boreal Period, perhaps nearer 7000 than 6000 B.C., relates that settlement and its sequels not only to their local surroundings but also to the whole physiography and prehistory of the British Isles and the adjacent mainland. The book will remain the standard work on its subject for a considerable time to come.

Dr. Movius begins with a synoptic account of the recession of the last Pleistocene ice-sheet in Northern Europe and its Post-Glacial sequels, with their accompaniments in human prehistory. He then sets out to reduce to comparable order the published documents for the contemporary sequence in the British Isles. It is easy to see that he found the two long chapters and six closely written appendixes on this the toughest part of his job. As a bibliographical study alone they are an achievement, but the result is no mere compilation. It is a synthesis, in which the stages of the recession from the 'New Drift' ice in Britain and Ireland are worked out and correlated with each other and with the established Baltic sequence. With his introductory complaint of our lack of a uniform nomenclature for glaciations many will sympathize ; and though all will not like his restriction of the term 'Old Drift' to the episode of the Upper Chalky Boulder-Clay of East Anglia and the Purple Drift of Yorkshire, this is understandable enough in a context concerned less with that episode and its precursors than with its successor, the 'New Drift' of Hunstanton and Hessle, with which he equates the important end-moraine of Southern Ireland. The intervening Interstadial period (Würm 1/Würm 2) is that of Aurignacian man in periglacial Britain ; but, as is abundantly confirmed in the later chapter on "The Antiquity of Man in Ireland", neither at Kilgreany nor anywhere else is there evidence of man's presence among the Late Glacial fauna of Ireland either then or in the final Upper Palæolithic stage represented by the British Creswellian culture.

The author recognizes that there has been triple retreat from the 'New Drift' glaciation in both islands. He correlates the main Ivernian ice-sheet with the first period, its successor with the Scottish re-advance and Highland glaciation, and the third, that of the valley glaciation in Scotland, with the local glaciations of the Irish mountains. His correlations with Scandinavia equate these three with the Daniglacial, Gotiglacial, and Finiglacial respectively, so that the ultimate melting of the ice in the British Isles coincides with the Ragunda stadium that De Geer's geochronology has dated 6800 B.C. The Irish Late Glacial peats and laminated clays, as interpreted by Jessen at Ballybetagh and Ralaghan, fit in very happily ; and when the work begun by De Geer on the Dunning varved clays of Perthshire is carried further, the British side of the picture may be expected to take clearer shape. (A Committee for Quaternary Research in Ireland has been at work since 1934 : how long will it be before such a national

committee is formed in Great Britain ?) For early Post-Glacial times the evidence is less intricate, but Dr. Movius's lucid exposition of the Litorina ("25-foot") raised beach is very welcome, and leads him naturally to the subject of the land-bridges and the human migration into Ireland from Britain. All this will be read by natural science workers with interest, and no doubt with appropriate criticism; but it is no less important for the prehistorian, in that the initial Irish Stone Age gives us no 'classic industries' which can be used as dating-fossils on a received typological basis, but itself requires dating—and by means that only a natural chronology can supply.

This Dr. Movius has seen to. On to the natural chronology summarized in his Table 6, his excavations have enabled the Irish Stone Age cultures to be projected. They are confined to the north-east, where alone flint for their tools abounded. The earliest station is the site near Tombe Bridge on Lough Neagh, sealed below Late Boreal–Early Atlantic peat, and material of the same initial culture is present in secondary position, preceding the maximum Litorina submergence of Atlantic times, in three coastal sites within varying distances of Larne, whence the cultures are to be known as 'Larnian'. To the Early Larnian succeeds the Late Larnian of the overlying deposits here and elsewhere along the coast; and after that the story continues into the 'Neolithic' Age which came in with the Sub-Boreal period towards 2000 B.C., and beyond the limits of this book.

Who and what were the Larnian people ? They were fishermen, hunters, and food-collectors, like their 'Obanian' counterparts of south-west Scotland, and the author's analytical and comparative study of their material culture shows them to have been descendants of the final Upper Palæolithic remnant who had crossed over from Great Britain well back in the Boreal period. Little touched (owing to the ensuing Litorina submergence) by external Mesolithic influence, they lived in a Mesolithic fashion of their own, developed in response to their secluded natural environment. Neolithic and later colonists pushed them in part into the interior, but they and their ancient food-gathering economy came to no abrupt end. In fact, they have demonstrably lived on as a basic stock among the Irish people to this day.

C. F. C. Hawkes.

SCABIES AND ITS TREATMENT

Scabies

By Dr. Kenneth Mellanby. (Oxford War Manuals.) Pp. xi+81. (London: Oxford University Press, 1943.) 5*s*. net.

SCABIES is at present a very important factor in both civil and military life. The itch is the commonest skin disease and, paradoxically, the one least recognized by the average medical man. War has been blamed for increases in the amount of scabies in Great Britain, but Dr. Mellanby doubts this and produces figures to show that there was already an increase in the scabies rate in the country between 1935 and 1939. He puts the present infestation rate at about 2 per cent of the population, rising to 5 per cent in some areas.

There is an excellent illustrated description of the life-history of *Sarcoptes scabiei* and instructions in the art of searching for the mite and extracting it for examination. Counts of live adult females on patients have revealed that the mean parasite-rate is astonishingly low, 11·3 per case, in spite of the widespread distribution of lesions. In only 3 per cent of cases were more than fifty parasites discovered.

It is confirmed that the chief mode of spread in adults is by close contact in warm conditions, so that a high percentage of cases come into the category of venereal infections. Bedding and fomites generally are not considered to be of real importance in spread, and Dr. Mellanby is of the opinion that dis-infestation of the clothing and bedding of cases after treatment is largely a waste of time, since any parasites therein are destroyed by the parasiticide used. This view has not yet found universal acceptance.

For treatment, sulphur ointment, Marcussen's ointment, mitigal and benzyl benzoate are ranked about equal for effective 24-hour treatment. The methods of treatment are described and the preparation of benzyl benzoate emulsions is included. Some illusions will be destroyed in the statement that scabies can be cured without the time-honoured baths and scrubbing, and in twenty-four hours at that.

This little book is the outcome of long and, as the reviewer knows, painstaking research on a large number of civil and service patients. The whole subject is completely covered and admirably condensed into an hour or two's easy reading.

VALVE TECHNIQUE IN SUBATOMIC RESEARCH

Electrical Counting

With Special Reference to Counting Alpha and Beta Particles. By Dr. W. B. Lewis. Pp. vii+144. (Cambridge: At the University Press, 1942.) 10*s*. 6*d*. net.

INVESTIGATIONS on radioactivity and cosmic radiation often require the detection of fast particles or the determination of their ionization. Ionization chambers and Geiger-Müller counters are used for these purposes; but the very small electric quantities obtained directly make high amplification desirable.

Research workers will welcome Dr. Lewis's book covering many aspects of valve technique in recording or observing fast particles. Among many other problems the book deals with the design of linear amplifiers suitable for the measurement of the ionization of α-particles. A survey is given of the various types of recorders suitable for high input-rates. A scale-of-ten circuit is described which has the advantage of being 'all electric', that is, it avoids the use of a mechanical recorder altogether. The Rossi coincidence circuit is described, and methods are discussed for obtaining high resolving power coincidence circuits.

The book deals only with material which was available before the outbreak of war. This is regrettable as the illuminating investigations on the discharge mechanism of Geiger-Müller counters carried out since are not dealt with.

In our experience the excessive precautions recommended for the use of Geiger-Müller counters (see p. 102) are rather exaggerated.

The presentation of the book is somewhat sketchy. Details might have been left out to make room for a more thorough discussion of some important points, such as the limits of resolving power of simple coincidence circuits or the properties of multivibrator circuits.

L. Jánossy.

Magnetic Crack-Detection

Notes on Working Principles and Use of Apparatus. By G. B. Young. Pp. vii+60. (London: Charles Griffin and Co., Ltd., 1942.) 2*s*. 6*d*. net.

THE author states that this little book has been prepared at the request of friends in inspection departments to combine an outline of the working principles with the practical information needed in connexion with magnetic crack detection. In the light of this it is difficult to find justification for the historical notes which form the opening. On the other hand, the principles underlying this method of inspection might, with great advantage, have been more fully and more clearly stated. The majority of its readers will have a very slight knowledge of the fundamental principles of magnetism, and probably none of their bearing on exceptional cases as represented by flawed material. Terms such as flux, field distortion, magnetic susceptibility will be almost meaningless to many, as the average examiner of crankshafts, gear-wheels, ball-races, etc., is by no means likely to have qualifications in magnetism. The discussion of different types of flaws with little, if any, reference to their influences on the magnetization of the body in which they occur may be regarded as extraneous, as the reader is, or should be, presumed to know them all already, while the man who is unfamiliar with this branch of inspection will find the information inadequate.

Halfway through the book, the author begins to open up his subject proper by giving practical directions on the methods of operating the machines in magnetizing and testing bars, slabs, disks and flat surfaces. For the testing of rings, the Johnson-Fel ring jig is recommended, but, though it is thus indicated as an accessory to the actual process of examination, not a word of description is devoted to it. There certainly will be found many practical hints or tips which would be most useful to the examiner who has learned to use the machines, and has already been trained in the subject of crack detection. Considering, however, the many possibilities of cracks or flaws being overlooked in consequence of mishandling the machine, say, by exceeding, or failing to reach the correct magnetic strength, one is bound to say that a more comprehensive view of the needs of the uninitiated reader should have been adopted.

The Tropical Sky

Maps of the Constellations visible in the latitudes of the West Indies, Guianas, Nigeria, E. Africa, Ceylon, Malaya, etc. (5° to 10° N. or thereabouts), and of the Planets and Solar System, showing how and where to Identify Them in their Starry Background. Compiled by H. E. Watson. Pp. 27+3 maps. (Georgetown: *Daily Chronicle*, Ltd., 1942.) 3*s*. 6*d*. net.

THE title of this work is a sufficient explanation of its scope; the maps will prove helpful to beginners who wish to learn the positions of the constellations and their principal stars, which are given up to magnitude 5. Separate charts are provided for finding the planets, and directions are supplied for making use of these charts at different periods.

A number of explanations are given of various astronomical matters, but unfortunately many of these are either inadequate or misleading. Some examples are selected and perhaps these will be rectified in a later edition. P. 8¾: It is incorrect to say that the Star of Bethlehem was a comet. There is no proof for this supposition. On the same page it is stated that meteors "are pulled down on to the earth if they approach us too closely". Meteors encounter the earth irrespective of our planet's attraction, which has very little to do with the cause of the encounter. P. 9: It is stated that the Milky Way contains some 3,000 million stars. The actual number is probably about thirty times this figure. P. 11: It is doubtful if an object glass 1½–3 in. in diameter, complete with brass cell, can be purchased for 15–30*s*. If such a price were paid one might suspect that the resulting telescope would not be achromatic. P. 13: It is not correct to say that Galileo was tortured until he recanted.

On Map 1 the constellation of Telescopium is printed as "Telescopum". M. D.

Electrical Engineering Practice

A Practical Treatise for Electrical, Civil and Mechanical Engineers. By J. W. Meares and R. E. Neale. Fifth edition, revised and enlarged. In 3 vols. Vol. 2. Pp. xii+668+32 plates. (London: Chapman and Hall, Ltd., 1942.) 35*s*. net.

THE previous edition of this book appeared in 1927, and many changes in practice have taken place since that year, so that the new edition should prove welcome. The work is too well known to need detailed comment, and it is only necessary to remind readers that this particular volume is concerned with the transformation, conversion and storage of energy; distribution and control in branch circuits; and applications of electrical energy. These main divisions include transformers, rotary convertors, rectifiers, electronic devices, secondary cells, circuits and systems of supply, circuit accessories and wiring systems, and, on the applicational side, lighting, heating, cooking, cooling, air-conditioning, and welding and cutting.

The book has been revised completely and new material has been added where deemed necessary. The basic conception remains as originally planned, and the work is useful alike to the student and the general engineer. In its new form the book should enjoy all the popularity of its predecessors.

Electrical Technology for Telecommunications

By W. H. Date. Pp. iv+160. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1943.) 5*s*. net.

AS times change so the fundamental needs of particular types of students require re-orientation. The author has had considerable experience in training electrical students for varied branches of applied electricity, and the war-time pressure on educationists to emphasize telecommunications, especially radio, must lead them to reconsider what in fundamental theory their students must know in view of the known work they are later to undertake. Without anticipating more specialized telecommunication work, the author has found space, by rejecting the direct-current machine and the associated technology, for whole chapters on inductance, capacitance, and transformers, and their reaction to alternating currents. As a first introduction to the subject the author is clear and comprehensive, at every step indicating examples of magnitudes and usage; the more subtle aspects of the subject do not, of course, appear.

L. E. C. HUGHES.

CALCIUM METABOLISM AND NUTRITION PROBLEMS*

By Dr. J. D. ROBERTSON
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Normal Calcium Metabolism

THE skeleton is the sole calcium store in the body[1]. The calcium in the cortex of the bones is relatively stable, only being drawn upon in severe calcium deficiency; the calcium in the bony trabeculæ is, however, continuously taking part in the calcium exchanges of the body. In banking terms, the cortical bone calcium represents the deposit account, and that in the trabeculæ the current account.

The presence of this store must explain the remarkable constancy of the blood calcium in spite of fluctuations in the intake and output of calcium. There is practically no calcium in the blood cells, but the serum contains about 10 mgm. per 100 ml. (In sixty normal healthy men and women the average was 10·4 mgm. per 100 ml., all the values lying within the narrow range of 9·9–11·1 mgm. per cent.) The serum calcium is higher in children than in adults, but no variation has been detected in old age[2].

The chief exogenous sources of calcium in the food are milk, eggs and similar dairy products and green vegetables—though it should be remembered that the large amounts of calcium present in spinach are not absorbed owing to its high oxalic acid content[3]. It must also be borne in mind that the absorption of the ingested calcium from the gut is influenced by several factors. The presence of free hydrochloric acid in the stomach aids absorption by forming soluble calcium salts; good fat absorption also promotes calcium absorption. The ratio of calcium to phosphorus in the diet is important, particularly in infants, where the ideal Ca : P ratio is 2 : 1, as is found in maternal milk; with increasing age the maintenance of this ratio becomes less essential, though the phosphorus must not greatly exceed the calcium, for insoluble tertiary calcium phosphate may be precipitated in the bowel under such conditions. Vitamin D also aids absorption of calcium from the gut when it is given in doses of 700–1,000 I.U. daily (the anti-rachitic dose); larger amounts, however (50,000–1,000,000 units: the calcæmic dose), promote the mobilization of calcium from the skeleton and its subsequent excretion. Recent experimental work has also produced evidence that the presence of phytic acid[4] in the diet inhibits the absorption of the calcium, while the presence of protein[5] tends to promote it.

Calcium may also be derived endogenously from the skeletal reserve present in the body stores as described above.

Excretion of calcium from the body occurs both through the kidney and the gut; 25 per cent being lost in the urine and 75 per cent in the fæces. The fæcal calcium is composed of that part of the ingested calcium which is not absorbed as well as of calcium actually excreted into the bowel. Calcium is also lost from the body of the pregnant woman in building the fœtal skeleton and also secreted in large amounts in the milk during lactation.

The normal calcium metabolism of the body is influenced by the activity of the thyroid and parathyroid glands—chiefly by the latter. Experimentally, in both man and other animals, parathyroidectomy results in a fall in blood calcium which may be cured by the administration of parathyroid extracts[7]. The effect of the thyroid gland is not so well known, but thyroxine apparently influences the excretion of calcium by the kidney. In thyrotoxicosis the calcium output in the urine is increased, but on the other hand it is decreased in myxœdema. Subtotal thyroidectomy in the first case and thyroid administration in the second relieves the clinical conditions and under such treatment the urinary calcium output returns to normal[8].

* Substance of lecture before the Royal Society of Arts, delivered on March 3.

Normal Calcium Intake

The optimal amounts of calcium that should be ingested daily to promote ideal health are believed by nutritional experts[9] to be the following: adults, not less than 800 mgm. daily; children, not less than 1,000 mgm. daily; pregnant and lactating women, about 2,000 mgm. daily.

These figures have been derived from studies on the calcium balances of normal healthy people. Individuals fed on a calcium-free diet still excrete calcium (when such a diet is fed indefinitely calcium is lost from the skeleton, and though the body makes an effort to conserve calcium by decreasing its excretion, calcium never becomes completely absent from urine and fæces). If calcium is added to this diet in gradually increasing amounts, the calcium lost will at first still exceed the intake, but eventually a level of calcium intake is reached where there is equilibrium—intake and output being equal. In normal people this equilibrium is reached with an intake of about 550 mgm. per day. Some individuals may show an equilibrium intake as low as 200 mgm. per day; this is evidence that they habitually take a calcium-deficient diet, since the body has adjusted itself by decreasing its normal output so far as it can, as happens in prolonged complete deficiency as described above. The optimal calcium intake is higher than this equilibrium figures, since it has been shown that such higher intakes benefit growth, weight, fitness, health and maternal efficiency in both animals[10] and man[11].

It is a noteworthy fact that an intake of 800 mgm. per day which is given above as the optimal intake for a normal adult also represents the minimum amount of calcium required to bring about maximum storage. That is to say, any intake in excess of 800 mgm. per day will be excreted unchanged in the fæces unless the individual is calcium deficient.

During pregnancy and lactation, of course, the calcium requirements of the body are much higher—generally about 2,000 mgm. per day. As two-thirds of the fœtal skeleton is formed during the last three months of pregnancy the increased intake should start during the fifth month of pregnancy, or earlier, and should be continued throughout the period of lactation to supply the calcium secreted in the milk. The pregnant and lactating woman loses as much calcium in the urine and fæces as she does normally[12], showing that there is no mechanism for conserving calcium in spite of the abnormal demands made on the body.

Calcium Deficiency

Clinical examination will only provide evidence of severe degrees of calcium deficiency; the chief signs are softening and bending of the bones (osteomalacia), brittleness of the bones, which become very liable to fracture, and tetany. In spite of this insensitivity in

the estimate of calcium deficiency, osteomalacia and tetany have been reported in Great Britain, due to a low calcium intake[13].

Radiographic examination of the skeleton gives a somewhat more sensitive indication of calcium deficiency, but again the low degrees of deficiency are undetected, as is shown by the fact that in spite of the marked calcium loss in thyrotoxicosis only the most severe 25 per cent of cases show any decalcification of the trabeculæ in their radiograms[16]. Radiographic evidence of decalcification resulting from low calcium intake has been found in Great Britain[17].

A different method of approach is that of the mass dietary surveys that have been made in Great Britain and the United States[14]. Sir John Orr[14] finds that the lowest three of the six income groups into which he divides the population are getting insufficient calcium; these groups comprise a total population of twenty-two million people. It was found that the consumption of staple foods with a low calcium content such as bread and potatoes was almost the same throughout all six groups; the consumption of the foods with high calcium content (milk, cheese, eggs and green vegetables) increased, however, with increasing income. The higher income groups with the higher calcium intake showed lower incidence of disease, an increased rate of growth in the children, an increased adult stature and generally improved health and physique when compared with the lower income groups. That these benefits were not derived from the better housing conditions and decreased overcrowding is shown by the data of McGonigle and Kirby[15], who studied the health of a group of slum dwellers who were re-housed in a new estate in Stockton-on-Tees. Contrary to expectation, there was an increase in their sickness-rate. This was attributed to the fact that the increased rents led to a decrease in the money spent on food.

Another method of estimating the calcium saturation of the individual is that of the calcium balance determination. As described in an earlier paragraph, any individual who attains calcium equilibrium on a calcium intake of less than 550 mgm. per day, or if an intake of more than 800 mgm. per day results in a greater amount of storage than an intake of only 800 mgm. per day, may be considered to be calcium deficient. Such evidence for calcium deficiency in Britain also exists[17,18].

Calcium Intake in War-time Diets

Under war conditions the supply of the calcium-rich foods is limited: milk and cheese are rationed, eggs almost non-existent, green vegetables only available seasonally, and fish scarce. The priority class of children under five and pregnant and lactating women are allowed one pint of milk per day and a variable cheese ration which at present is 4 oz. per week. The calcium content of this ration is about 800 mgm. per day, which means that, with other sources, the total intake will be at least 1,000 mgm. per day. School children of 5–18 years of age get about $\frac{3}{4}$ pint of milk and their daily intake is probably 800–900 mgm. of calcium daily. The adults, with their daily milk ration of $\frac{2}{7}$ pint of milk, will have a daily calcium intake of about 500–600 mgm. In practice, the women and children probably do not eat all their cheese ration and the men probably forgo some of their milk. This may mean that the figures computed above are on the high side. If we eat all our rations our calcium consumption is only equal to that under pre-war conditions, and it has been shown above that there is ample evidence to show that our pre-war consumption was sub-optimal. Since it is impossible to increase the available amounts of the calcium-rich foods, calcium has been added to one of the staple calcium-poor foods—bread.

Addition of Calcium to Bread

This proposal has led to some controversy so that it is important to stress the following facts. The suggestion that a daily supplement of calcium to the diet would be beneficial is at least eighty years old[19] and actually led to improvement in health and physique. (See, for example, the recent experiment carried out in India showing that daily supplements of calcium lactate or milk had equally beneficial effects on a group of school children[20,21].) The practice of adding calcium to grain was established in Mexico and Peru when Columbus discovered America[22] and was employed with success by Germany in the War of 1914–18[23]. In Great Britain the amount of chalk added to 280 lb. of flour is 7 oz., while the daily intake of bread is about 14 oz. per day per person; which means that the average extra calcium consumed is less than 200 mgm. daily. There have been suggestions that this added calcium might have harmful effects. If this were so, such harmful effects of excess calcium should be observed in the hard-water districts of Britain, where the water contains 12 mgm. of calcium per 100 ml., so that 200 mgm. would be consumed for every three pints of water drunk. The million or so people who live in such districts, however, show no signs of ill-health. The districts are generally considered the most healthy in Great Britain, including most of the health resorts and watering places (for example, Weston-super-Mare, Bath, Ramsgate, Margate, Leamington Spa, Bournemouth and Folkestone among many others).

Summary

The normal processes of calcium metabolism and the factors influencing it are described.

Methods of determining the optimal calcium requirement and estimating degrees of calcium deficiency are reviewed, together with the evidence that such deficiency exists among large groups of the population.

Difficulties of increasing the calcium intake in war-time are pointed out.

It is calculated that the excess consumption of calcium due to the fortification of bread with chalk is no greater than that of people living in hard-water districts, which include most of the British health resorts and watering places.

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ANCIENT MONUMENTS OF CYRENAICA AND TRIPOLI*

By PROF. J. L. MYRES, O.B.E., F.B.A.

BETWEEN the western edge of the Nile Delta and the most eastern spurs of the Atlas ranges, before they pass over from Tunis into Sicily, North Africa consists of three distinct geographical regions, with distinct historical experiences. The 'Western Desert' from the Egyptian point of view, or 'Eastern Libya' —to distinguish it from what lies farther west still— is a low-lying slab of Tertiary limestone, marls and sands. It receives less Atlantic moisture, and greater summer heat, and has long been essentially desert; but ancient Egyptians knew it as a reservoir of pastoral tribes and of olive culture, and their general name *Tamahu* meant both 'Berber' and 'olive'. Its oases, Kharga, Siwa, and others, are still centres of population and intercourse, and as it extends westward inland of Cyrenaica, we should include, with those, the oases of Jerabub and Augila. Indeed, there is no natural frontier or change of regime, in the far interior, east of the Red Hamada plateau, of which the sea frontage is Tripolitania. This Eastern Libya has a dangerous and almost harbourless coast: Mersa Matruh is the only landing place, and a very poor one, between Alexandria and Bardia.

West of Sollum, the low interior plateau rises, and also extends to the sea, in the abrupt *Katabathmos* or 'Step-down' through which the only passage is *Halfiya* ('Hell-fire Pass'). It continues to rise, and to present a steep cliff frontage, nearly to Benghazi, and also forms a nearly semi-circular promontory seaward; while southward it subsides into the low desert hinterland. This block of Africa has in fact broken loose, and failed to subside with the regions east and west. But there are two distinct blocks, with escarpments one behind the other and a lower terrace between, all deeply dissected by ravines draining the wide plateau inland. Sometimes, and especially to westward, there is a coast plain seaward of the lower escarpment. As the plateau rises to 2,500 ft., Cyrenaica has enough winter rainfall for pasture in the interior, and retains patches of its old forests on the escarpments; and at the base of the upper escarpment deep springs break out, the most famous of which, sacred to a local deity, Cyra, gave its name to Cyrene, as Apollo's spring to Apollonia on the coast. Near Benghazi, underground water has caused the plateau to collapse into deep basins lined with rich moist soil, the 'gardens of the Hesperides' which gave Benghazi its earlier Greek name.

Greek settlement began in 631 B.C., at Cyrene, which became very prosperous, with corn, vines, and olives on the terrace and escarpments, sheep on the moors inland, and a monopoly of the *silphium* plant, an umbelliferous household remedy, gracefully advertised on its lovely coins. It attracted friendly natives, and Greek adventurers from all parts, and hived off other colonies along its seaboard, all recognizable, though none so impressive as Cyrene itself. Benghazi (renamed Berenice from an Egyptian patroness) had a notable sanctuary, and has yielded the only Greek statue of real merit. Barca's rich tombs were furnished with Attic vases of good period; Teucheira and Tolmeita (Ptolemais) have walls and Roman mausolea; Tolmeita had also a guild of gladiators, who adopted professional names: 'Hermes formerly Philo'. Apollonia, the port of Cyrene, was wrecked so utterly by earthquake that the site is a wilderness of columns and architraves, with the rock-cut road winding up the ravine, with deep wheel-ruts from its heavy traffic.

Cyrene itself stands above its spring, where two deep ravines isolate and defend its citadel, a bluff spur of the upper plateau, with the sacred spring in its eastern face. Here a natural shelf has been enlarged, and temples of Apollo, Artemis, and other deities have been built, with accommodation for pilgrims; for the sanctuary became famous, and the original shrine was twice rebuilt, with unusual architectural makeshifts. It has recently been cleared, and partly reconstructed. Round the head of the ravine which carries the road grew up the spacious city, with market-place and public buildings, other temples, and a racecourse and cisterns out on the plateau.

What makes Cyrene unique among Greek cities, however, is its amazing cemetery. The tabular limestone was easily excavated into chamber-tombs, with architectural façades and forecourt, in recognized styles, Doric, Ionic, and Egyptian, and many queer experiments. Of these tombs there are many hundreds, besides free-standing shrines like little temples, sculptured sarcophagi, and tower-like family mausolea. Probably, like the Temple of Apollo, these monuments were originally decorated with stucco and bright colour. Unfortunately, all that are exposed have been looted long ago: the only chance of discovery would be where debris from uphill has smothered some of the lower ranges of these chambers.

Fortunately, Cyrene lies a little aside from the main thoroughfare from east to west; and as it has not appeared in the news as a strong-point, it may be hoped that the monuments have not been damaged.

Tripoli, the third geographical region, is itself in three districts: (1) lowland almost waterlogged behind the Great Syrtis—the 'quicksands' of St. Paul's voyage—from El Agheila westward; (2) the Tarhuna moorland, behind Misurata and Homs; (3) another lowland, where the Tarhuna downs draw back from the coast into the higher and steeper frontage of Gharian, before returning coastward in the Matmata ridge and the Mareth position at its seaward end. Of the 'Three Cities' (*Tripolis*) which gave this region its ancient name, the most easterly, Leptis (now Homs), lies among the seaward spurs of Tarhuna; Sabrata (now Zlieten) and Œa (now Tripoli) are on the frontage

* Summary of an address to the Royal Anthropological Institute delivered on March 23.

of the coast plain, farther west. Tripoli alone has a defensible position and a permanent harbour, for a low ridge of tabular limestone protrudes beyond the long beaches, and bending eastward encloses a considerable port. Leptis in earlier times had been the chief centre, but its harbour was constructed in the mouth of a small stream, and this has silted and destroyed it: the coast also has risen some twenty feet since Roman times, and the quay wall, with lighthouse, boat-steps and bollards, is high-and-dry.

Unlike Cyrenaica, which came into Greek hands without trouble with the Libyan natives, Tripolitania was from the first a cause of quarrel between Greeks and Carthaginians, and the natives supported the latter. For long it was simply 'the depots' (*Emporia*); but after the fall of Carthage in 146 B.C. the Roman protectorate made it accessible, and it became a great source both of grain and of oil. Like Cyrenaica, too, it attracted many Jewish traders. At the end of the third century A.D., Leptis gave Rome one of its most efficient emperors, Septimius Severus, who did not forget his birthplace, and built a palace for his wife, and other impressive buildings. These, overlooking the harbour, became buried in sand dunes when disaster came, so rapidly and completely that after recent excavation they rival Pompeii and Algerian Timgad as an illustration of Roman culture in its later prime.

Neither Tripoli nor Zlieten have monuments to compare with those of Leptis; but the four-faced triumphal arch built for Marcus Aurelius in 164 A.D. in the civic centre of Œa is a fine monument of its kind; and at Zlieten the ground plan of the principal buildings can be traced, and has been partly excavated. The mosaics in private houses, though not so large or splendid as those of Sousse (Hadrumetum) in Tunisia, are among the best in North Africa.

When Tripoli fell to the Arabs, the conquerors were amazed that indemnities and tribute were paid in gold coin; but the citizens explained: "This is what people pay for our oil". How extensive this oil industry became is shown by hundreds of oil farms with stone-built presses, all along the Tarhuna highland. When first visited by travellers, they were described as 'megalithic'—and indeed their stones are very large; but they are based on Roman concrete, on sites with Roman masonry and potsherds, so there is no doubt of their date; the whole process of milling and pressing the olives is depicted on Roman reliefs and frescoes; and the same type of lever press has been seen at work by a modern traveller in Morocco. After the present turmoil, one may hope for re-establishment of this characteristically Mediterranean industry in what seems to have been one of its earliest and most productive homes.

SCIENCE AND THE CITIZEN: THE PUBLIC UNDERSTANDING OF SCIENCE

THE Division for the Social and International Relations of Science of the British Association held a conference at the Royal Institution in London during March 20–21 to consider ways and means for increasing the public understanding and appreciation of science. For more than a hundred years the British Association through its annual conferences has endeavoured to introduce science to the citizen, but the fact remains that to-day, in the midst of a scientific age, science and the citizen are still very insufficiently acquainted. As was so frequently stressed during the course of the conference, we are living in an era in which the discoveries of science are becoming an essential constituent of our everyday life, and an understanding of the spirit and service of science is of the utmost importance for the people and its leaders if our civilization is to survive.

The Exposition of Science

Sir Richard Gregory, president of the Association, in opening the conference, said that since the beginning of history there has always been a lag between stages of scientific knowledge and social and moral wisdom. He considers that what is particularly needed to-day is the promotion of public interest in the close relationships of natural science with other humanistic studies which influence the thoughts and actions of all citizens.

A message from Sir John Anderson, Lord President of the Council, emphasized the vital contributions which science will have to make to the solution of post-war problems. It pointed out that much harm may be done if those without scientific training are encouraged by extravagant advocacy of the marvels of science to expect from science alone remedies for all the social problems which will have to be faced.

A message from Prof. Joffe, vice-president of the Academy of Sciences of the U.S.S.R. (see below), was received but unfortunately not in time to be read to the meeting, and another from Dr. Harlow Shapley and Mr. Watson Davis of Science Service, suggesting immediate international co-operation in the distribution and popularization of scientific information.

Sir Henry Dale, who presided, reminded the audience of some points in the history and associations of the Royal Institution, which was formed with aims closely resembling those to be considered by the conference. He said that the public understanding of science needs for its achievements the co-operation of the two parties concerned—the men of science and the people. The former must study all the means available for interpreting and expounding their problems and achievements, and the whole people must be prepared to receive the message. If Great Britain is to play its part in the civilization now in the making and to keep step in the march of progress with the other great world communities, nothing will suffice short of a recasting of our schemes of education. Science must be given its proper and central place at every stage in elementary, secondary, university and adult education.

Sir Lawrence Bragg dealt with the difficulties of getting the scientific message to the public. Scientific workers are often accused of being too technical in their presentation of their subject. There is some truth in this, but the real trouble is that science has not been regarded as an essential part of a balanced education. We have a number of fine industrial laboratories in Great Britain, but the industrial leaders more often owe their positions to their commercial and financial ability than to their

technical ability. In industry, scientific men are too often regarded rather as experts to be called in when there are troubles, not as colleagues to be called in when making plans. He advocated greater personal contact between scientific consultants and members of the Government, rather than the appointment of advisory committees.

Sir Lawrence gave some useful advice as to how to give a popular scientific lecture, his own talk being an admirable illustration of the points he mentioned.

Prof. Allan Ferguson gave an account of the great expositors of science in the eighteenth and nineteenth centuries with particular reference to Faraday and Huxley, whose passionate love of truth and clarity of expression are eternal examples for future generations to emulate.

Dr. Arnold Raestad, former Minister of Foreign Affairs to the Norwegian Government and now governor of the Norwegian Bank, spoke about the international dissemination of science. He formerly presided over the committee of scientific men appointed in 1938 by the League of Nations (through the International Institute of Intellectual Co-operation in Paris) to consider the means of improving, by organizational measures, the way in which the results and methods of science may be presented to a general public. All modern media of current presentation were considered—lectures, press, films, exhibitions and radio. The committee recommended the creation of an international centre for scientific information. The War has interrupted these efforts, but war-time experience has only emphasized the urgent necessity of such work, and it is to be hoped that as soon as conditions permit the committee will renew its attempt to bring a knowledge of international scientific progress within the reach of every citizen.

Mr. J. A. Lauwerys spoke about museums and the interpretation of science. He considers that the national museums of Great Britain are second to none in the world, and two hundred others are good. But the remaining six hundred are junk shops in which curators, generally very poorly paid, collect salvage. They bear very obviously the marks of the social system which has given them birth. Even among the good museums, science is but poorly represented. There is not a single planetarium in the whole country, though many German and American cities possess good ones.

In this matter, we have much to learn from the United States. There, a great many museums are attempting to present ideas to the public, instead of merely housing and preserving collections. Their methods of display, based upon the fundamental laws of effective display, are often superb. They use the resources of modern engineering and craftsmanship, and they have learned much from the art of the modern window-dresser. Materials are presented so as to show their functions ; exhibits are presented in progressive stages of development ; the displays are integrated and the relationship between what is shown and contemporary civilization is plain.

Mr. Lauwerys advocates a Museum of Science as one of the most important buildings of a great civic centre in each of our cities after the War.

Radio and Cinema

Sir Allan Powell, chairman of the Board of Governors of the B.B.C., took the chair at the second session, when radio and the cinema were discussed. He commented on the great progress which has been made in radio technique since the War.

Mr. G. Ivan Smith, who has produced many talks on science in Australia and in the B.B.C.'s Empire Service, considered the difficulties with which a producer of science talks has to contend. He thinks that science must be introduced to the untrained listener by an emotional appeal. The listener must be made to 'sense' the close relation of science to his own personality by programmes on the chemistry of the body, the soil, plants, or the applied physics which create his material environment. Then the scientific worker must be induced to take infinite pains to interpret himself to his fellow citizens in language that can at once arrest their attention and be easily intelligible.

Sir Robert Watson-Watt sees the greatest obstacle to bringing science to the citizen in the lack of a common language. In using the radio as a medium for the explanation of scientific facts, it is most desirable that the personality of the speaker should be projected into the home audience. For this, high-quality transmission is a first consideration.

According to Dr. C. D. Darlington, science, as we now have it, is nothing less than the arrangement of knowledge for the benefit of mankind. For a hundred years science has been transforming the world, and for a hundred years government has been painfully stumbling behind. More than ninety per cent of the people who govern us are ignorant of the method and meaning of science. They have been educated in a pre-scientific age by an educational system which instead of integrating the future with the past has bent all its efforts to their separation.

After commenting on the strange oversight which excludes from the Board of Governors of the B.B.C. a representative of the profession which brought the radio into being, Dr. Darlington said that the first step is to establish a science committee to prepare, co-ordinate, and direct a science policy in broadcasting. This committee would have to think out how to raise the scientific interest and understanding of the public. It would address itself to the educable fraction of listeners, which Dr. Darlington thinks might be increased from 5 to 25 per cent. Programmes would be included to cover industry, housing, agriculture, food, medicine, health, education and social habits, biography and topical science news.

There should be plenty of time for such broadcasts. The 'Home' programme at present includes 7 hours of religious broadcasting a week and 20 minutes of scientific. The 'Forces' programme includes 1¼ hours of religion and no science at all. Whatever the obstacle to scientific broadcasting may be, it is certainly not time.

Dr. D. McClean, speaking as a representative of the Association of Scientific Workers, outlined a scheme for the general orientation of the B.B.C. programmes in order to convey the scientific attitude without dulling the appetite of the ordinary listener. He advocates the adoption of a general scientific outlook or method of approach in all discussions, social, economic, educational and informative, and also an increase in the specifically science programmes. He suggested that there should be a scientific worker as a regular commentator on passing events, and a permanent committee of representatives of the scientific profession to advise on and to develop ideas for the B.B.C. programmes.

Miss Mary Field discussed the principles of making a biological film, and the role of the biological film in

education. She stressed the point that the biological film, as so many people tend to forget, is only a piece of educational equipment in the hands of the teacher. It cannot teach by itself or take the place of slow, painstaking personal observation and work. But for introductory or revision work, for showing movement of all kinds and for studying the behaviour of specimens, at all times of the year or over a period of years, it is invaluable—nor can biology be taught so well without it.

Mr. Paul Rotha sees a great future for scientific films in educating our political leaders, industrialists, Civil servants and others in whose hands lie the power to make use of science, and who are scientifically illiterate or obstinately anti-scientific. Films will also be needed for specialists in many fields who need to know how science affects their work, for example, farmers. A lead in scientific film-making has been given by the Ministry of Information, and certain industrial firms. The film industry itself must be induced to produce films about science.

Science as a Humanity

Speaking from the chair on the history of humanism, Prof. J. L. Myres maintained that: (1) from the beginnings of a humanistic outlook, in antiquity, and also at the revival of learning (in the fourteenth century), the natural sciences had undisputed and indispensable place among the humanities; and (2) that they lost that place when the technological demands of modern industrialism claimed for them a status apart from the 'more humane studies', in the hope of producing experts and specialists in some one line of lucrative research at the age of twenty-two or so. He decried the overburdening of modern timetables, which left zoologists no time to read the "Origin of Species".

Prof. B. Farrington gave a brilliant interpretation of the first two hundred years of Greek science (600–400 B.C.), when for the first time in history the idea of a scientific attitude to external Nature, to man and to society was conceived. Modern historians have conspired to describe their achievements as a miracle, a tribute no doubt to the brilliance of their ideas, but a sad comment on the success of their endeavour, which was to banish miracle from Nature. The originality of the Ionian method of explaining Nature was that it sought to interpret all Nature in terms of the familiar processes by which man himself exercises control over limited portions of Nature's domain. The things going on in heaven and under the earth were the same sort of things as were going on in the kitchen, in the workshop, in battle and on the farm. This way of explaining Nature belongs to a period when techniques were held in high honour in society and form an integral element in the culture of the dominant class. Ionian science changed its character, tending to become exclusively logical and mathematical when the growth of the institution of slavery freed the citizen from manual work and separated him from most forms of practical operational control of nature.

Mr. F. R. G. Duckworth, chief inspector of secondary schools for the Board of Education, thinks that the scientific approach and the artistic approach must be taught concurrently for the full understanding and appreciation of natural phenomena.

Dr. R. V. Southwell devoted his address to a consideration of the 'average man', to whom the exposition of science by the radio, cinema and press will in the future be addressed. The cultural value of science is in its development of a special kind of thinking, and it is some acquaintance with this 'scientific thought' which is wanted in the education of normal citizens, rather than the teaching of factual knowledge about science. It should be the aim of education to develop also other kinds of thought which are necessary for a fully developed personality: the thinking needed for an appreciation of the arts, the thinking trained by a study of languages, the thinking which reveals itself as wisdom in the affairs of life itself. It is in a truly balanced education of this kind that science should play its part.

Prof. W. E. Le Gros Clark considered the place of the biological sciences in the humanities, and how in general education they may be treated in particular relation to their bearing on human problems—the problems of the individual and collective living. Thus, the concept of organic evolution is of vital importance in emphasizing the unity of man with the organic world. The principles of heredity, dealt with by reference to laboratory experiments on insects and plants, can be applied to heredity as it affects man in the control of hereditary disease and the improvement of animal stock. Plant physiology can be related to agricultural problems and food production, animal physiology to human physiology. With the introduction of biological sciences into the general educational curriculum, biological problems which intimately affect human society will be more rapidly and satisfactorily solved, since the social conscience will have been awakened and inertia based on public ignorance will no longer be possible.

An account of the growth of discussion groups in the Army under the direction of the Army Bureau of Current Affairs was given in a paper by Mr. W. E. Williams, director of the Army Bureau of Current Affairs, read by Dr. O. J. R. Howarth. A.B.C.A. is an improvised experiment in mass education. The discussions, which are compulsory, and take place in working hours, cover a wide field of interest. The most popular topics are those which affect the individual. 'What does it mean to me?' is the approach which most quickly rouses attention and eloquence. The most frequent deficiency in the discussions is accurate knowledge, and the effects of cutting off education at the age of fourteen are often lamentably evident. As a war-time innovation, A.B.C.A. has already made a profound effect on the Army, and it is to be hoped that something of this experiment will survive the War and be incorporated into civil life in peace-time.

Dr. C. H. Waddington, whose paper was presented by Dr. D. P. Riley, envisages science not so much as one of the humanities but rather as potentially providing a point of view which can succeed that of the humanities as the ideological focus of the new society which is coming into existence. If science can formulate a view of man which, by emphasizing his essentially social nature, is profounder than that of the individualistic capitalist era, it will have played a by no means negligible part in bringing the new society to birth.

Science and the Press

At the final session, the chair was taken by Sir Richard Gregory, who dealt with some prominent characteristics of the scientific movement following the publication of the works of Mill and Darwin. These works had a great influence in releasing thought

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and inquiry from conventionalism and in revealing relationships between the nature of man and his environment. The foundation of NATURE towards the latter part of the last century was a landmark in promoting this movement.

Mr. Ritchie Calder, formerly science editor of the *Daily Herald*, was optimistic about the effect of the War on the mental attitude of the average reader, the average journalist and the average scientific man. The newspapers have been purged, scientific men have been drawn from their isolated position into public life and the average reader, through national service, has been given a new way of life and a new outlook. In a war of scientific weapons, they have become to a greater or lesser degree scientific. This new population will demand new treatment from the Press. He thinks that there will be a need for a British Institute of Scientific Information linked with similar organizations throughout the world, which will maintain a regular supply of scientific information for dissemination in the various countries. A similar idea was put forward by Mr. Henry Martin, of the Press Association.

Mr. J. G. Crowther put forward many suggestions for increasing the popular understanding of science, pointing out that there is no simple way of bringing this about. The improvement of science reporting in the Press depends on the simultaneous advance of several interests: the increasing interest and demand from the public; the effects of a higher standard of science teaching; the raising of the school-leaving age; the recognition by owners and editors of newspapers of the growing importance of science; recognition by the State and philanthropic bodies of the necessity for better public understanding of science; the efforts of scientific men themselves to make their activities better known and understood, and the promotion of scientific interest which arises from the increasing mechanization of daily life. He advocates a full-time science editor for every newspaper, and a science news service providing reliable science news to all newspapers which subscribe to it.

The work which the Association of Scientific Workers is doing in publicizing science was described by Dr. D. S. Evans. The Association already has groups of people actively engaged in publicizing science in a large number of its branches, and steps have been taken to train members in the technique of popular science writing. Their aims are to counteract the perverted ideas of science in the Press as instanced by astrology pages and pseudo-scientific advertisements; to show the people what can be done by science during the period of reconstruction after the War and to protect the people from wrong systems of government offered in the light of arguments which appear to have a scientific background.

The Press was further criticized by Prof. J. B. S. Haldane, who said that more space is devoted to anti-science than to science. One of the first things to effect is a revision of the laws of libel so that some action could be taken against the lies perpetrated in patent medicine and other advertisements. He advocated a science news service; science features in every newspaper; a science reporter for every newspaper, and scientific and technical advisers attached to the staff of every newspaper to direct policy.

Mr. Francis Williams considered how the Press, instead of giving occasional publicity to sensational science news, could become a vehicle for the consistent interpretation to the public of the social impact of scientific development upon the world. He considered the possibility of producing a paper independent of advertisement revenue.

It was at this final session on science and the Press that Mr. H. G. Wells sounded the death knell of newspapers as we know them to-day. The time has gone, he thinks, when we shall have to buy four daily newspapers in order to find out what is being concealed from us. He visualizes a time not far off when we shall dial NEWS as we now dial TIM, and receive the latest bulletin over the wires. There are promising signs that the public are demanding informative matter to read and will no longer tolerate newspapers which give no news and exist for the commodities advertised in them. Bound books will disappear. Ideas will be ventilated in paper-covered books and pamphlets, sold at a price within the reach of all, and these will do what the newspapers have failed to do. Finally, old, stale, out-of-date text-books must be burnt. The best-sellers of the future will be scientific books bringing to the citizen an awareness of the age in which he lives.

B. M. H. Tripp.

Message from Prof. Joffe, Vice-President of the Academy of Sciences of the U.S.S.R.

I deeply regret being unable to avail myself of the kind invitation from the president of the British Association and from the British Council, conveyed to me by the British Ambassador, Sir Archibald Kerr. The reason preventing me from travelling to London is excellently expressed in the very subject of this Conference: "Science and the Citizen", which does not admit of my leaving my post and my work just now. . . .

The great pathos of the war for the freedom of my country and of all mankind has aroused in all of us a feeling of responsibility to our people. We know that science is no longer a plaything in our hands but a mighty weapon which, in these stern times, must serve the cause of defending humanity, ensuring mankind a happier future; and these are the tasks of science in days of peace also. The destinies of mankind are not determined by wars alone, as the Nazis preach; they are moulded by centuries of creative toil. In peace and in war-time our object is one—the happiness of our peoples, a happy life for all mankind. Science has already accomplished much towards this; people hear each other and will soon see much of each other across the seas and oceans; in cinemas they are witnesses of the great battles of Stalingrad and Moscow and in Libya; within a few hours they are conveyed from one end of the country to the other; they build ships in one month; they raise fruit and vegetables in the winter; they overcome pneumonia and contagious diseases. But at the same time we scientific men know better than anyone else what vast opportunities still lie dormant, how long is the path from scientific discovery to its ultimate realization.

What is needed is to shorten this process so that every citizen himself feels the full benefit of science and research.

We have long ago in the U.S.S.R. set ourselves this task. Our people, our Government have demanded its solution of us. With this aim in view we carefully thought out plans for our work, concentrating our forces on the most vital problems and seeking the most effective means to introduce into practical life

what we had mastered. We do everything possible so that our knowledge speedily becomes the domain of engineers, physicians and agronomists who can give it practical application; the domain of the workers who effect those physical and chemical processes which we investigate. Finally, it is necessary that this knowledge forms part of the foundation of general education in the schools and among the general population.

We organize joint work between scientific men and engineers. Even without planning, science brings benefit, but its role vastly increases when this aim is consciously striven for.

Allow me to disperse some regrettable misunderstandings. The introduction of planned principles in science by no means signifies rejection of fundamental theoretical researches which give no immediate practical results. On the contrary, a proper plan demands that, side by side with the utilization of science for current tasks, it also lays the foundation for the future. History teaches, and our experience proves outright, that major practical results are achieved when succeeding in revealing the mechanism of natural phenomena, when attaining the broadest possible generalizations.

Theory and practice mutually support each other. There is no better checking of theory and analyses of its shortcomings than the experience of mass production. Allow me to cite an instance of my own experience: solely by means of developing quantum theory semi-conductors we have succeeded in raising dozens of times over the current given by new rectifiers, photo-elements and thermo-elements. On the other hand, many features of this theory were prompted by failures in factory production.

Another misunderstanding which has not yet been fully dispersed is the conviction that the sole aim for scientific creation should be the striving for knowledge and not its benefit for mankind. When you learn that so and so many ships with thousands of sailors have been saved, that so and so many air-raids threatening our native towns have been averted, that so and so many tanks have been saved owing to your work; if you are given grounds to think that the scientific activity of yourself and your comrades in the Academy of Sciences helps to avert the menace threatening to enslave your people—does not this multiply our strength and promote the success of our research?

We scientific men enjoy the privilege of combining two supremely gratifying features; in striving for knowledge we thereby increase the happiness of our people and win its recognition. Both these aspects stimulate the development of science and make the man of science a worthy citizen.

Modern science is proceeding by the united efforts of many scientific men who all tackle one problem from various angles. Individual attempts seldom yield important results. Therefore, a man of learning who is isolated from life is not only a bad citizen but also a poor man of science.

I feel that I am not telling you anything new, the reason I am telling you these truisms is that for us they are the result of the experience of twenty-five years on which our science has grown up and which is so highly appreciated by our people. From the first day of war we men of science joined the peoples' ranks and took our stand in the defence of our country. From us scientific men, each soldier and sailor expects help, and we don't disappoint them. As they at the front, we in the laboratory dedicate day and night to our single cause. This is the cause of all scientific men, all citizens who love their freedom and respect the freedom of other nations. Stimulated by patriotic feelings, science constitutes a prepotent force; and this force is in our hands. . . .

Before us stretch bright perspectives of progress and free development of all peoples along the roads they themselves may choose. Before us stretch the boundless perspectives of scientific creative endeavour. Let us then unite our efforts quicker to disperse this menace so that the free citizen can breathe deep again. Time does not wait, the sufferings of millions grow.

OBITUARIES

His Eminence Cardinal Hinsley

ARTHUR, CARDINAL HINSLEY, whose death occurred on March 17, was born in 1865 in Yorkshire. He was thus seventy years of age when, on St. George's Day 1935, he took possession of the Metropolitan See of Westminster, to which he had been appointed by Pope Pius XI. In the seven years which followed, he became a great national figure, whose influence extended far beyond the limits of his own flock, and whose clear, uncompromising leadership in his country's crisis was recognized as a great national asset. His voice at the microphone conveyed a message which awakened an immediate response in the heart of the British peoples in every part of the Empire—he could express high thoughts that were struggling for utterance in the nation's soul, in forthright words and manner that the nation recognized as its own.

Such an achievement, in so short a time, and at such an advanced age, was the outcome of immense self-forgetting energy, and should greatly hearten those whose advancing years lead them too easily to give in to feelings of inadequacy. Those who had business with the Cardinal were often amazed at the detailed attention he gave to his correspondence and at the number of letters he wrote with his own hand, at a time when his health was giving constant cause for anxiety. These manuscript letters will long be cherished by those who have them—the writer of this notice has a number of them before him as he writes, each with its words of kindness, of insight and genuine interest, and of encouragement. The Cardinal's personality seems to 'come through' in his letters just as it did in his voice heard on the radio.

Even before his appointment to the See of Westminster, His Eminence had earned a title to the gratitude of his countrymen for the work he had done in the field of education. After graduating at the University of London, he obtained a doctorate at the Gregorian University in Rome and gained the diploma in philosophy of the Academy of St. Thomas. Thereafter his practical interest in education never flagged during the whole of his long life. In 1928 he was appointed Apostolic Visitor to the African Missions in British Territory, and for six arduous years carried out the delicate and responsible task of

securing the co-operation of missionary educational agencies with the advances in native education being urged at that time by the Colonial Office. His success in this work, and the satisfaction he gave both to ecclesiastical and government circles, were such that in 1930 he was appointed Apostolic Delegate in Africa and his powers consequently extended to missions in certain non-British territories.

During his years at Westminster, the Cardinal maintained the liveliest interest in questions affecting African education, and was instrumental in inaugurating a special colonial course for intending missionaries to fit them for the educational and administrative responsibilities they would be called upon to assume. The main part of this course was given in the Institute of Education of the University of London, and it was supplemented by series of special lectures on cultural anthropology, comparative religion, native psychology, etc.

The Cardinal gave every encouragement to professional men and women of his own flock to play their part fully in the scientific life of the country—especially in furthering the applications of the social sciences to the material, mental and spiritual well-being of mankind. He was quick to recognize good wherever he saw it, and favoured the closest possible co-operation, consistent with firm principles, with the various agencies working in the social field outside his own communion.

WE regret to announce the following deaths :

Major Leonard Darwin, president during 1911–28 of the Eugenics Society, on March 26, aged ninety-three.

Mr. E. Harrison, registrary of the University of Cambridge, and fellow and formerly senior tutor of Trinity College, on March 28, aged sixty-five.

Mr. E. Heron-Allen, F.R.S., known for his work on the Foraminifera, on March 28, aged eighty-one.

Mr. A. Holm, C.M.G., C.B.E., formerly director of agriculture, Kenya, aged sixty-four.

Mr. R. W. Paul, founder of the well-known instrument-making company known by his name, which was eventually amalgamated with the Cambridge Instrument Co., Ltd., on March 28, aged seventy-three.

Prof. C. F. Tolman, professor emeritus of economic geology of Stanford University, on October 13, aged sixty-nine years.

Mr. W. Trevor Watson, K.C., who specialized in patent law and scientific cases, on March 24, aged fifty-six.

NEWS and VIEWS

Avebury

But for the War, the acquisition by the National Trust of Avebury, and also of Windmill Hill, would certainly have created a more considerable stir. This Bronze Age monument is one of the most impressive of its kind in Europe ; and the lesser site at Windmill Hill has given its name to one of the main neolithic pottery groups of the British Isles. Doubtless the Avebury stone circle owed its importance to its geographical position, situated as it was at the meeting place of a number of ancient downland roads. In its prime, after its last reconstruction, it must have formed a magnificent ensemble with its great circular ditch and rampart and approaching avenue of tall standing stones. Great Britain owes a great deal to Mr. Keiller, who has been excavating Avebury at his own expense for many years past. The lack of interest in former days, and the propinquity of a village, had resulted in the partial destruction of a great deal of the monument and the breaking up of many of the stones for building purposes. Mr. Keiller acquired the property and set to work to examine the site scientifically, and, where possible, to re-erect the fallen stones. The result has been the saving of a unique possession. Windmill Hill, too, is of extreme scientific interest. Earlier in date than the Avebury we see to-day, its excavation has yielded precious data for the elucidation of British culture at a remote period. It is satisfactory to feel that the monuments and Mr. Keiller's work on them will now be preserved for all time for the nation.

Engineering Economics

THIS was the title of a paper presented on March 25 before a joint meeting of the Institutions of Civil, Mechanical and Electrical Engineers by Sir Frank Gill, who explained that his purpose was to urge the leading institutions to include the subject of engineering economics in the qualifications required for admission to corporate membership. Although an essential part of the equipment of a practising engineer in fitting him to decide or advise upon the most economically sound detail or scheme to adopt, this is a branch of training which has, in the main, received little attention. He described 'engineering economics'—distinct from the university meaning of economics—as being related to the question "Which of several plans, schemes or designs, each technically sound for the same job, is it advantageous to select ?" Engineering plans and decisions must be technically sound ; they must also be financially advantageous, and to stress this view several examples were mentioned. In deciding upon the size of a telephone exchange, for example, the advantages increase up to a certain number of subscribers but beyond this they diminish, and it was for a training in the methods by which such economic analyses should be made that Sir Frank pleaded.

Unfortunately, the discussion was mainly wide of the mark, and most of the speakers criticized mere details such as the limited nature of the examples cited, which had no real bearing on the point at issue. Although not helpful, the remarks made by the several speakers carried the implication that the training advocated by Sir Frank is necessary. How advantageous, then, would have been a discussion on the method by which the training might be given, at what stage and the means by which the obvious difficulties might be overcome in the schools. Prof. R. O. Kapp, Pender professor of electrical engineering at University College, London, alone gave some suggestions from his experience in trying to fill the gap, and one came away feeling that, with good will, teachers in the universities and colleges could very easily give a lead in inculcating the principles and technique by introducing an economic as well as a technical objective in the problems and designs which are set for the training of their students.

Centenary of the Royal Dockyard Schools

AT Portsmouth on March 28 the Royal Dockyard School celebrated its centenary when Mr. A. V. Alexander, First Lord of the Admiralty, distributed the prizes. In his speech to the apprentices Mr. Alexander said that "from the dockyard schools have come many leaders in naval construction and engineering and some had been elected Fellows of the Royal Society. In founding the schools and making attendance compulsory the Admiralty anticipated by twenty-seven years the adoption of compulsory education by the State and anticipated day continuation schools by scores of years." The list of eminent naval constructors, shipbuilders and marine engineers who began their scientific training in the dockyards is indeed a long and distinguished one and the country owes a debt to the pioneering work done by the Admiralty in technical education. There had been a School of Naval Architecture at Portsmouth from 1811 until 1832, but that had been closed in a foolish fit of economy by Sir James Graham, the First Lord. It had left its influence, however, and by 1841 another scheme was afoot for training apprentices. This led finally to an Order in Council of February 1, 1843, for approving the establishment of schools in the dockyards, each of which had had a committee preparing plans. In 1843 Chatham, Portsmouth and Pembroke Schools were opened, and the schools at Sheerness, Devonport, Deptford and Woolwich were opened between 1844 and 1848. A notable event in the history of the schools was the appointment in 1846 of the Rev. Henry (afterwards Canon) Moseley as the inspector of schools, and it was largely due to his experience, criticism and proposals that the schools were placed on a really sound footing. At the present time no fewer than eleven ex-Portsmouth dockyard apprentices are studying at the Royal Naval College, Greenwich, which was opened in 1873 on the closing of the famous Royal School of Naval Architecture and Marine Engineering at South Kensington.

Continuation of Education Interrupted by War Service

THE Government has announced that steps are being taken, as at the end of the War of 1914–18, to provide suitably qualified men and women with the means to continue, on demobilization, education or training which has been interrupted by war service, with the object of replenishing the supply of those qualified to fill responsible posts in the professions, industry, including agriculture, and commerce. The scheme will apply to all those whose further education has been interfered with by service in the Armed Forces, civil defence bodies, or by undertaking work of national importance. It is intended to cover training in business concerns as well as courses at universities, technical colleges and training colleges. It is also proposed to take steps to provide facilities for those who will be retained by Service Departments during the period of resettlement before demobilization is complete. An interdepartmental committee, including representatives of the universities, is being appointed to ensure that training and educational arrangements are related to prospects of employment at home and abroad. An independent committee will advise the Minister of Labour and National Service, acting through the Appointments Branch of the Ministry, on methods of securing co-operation with professional, industrial and business organizations and with education authorities, in order to assist trained men and women to obtain posts after the War. Lord Hankey will be chairman of both these committees. Inquiries regarding these schemes should be addressed to the Secretary, Board of Education, Belgrave Square, London, S.W.1 (by those normally resident in England or Wales), or to the Secretary, Scottish Education Department, St. Andrew's House, Edinburgh, 1 (by those normally resident in Scotland).

Summer School in Biology and Health

THE re-organized Central Council for Health Education, which enjoys the support of the Ministry of Health and the Board of Education, together with the most important health and educational associations, is arranging a Summer School in Biology and Health to be held at the Chelsea Polytechnic, London, during August 4–14. The first three days will deal with "The Biological Basis of Education", and various sessions will trace the life of a child from conception to adolescence. The lectures will cover heredity, early childhood, stages of physiological and psychological development, and questions of individual and social health. This course should be of value not only to all teachers and educational administrators, but also to youth leaders, play-centre and nursery-school workers, health visitors and school nurses, and, indeed, all who have to do with children and young people. The succeeding week will deal with "Biology in the School", and is designed specially for teachers of biology and others interested in that subject. While the mornings will be devoted to 'text-book' biology, and the afternoons to experimental demonstrations and visits, the evening lectures will relate biology to its social setting.

The Council has been fortunate in securing the services of several eminent men of science and educationists. Prof. C. W. Valentine, professor of education in the University of Bristol, will speak on "Early Childhood", and Prof. Winifred E. Cullis on "Sex Education". A matter of great topical importance, "The Social Aspects of Nutrition", will be dealt with by Prof. J. R. Marrack, professor of chemical pathology in the London Hospital Medical College, and if his other engagements permit, Prof. Lancelot Hogben, professor of zoology in the University of Birmingham, will speak on "Biology as a Social Science". It is hoped that other authorities well known for their views on biology as an educational discipline will address the school. The lighter side so essential to the success of a Summer School has not been neglected. Visits will be arranged to the Science Museum, Kew Gardens, and Rothamsted Experimental Station; socials and dances will be held at the Polytechnic, and time will be left free for other individual arrangements. The Summer School fee will be 5½ guineas for the full ten days, and 2½ guineas for the first three days only. These figures include not only tuition, but also lunch, tea, and dinner each day. Since many students will prefer to stay with friends in London, the fee is not calculated to include sleeping accommodation and breakfast, but the organizers of the school will be glad to help other students to make such arrangements. The school will be jointly directed by Mr. L. J. F. Brimble, chairman of the Central Council's Educational Advisory Committee, and Dr. F. J. Harlow, principal of Chelsea Polytechnic. The Summer School Secretary is Mr. Cyril Bibby, Education Officer, Central Council for Health Education, Tavistock House, London, W.C.1, to whom enquiries should be directed.

Vacation School on Social Biology

A VACATION school on "Social Biology in Relation to Human Life and Culture" is to be held under the auspices of the British Social Hygiene Council, beginning on July 30 at Eton College. The school will last for a fortnight; the cost will be £6 6*s*. a week inclusive. The programme will consist of morning instructional courses on social biology, its place in education and its bearing on current social problems. For these, Prof. A. E. Heath, professor of philosophy in University College, Swansea, Dr. Marjory Gibbons, Mrs. E. J. Hatfield, Prof. L. P. W. Renouf, professor of zoology in University College, Cork, Mr. R. Weatherall (of Eton College) and others are making themselves responsible. Still wider aspects of social biology will be dealt with in evening lectures and conferences, in which Prof. F. A. E. Crew, Mr. W. L. Sumner, and Father Leycester King are hoping to participate. In the first week the courses will be planned to appeal mainly to teachers of all kinds, not only to science teachers. In the second week they will relate to problems which concern not only educationists but also welfare workers, magistrates, labour managers and all others confronted with present-day social and administrative problems. Further information can be obtained from the British Social Hygiene Council, Tavistock House South, Tavistock Square, London, W.C.1.

The Ray Society

AT the general meeting of the Ray Society held on March 25, it was agreed that, under suspension of the laws of the Society, the officers and Council at present serving be re-elected for the current year. In the annual report of the Council it was stated that the affairs of the Society continue in a satisfactory condition. Prof. Tattersall's monograph on the "British Mysidacea" is approaching completion and a considerable number of the illustrations are in the hands of the engravers. Proposals for the publication of several other works are under consideration by the Council, but under present conditions considerable delay in publication is unavoidable.

Science and the War Effort in the United States

A PAPER on "The Fuller Utilisation of Scientific Resources for Total War" presented by Dr. T. Rosebury at a meeting of the New York Branch of the American Association of Scientific Workers on October 7, which has now appeared in *Science* (96, 571; December 25, 1942), shows a similar concern over the failure to utilize scientific resources to that which exists in Great Britain, and also that the American Association of Scientific Workers is actively concerned with this problem. The broad outlines do not of course differ in the two countries, and with much that is being done in the United States readers of NATURE are already familiar. The chief feature of interest in Dr. Rosebury's paper is its account of the encouragement and organization of individual volunteer scientific activity by the Office of Scientific Research and Development. Emphasizing that leadership however competent is not enough, Dr. Rosebury points out that any responsible scientific worker can formulate a war project and submit it as an application for a contract to the O.S.R.D. or to one of its sub-committees. If the application is approved, a contract is granted, and funds for assisting personnel and for equipment and supplies are made available for the work; Dr. Rosebury describes the way in which the services of a group of bacteriologists in New York were utilized in this way. Finally, he indicates the way in which scientific workers can assist on the home front, and deal with the problems that will result from shortages of trained personnel and assist in securing the full utilization of scientific facilities, equipment and materials, where the National Registry of Rare Chemicals, maintained under the auspices of the Armour Foundation, and the National Research Council have already pointed the way. Dr. Rosebury, however, suggests that ultimately all scientific activity should be centralized and co-ordinated by a single government agency.

Sterilization of Sulphanilamide Powder

THE report of a fatal case of tetanus due possibly to infection from the container of a sulphonamide powder applied locally emphasizes the desirability of the practice, already adopted in the United States, by which all sulphonamide preparations intended for topical application are marketed ready sterilized in sterilized containers. At a conference recently held between representatives of the Medical Research Council and of the Association of British Chemical Manufacturers, it was agreed that the Hynson, Westcott and Dunning procedure is suitable for adoption also by British manufacturers of sulphanilamide powder, and that the powder thus sterilized should be issued in sterile packets each containing 5 gm. Since this recommendation must inevitably take some time to put into full effect and would not apply to existing stocks of the powder held at hospitals and first-aid posts, suitable methods for small-scale sterilization were also considered and various procedures recommended. It is thought that sulphanilamide powder for local application should not cake or be more than slightly discoloured by any of the proposed techniques.

Announcements

THE Association of University Professors and Lecturers of the Allied Countries in Great Britain has arranged a conference, to be held at the Royal Institution on April 10. The morning session, beginning at 10 a.m., will deal with "The Function of a University in a Modern Community"; the afternoon session, beginning at 2.30 p.m., with "Methods of Practical Co-operation between Allied Universities in the Future". Tickets can be obtained from the Conference Secretary, Association of University Professors, 40 Queen's Gate, S.W.7.

THE Ministry of Agriculture and Fisheries invites applications for ten senior scholarships, tenable at agricultural colleges or university departments of agriculture, for diploma or degree courses in an agricultural subject or at veterinary colleges for courses in veterinary science; and six extended junior scholarships (for those who have already held junior awards), and thirty junior scholarships, tenable at farm institutes or similar institutions, for courses not exceeding a year in duration, in agriculture, horticulture, or dairying. Information concerning the scheme and forms of application may be obtained from the Secretary of the Ministry, Block 4, Bickenhall Mansions, Baker Street, London, W.1, or from the offices of County Councils. The latest date for submitting applications is April 30.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Reactions of Hæmoglobin and its Derivatives with Phenyl Hydroxylamine and Nitrosobenzene

ON addition of a small amount of phenyl hydroxylamine ($C_6H_5.NHOH$) to a fresh alkaline solution of hæmatin prepared from hæmin crystals, the colour of the solution turns rapidly from brown to bright red and its absorption band at about 630 mμ is replaced by two strong but somewhat diffuse bands at 562 mμ and 532 mμ. Two molecules of phenyl hydroxylamine per molecule of hæmatin are required for the complete formation of this new compound. Its instantaneous formation suggests in the first instance the view that in this reaction hæmatin combines directly with the phenyl hydroxylamine in the same way that it does with a variety of other nitrogenous substances. This view was not, however, supported by further experiments, which can be summarized as follows :

(1) The new compound is formed much more slowly in complete absence of oxygen. Thus, if hæmatin solution is put in a Thunberg vacuum tube, the phenyl hydroxylamine in its hollow stopper and the contents of the tube are mixed only after the complete removal of air, the new compound appears very gradually.

(2) Although the presence of oxygen greatly accelerates the formation of this compound, it is, when formed, more stable in the absence of oxygen. In air it gradually decomposes, liberating the hæmatin, and this decomposition is accelerated by shaking the solution with air.

(3) Addition of sodium hyposulphite to the new compound decomposes it, liberating the unbound hæm (Fe··).

(4) Addition of potassium ferricyanide also decomposes this compound, liberating the unbound hæmatin (Fe···).

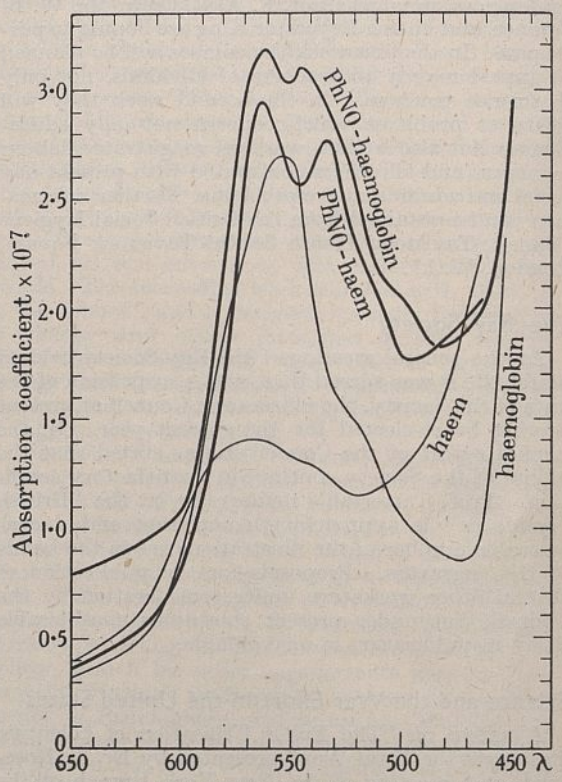
(5) In presence of carbon monoxide the new compound turns gradually into CO-hæm.

(6) A compound with similar properties is obtained by treating different parahæmatin compounds, such as pyridine parahæmatin, with phenyl hydroxylamine.

Somewhat similar results are obtained on addition of phenyl hydroxylamine to solutions of oxyhæmoglobin or methæmoglobin. In the case of oxyhæmoglobin, the reaction begins with the appearance of acid methæmoglobin. The latter, however, undergoes a marked change ; its colour turns from brown to purple and its characteristic absorption spectrum is replaced by two bands at 560 and 543 mμ.

As in the case of hæmatin, this new compound is much more rapidly formed in the presence of oxygen. In the absence of oxygen, phenyl hydroxylamine reduces methæmoglobin to hæmoglobin, and this reduction is followed by gradual appearance of the new compound. This new compound is not stable. Exposed to air, it reverts gradually to free methæmoglobin and this reaction is accelerated by shaking the solution. On treating it with potassium ferricyanide it turns immediately to methæmoglobin ; in presence of carbon monoxide it forms carbon monoxide – hæmoglobin, while on treatment with sodium hyposulphite it forms reduced hæmoglobin, which on shaking with air oxygenates to oxyhæmoglobin.

The above experiments show that phenyl hydroxylamine reacts both with hæmatin and with methæmoglobin, forming two very similar but not identical compounds. The facts that in presence of carbon monoxide and without addition of a reducer these two compounds give carbon monoxide – hæm and carbon monoxide – hæmoglobin respectively, clearly indicate that the iron in these two new compounds is in the ferrous state. The first step in this reaction is therefore the reduction by phenyl hydroxylamine of hæmatin and methæmoglobin to hæm and hæmoglobin respectively. This is, moreover, supported by the fact that these compounds are rapidly decomposed by potassium ferricyanide, liberating hæmatin



LIGHT ABSORPTION CURVES MEASURED WITH THE HILGER NUTTING SPECTROPHOTOMETER. ABSORPTION COEFFICIENT $= \frac{1}{cd} \ln \frac{I_0}{I}$ WHERE c IS HÆMATIN CONCENTRATION EXPRESSED AS GM. MOLS C.C.

and methæmoglobin. On the other hand, the facts that hæm and hæmoglobin in absence of oxygen react very slowly with phenyl hydroxylamine and that both new compounds are rapidly destroyed by sodium hyposulphite, liberating hæm and hæmoglobin, indicate that in these compounds, hæm and hæmoglobin are combined not with phenyl hydroxylamine but with one of its derivatives. Of several derivatives of phenyl hydroxylamine tested, such as aniline, hydrazobenzene, azobenzene, azoxybenzene, nitrobenzene and nitrosobenzene, only nitrosobenzene (PhNO) was found to give, with hæm and with desoxygenated hæmoglobin, compounds absolutely identical with those which phenyl hydroxylamine gives with hæmatin and methæmoglobin respectively.

The reaction of phenyl hydroxylamine with

hæmatin and methæmoglobin can, therefore, be explained as follows : phenyl hydroxylamine reduces hæmatin and methæmoglobin to hæm and hæmoglobin respectively, undergoing at the same time oxidation to nitrosobenzene. The latter then combines with hæm and hæmoglobin, forming the two new compounds (see accompanying graph). These results confirm a recent observation by Jung[1], who found that reduced hæmoglobin forms a well-defined purple compound with nitrosobenzene. Neither catalase nor cytochrome *c* react with phenyl hydroxylamine or nitrosobenzene.

The reactions described in this communication have some bearing on observations by Warburg, Kubowitz and Christian[2], as to the effect of phenyl hydroxylamine on red blood corpuscles of rabbits. On treating these corpuscles with phenyl hydroxylamine they have obtained brown methæmoglobin corpuscles, the oxygen uptake of which in presence of glucose was about twenty times higher than that of the untreated corpuscles. They also found that methæmoglobin of these brown cells, while it catalyses the oxidation of glucose, does not turn into oxyhæmoglobin as one would expect if this catalysis is accompanied by valency changes of iron.

They believe that methæmoglobin acts here as a real catalyst undergoing reduction to hæmoglobin, which instead of becoming oxygenated becomes reoxidized to methæmoglobin. According to these workers, such behaviour of methæmoglobin, although chemically unexplained, is of great importance for the theory of respiration.

The reactions between hæmatin compound and phenyl hydroxylamine described above suggest, however, that the peculiar behaviour of methæmoglobin within the red blood corpuscles described by Warburg *et al.* is not due to any special unexpected property of methæmoglobin itself but to the presence within these corpuscles of some derivatives of phenyl hydroxylamine. Of these derivatives nitrosobenzene combines with hæmoglobin every time it is formed by the reduction of methæmoglobin and protects it from oxygenation but not from oxidation to methæmoglobin. In fact, as we have just shown, nitrosobenzene-hæmoglobin exposed to air undergoes oxidation to methæmoglobin rather than oxygenation.

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E. F. HARTREE.

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[1] Jung, F., *Naturwiss.*, **28**, 264 (1940).
[2] Warburg, O., Kubowitz, T., and Christian, W., *Biochem. Z.*, **242**, 170 (1931).

Asymmetric Transformations

SINCE our work on asymmetric transformation is suspended owing to the existing emergency, we desire to make a statement of the present position and the essential steps leading up to it.

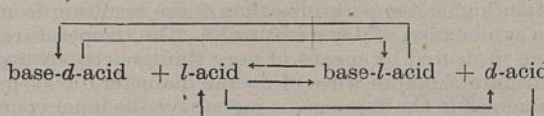
Read and McMath[1] observed that acetone solutions of *l*-hydroxyhydrindamine chlorobromomethanesulphonate exhibited marked mutarotation, and concluded that equilibration between *l*-base-*d*-acid and *l*-base-*l*-acid was responsible. They assumed that the active base exerted an 'asymmetric influence' on the optically unstable acid molecules. Mills and Elliott[2] in 1928 found that the brucine salt of N-benzenesulphonyl-8-nitro-1-naphthylglycine underwent what they termed "partial activation" in chloroform (acid : base ratio = 0·845 : 1), and attributed this to the "difference between the velocity coefficients of partial racemisation of the undissociated salts", although they also said that the observed mutarotation "must have been due to the establishment of an equilibrium in which an excess of brucine-*d*-acid salt was present". They made no quantitative measurements, but made a qualitative observation that the equilibrium rotation was changed by increasing the acid to base ratio, and concluded that "this may indicate a slight dissociation of the salt in chloroform".

In the case of diastereoisomerides in which one centre of asymmetry is labile and capable of being influenced by the other centre, the term 'partial racemization' has no physical meaning. Since the interconvertible salts, base-*d*-acid and base-*l*-acid, in which the acid is the optically labile component, will have different free energies in non-dissociating solutions, the amounts of the two salts at equilibrium will be unequal. In the equilibrium :

$$\text{base-}d\text{-acid} \underset{k_l}{\overset{k_d}{\rightleftharpoons}} \text{base-}l\text{-acid},$$

K, the equilibrium constant, is equal to k_d/k_l, and the measured rate constants for the approach to equilibrium from base-*d*-acid, base-*l*-acid and base-*dl*-acid must all be equal, being the sum of k_d and k . This simple conception was first put forward and experimentally established by us[3] in 1938. Further, knowing the specific rotations of either base-*d*-acid or base-*l*-acid, of base-*dl*-acid, and of the equilibrium mixture, together with $k_d + k_l$, we were able to calculate the individual values of k_d and k_l. We had previously obtained irresistible evidence[4] that in the systems we were investigating any dissociation effect must be extremely small. The term 'partial racemization' as applied to such a pair of diastereoisomerides should be abandoned in favour of the more accurate term 'equilibration'. 'Optical activation' is still a useful term for describing that part of the common equilibration process which is observable when base-*dl*-acid is the starting material.

Addition of excess of *dl*-acid upsets the equilibrium, but so far there is not enough evidence to enable a decision to be made as to whether this is due to disproportionation of the salts, of the free acids, or of both. The initial disproportionation may either be enhanced in the same optical sense, or reversed, by the addition of excess of *dl*-acid. As an example of the reversal effect, it was found in one case (Jamison and Turner[5]) that the 1 : 1 acid-base mixture contained more of the *d*- than of the *l*-acid (combined), and that the 3 : 1 acid-base mixture contained more *l*- than *d*-acid (free plus combined). As a result of this reversal effect, there is a certain ratio of *dl*-acid to base *at which no mutarotation occurs*. Combination of acid and base to give salt is extremely rapid (Jamison and Turner[6]) and therefore the only processes which need be taken into account in considering the equilibrium are representable (Jamison and Turner[7]) as below :



At the point of no mutarotation, the concentrations of the various components must be those actually

put into the mixture, that is, the concentrations of base-*d*-acid and base-*l*-acid are equal to one another, as are those of *d*-acid and *l*-acid, and any subsequent changes are mutually compensating. The concentrations of the components are known only at this point and at that at which there is no excess of *dl*-acid present. Attractive as the problem is, there is as yet insufficient evidence for its complete solution.

Exchanges and inversions of these types must involve transition complexes such as

d-acid ——— base ..... *l*-acid,

in which the base may be able to exert an asymmetric influence on more than one molecule of acid. That this influence has to be more intimate than a purely environmental one would appear to be probable from some preliminary (unpublished) experimental results obtained by us in 1941, concerning the rates of mutarotation of the brucine salt of *l*-2-chloro-N-benzoyl-6′-methyldiphenylamine-2′-carboxylic acid, in solution in *d*-, *l*- and *dl-sec.*-octyl alcohols. These rates, as measured, were experimentally indistinguishable, and although much more detailed work remains to be done, we are of the opinion that there has to be a fairly close association between the 'influence' and the labile substance for the latter to be affected. A similar conclusion follows from the many cases we have studied in which salt activation occurs in a non-dissociating and not appreciably in a dissociating solvent.

The mechanism of "second order" asymmetric transformation has been understood for a considerable time (see, for example, Leuchs and Wutke[8]), but until the appearance of our recent memoir[9] it had not been realized that if second order transformation, with separation of one pure diastereoisomeride, can occur in a non-dissociating solvent, then it must be preceded, that is, in solution, by a first order asymmetric transformation, optically antagonistic to the second order change, although the *measurable* effect of the first order change will in some cases be very small.

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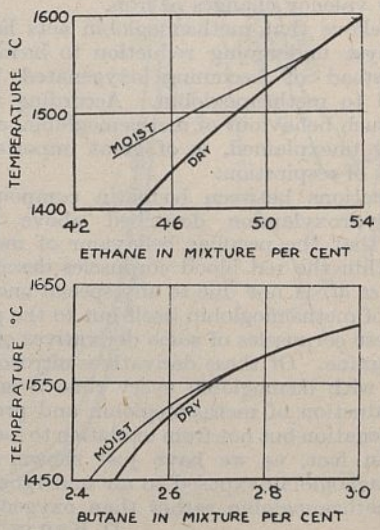
March 16.

[1] *J. Chem. Soc.*, **127**, 1572 (1925).
[2] *J. Chem. Soc.*, 1291 (1928).
[3] *J. Chem. Soc.*, 1646 (1938).
[4] *J. Chem. Soc.*, 1650 (1938).
[5] *J. Chem. Soc.*, 266 (1940).
[6] *J. Chem. Soc.*, 1650 (1938).
[7] *J. Chem. Soc.*, 270, 272 (1940).
[8] *Ber.*, **46**, 2420 (1913).
[9] *J. Chem. Soc.*, 437 (1942).

Influence of Water Vapour upon the Combustion of Hydrocarbon Mixtures

IT has been reported previously that flame gases resulting from the combustion of moist carbon monoxide – air and moist hydrogen – air mixtures attain higher temperatures than those resulting from the combustion of dry mixtures[1,2]. The temperatures were measured by means of very thin quartz-covered platinum-rhodium wires of overall diameter 0·0005 in. immersed in the flame gases just above the inner cone. The mixtures which were fed to the burner were on the weak side of the theoretical mixtures, and for any given combustible gas content the temperatures of the moist mixture flame gases were of the order of 50° C. higher than those of the dry mixture flame gases.

Similar experiments have been carried out with moist and dry mixtures of air and butane, propane, ethane (which contained approximately 10 per cent of ethylene) and ethylene. The results of the experiments with ethane mixtures (which showed the largest differences) and with butane mixtures (which showed the smallest differences) are summarized in the accompanying graphs. It will be seen that in the case of the weakest mixtures used the moist ethane mixtures yielded temperatures some 70° C. higher than the dry mixtures, whereas the moist butane mixtures yielded temperatures only about 25° C. higher than the dry mixtures. It will also be seen that as the mixture strength was increased the differences between the moist and dry mixture temperatures became less and less, until mixture strengths were reached in which the proportion of the combustible gas was about 90 per cent of the theoretical proportion, when the moist and dry temperatures were sensibly the same. Similar results were obtained with the propane and ethylene mixtures.



Reference to our previous letter relating to moist and dry hydrogen – air mixtures[2] will show that in the case of the flame gases from these mixtures the differences in the quartz-covered wire temperatures also tended to become less as the mixture strength was increased. Thus, for mixtures containing 21 per cent hydrogen, the moist mixture temperature was about 50° C. higher than the dry mixture temperature, but for mixtures containing 24 per cent hydrogen it was rather less than 40° C. higher. Further experiment has shown that with still stronger mixtures the difference between the moist and dry mixture temperatures steadily decreases; for mixtures containing 26 per cent hydrogen the difference was only about 20° C.

It should perhaps be added that a burner of special design was employed in these experiments, and that the combustible gas – air mixtures fed to it were previously carefully mixed in a large tank.

Engineering Department, University, Leeds.
W. T. DAVID.
J. MANN.
March 10.

[1] David and Pugh, NATURE, **140**, 1098 (1937).
[2] David and Mann, NATURE, **150**, 521 (1942).

Formation of Porphyrin by Autolysing Yeast and by Yeast Press Juice

PRIOR to the outbreak of war, I was investigating the synthesis of porphyrins by yeasts, hoping to discover some clue as to the nature of the chemical reactions whereby hæmoglobin is elaborated by the animal organism. The main research had necessarily to be postponed, but I venture to think that certain observations made at the time may be worth recording.

It was found that some, but not all, yeasts, when allowed to autolyse at 48° in the presence of 1 per cent of toluene, showed an increase in coproporphyrin. That the precursor of this porphyrin was neither hæmatin, protoporphyrin nor uroporphyrin was demonstrated by the failure of additions of such materials to increase still further the 'extra' coproporphyrin found during autolysis. The same results were obtained when using zymin in place of fresh yeast, although quantitatively the increase on autolysis was smaller. Stale yeast (twelve days old) formed no extra coproporphyrin on autolysis, suggesting that possibly the amount of precursor or essential raw material for the synthesis is limited. This was borne out by the observation that even with a fresh yeast there is little further porphyrin production after the first thirty-six hours of autolysis.

A concentrate was then prepared from a fresh bakers' yeast, shown to about double its porphyrin content during autolysis, by boiling for ten minutes in water at *p*H 4·7, filtering and evaporating to the consistency of thick syrup. When such a concentrate was added to an active autolysing yeast, a large extra increase of coproporphyrin occurred.

Yeast press juice was then employed in place of autolysing yeast cells, and all the main results outlined above were reproduced, namely, some specimens of press juice did, and others did not, produce extra coproporphyrin, when incubated alone at 48° in presence of toluene. Addition of the yeast concentrate led in all cases, however, to considerable fresh porphyrin production. No significant increase occurred as the result of addition of either hæmatin, protoporphyrin or uroporphyrin. The table summarizes the results of the investigation.

Production of porphyrin by autolysing yeast and yeast preparations. All experiments carried out at 48° in presence of 1% of toluene. Coproporphyrin determined by acetic acid-ether extraction and comparison of absorption in acid solution with that of standard coproporphyrin.

Type of yeast or yeast preparation	Conditions of experiment	Duration	Result
'Stag' brewery yeast, 12 days old....	Autolysis in water	6 hr. 3 days	No increase in porphyrin ,, ,, ,, ,,
Dried yeast (Lister Institute) no longer capable of fermenting	Autolysis in water	115 hr.	No increase in porphyrin.
,, ,, ,, ,,	Autoclaved ½ hr. at 10 lb. prior to autolysis	36 hr.	,, ,, ,, ,,
	Autolysis with added concentrate	72 hr.	,, ,, ,, ,,
Distillery yeast, poor in cytochrome, 1 week old	Autolysis in water	6 hr.	Doubtful increase in coproporphyrin
As above, but fresh	Plasmolysed by NaCl, then autolysed	72 hr.	Approx. 75% increase in coproporphyrin
As above, rich in cytochrome, fresh	,, ,, ,, ,,	72 hr.	Approx. 70% increase in coproporphyrin
Zymin, active in fermentation	Autolysis in water	36 hr.	47% increase in porphyrin
,, ,, ,, ,, ...	,, ,, ,, ...	115 hr.	53% ,, ,, ,,
,, ,, ,, ,, ...	,, + 1·4 mgm. Hæmatin	84 hr.	Possible "slight" (23%) extra coproporphyrin production
,, ,, ,, ,, ...	,, + 0·36 mgm. Protoporphyrin	,,	± Increase (12%) in coproporphyrin production. Only 35 μ gm. protoporphyrin recovered
Baker's yeast, fresh	Autolysis in water	24 hr.	Approx. 100% increase in coproporphyrin
Concentrate prepared from above	Incubation in water soln.	60 hr.	No increase in porphyrin
Press juice from fresh brewery yeast	Incubation alone	36 hr.	Approx. 100% increase in coproporphyrin
,, ,, ,, ,, ...	,, + 0·54 mgm. Hæmatin	,,	No extra increase in coproporphyrin
,, ,, ,, ,, ...	,, + 0·36 mgm. Protoporphyrin	,,	Slight ,, ,, ,, ,, ,,
,, ,, ,, ,, ...	,, + 1·46 mgm. Uroporphyrin	,,	No ,, ,, ,, ,, ,,
,, ,, ,, ,, ...	,, + 0·25 mgm. Coproporphyrin	,,	Complete recovery
,, ,, ,, ,, ...	,, + concentrate (≡ 50 gm. yeast)	,,	700% increase in coproporphyrin
Bakers' yeast	Autolysis in water	60 hr.	No increase in coproporphyrin
Concentrate prepared from above	Incubated alone	,,	No significant increase in coproporphyrin (control 14 μ gm., test 20 μ gm.)
,, ,, ,, ,, ...	,, + concentrate (≡ 100 gm. yeast)	,,	500% increase in coproporphyrin

The nature of the thermostable porphyrin precursor or raw material for porphyrin synthesis in the concentrate was not determined. The chemical reactions involved can apparently take place in a cell-free medium, which renders control much easier from a quantitative point of view, and by choosing suitable yeast for pressing, followed by a fractionation technique, the production of a stable active material which can be stored and used as required seems not impossible. Given these conditions, examination of the enzymic or chemical system responsible should aid materially our knowledge of the chemistry of pigment production.

C. RIMINGTON.

National Institute for Medical Research,
Hampstead, London, N.W.3.
March 15.

Polygenes and Oligogenes

IN a recent communication[1], I suggested that we can consider embryonic development in terms of two types of process; on one hand, processes which 'switch' the developing tissues into some one of a number of alternative paths, and on the other hand, the 'buffering' processes by which those paths are defined. Mather[2] afterwards attempted to develop this idea by identifying the genes which act in a buffering manner with his so-called 'polygenes' and the genes acting by switch mechanisms with 'oligogenes'—a new word which he coined to include the genes with comparatively large effects normally studied in genetic laboratories. I wish to show that this identification cannot be sustained and has only been suggested by extremely confused thinking.

In the first place, the concept of alternative paths of development has been applied to (in fact arose from) early embryonic changes, such as the determination of neural tissue at gastrulation. The genes which affect the differentiation of the neural plate into the neural tube would be acting as buffers in my sense, and they could not possibly be thought of as falling within Mather's definition of polygenes, since their effects on the adult would be profound and striking. Thus genes with large effects may nevertheless act in a buffering manner. Again, genes with small individual effects may act together to constitute a switch. This seems to be the case with the sex differential genes in many forms. Another example is provided by the genes *dachsous*, *four-jointed* and *combgap* in Drosophila; each has only a very small effect on the eye, but when all are present they combine to switch development of the eye-disk into a path of development which produced an antenna.[3]

Similar examples could be multiplied. What remains true in Mather's thesis is the obvious fact that genes which produce very minor changes in a character must be acting as rather ineffectual buffering agents on the last phases of its development. Such genes have been a commonplace of genetic thought since they were first considered by Nilsson-Ehrle in 1908. They have usually been known as 'multiple genes' or 'polymeric genes', but such phrases, like Mather's more recent name 'polygenes', actually imply a fallacy—the fallacy, namely, of making a one-one correlation between the gene and one of its effects. It is the same fallacy as is involved in speaking of the 'white eye' gene in Drosophila, when it is well known that the same gene also affects the colour of the testis-sheath, the fertility, the life-span, and other characters. Such a method of speaking is so convenient that its dangers can usually be accepted with advantage. Mather, however, seems to have fallen into the trap of thinking that polygenes, defined from "the polygenic nature of the variation which they determine", are genes of a special nature, which can be contrasted with other genes of a different nature, the so-called 'oligogenes'. Actually, one and the same gene can be a 'polygene' in respect of one of its effects and an 'oligogene' in respect of another; for example, to go no further than the example given above, the white gene in Drosophila would be a polygene if we were interested in its effects on life-span or fertility, an oligogene if we studied eye-colour. There is a true distinction between polygenic variation (determined by numerous genes) and oligogenic variation (determined by few genes); but this is certainly not a distinction between the kinds of genes involved, and need not correspond to a distinction between the modes of action of the genes during development. There may also be a valid classification of genes into 'active' and inactive ones (corresponding to the active and inert sections of the chromosome). This distinction is still almost entirely a theoretical one, relating, as it does, to the primary gene activities which remain obscure. But even if the possibility of such a distinction is accepted, it is clearly incorrect, as is shown by the example of "white eye colour" mentioned above, to identify the inactive genes with those determining polygenic variation.

With these considerations in mind, it might seem advisable, while retaining the useful adjective 'polygenic', to dispense with the substantive 'polygene', or at least always to use it with suitable qualifications; for example, in a phrase such as "the gene A acts as a polygene with respect to the character X".

C. H. WADDINGTON.

1 Willow Road, London, N.W.3.

[1] Waddington, C. H., NATURE, **150**, 563 (1942); see also "Organisers and Genes" (Cambridge, 1940).
[2] Mather, K., NATURE, **151**, 68 (1943).
[3] Waddington, C. H., *J. Gen.* (in the Press).

Laboratory Synthesis of Diamond

THE letter by Mr. Bannister and Mrs. Lonsdale in NATURE of March 20, p. 334, records very interesting results. Whether Hannay did in fact succeed in producing diamonds must in the last resort be decided by the success or otherwise with which his experiments can be repeated. I have reason to believe that he presented a further paper on this subject to the Royal Society about 1894, which was not published by them, but the archives are not accessible at the moment and it is impossible to carry the question further.

Coming to the experiments of Sir Charles Parsons, I wish to put it on record that at the end of his life he did not believe that the hard crystals he had obtained at an earlier time were really diamonds: the reason being that they would not burn in oxygen. I make this statement on the strength of repeated conversations with him on the subject.

Terling Place, Chelmsford. RAYLEIGH.

Exotic Woodlice in the British Isles

I HAVE recently received from a greenhouse near York a small (2 mm. long) white woodlouse, which I identify as *Trichorina thermophila* (Dollfus)[1], a Central American species. This, or an allied species, has previously been reported from glasshouses at Kew, Newcastle-on-Tyne, Winlaton Mill[2], Glasgow[3] and Belfast[4]. Kraepelin[5] reports the occurrence of this species at Hamburg, which had been imported with orchids from Nicaragua.

Among other species introduced into Great Britain are *Trichoniscus linearis* (Kew Gardens), *Nagara nana* (Belfast), *N. cristata* (Wylam-on-Tyne), *Angara lenta* (Chester), and *Cubaris* sp. (from Mombasa, British East Africa), one dead specimen, with bulbs.

In connexion with studies on the dispersal of woodlice, I should be glad to learn of other occurrences.

141 Fulford Road, York. WALTER E. COLLINGE.

[1] *Feuil. Jeun. Nat.*, 90–94, Figs. 1, 2 (1896).
[2] *Derwent Trans.*, 1–22, 14 figs. (1913).
[3] *Derwent Trans.*, 9 (1913).
[4] *Irish Nat.*, **20**, 155 (1911).
[5] *Mitt. Naturhist. Mus. Hamburg*, **18**, 204 (1901).

INFLUENCE OF A PROLONGED PARTIAL DEFICIENCY OF VITAMIN C ON THE RECOVERY OF GUINEA PIGS FROM INJURY TO BONES AND MUSCLES

By Dr. E. KODICEK

Nutritional Laboratory, University of Cambridge and Medical Research Council,

and

Dr. P. D. F. MURRAY

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ISRAEL and Fränkel[1] and Schilowzew[2] have claimed that a deficiency of vitamin C in guinea pigs causes reopening of healed fractures, but Roegholt[3] and Hertz[4] could not confirm this finding. The former authors used diets which were probably deficient in vitamin D as well as in vitamin C, whereas Roegholt and Hertz supplied vitamin D. In view of these conflicting results we have studied the effect of a combined deficiency. Preliminary results had shown no indication of reopening of the callus on diets poor in vitamin C but containing ample vitamin D. In the present study we fractured the fibulæ of guinea pigs of about 300 gm. weight while they were on diets containing 1 mgm. of ascorbic acid daily, an amount of the vitamin which maintains normal growth in animals of this weight. Fourteen days later when, as shown by preliminary experiments, the callus had been formed, the animals were transferred to diets partially deficient in vitamin C. To investigate the influence of vitamin D, two groups of guinea pigs were given a diet almost devoid of vitamin D, as described below. We may say at once that no reopening of healed fractures could be observed, but we found other results which we wish to report shortly in this communication.

Experimental. Forty young guinea pigs were divided into four groups the diets of which were briefly as follows :

Group 1 (seven guinea pigs) : *positive control, complete basal diet* (oatmeal, bran, dried yeast, and salt mixture) with daily 6 drops of 'Radiostoleum' (vitamins A and D) and 10 mgm. of ascorbic acid.

Group 2 (twelve guinea pigs) : *almost totally deficient in vitamin D* (diet as Group 1, but instead of 'Radiostoleum', 8 gm. of carrots were given weekly).

Group 3 (four guinea pigs) : *partially deficient in vitamin C* (diet as Group 1, but with only 0·5–1·0 mgm. of ascorbic acid daily).

Group 4 (sixteen guinea pigs) : *partially deficient in vitamin C and almost devoid of vitamin D* (diet as Group 3, but with carrots instead of 'Radiostoleum'). Animals of this group received daily in their carrots almost 0·03 mgm. more vitamin C than was received by Group 3, a difference which could scarcely be significant.

Animals of Groups 2 and 4 went on to the vitamin D-deficient diet on day 1 of the experiment ; the deficiency was then continued until the end of the experiment. Animals in Groups 3 and 4 received 1 mgm. of ascorbic acid daily from days 1 to 26, and then 0·5 mgm. for the next three weeks ; thereafter, their requirements having increased, they were given 1 mgm. daily and in a few cases the amount was increased for periods of one or two days if the animal began to lose weight rapidly. Most of the animals were killed after three months, but some after two and a half months.

On day 12 of the experiment, under ether anæsthesia, without incision, and using forceps resembling those described by Hertz[4], we attempted to fracture one fibula of each animal. This was not always successfully accomplished, as X-ray photographs showed, but the occurrence or not of a definite fracture did not appear to influence the changes described below. The X-ray photographs showed that in many cases some damage was inflicted on the tibia as well as on the fibula.

Results. X-ray photographs showed no signs of reopening of the callus in any group. Groups 1 and 2 appeared completely normal and Groups 3 and 4 showed no signs of rickets that could be detected macroscopically or with X-rays. Animals in Groups 3 and 4, that is, those low in vitamin C, displayed conditions which seemed to us of particular interest.

Fig. 1. Left : Hyperostotic left tibia and fibula of a guinea pig of Group 4. Right : The normal right tibia and fibula of the same guinea pig.

(1) A hyperostosis of the tibia and fibula (Fig. 1) occurred in three of the four in Group 3, and in a smaller proportion of cases in Group 4. Hyperostosis was frequently, though not always, associated with the changes in the muscles and the stiffness of the knee joint to be described below. Transverse sections (Fig. 2) showed that the original bone had suffered much porosis. It was surrounded by a great mass of trabeculæ of poorly developed new bone, which occupied a wide area beneath the periosteum. Resorption of the old bone and deposition of new periosteal bone were proceeding simultaneously. The occurrence of hyperostosis in the tibia as well as in the fibula probably reflects injury to both these bones by the fracture forceps. Mouriquand and colleagues[5,6] described periosteal thickening in uninjured guinea pigs suffering from a chronic deficiency in vitamin C ; in our experience there is a definite association with injury, but in an uncompleted experiment we have at least one case of hyperostosis in a limb not injured more seriously than is unavoidable by handling in taking X-ray photographs.

(2) In a number of animals of both Groups 3 and 4 the muscles of the hind legs were greatly swollen, of tougher consistency than usual, while individual muscles could only be separated with great difficulty and felt slippery to the touch. Sections showed an abnormally large amount of a very loose connective

tissue within the muscles and between them ; obvious changes in the muscle fibres themselves seem uncommon. In many of these cases there are hæmorrhages in the muscles. Muscles of other parts of the body always seemed normal, except for some hæmorrhages. In at least one case the muscles were

Fig. 2. TRANSVERSE SECTION OF THE HYPEROSTOTIC TIBIA (RIGHT) AND FIBULA (LEFT) OF A GUINEA PIG OF GROUP 4. THE OLD BONY CYLINDERS SHOW A HIGH DEGREE OF POROSIS BUT ARE SURROUNDED BY A WIDE ZONE FILLED WITH RADIATING TRABECULÆ OF NEW BONE.

affected in the manner described on the unoperated as well as on the operated side.

(3) The hind legs of all animals in Group 3 and of a few of those in Group 4 were found to be fixed in flexion, and could not be fully extended, and attempts to extend them evidently caused pain. This condition was first noticed during the third month, but in experiments now in progress it has had an earlier onset. In some cases it was present in the uninjured as well as in the injured leg, and this is confirmed in the new experiments. It may possibly be due to the condition in the muscles described above, but more probably to ankylotic changes in the knee joint, such as have been described by Mouriquand[5,6] in chronic vitamin C deficiency.

Comments. The intimate pathology of these findings will be dealt with in a later publication. It is certain that all three of the conditions described occurred only with prolonged partial deficiency in vitamin C and irrespectively of whether the animals were supplied with vitamin D or not. We think it probable that the periosteal thickening is associated with the separation of the periosteum from the bone surface, and that this was in part caused by the weakening of the collagen fibres attaching it to the bone and in part to the subperiosteal hæmorrhages which, as is well known, occur in vitamin C deficiency.

The immediate interest of the observations lies in the occurrence of pathological changes during mild deficiency of vitamin C which began in the later stages of recovery from an injury, but which was not sufficient to cause death or severe external signs of scurvy, other than retarded growth. Although, apart from retarded growth, the animals appeared normal, there were nevertheless severe changes in muscle and bone which had been exposed to injury as described above. It may be noted that, in the latter part of the experiment, owing to their increased weight, the animals were given 1 mgm. of ascorbic acid daily, and that this was not sufficient to prevent the changes described.

Assuming that similar causes may produce similar effects in man, the results emphasize the desirability for a liberal supply of vitamin C to patients recovering from injury to bones and muscles. The observations made by Ellis[7] of periosteal thickening in both ulnæ of an infant which he considers to have been deficient in vitamin C suggest that this assumption may be well founded.

Further experiments are in progress.

Summary. (1) The effect of a partial deficiency of vitamin C on the healing of injuries to bones and muscles in guinea pigs was studied. No apparent clinical sign of an impaired nutrition was evident other than retarded growth. No reopening of healed fractures was observed.

(2) Many of the guinea pigs recovering from injury to bone and muscle on diets partially deficient in vitamin C (or partially deficient in vitamin C and almost wholly deficient in vitamin D) showed the following conditions : (*a*) a very marked overgrowth of sub-periosteal bone of a histologically inferior type, while the original bony cylinder showed a typical scorbutic porosis ; (*b*) a swelling of the leg muscles involving an overgrowth of the inter- and intramuscular connective tissues ; (*c*) an immobilization, possibly ankylotic, of the associated knee joint.

Attention is directed to the possible clinical significance of these findings in the treatment of injuries to bone and muscle in man.

[1] Israel, A., and Fränkel, R., *Klin. Wschr.*, 95 (1926).
[2] Schilowzew, S. F., *Dtsch. Z. Chir.*, **209**, 320 (1928).
[3] Roegholt, M. N., *Arch. klin. Chir.*, **168**, 783 (1931–32).
[4] Hertz, J., "Studies of the healing of fractures with special reference to the vitamin content of the diet", Oxford University Press (1936).
[5] Mouriquand, G., Tête, Wenger, Viennois, *C.R. Acad. Sci.*, **204**, 921 (1937).
[6] Mouriquand, G., Dauvergne, Tête, Edel, *C.R. Acad. Sci.*, **210**, 515 (1940).
[7] Ellis, R. W. B., *Proc. Roy. Soc. Med.*, **32**, 139 (1938–39).

AGRICULTURAL RESEARCH IN GREAT BRITAIN

THE Agricultural Research Council, which is the body responsible for the co-ordination of agricultural research in Great Britain, has issued a report* on the investigations now in progress.

The first part of the report deals with the organization of agricultural research, describing the role of the responsible authorities, namely, the Ministry of Agriculture and Fisheries, the Department of Agriculture for Scotland, the Agricultural Research Council, and the newly formed Agricultural Improvement Councils, one for England and the other for Scotland. The Improvement Councils have been created to advise the Minister of Agriculture on problems needing research, and on the testing of promising results with the view of their introduction into farming practice. It may not be easy, at this stage, for an observer to understand the necessity for creating an additional body to deal with agricultural research

* Agricultural Research in Great Britain. Pp. 100. (London: H.M. Stationery Office, 1943.)

in Great Britain, and why the functions of the Improvement Councils could not be carried out by the Agricultural Research Council and the Technical Development Committee of the Ministry. The report, however, indicates the useful work already performed by the Improvement Councils, and considers that they will play a very useful part in aiding research and putting results into practice.

The report also deals with the institutions and organizations carrying out research, such as the research institutes, some of which are under the direct control of the Ministry of Agriculture, and others of the Agricultural Research Council; the university and advisory departments also play an important part in agricultural research, and their roles are described.

The summary of investigations has been classified on a subject basis; the work of a particular institute may thus appear in more than one section of the report. This does not, however, detract from the usefulness of the report or its convenience, because many institutes have been formed to carry out research on a particular crop or subject. As is to be expected, the work in progress has been greatly influenced by war needs, much fundamental long-term work having been suspended in order to secure information necessary for the immediate food production campaign. The Chemistry Department at Rothamsted, for example, now devotes much attention to the estimation of national fertilizer requirements and to the development of efficient methods for allocating fertilizers at varying levels of imports and supplies. Experiments are also in progress there to test new sources of phosphates, town refuse as manure, the value of salt as a substitute for potash, etc. An example of large-scale war-time work is provided by the work of the advisory departments in carrying out the large number of soil tests for lime and phosphate in order to ensure that these important fertilizers reach the soils most in need of them; in 1942 more than 113,000 tests were carried out. These tests aid research because of the value of their results in the mapping of soils. As a contrast to the types of investigation mentioned above may be quoted problems of a more limited nature such as the investigation of the control of weeds in onion crops by chemical methods, in order to reduce the heavy labour involved in the hand weeding of the crop.

There are many investigations described in the report which, though they are of a long-term nature, will yield results of value in the present food production campaign. The grassland investigations in progress at the Welsh Plant Breeding Station, Aberystwyth, and at the Grassland Improvement Station, Dodwell, will result in the gaining of knowledge and experience, which will help to establish sound systems of ley farming under various soil conditions after the War. These investigations, however, have already yielded results which assist ley farming, with its system of restorative crops; this helps in the all-important problem of keeping the land fertile and clean under war-time cropping.

The importance of milk in the national diet of to-day adds interest to the investigations in progress on the yield, nutritive value and keeping qualities of this product. These are carried out at the National Institute for Research in Dairying at Reading, the Hannah Research Institute, Ayr, and at the provincial advisory centres. The effects of certain diseases, such as mastitis, on milk are also being studied. The investigation on mastitis in relation to dairying forms part of a larger programme of research planned and co-ordinated by the Agricultural Research Council, a section of which is undertaken at the Council's field station at Compton. Investigations on other diseases of dairy cows, forming part of the programmes of work at various animal health research centres, also have an important bearing on the milk situation.

Mention should be made of the co-operation between the Agricultural Research Council, the Department of Scientific and Industrial Research and the Medical Research Council. The three organizations have been created to promote and co-ordinate scientific research on all problems affecting the life and activity of the nation as a whole. It can be readily understood that the relations between these organizations should be very close, since agriculture touches the processing and storage of agricultural products on one hand and medicine or public health on the other. The report illustrates the close relations existing between these three bodies, and summarizes some of the problems that are under investigation by the last two, and that are at the same time of interest to the Agricultural Research Council.

The extensive field of research work covered by the various organizations has been dealt with in an effective manner, and the classification is clear. The only defect is that referred to in the report itself, namely, that there is little indication as to the relative weight of the attacks on each of the problems listed. As explained in the report, this is difficult, if not impossible, to accomplish in view of war-time conditions regarding shortage of staff, etc.

AMERICAN INSTITUTE OF PHYSICS

A SURVEY of the first ten years of the work of the American Institute of Physics has been presented in a ten-page "Report to Physicists" (*Rev. Sci. Inst.*, **13**, 471; 1942). The tendency with the growth of physics is for different groups to 'split up' and form a large number of separate societies. The American Institute was planned rather to promote co-operation. A joint committee representing the American Physical, Optical, Acoustical and Rheological Societies recommended that an American Institute of Physics should be founded "to provide a medium to combine their strength for common objectives, to study the publication problem, to obtain financial support and to halt the dispersive trend of physics". The Institute was formally founded in 1931.

A penetrating analysis of the cost of publication of scientific journals led to a proposal to combine current journals into a single large journal of physics with specialist subdivisions. Practically, however, this left out of account the established tradition and names of the journals, and disregarded the 'society' pride and sense of responsibility with which they were endowed. The proposed change was too drastic to entrust to a new untested organization. As a compromise, the separate journals were brought into a single routine of publication without any change of sponsorship. Unlike the Institute of Physics in Great Britain, it has no individual members and collects no subscriptions in the usual sense. It is a non-profit, educational corporation, the only members of which are the five founder societies, each as

an entity. The American Association of Physics Teachers forms the fifth member. The Publications Department issues eight periodicals, the *Physical Review*, *Reviews of Modern Physics*, *Journal of the Optical Society of America*, *Journal of the Acoustical Society of America*, *American Journal of Physics* (formerly the *American Physics Teacher*), *Review of Scientific Instruments*, *Journal of Applied Physics* (formerly *Physics*) and the *Journal of Chemical Physics*. In 1941, 6,834 pages were published containing approximately 52 million type characters, each of which was checked three or more times by the Institute publication staff.

The Institute has succeeded in obtaining much-needed new funds for publishing and other services helpful to physicists. During the ten-year period from 1932 to 1941, about 350,000 dollars of 'new' income was obtained in addition to about 450,000 dollars collected by the Societies as members' subscriptions. Associates of the Institute pay each a subscription of 175 dollars per year. The associate membership in 1942 consisted of twenty-six well-known industrial organizations.

Attention is directed to the necessity of advertising physics. "Physics is a human activity and, like all others, depends upon the interest with which people in general regard it. In the long run, solid achievement is the best road to general recognition, but even achievement can be overlooked, taken for granted, forgotten through familiarity, or credited to the wrong agent. Unless physicists and their friends occasionally take positive steps to demonstrate and call attention to the advances and services of physics, public attention will readily be diverted to fields which are better displayed and more repeatedly praised." Several readable books about physics and its applications have been written and published at the instigation of the Institute as part of its education and publicity plan. A number of successful symposia have been arranged to present the capacities of physics to well-selected audiences. Noteworthy is the conference on biophysics held in Philadelphia in November 1937, which was attended by some eight hundred biologists, medical men, chemists and physicists, providing a valuable excursion into a borderline subject. This conference was expertly reported by the newspapers. The Institute sponsors such symposia to direct the attention of the public and its industrial and educational leaders to physics by showing its advances and their applications. With the world of business the Institute has established an advantageous connexion for physics and research in general through the National Association of Manufacturers. Encouragement has also been given to the Research Advisory Service extended by a number of banks in various cities to their customers. By these means, industrialists hear an advocacy of research from other industrialists and from bankers "often to be better persuaded than when they hear such a message from research men themselves !"

The War has brought many new problems in which the Institute has been able to act as an established central organization. As to the future, much attention has been given to the training and opportunities for service of the future physicist. The report forms an impressive account of ten years outstanding achievements in physics and in service to the community. The founders of the Institute were concerned with a growing tendency for physics to 'split up'. This same tendency unfortunately extends to many other human activities. The War is, however, already bringing into closer contact British and American physicists. Developments of transport are shortening time-distances so much that the end of the next ten years may well see a single international Institute of Physics, into which all the separate Institutes have merged as a section of a World Institute of Science. W. H. G.

FORTHCOMING EVENTS

(Meetings marked with an asterisk are open to the public)

Monday, April 5

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Miss Marjorie Sweeting: "Wave Trough Experiments on Beach Profiles".

Tuesday, April 6

CHADWICK PUBLIC LECTURE (at the Royal Sanitary Institute, 90 Buckingham Palace Road, London, S.W.1), at 2.30 p.m.—Mr. Thomas Sharp: "Town Planning and Public Health".*

ROYAL INSTITUTION (at 21 Albemarle Street, Piccadilly, London, W.1), at 3 p.m.—Sir Henry Dale, G.B.E., P.R.S.: "Chemistry in Modern Medicinal Treatment" (iv) "Present-day Developments".*

INSTITUTE OF PHYSICS (ELECTRONICS GROUP) (in the Royal Institution, 21 Albemarle Street, Piccadilly, London, W.1), at 6 p.m.—Dr. J. H. Fremlin: "Physics and the Static Characteristics of Hard Vacuum Valves".

Wednesday, April 7

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Major R. G. Proby: "Agriculture To-day and To-morrow", 8: "Methods and Results of Land Reclamation in England".

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Sir Edward Appleton, F.R.S.: "Radio Exploration of the Ionosphere".

Friday, April 9

PHYSICAL SOCIETY (in the Physics Department, Imperial College of Science, Imperial Institute Road, South Kensington, London, S.W.7), at 4.30 p.m.—Dr. C. R. Burch: "A Technologist Looks at the Future" (Duddell Medal Lecture).

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Annual General Meeting. Prof. S. Chapman, F.R.S.: "Magnetism in the Sun's Atmosphere" (Presidential Address).

ROYAL INSTITUTION (at 21 Albemarle Street, Piccadilly, London, W.1), at 5 p.m.—Air Commodore Geoffrey Keynes: "The History of Blood Transfusion".

Saturday, April 10

ASSOCIATION OF UNIVERSITY PROFESSORS AND LECTURERS OF THE ALLIED COUNTRIES IN GREAT BRITAIN (at the Royal Institution, 21 Albemarle Street, Piccadilly, London, W.1)—Educational Conference. At 10 a.m.—"The Function of a University in a Modern Community": at 2.30 p.m.—"Methods of Practical Co-operation between Allied Universities in the Future".

Saturday, April 10-Sunday, April 11

INSTITUTE OF PUBLIC ADMINISTRATION (JOINT MEETING WITH THE INSTITUTE OF INDUSTRIAL ADMINISTRATION AND THE METROPOLITAN AREA EDUCATION COMMITTEE OF THE NATIONAL ASSOCIATION OF LOCAL GOVERNMENT OFFICERS) (in the County Hall, Westminster, London, S.E.1).—Conference on "Post-entry Training for Administration—the Need for an Administrative Staff College".

Saturday, April 10

2.30 p.m.—Discussion to be opened by Mr. E. S. Byng.

Sunday, April 11

10.30 a.m.—Discussion to be opened by Prof. Harold J. Laski.

Thursday, April 8-Monday, April 12

BRITISH PSYCHOLOGICAL SOCIETY (at St. Hilda's College, Oxford).—Extended General Meeting.

APPOINTMENTS VACANT

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

HEAD OF THE BUILDING DEPARTMENT AND LECTURER IN CIVIL ENGINEERING—The Registrar, The Technical College, Sunderland (April 12).

GAS ENGINEER AND MANAGER—The Town Clerk, Town Clerk's Office, Municipal Buildings, Library Street, Wigan (April 14).

RESEARCH ASSISTANT—The Secretary, Animal Diseases Research Association, Moredun Institute, Gilmerton, Midlothian (April 26).

PSYCHOLOGIST (WOMAN) at the Harrow Child Guidance Clinic—The Clerk to the County Council, "R.2", Middlesex Guildhall, Westminster, London, S.W.1.

SCIENCE GRADUATE, capable of abstracting foreign articles on technical horticulture into correct English—The Deputy Director, Imperial Bureau of Horticulture and Plantation Crops, East Malling Research Station, Maidstone, Kent.

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