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CONTENTS

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RELIEF AND REHABILITATION IN EUROPE

A MAJOR problem now before the United Nations is the provision of food, clothing, medical supplies and other necessities of life in the newly liberated countries of Europe, so that they may be able to carry on until long-range plans for rehabilitation begin to take effect. The debate in the House of Commons on March 28 on supplies for Europe fairly reflected the growing concern which has been, and still is, felt in Great Britain. The seriousness of this question of relief and rehabilitation as a reconstruction measure has repeatedly been emphasized, in such books as Mr. Bryant's "Unfinished Victory" even five years ago, in Colonel Bonsal's recently published diary of the peace conference following the War of 1914–18 entitled "Unfinished Business", and in such scientific studies as those of the Royal Institute of International Affairs on "Medical Relief in Europe" and "Relief and Reconstruction in Europe : the First Steps". The picture of Berlin and the mind of Germany as they impressed Colonel Bonsal in the early part of 1920 are full of significance in regard to the probable position of Europe in the months immediately ahead.

The speech of Earl Winterton in opening the debate in the House of Commons shows clearly, however, that scientific workers have a special responsibility in this field to enable effective action to be taken. It is not disputed that the economic condition of the Western countries in Europe which have been subjected to the German occupation is serious. Nor can it be disputed that the position means much present human suffering and future political danger. It is clear also that a great responsibility rests upon Great Britain and the United States in the matter, since we command practically all external air and sea transport and, for military reasons, most of the internal transport. The figures quoted by Lord Winterton were not disputed by the Lord President of the Council in his reply, though Mr. Attlee insisted that there has been no discrimination against France, as Lord Winterton implied, and that France has shared in the general pool of shipping. Broadly, we are trying to get supplies from where they are to where they are needed, and at the same time to ensure the greatest economy in shipping, haulage and port facilities.

Mr. Attlee's sober statement was somewhat reassuring, and in particular his announcement that the Ministry of Food was releasing to the liberated areas, which includes some of the Mediterranean areas as well, 900,000 tons of food from British stocks, and that the Ministers of Production and Food had gone to the United States at the invitation of the President to discuss the special food problems of the liberated areas. Mr. Attlee's speech, furthermore, put the proposals with regard to 'food parcels' in their proper context, and his emphasis on the position of Britain as a food-importing country was phrased so as to avoid alike any possibility of international misunderstanding or recrimination, or doubt

as to the Government's realization that it is vital to get as good conditions as we possibly can in the liberated areas, as soon as we can. That, he agreed, is as essential for winning the victory of freedom and democracy as destroying the enemy in the field.

Mr. Attlee's statement should also help to make the position of the United Nations Relief and Rehabilitation Administration in this matter clearer; in this he was supported by Sir Arthur Salter, who pointed out that the activities of the Administration have always been subject to military considerations. Lord Winterton's fourth contention, however, was that the question for decision was whether we and the United States had taken sufficient remedial measures, having regard not merely to the supreme military needs of the moment but also to the fact that hungry people are not discriminating, and that France, Belgium and Holland are democratic countries *par excellence*. If the ordinary people there think that Britain and the United States have mishandled the food situation for military reasons, the war of liberation will cease to be as popular as it should and the liberating powers will not receive the gratitude they deserve.

This point was really met by Sir Edward Grigg in winding up the debate, when he said that in considering measures of military relief, the agreed policy of the United Nations is, and must be, to encourage the liberated peoples to assume responsibility for their own affairs as soon as possible. That is a definite instruction to all civil affairs officers who go into liberated territories. This assurance is welcome, as any other policy would involve the responsibility for future misery in Europe being saddled on Britain instead of firmly and primarily on Germany and the Axis Powers, and secondly on the local authorities responsible for local shortcomings.

Sir Edward Grigg's speech, while claiming that the military authorities, within their limited functions in the matter, have done and will continue to do their utmost to prevent disease and unrest in the immediate wake of the armies, never concealed that we are faced with a problem the gravity of which it is impossible to over-estimate, and neither his speech nor the trend of the debate as a whole left any room for complacency. A sense of urgency permeated the debate, and the suggestion advanced by Sir Arthur Salter that we should establish without delay an authority such as a supreme reconstruction council, comparable with the Supreme Economic Council established in 1919, was welcomed by one speaker after another before Sir Edward Grigg promised that the Government would take note of the matter.

Sir Arthur Salter's suggestion was for an authority which would co-ordinate for the principal victorious powers all their policy and efforts in assisting the reconstruction of Europe. He does not regard it as work for the Social and Economic Council of the Dumbarton Oaks proposals, or any organization set up as a result of the San Francisco Conference. He believes it is essentially a part of the peace settlement itself and should be established quickly; if we thus supplement our present system, we have good hope of meeting the greatest challenge to the constructive effort of men that has ever been witnessed in the history of the world; but without it our present system will be completely inadequate.

There was, in fact, not only a large measure of agreement on this proposal running through the debate, but also on other aspects of the situation, and the debate should have done something to educate public opinion still further as to the urgency of the situation, and to bring people to realize how serious is the problem and how grave is the prospect for European civilization if we do not take the right action now. The enlightenment of public opinion is an indispensable condition of success, in Great Britain as in other countries, for only so can we be sure that adequate support will be forthcoming for the measures demanded, and that the personal sacrifices involved in the continuance of rationing and other necessary controls will be cheerfully accepted. Above all, it is only the force of public opinion which can deal effectively with 'black marketing' and other disorders which endanger morale. Mere organization, however superlative, will never win the peace and establish a world order out of the chaos into which it is now clear that the Nazis have been deliberately seeking to engulf the whole of Europe.

In that task of education, however, scientific workers have a special part to play, parallel to that which they played in regard to nutrition in Great Britain, and which, as Lord Woolton has justly said, did so much to secure the acceptance of a food policy which averted disaster. Dr. Haden Guest rightly pointed out that the United Nations Relief and Rehabilitation Administration has in fact done a great deal of valuable work in surveying world resources of food and materials and, if used as the Civil Service of a supreme economic authority, it could do more still. The chairman of the combined food organizations has said that with the co-operation of Governments, the overall needs of Europe in 1945 could be supplied, not indeed by moving rapidly to a full diet, but by providing a normal calorie programme of rations. Certain items such as meat and fats admittedly are likely to be scarce for five or ten years or more, and Mr. Attlee referred to the danger of world shortages in fats and milk products particularly.

What is required, however, is to translate into terms understood by everyone the meaning of the differences between the accepted standards of an adequate diet based on scientific investigation, such as the agreed minimum daily ration of 2,800 calories, and those actually received in France, Italy, Holland or elsewhere, and the cumulative effect of the policy of starvation or semi-starvation deliberately imposed for four or even five years by Germany on the peoples of occupied Europe. The physical, mental and psychological consequences—the lowering not merely of physical vitality but also of powers of moderation and judgment through loss of vitamins and malnutrition—are matters of scientific fact which men of science are well qualified to interpret to their fellow citizens;

and it is one of their first duties to show convincingly why and how this policy of relief and food and medical supplies is both a humanitarian issue and a matter of the fundamental interests of the United States and Britain. They of all men and women should not need the words of Lord Templewood to remind them that unless we make a swift and united effort, the Nazis, although broken in the military field, may win in the civil by the victory of destruction. It is not, however, the question of food supplies alone, though that is important. As Dr. Haden Guest and Mr. Greenwood reminded us, we have escaped epidemics so far, but the circumstances in which epidemics grow are being spread all over Europe at the present time. Prevention is very urgent indeed, and the displaced populations to which reference was freely made in the debate, whether refugees, prisoners of war or those forcibly deported, only accentuate the difficulties and dangers. Even in Great Britain we do not stand outside the range of large-scale epidemics if they start in Europe.

On this count also, Dr. Guest believes that some further inter-government staff organization is required. Besides this, however, there is the question of getting European agriculture and husbandry started again, as was emphasized by Mr. Greenwood and Sir James Grigg. Food and clothing are not the only necessities. Fertilizers, seeds and agricultural implements will also be required, apart altogether from the question of raw materials to get the factories of Europe started again, though industrial reconstruction is part also of this question of quickening European life. Even from the point of view of food supply, the reconstruction of European agriculture is an urgent task, the successful performance of which implies all the difference between chaos and the return of individuals and nations to peaceful life. How important is this task and how great are the difficulties are well shown in an article by Prof. K. Brandt of the Food Research Institute, Stanford University, California, in a recent number of *Foreign Affairs*, which states that while such reconstruction must be the responsibility of national governments, economic policy should be worked out by international agreement. The major part of the job, however, lies outside agriculture, and Prof. Brandt points out that the recovery of European agriculture depends on the prior recovery of industry in Great Britain and all the Continental countries, and on the volume of post-war international trade, and primarily on decisions taken by the United States, the world's leading industrial power and the greatest creditor among the nations.

Prof. Brandt's article deserves attention, for the urgent problem of relief cannot be separated entirely from the long-term problem of reconstruction. The relation was not always made clear in the House of Commons debate, except perhaps in so far as the fact that Great Britain is herself a food-importing country was rightly stressed. It is essential that such limitations should be as clearly understood as the implications of the continuance of undernourishment and starvation in Europe. It may well be that such a gesture as food parcels may be administratively impracticable or inefficient. It may even be that on the examination which Sir James Grigg promised, Mr. A. P. Herbert's proposal for the assembly and organization of small craft to take food and supplies to the Continent as they once brought back the British army may prove impracticable; though for psychological reasons neither gesture of sympathy, apart from its practical service, should be lightly dismissed. If such proposals are rejected, however, the reasons must be clearly and fully explained, for the widespread public concern to which the debate testified cannot be disregarded. Moreover, if it is important that scientific workers should continue their task of interpreting the findings of the science of nutrition in terms of an adequate diet and a reasonable food policy not only for Britain but also for other countries, and that their attention to agricultural research should be sustained by a high sense of social service, it is equally important that the full facts of the world situation should be fully understood by the general public.

The people of Britain must be brought to recognize the limitations as well as the possibilities of action by their Government alone or in co-operation with those of other countries. The same generous spirit which inspired the idea of food parcels will effectively support the Government in whatever action may be required, and accept with patience and fortitude not merely the continuance of our present ration-scales which, as Sir Edmund Grigg said, are not large, but also, now that the fighting itself has come to an end, whatever further controls may be required to implement the chosen policy. To avoid reaction against such controls and rationing, and the all-important effort of food production on allotments, for example, their purpose must be made plain to all. Their relation must be demonstrated to the larger tasks of defeating the deliberate attempt which Germany has made to render civilization and an ordered life impossible in Europe, and establishing a world order from which disease and want and squalor have been banished, so far as lies within man's power.

SIX DECADES OF AMERICAN BOTANY

John Merle Coulter

Missionary in Science. By Andrew Denny Rodgers, III. Pp. x+321+2 plates. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1944.) 25*s*. net.

THE history of botanical science in the United States is being duly surveyed and conserved. Already from the Princeton University Press there has come an account of the work of John Torrey; a volume on American botany from 1873 until 1892 is promised in the near future; now there is available a considerable work on John Merle Coulter. The method of presentation is biographical, but the work is really as much the history of a period as an account of the life and work of an individual. It is well that such studies should be undertaken before the essential

documentary materials are lost or begin the inevitable drift into obscurity.

John Merle Coulter (1851–1928), who was to become a leading figure in American botany, graduated from Hanover College, Indiana, in 1870 and almost immediately began the active life of teaching and research that was to extend well into the present century. It may be profitable to pause for a moment and consider broadly some of the more evident antecedent and contemporary developments in biology, and of botany in particular, in Europe. Hofmeister's "Higher Cryptogamia" and "Allgemeine Morphologie" and the studies of Naegeli, Von Mohl and their contemporaries were available to botanists interested in the life-history, anatomy and morphology of many classes of plants. Darwin's "Origin of Species" had been published, Huxley's incisive views on the relation of the new scientific developments to contemporary theological views were already well known, while Hooker had shown what could be made of the systematic and geographical study of the flora of regions hitherto untouched. The great and progressive German schools of botany were in the ascendant and yearly were attracting more and more of the younger British botanists who had failed to find the guidance and inspiration they had sought in their own universities.

And now to return to the American scene. The education given at Hanover College—a Presbyterian foundation—was essentially classical, and not until 1874 was the teaching of science nominally put on an equal footing. Coulter's introduction to botany was through the medium of excursions: it is perhaps scarcely surprising that his initial interest, which he retained throughout his life, was in taxonomy. On all sides, in a vast territory where the recent decline in Indian warfare was making scientific expeditions possible, there was immediate work to be done in collecting, naming and classifying plants and in relating them to their highly diverse environments. Thus in 1872 we find young Coulter and other members of the Yellowstone Geological Expedition forgathering in the Mormon town of Ogden. We are given a vivid picture of how their eyes opened wide as they walked through the town reading the signs above the Mormon stores: "Holiness to the Lord! Zion's Cooperative Mercantile Institution". Coulter set out on the expedition to assist in the geological survey; but, because of his spontaneous interest in plants and his zeal for collecting them, he returned with the official title of botanist. Thereafter, by steps that need not be described in detail, he became professor of natural science at Hanover, then at Wabash College, Indiana.

His essential contributions to botany in this initial phase were two-fold: first, like many of his contemporaries, he contributed to the production of regional floras, for example, his "Catalogue of Indiana Plants" (1881) produced in collaboration with his brother and Barnes; and secondly, he founded the *Botanical Gazette* in 1875. At that time he was probably a typical product of the prevailing Presbyterian background and, as the author informs us, to him "Science was the instrument of theology". Although a professed biologist, the theory of evolution was apparently not one which had stirred him deeply. But in 1879 and 1880, a new phase began. By attending the summer courses given at Harvard University under Prof. Asa Gray, the leading figure in American botany, and by coming into contact with such men as Farlow and Goodale, both of whom had studied in the great European laboratories, he began to realize something of the potential scope of his science. The new studies included morphology, anatomy and physiology. It was made clear to him that observation, the basic method of science, must be amplified by experimentation. At that time probably not more than half a dozen botanical laboratories in the United States had other than taxonomic facilities for study, a situation very like that obtaining in British universities. The publication of Bessey's "Botany" (1880), containing sections on anatomy and physiology, was a landmark: it apparently did for American botany what the publication of Sach's "Lehrbuch" in English (1775) did for British botany. At this point there occurs one of the most fascinating sketches in the book. It was probably typical of the beginnings of many New World institutions. It concerns the young botanist Bessey, who, three months after graduation at Michigan, found himself called to the chair of botany and horticulture at the new Agricultural College of Iowa. He found "A few 'slender sticks' for trees, one building for the College, an old farm house, and two homes for Professors, all in an open field, parts of which were later ploughed up to grow potatoes and corn". Inside the building there was no apparatus of any kind—not even a microscope. His first class of forty-three students was chiefly occupied with descriptive and systematic studies—for which purpose the class simply moved out on to the campus. In the winter of 1870–71 a compound microscope was purchased. This was placed on a table with some simple reagents and each student was allotted a period for microscopic study. On the door of the room was nailed a sheet of cardboard bearing the legend "Botanical Laboratory". No doubt the other professors jeered, but botany had come to stay.

Space does not permit of a citation of the gradual advance, diversification and deepening of American botany under such leaders as Gray, Farlow, Goodale, Bessey, Arthur and Coulter, or of the books which mark the successive stages. In many respects a remarkable parallel is afforded with comparable developments in teaching and research in British universities. Coulter himself stood for a science of the widest possibilities, and as editor of a journal of increasing influence was able to give his views a wide publicity. Indeed, his facility with the pen aided by the spoken word, and his keenness as a promoter or supporter of new movements, may not be his least title to pre-eminence.

From 1880 onwards Coulter's output of work was surprising both for its amount and the diversity of interest which it disclosed. Thus there were studies of floral development, of the stamen, the embryo-sac and the embryo, and of what may be described in general terms as physiological anatomy. By the year 1885 we may suppose that the teaching of botany in the United States was beginning to be more or less on an even footing with that in Europe, the works of De Bary, Strasburger, Sachs, Prantl and Vines being then in general use in American laboratories. The microtome was coming into general use and detailed studies of difficult materials correspondingly intensified. Cytology, gymnosperms and fossil materials began to receive increasing attention. Coulter was associated with many of these developments, both directly and through his editorial activities, but his over-riding interest was still taxonomic: in the survey of the vast territory of the United States there was still much ground to cover. Associated with this

work the studies of plant geography and ecology developed apace.

Coulter became president of Indiana University, then of Lake Forest College and finally in 1896 was elected to the chair of botany in the University of Chicago. The great days of American botany had arrived. A huge endowment, a matter of a million dollars, made possible the creation of the Hull Biological Laboratory. Here Coulter's administrative experience stood him in good stead, and he soon had organized a representative department and had recruited to his staff young men with particular aptitude for the several special branches. Of such, for example, was Chamberlain, whose skill as a technician did much to advance anatomical and morphological investigations.

At the turn of the century Coulter, in the midst of many other activities, was still deeply involved in taxonomic work. Thus, in collaboration with Rose, he published, in 1900, "A Synopsis of Mexican and Central American Umbelliferæ" and a "Monograph of North American Umbelliferæ". At this time he was also gathering laurels as a morphologist and, together with D. H. Campbell, was elected to the American Academy of Arts and Sciences in 1898. The early years of this century saw the publication, in collaboration with Chamberlain, of the books by which he is probably best known to botanical students in Great Britain, namely, those attractive books on the "Morphology of Spermatophytes: Gymnosperms" and "Morphology of Angiosperms". Together with his other papers and essays (on such themes as evolution, religion and science, etc.), his output of work was formidable. Coulter was truly, as his biographer remarks, "a prodigious worker and a lover of writing"—and it might be added of lecturing and public speaking. Indeed, it is not too much to say that he took a share, and a productive share, in all that was going on, and hence his work serves as an indication of the general trend of American botany. The developments of botanical science during the first three decades of the century cover more familiar ground and need not be considered in detail here.

There can be no doubt as to the interest and value of the work which Mr. Rodgers has undertaken and brought to fruition. On occasion, perhaps, one may entertain doubts regarding his sense of values—as, for example, when at various points he extols Coulter as the man of vision and prophet of the future of botany—but this may well be true if restricted to its American context. Again, the American reaction to the controversy between science and religion during the Darwinian and post-Darwinian period might, one feels, have been given more incisive treatment. There is also a question of the final evaluation of Coulter's contribution to science. Probably it is too soon to come to any decision. It may be that in spreading himself over so many aspects of his subject—and he left few untouched—he failed to make that major contribution which comes from concentration of effort and singleness of purpose; in other words, that he lost in depth what he gained in breadth. But it may also be that the best use of his talent was the one to which he actually put it, that is, for the general advancement of a new science in a new country.

Lastly, in these days of books produced "in conformity with authorised economy standards", it is a pleasure to handle a work so clearly printed and so handsomely bound.

C. W. WARDLAW.

SCIENTIFIC METHOD AND SOCIAL PROBLEMS

Race Relations and the Schools

A Survey of the Colour Question in some aspects of English Education, with a number of Proposals and Suggestions. Foreword by Dr. G. P. Gooch. (League of Coloured Peoples, 19 Old Queen Street, S.W.1.)

Social Differences in English Education

By T. H. Pear. (From the *British Journal of Educational Psychology*, 14, Part 3.) 7*s*. 6*d*.

IN his highly appreciative foreword to "Race Relations and the Schools", Dr. G. P. Gooch lays it down that "conduct as a rule is determined by tradition and sentiment, and it can only be changed by greater knowledge, wider imagination and deeper insight". He reminds us that "their traditional values and way of life are as real and precious to coloured peoples as are ours to us, and that we can be proud of our own civilization without exhibiting a complacent and justly resented superiority complex."

Convinced that the race problem in the British Empire needed careful reconsideration, a group of English representatives of education, whose names and positions command the utmost respect, resolved to undertake a survey of the relevant contents of text-books of geography and history commonly used in British schools, both elementary and secondary. The results were certainly revealing, and constitute little less than a broad black blot upon the educational schemes of such a nation as ours. The investigation revealed, in fact, that in our school text-books, the life and needs of the sixty-five million coloured peoples of the British Empire, excluding India, are almost entirely ignored. This will never do. The days of exploitation are happily a thing of the past, and the days of benevolent trusteeship are at hand. The critical eyes of other nations are turned upon a nation which in the course of history has succeeded in painting a large part of the map of the earth's surface red, and criticism must be met with a clear conscience. This comprehensive report, which includes an examination of school-books, suggested methods of dealing with the colour question, and a useful bibliography, points the way to desirable changes, not extensive but nevertheless significant, in school-books, in training courses for teachers, and in films designed for educational purposes. The report is informed throughout with the spirit of scientific method.

Still more obviously—and one may even say unrelentingly—does the spirit of scientific method pervade Prof. Pear's paper on "Social Differences in English Education". He points out that English social stratification occasionally interests historians and economists, but that a psychological approach to the subject is rare. Psychologists are "blameless for the innocence of psychology displayed by the framers of the Norwood Report, and of the White Paper on education". He quotes a writer in the *New Yorker* who says that "from the rash and impetuous American viewpoint the English educational system, to our innocent eyes, has always seemed caste-ridden and money-dominated". Yet, adds Prof. Pear, there has been a taboo upon considering psychologically (that is, scientifically) these aspects of the system. In breaking this taboo he is well

aware that he may be asked what are his qualifications for the necessary degree of scientific impartiality and aloofness, seeing that a man can no more get away from his own upbringing than he can get away from his own shadow. To meet this objection, he gives enough of his personal history to enable the reader to judge for himself.

At an early point in his inquiry, Prof. Pear states a curious fact which has probably escaped the attention of many serious students of psychology. No living English professional psychologist appears to have come from any of the great public schools, no matter how strictly or loosely you define 'great'. We have no account of his social psychology, "written by one who not only sympathises with but 'empathises' their special culture pattern". We lack also a corresponding description of his way of living by a proletarian psychologist. Until recently, "our English social psychology has been written by the middle class about the middle class". He says this fact is well known; it is no doubt well known to some people.

Prof. Pear concludes his fresh and interesting investigation by expressing his full agreement with Prof. D. W. Brogan's opinion, that "politically England is a democracy, perhaps the most mature democracy in the world. But democracy is not merely a matter of government—it is an attitude to life. And England will not be a full or anything like a full democracy as long as one of the kindliest and most united peoples in the world is internally divided in a fashion that impoverishes the national life".

Such is the verdict of one who has done his utmost to pursue scientific truth, wherever it may lead him.

T. RAYMONT.

NATURALISTIC PHILOSOPHY

(1) Verifiability of Value

By Ray Lepley. (Columbia Studies in Philosophy, No. 7.) Pp. xi+267. (New York: Columbia University Press; London: Oxford University Press, 1944.) 22*s*. net.

(2) Naturalism and the Human Spirit

Edited by Yervant H. Krikorian. (Columbia Studies in Philosophy, No. 8.) Pp. x+397. (New York: Columbia University Press; London: Oxford University Press, 1944.) 30*s*. net.

THESE two books are expositions of the naturalistic philosophy now popular in the United States and mainly derived from the teaching of John Dewey. The starting point is the view that scientific methods of investigation are valid for all spheres of thought and action. These Naturalists, however, do not use the arbitrary restrictive criteria of truth and verifiability of the Logical Positivists, and therefore their theory does not run counter to actual scientific practice as Positivism does. So far as the argument in Lepley's book is designed to show that judgments of value can be accommodated within the scientific scheme just as easily as judgments of fact and that they do constantly occur, it is evidently sound. Those essays in Krikorian's book which are straightforward inquiries into specific subjects are well done. Thus, Eliseo Vivas on "A Natural History of the Aesthetic Transaction", George Boas on "The History of Philosophy", Edward W. Strong on "The Materials of Historical Knowledge", the editor on "A Naturalistic View of Mind" and, especially, Ernest Nagel on "Logic Without Ontology" make valuable contributions to their subjects—so far as they go. These essays display the best aspect of Dewey's teaching; they are careful, fair-minded, undogmatic.

It is when they come to questions which are most genuinely philosophical, those concerned with underlying presuppositions, that writers of this school tend to shirk or fumble. Lepley, in the first volume, argues that judgments of fact and of value, descriptive and normative judgments, occur together inseparably connected and that both sorts are found equally within the sphere of science, as ordinarily understood, and the spheres of art and morals; that verification in science, though perhaps simpler and easier, is not radically different from verification in art or morals. All this may be granted. But he fails to observe that discussion on matters of art and morals constantly turns on questions of ends, as distinct from questions of means where the factual and causal element enters. In scientific discussion, ends are taken for granted and are not discussed, so that all ordinary judgments that are in any way valuational or normative are judgments of means only. Lepley does not consider whether a judgment about an end, say truth or justice, can be dealt with naturalistically: whether science can produce criteria to judge the value of its own method.

Similar defects appear in those essays in the second volume which should deal with such problems. In the one on "Naturalism and Democracy" by Sidney Hook, we are given to understand that the justification of democracy is that it is an experiment designed to realize certain moral ideals which is in fact successful; also that the moral ideals are hypotheses requiring empirical verification. Thus, if Hitler had won the War, the writer would presumably have decided that the democratic experiment had failed and the related hypotheses were false. Both Hook and Sterling P. Lamprecht, who writes on "Naturalism and Religion", consider that there is not enough empirical evidence to justify the hypothesis of theism, but the evidence is not examined; nor is there any attempt to discover those ends of thought and action of which religion is the expression. The writers appear to be following fashionable opinion instead of examining their presuppositions. Similar criticisms apply to other essays. This does not mean that their presuppositions are not in fact sensible and their positive statements also sensible. It only means that they have neglected their philosophical duty. Nothing is said to prevent Naturalism from sinking to intellectual indolence. Science is fashionable; so let us call our opinions on any subject scientific and then stop thinking.

The essay on the Naturalism of Frederick Woodbridge by Harry Todd Costello (containing a pleasing story about Bernard Shaw) is puzzling, as are the other references to Woodbridge, because no writer of recent years has so neatly and effectively displayed the defects of Naturalism ("An Essay on Nature", 1940, p. 265ff.). Three other essays should be mentioned. One, on "The Unnatural", a good piece of metaphysical argument, seems rather out of place among its companions. One, on "Naturalism and the Sociological Analysis of Knowledge", may be excellent but is written in a difficult dialect of jargonese. Finally, there is an essay by the octogenarian Dewey, who attacks the things he dislikes with a vigour that puts more youthful disciples to shame.

A. D. RITCHIE.

CO-OPERATION IN THE WAR AGAINST DISEASE

By SIR PHILIP MANSON-BAHR, C.M.G.

THE modern statesman is inclined to reject the terms of narrow nationalism, both in commerce and policy. He maintains his faith in the development, for the public good, of such co-operation and good-will which cannot be compatible with international mistrust and concealment. He is impelled to adopt this view, it is hoped, by the ideals of humanitarianism no less than by logic which implies search for efficiency. Yet it is self-evident that at present, without a radical change in method of government, which would go beyond political imagination, the control of geographical areas, or countries, must rest with the people of those areas. How far this control should be sovereign is a matter for debate ; but there is little doubt that, in the matter of transmissible disease, the safety of the whole world community ought to take precedence over the rights of any particular people. In this respect there is one subject into which political considerations do not intrude and that is the advisability of a united, co-ordinated policy in the war against disease. This stands for the communal good. It is therefore opportune to formulate some ideas how such a campaign may be conducted. The causes of the main tropical and subtropical diseases are now well known, their conveyance to man and their effective treatments accurately ascertained. A proviso should here be made that the diseases, so named, may also be important in temperate lands. To illustrate this point, reference may be made to certain of these diseases and to some of the reasons which compel international attention. In this article, certain problems will be briefly stated and certain lines indicated which appear indispensable to their solution.

Malaria is perhaps the commonest disease in the world ; it takes a heavy toll of infant life and causes more incapacity than most people realize. But it is not a static disease ; it may, from time to time, appear in epidemic form and as such spread over international boundaries. To understand this it is necessary to comprehend something of the modes of spread of this disease, which is a complex partnership between the parasite, the mosquito, and man.

The cause of malaria is, of course, the malaria parasite, of which four species are recognized in man ; they differ from each other in appearance and in their effects. The most dangerous is undoubtedly the malignant tertian parasite, which is particularly tropical in its distribution—though found as far north as Italy, Greece and Rumania—and which is the essential cause of the much-dreaded blackwater fever, a sequel which has cost the lives of so many Europeans in Africa and elsewhere.

The limited range of this parasite is explained by the ascertained fact that it requires a higher atmospheric mean temperature to complete its development inside the mosquito. It is one of those unexplained, and at present almost inexplicable, facts of biology that only mosquitoes of the genus *Anopheles* have been proved capable of transmitting malaria from man to man. In members of this genus the malaria parasite undergoes an essential stage of development before it is capable of once more infecting man ; but for the essential points in the present argument it is necessary to realize that not every member of the genus *Anopheles* is able to transmit malaria ; that of those species which can do so, some are highly effective and others less so ; that their effectiveness depends largely on the degree to which a species seeks human blood rather than that of animals, and that the effective spread of malaria depends upon the ability of efficient carrier mosquitoes to herd in close association with man.

Of efficient carriers there are at least six in Africa and many more in Asia. For breeding, some species need water open to the sun, others demand shade ; some need relatively high temperatures, others prefer cool waters ; some even require brackish water which is prohibitive to others ; some need clear, limpid streams, others will breed in a muddy water-filled hoof-print. Then different species of *Anopheles* have characters which are relatively constant and are therefore vitally important. Thus a locality may be infested with *Anopheles* and yet have no malaria, but a change in agricultural habits of the people, for example, introduction of artificial irrigation, may so modify the composition or condition of the water that *Anopheles* of dangerous species, present in contiguous areas, may infiltrate, to initiate an epidemic of malaria in a population devoid of immunity.

In other circumstances the water may be suitable to the breeding of *Anopheles* ; but these mosquitoes may not be present. If in such cases they are introduced, and, if persons carrying the malaria parasite in their blood exist in sufficient numbers, then conditions for epidemic transmission will have been created. This is the present position in certain groups of islands in the Pacific. *Anopheles* are not yet there, but may well be introduced in ships or in aircraft from other lands.

Again, malaria may be present, but the local *Anopheles* may be a relatively poor transmitter, so that the disease is maintained at a low rate of incidence ; but if to such a community a vigorously breeding, man-loving *Anopheles* is introduced, the result may be an epidemic of malaria lasting many years, in which the human death-roll may amount to tens of thousands. This is not speculation, but is exactly what happened to Brazil about 1930, when that most versatile malaria-carrier, *Anopheles gambiæ*, was transported from West Africa to Brazil in the fast steamers which ran between Dakar and Natal (a port in Brazil), became established there and carried death and ruin to a large peasant population for ten years. At the cost of enormous exertion, this mosquito has at last been eradicated from Brazil by the combined efforts of the Government and the Rockefeller Foundation, and the epidemic has ceased ; but though the organization which made this great feat possible was brilliantly conceived and should serve as a model for the world, the tragic episode underlines the overwhelming truth of the old adage that prevention is better than cure ; and prevention would be difficult without co-operation between sovereign States—between the country from which the mosquito originated and that to which it travelled. Prevention demands, for example, that no mosquito which may enter an aircraft at an aerodrome in West Africa should be allowed to escape on arrival in Brazil—the authorities at each end must take their complex precautions. Moreover, the work of eradication of *Anopheles gambiæ* from Brazil was assisted

by—note the title—the International Health Division of the Rockefeller Foundation. India also has its own malaria problems; but India knows no *Anopheles* so vicious as *Anopheles gambiæ*, and it is conceivable that this mosquito, to which West Africa owes most of its evil health reputation, might be taken by aircraft to India, there to repeat its Brazilian feat. Thus the rapidity of modern travel has raised problems previously unknown.

It is therefore clear that prevention of malaria on an international scale entails the close co-operation of specialists in many directions. It demands the mutual understanding between doctors, entomologists, agriculturists and irrigation engineers; without this an individual alone is helpless. The medical entomologist is there to identify the *Anopheles*, to detect its breeding places and to direct methods for its eradication. To give some idea of the technicalities involved it has to be pointed out that there are variations even in one species which are of great importance. Thus *Anopheles maculipennis*, the chief transmitter in Europe and North Africa, is divisible into no less than seven races in the Old World and one in the New, which can be distinguished from one another (like birds) by the colour pattern of their eggs. Some are important species in the present sense: others not at all.

What is true of malaria bears a definite relation to another great mosquito-borne disease—yellow fever. "Yellow Jack" once destroyed one of Napoleon's armies in the West Indies and frustrated the French attempts to force a canal through Panama until finally defeated by the Americans under General Gorgas; it was the terror of Caribbean sailors and West African traders; the pernicious and deadly jaundice which gives it its name was the origin of the yellow colour long ago adopted, and still maintained, for the quarantine flag. Yellow fever is caused by an ultra-microscopic virus, a group of organisms the members of which include the causes of measles, influenza, smallpox and numerous plant diseases, and this virus is transmitted from the blood of infected man to that of a healthy individual by mosquitoes during the act of biting. Unlike human malaria, yellow fever is a disease which affects certain wild animals, particularly South American monkeys, opossums, which constitute a reservoir of disease that must be taken into account, and it is transmitted chiefly by mosquitoes of the genus *Aëdes*, of which the most important is the semi-domestic species—the tiger mosquito—*Aëdes ægypti*.

These mosquitoes are abundant throughout the tropics, in America, Africa and Asia; but yellow fever has fortunately not hitherto been known in Asia and Australia. Should the virus be introduced there, the stage would indeed be set for an epidemic the like of which has, perhaps, not yet been known, and although there is a vaccine which, when inoculated, affords excellent protection, inoculation of the millions of people in India and the Far East would be such a gigantic task that it is preferable to take the most extensive and radical measures to prevent the entry of this disease.

But an infected mosquito might enter an aeroplane in Africa and escape from it in India, might infect a villager who in turn might infect a dozen local *Aëdes*, and so on. Or, again, a man in Africa might travel by air to India during the incubation period of the disease before recognizable symptoms develop, on arrival the disease might not be readily diagnosed, and in the interval he might easily infect local Indian *Aëdes ægypti*. All this is, of course, well recognized, and active precautions are being taken to guard against such happenings; but it is by no means easy to realize how detailed and how fine must be the system which attempts (so far with success) to protect the East against yellow fever. One crucial point in this protective system is international co-operation. Each threatened country must take its own precautions, but each already infected country has a responsibility to ensure that aeroplanes departing from its aerodromes do not carry with them infective material, human or otherwise. International conventions have indicated how these responsibilities should be met.

African trypanosomiasis (sleeping sickness) has for centuries played havoc with the natives of that disease-ridden continent, but as yet this affliction is confined to Africa. It is caused by a tiny protozoon in the blood, which is picked out and transmitted, in the act of biting, by tsetse flies. It is, again, one of the unexplained mysteries of biology why this organism is so selective that it cannot be transmitted by mosquitoes (apart from occasional mechanical transmission by certain other biting flies), and that it cannot undergo its essential development in insects other than the tsetse; yet the fact remains.

In the days of slave trading, negroes suffering from sleeping sickness were often transported to the West Indies. They died there of the disease, yet sleeping sickness was never established in the western hemisphere, because the requisite flies did not exist there. The tsetse is a land fly, it does not frequent harbours, it has no incentive to get aboard ship; but it does seek shade, and may be attracted to the shade of an aeroplane standing near a patch of trees on an aerodrome; it may enter the aeroplane and travel with it, and if living infected flies were to reach parts of America and become established there, there is little doubt that the disease would be propagated: the danger is, perhaps, somewhat remote, but the discovery of dead tsetse flies in aircraft arriving in Brazil has been regarded as something of an omen by the South American authorities.

These three diseases illustrate the fact that in warm climates some of the major dangers to health are transmitted from man to man, or from animals to man, by flying insects. But there are great epidemic diseases, conveniently labelled tropical because their present incidence is mainly in hot countries, which are, in fact, diseases of all climates and which are transmitted by arthropods which do not fly.

Plague was more than once rampant in England—the Black Death and the Great Plague were instances of spreading epidemics—and is now present in the rodents of the United States, as well as of Africa and Asia. It is essentially a disease of rats and field rodents, and is spread among them by their fleas. Fleas leave dead animals, and in default of living rodents on which to feed, will attack man. The cause of plague is a bacillus which is present in the blood of a diseased animal, and which is taken up by the flea when it feeds. In the flea it multiplies, and, in certain circumstances, may be injected into another animal (or man) at a subsequent feed. There is thus the cycle rat-flea-rat, and if the mortality among rats is high, and the chance of feeding on rats consequently low, and if the rat community is in close association with man, there is a spill-over of plague to man, which, in extreme conditions, may be of

great proportions, with devastating epidemics. Rats, of course, seek food which is to be found especially near human habitation, or in food stores, in bazaars of the East, and in ships. They are great climbers; and a dock area heavily infested will, unless transit is prevented, both give to and receive from incoming ships considerable numbers of rats. An infected rat may invade a ship, start the disease in the ship's rats, and an infected rat may leave the ship at another port, infect the rats of that port, and originate an epidemic in man. This course of events has happened often in the past and the danger is always present. There has recently been an outbreak in Haifa and Jaffa; the rats of Rangoon and Hawaii have been infected for many years; human deaths from plague are constantly reported from Istanbul; in India, Java, and Madagascar plague in man is constantly present.

Plague, therefore, is a disease which is peculiarly associated with commerce and trade routes, with ports and shipping. These are pre-eminently the international links, and it is just here that control measures must be, and indeed are, co-ordinated by international agreements.

Typhus, which Zinsser regarded as a more potent arbiter of the fate of nations than the Caesars or Napoleons of history, is transmitted from man to man by the louse. It is caused by a minute organism which is taken in by the louse when it feeds. Typhus flourishes when lice flourish, in cold weather when clothing is not often removed, and particularly when social life is disorganized by war, with its masses of refugees herded together and without the means of cleanliness, or in famine, when the people flock to the great cities and live in crowded conditions, as in North Africa. Typhus killed more people than all the weapons of war in 1914–20; in the present War the great attention given to it by the Germans indicated a prevalence they were not anxious to admit. In North Africa the incidence has been heavy during the last few years; in China the refugees from invasion were heavily diseased; in Spain a violent epidemic followed the civil war. The introduction of typhus into a crowded community, which is already infected with the necessary lice, may produce the final condition needed for an outbreak.

Those diseases which are not specifically insect-borne present problems not less complex and not less urgent. Cholera may be introduced into a country by the movements of labourers, by pilgrims or by refugees from war; smallpox has many times invaded tropical countries in the same way; the common fevers of childhood, such as measles, at one time played havoc in Fiji, where the natives had no immunity, and the same course of events has recently been enacted in remote villages traversed by the newly built Alaskan highway. The same thread runs through these happenings: the introduction into one area of diseases prevalent in another, across national boundaries.

Moreover, there are less spectacular diseases, such as tuberculosis, leprosy, venereal diseases, yaws, hook-worm infection, unevenly spread over the tropics but affecting grossly the health and happiness of enormous communities, and their eradication could not satisfactorily be undertaken by the uncorrelated actions of individual States. These are the responsibilities of Governments, but the resources of some of the tropical countries are totally inadequate to their needs. At the root of much of this chronic illness is the poor state of nutrition of the people, the poor state of agricultural knowledge and equipment and the low state of general hygiene.

The science of nutrition is still in its infancy. This sounds a queer statement, as the desire for food and the adequate nutrition of the body is surely a primitive instinct. So it comes as a rude awakening to realize that lack of proper ingredients in the diet is at the root of most human evils. Just as weeds will grow and flourish on poor soil, so will the germs of disease when the defence mechanisms of the human frame are weakened by insufficient nutriment.

It has now been established beyond doubt that the majority of tropical peoples are existing on grossly insufficient foods. This is especially the case in the West Indies, Central Africa and China. There the native foodstuffs do not provide the necessary amount of proteins and fats. Some tribes are under-nourished because they do not eat meat or drink milk, even when they are at hand. There are taboos, traditions and beliefs—all so ingrained that it may take centuries of education to eradicate them. There can be no reasonable doubt also that wrong feeding is one of the principal causes of the very high infant mortality in most tropical countries.

The main facts are summarized in the two reports of the Economic Advisory Council on Nutrition in the Colonial Empire published in 1939. A study of this mass of information makes illuminating reading and strengthens the belief that the subject of nutrition is all-pervading and of the utmost importance. It is the ground rock of health and one which underlies the maintenance of virile and healthy populations. It strengthens the belief, if proof were needed, that if the soil of the body is defective, no medical skill or specific drug treatment can be effective in eliminating the seeds of disease.

The argument sustained by these facts is that the responsibility of the advanced countries to their own peoples demands that they should urge the less advanced to prevent the export of transmissible disease, as well as that they should themselves prevent its ingress. The less advanced must be persuaded to adopt those sanitary measures, those quarantine restrictions, that the community of nations considers necessary to general well-being. But the advanced have a human responsibility to the uninstructed peasant populations of other lands, which should not be estimated on a safety basis or on a cash value. Self-interest is not a policy that can appeal much to a world which wants a faith, and in medicine more than in any other human activity there is need for co-operation and the pooling of resources on the widest scale.

To be more precise, the Government of each nation must do its utmost for the health of its own people, must protect its own people from disease brought in from abroad, must ensure, so far as possible, that reasonable steps are taken to prevent the export of its own diseases, and must be prepared to place at the disposal of the rest of the world reports on its own health and swift news of any major epidemic outbreak. The last, indeed, has already been the rule on a large scale, and before the War the Far Eastern Bureau of the League of Nations at Singapore issued early warning of the great tropical epidemic diseases throughout its area. The Pan-American Sanitary Bureau, and the Paris International Office of Public Hygiene performed like functions. But these organizations were not world-wide; they were not complete, and the position cannot be satisfactory until completeness is achieved.

Again to be precise, the controlling Governments of tropical Colonies must render to those Colonies services more regulated by their needs than by their capacity to pay. These services, in the matter of health, include education and research, equipment and personnel on a scale not often attempted, and embracing not only medicine but also agriculture, animal husbandry and industrial development. Moreover, it is a moral responsibility for the more advanced nations to lend to the less fortunate nations, without thought of reward, the services they need, even if those less fortunate peoples are self-governing.

Apart from good-will, high ideals and financial help, the essential basis for this co-operation between nations is knowledge. First, there is the knowledge of the outbreak of transmissible disease. This information must be given by the affected country to a central organization with the utmost speed and accuracy, so that spread to other countries may be prevented.

Second, there is the knowledge of the general state of health of these countries. Much of this can be, and in fact is, contained in official annual medical and health reports, but for many of the countries of the tropics such reports are difficult to obtain, or are not made. Any person interested in the health conditions of the British Crown Colonies, or of certain tropical dependencies of other nations, has at his disposal a satisfactory range of annual reports, but some other countries, of great importance to world health, do not offer this service.

Third, there is the knowledge of the complex problems of disease, which is being slowly and painfully acquired by research workers and investigation throughout the world. This knowledge is made available through the medical journals of all countries, which now make up a mass of literature so great, and in such a multiplicity of languages, that few workers even in restricted subjects, and none in wider fields, can hope to read all that should interest them. Outstanding achievements soon receive universal recognition, but each outstanding discovery is followed by a mass of investigation which modifies and re-assesses its application and value. It is necessary that accounts of this work be assembled by some agency in a form convenient for those who, desiring to know of it, are unable themselves to perform the tedious task of searching the literature.

Apart from the international aspect of this problem, the British Empire has a definite responsibility towards the many peoples over whose welfare it presides. Promotion of medical knowledge and raising the standard of health in every portion of the globe is the best method of securing good-will and strengthening the machinery of government. Medical education is being extended on British lines in India, Ceylon, Africa and elsewhere. The needs of native medical schools and practitioners has to be catered for by the dissemination of knowledge. It is therefore eminently desirable that Great Britain should take an honourable place in the provision of medical information suitable to its world-wide responsibilities. To strive for such an ideal is surely not beyond the powers of a nation which has stood shoulder-square to the perils of the last five years of war.

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AUTOSYNTHETIC MOLECULES

By DR. T. F. DIXON

KNOWLEDGE of the mechanism of cellular protein synthesis has been advancing rapidly with the aid of the ultra-violet and electron microscopes. Nucleic acids show characteristic high absorption maxima at 260 mμ, due to the purine and pyrimidine constituents which distinguish them from other substances in biological material. By using the quartz microscope with monochromatic ultra-violet light, information has been obtained about the role of nucleic acid in cell division[1] and the nucleoprotein nature of the chromosome and gene[2,3]. Indirect evidence for the latter has been obtained by ultra-violet irradiation of germinal tissue, when high efficiencies of mutation have been observed at 260 mμ[4]. Viruses also appear to be nucleoproteins.

All animal and plant cell nuclei give positive Feulgen reactions, indicating the presence of desoxypentose, whereas pentose is characteristic of the cytoplasm. Variations occur not only in the sugar and pyrimidine components of the nucleic acid portion and its degree of polymerization, but also in the proportion and nature of the protein with which the nucleic acid is combined. Thus nuclear material from fish sperm heads (the classic example) contains approximately 2 parts of nucleic acid combined with 1 part of the strongly basic protein protamine; whereas in tobacco mosaic virus nucleoprotein 6 parts of nucleic acid are linked with 94 parts of a less basic and more complex protein. The nucleoproteins may form complexes with lipides. For example, the viruses of Rous sarcoma[5], equine encephalomyelitis[6] and the elementary bodies of vaccinia[7] have been shown to be associated with phospholipid-nucleoproteins.

The word virus has been applied mainly to agents residing in multicellular organisms; and when individual free-living cells are the hosts, such as bacteria, they are referred to as bacteriophages. The property of obligate parasitism or infectiousness has been found to be associated with certain high molecular weight nucleoproteins which are foreign to the host proteins and are probably the viruses themselves. In many cases one attack of a virus disease in an animal may produce a lasting immunity demonstrable by certain serological phenomena such as complement fixation, agglutination, precipitation and neutralization. Enduring immunity may depend on the kind of tissue infected and is probably due to a long-term sojourn or persistence throughout the life of the host. Lasting immunity may not be obtained to influenza or to the common cold virus because the superficial cells lining the respiratory tract are being thrown off at intervals to be replaced by deeper cells, and thus do not provide a permanent abode for these viruses. The fact that injection of immune or convalescent serum has little influence on the course of some virus diseases is not surprising when it is considered that the viruses are multiplying within the cells and may never be subjected to the action of humoral antibodies.

Certain cancerous growths are associated with viruses. Such growths are transplantable, and agents with which the disease can be produced again can be extracted from them. Thus viruses are responsible for tumours of the renal epithelium of frogs, for a

variety of mesodermal growths of fowls and for papillomas of rabbits. In some cases viruses may be the causal agents, and the chemical carcinogens the 'provoking agents'. The 'milk factor', the transmissible agent of mouse mammary cancer, may cause no growths until it is 'provoked' by an œstrogen. That anti-viral antibodies frequently attain great strength in the blood of virus-induced tumours without preventing their growth is probably due to the selective permeability of the cells, which will neither admit hæmolysins or antibodies against bacteria nor those against viruses. The cell itself may be regarded as the host of the tumour virus, and not the organism which becomes implicated secondarily.

The nucleoprotein viruses of animals, plants and bacteria differ in size, stability and chemical composition. Their sizes[8] range from the larger, more complex and organized viruses such as vaccinia with a diameter of 225 mμ and an estimated molecular weight of $4{\cdot}3 \times 10^9$, to the smaller viruses such as foot-and-mouth disease with a diameter of 10 mμ and a molecular weight of 4×10^5, which perhaps may approach the minimum limit of size for self-reproducing particles. As an obligate parasite, vaccinia, or any other highly organized virus, may possess only a portion of the enzyme systems necessary for existence, relying chiefly on the intracellular nuclei for complementary systems enabling it to multiply. Although no independent metabolism of vaccinia has been demonstrated *in vitro*, it has been shown that copper, flavin-adenine-dinucleotide, biotin, phosphatase and catalase are present[9]. On the other hand, lipase, catalase and phosphatase were adsorbed from their solutions by the virus with ease and could not be readily eluted, so that it is difficult to distinguish between the enzymes which may represent an integral part of the virus and those which may be contamination from the host. In contrast to the simpler plant viruses, the more complex animal viruses such as vaccinia, psittacosis, yellow fever or lymphocytic choriomeningitis give rise to more than one specific antibody.

Electron micrographs of vaccinia indicate six rectangular plane surfaces and five dark areas[10], showing in many ways resemblances to bacteria and marked differences from plant viruses. Tobacco mosaic virus particles appear as rods 280 mμ long and 15 mμ across, representing a molecular weight of about 4×10^7. Bacteriophage suspensions consistently show the presence of sperm-shaped particles adhering to bacterial membranes[11]. The particles consist of heads 80 mμ in diameter and thinner tails 130 mμ long, and in the presence of sensitive bacterial cells absorb by either head or tail. X-ray diffraction studies on tobacco mosaic virus[12] show that it is built up of hexagonal prism units $8{\cdot}7$ mμ tall and $6{\cdot}7$ mμ across, with a molecular weight of $3{\cdot}7 \times 10^5$. There are also transverse spacings and demarcations at $4{\cdot}4$, $2{\cdot}2$ and $1{\cdot}1$ mμ. It may be speculated that during self-reproduction, the assembling of these units of $1{\cdot}1$ mμ cubes, containing perhaps eighteen amino-acids, leads to the construction of a layer, and that the virus may consist in part of similar layers joined by nucleic acid fragments.

The production of a mild form of a disease to create an active protection has long been known. Generally, as with bacteria, it is not practicable to produce an artificial protection with small amounts of a fully virulent virus under conditions corresponding to natural infection, since there is the danger of provoking a severe attack in a susceptible patient. Unlike bacteria, viruses cannot usually be treated with formaldehyde or other chemicals *in vitro* to destroy their virulence without losing their antigenic properties in a parallel manner; although they may lose their virulence or their tropism for a particular tissue by repeated transmission through another host. Long-known examples of modifications of viruses which can induce protection are the Jennerian cow-pox, probably arising as a mutation of human smallpox, and the modified Pasteur rabies virus produced by brain-to-brain passage in rabbits. A third more recent outstanding example is the yellow fever virus strain 17*D* which was evolved by hundreds of passages in tissue culture in media containing embryonic tissue from which neural tissue had been removed. The resulting virus lost its neurotropic character and has been widely used for human immunization[13]. Nothing was known concerning the chemical changes involved in the production of a given variant until amino-acid analyses were performed on six mutant strains of tobacco mosaic virus each producing characteristic leaf symptoms and which had been prepared in essentially pure form. Briefly, besides serological differences, tobacco mosaic, green and yellow aucuba, *J*14*D*1, Holmes masked and ribgrass strains showed differences in their contents of tyrosine, tryptophan, phenylalanine, arginine and sulphur. In addition, the ribgrass strain contained histidine, which was not detected in the others[14,15]. Attempts to alter the tobacco mosaic virus *in vitro* have been made by preparing acetyl-, phenylureido-, carbobenzoxy-, *p*-chlorobenzoyl- and malonyl-derivatives[16]. Providing the reactions were not carried too far, a large portion of the amino- and phenolic-groups could be combined without loss of infectivity. Although the derivatives failed to perpetuate themselves as such and the virus eventually isolated was the ordinary tobacco mosaic virus, it is hoped eventually to obtain known structural changes in a virus which will be heritable.

Both virus and gene have the ability to reproduce within, and only within, certain living cells, and may undergo changes spontaneously or as a result of external factors. That new virus strains appear to become dominant when grown in an unnatural host suggests that the altered environment of the host may supply different building blocks. In general, a chemotherapeutic agent deprives an organism of essential enzymes or metabolites. It may do this, with bacteria, by interfering with capsule formation or by altering cell permeability so that essential metabolites are either washed out of the cell or fail to penetrate it. Or there may be competition with a structurally similar essential growth-factor at enzyme surfaces, as postulated for the sulphonamides and *p*-aminobenzoic acid. So far, the few viruses which have proved susceptible to sulphonamides, such as the agents of lymphogranuloma venereum, inclusion blenorrhœa and mouse pneumonitis, are those which in complexity and size occupy a position, perhaps analogous to the rickettsia, between bacteria and the smaller, less organized viruses, and their susceptibility may express their more complex needs and metabolism. Research into the metabolic requirements of the viruses offers an opportunity for a fundamental reasoned approach to their chemotherapy which has been lacking in the search for antibiotics. The susceptibility of organisms in general to virus infections when inadequately supplied with essential feeding-stuffs merits full investigation. In particular, bacterial viruses should serve

well for this study, since their growth can be observed quantitatively under controlled conditions.

It has long been known that X- and γ-rays interfere with gene function and suppress organizer action, and that this is connected with the beneficial effects of radiotherapy in cancer. Recent work[17] bearing on intracellular metabolism and the gene – cytoplasm equilibrium shows that these rays inactivate certain enzymes and viruses *in vitro*, and in proliferating and in incompletely differentiated cells produce an inhibition of desoxypentose nucleic acid synthesis in the nucleus and an accumulation of pentose nucleic acid in the cytoplasm.

Nucleoproteins are found in high concentrations wherever growth occurs in a living medium, whether in the metaphase chromosome, the normal gland cell, the avian neoplasm or the embryo. The cell was once considered the ultimate duplicating life-unit. Now the nucleus is thought to be the centre for protein synthesis, and the nucleic acids the essential units, either as polymerized desoxypentose nucleic acids associated with the gene proteins (of which chromosomin is stated to be a constituent[18]), or as cytoplasmic pentose nucleoproteins. Examination of the nuclei of rat liver cells has not revealed the complexity or concentration of the enzymes which are found so abundantly in tissues or organs[19]. This may be because the genes produce only formative enzymes of the sort used in protein synthesis. The use of radioactive nitrogen (^{15}N) as a tracer has shown that nearly all body proteins even when fully synthesized are continually undergoing breakdown and repair and exist thus in a state of dynamic equilibrium, and this probably applies to the gene and cytoplasm proteins[20]. When an œstrogen causes proliferation of uterine epithelium, when a carcinogen produces a sarcoma or when an evocator stimulates a gastrula to neural differentiation, certain circulating compounds may act on this gene – cytoplasm equilibrium in the particular tissue causing it to be reconstituted in a different way. Thus at a critical instant in the life of the tissue, a crucial cellular reaction may be influenced, causing differentiation to proceed towards one type of cell or another. Although knowledge of the intricate processes occurring in the cell is very far from complete, the pattern of organization and nuclear structure is just beginning to appear.

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THE SUPER-FLUIDITY OF LIQUID HELIUM II

THE study of the properties of liquid helium has been very fruitful in revealing unexpected phenomena—super-conductivity, abnormally high thermal conductivity, super-fluidity and others. Of these, super-fluidity and some associated effects are comparatively new and were being investigated in several laboratories just before the War. Prof. P. Kapitza, who is one of the chief workers in this branch of low-temperature physics, and who introduced the term 'super-fluid', has recently published an article[1] in which he surveys his work on this subject and discusses possible explanations of the flow phenomena.

When helium is progressively cooled below 4·2° K. (the liquefaction point) under atmospheric pressure a change takes place at 2·19° K., the λ-point. The most obvious effect is the sudden cessation of boiling. The change is usually referred to as the passage of helium I into helium II, and the peculiar properties of liquid helium are associated with helium II ; for example, Keesom found that the thermal conductivity of helium II in a capillary was many times greater than that of the best metallic conductors.

Kapitza repeated Keesom's experiments under somewhat different conditions and obtained still higher figures for thermal conductivity. It was while seeking an explanation for this effect that he was led to the idea of super-fluidity and to the carrying out of experiments[2] which proved that the viscosity of helium II is vanishingly small. The normal mechanism of heat conduction—the handing on of thermal agitation from molecule to molecule—could not apply in this case, and the alternative appeared to be a form of conduction by means of convection currents ; but, if this were the method, gravity was not a sufficient cause and convection currents must arise with extraordinary ease in helium II, implying that the liquid had an exceedingly small viscosity.

The latest determinations of viscosity have indicated a figure of 10^{-11} poise as the provisional limit. This is a thousand-millionth that of water, and may be reduced still further if the sensitivity of the method can be increased.

Confirmation that powerful convection currents of a special type can occur in liquid helium II when a temperature difference is set up was obtained by Kapitza by means of the apparatus shown diagrammatically in Fig. 1 (this and the other diagrams are from Prof. Kapitza's paper, ref. 1).

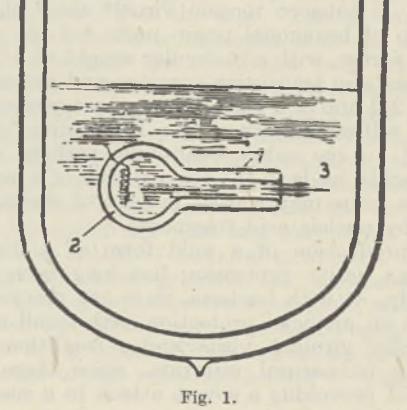

Fig. 1.

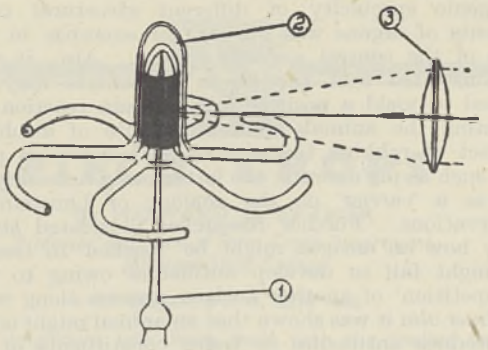

Fig. 2.

A small flask (1), open at the neck (3) and containing a heating spiral (2) was immersed in super-fluid liquid helium. When an electric current was passed through the spiral, a continuous current of helium was found to flow out through the neck of the flask. A delicate vane suspended in the neck was deflected by this current and served to measure its force and speed. An apparatus more suitable for demonstration purposes is illustrated in Fig. 2. A cinematograph picture has been taken of this apparatus in action. A glass 'spider' mounted upon a needle (1) consists of a small bulb (2) provided with a number of outlet tubes which are all bent back in the same sense. When the whole spider was immersed in liquid helium II and the centre vessel heated by directing light on to the blackened interior by means of a lens, a continuous stream of liquid issued from each of the little tubes—the legs of the spider—although there was actually no through channel for liquid in the spider. As a result of the reaction of the escaping liquid, the spider was caused to rotate.

Reverting to Fig. 1, the paradox of the experiment is that no return flow was ever detected with any position of the vane. The explanation first suggested for this was that the return flow might be in the form of a very thin mobile film along the glass surface. To test this theory, the wide mouth of the flask was replaced by a very fine slit to cause the whole slit opening to be used by the suggested reverse current following the wall. The width of the slit, which was made with great precision, was reduced by stages to 0·14 micron, but no change in the character of the phenomenon was observed.

Experiments with slits brought out the important fact that the effect is thermodynamically reversible. The thermally induced rotation of the spider (cf. Fig. 2) in a liquid which, being super-fluid, causes no frictional loss, provides a mechanism which has the utmost possible coefficient of efficiency.

When helium II flows through a capillary from a higher level to a lower (Fig. 3) the liquid at the lower level is found to be cooler than that at the higher. If this effect remains reversible however low the temperature, then by forcing liquid helium through capillaries and repeating the process a sufficient number of times we should have a method of getting as near as we might wish to absolute zero. Employing this method, Kapitza was able, just before the War, to obtain a reduction in temperature of 0·4° and he is now proposing to proceed with these experiments. The normal method of cooling, which depends upon the de-magnetization of para-magnetic salts, has both theoretical and practical limits to its further usefulness, but there is no reason to suppose that the flow method has any limits whatever.

When the slit experiments appeared to dispose of the film theory, the flow phenomena (Figs. 1 and 2) appeared utterly mysterious. A theory which appears at first sight to be incompatible with normal physical thought has been evolved to explain them. Its first rough outlines were sketched by Tisza in 1938 [3], but its scientific development is due to the Soviet physicist, L. Landau [4]. According to this theory, at temperatures below the λ-point liquid helium is a mixture of two liquids, one of which is a normal liquid and the other a liquid characterized thermodynamically by zero entropy and physically by the absence of viscosity. Just above 2·19° K. the liquid is entirely in the normal state. As the temperature is lowered, super-fluid helium starts to appear; and its concentration increases progressively and that of ordinary helium decreases until at absolute zero the whole liquid, so it is supposed, has zero entropy and no viscosity. This picture is adequate to explain the flow and the thermohydrodynamical phenomena referred to above. In the neck of the flask (Fig. 1) there can exist simultaneously currents of the same liquid flowing in opposite directions. The current flowing into the flask will not be affected by friction in its passage through the stream of outgoing helium; and when it reaches the heater it will be transformed into a normal liquid. The vane is thus capable of detecting the normal liquid but not the super-fluid helium.

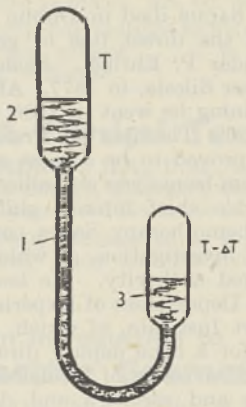

Fig. 3.

The mechanism of the conduction of heat is to be understood as an abnormal type of convection process which arises from the fact that to bring helium from the state of zero entropy into the normal state a quantity of heat must be expended. A rough analogy may be drawn with the contrary streams of cloaked and uncloaked people which can be imagined as moving along the passage-way to the cloak-room of a theatre. Those that are dressed for going out will represent the normal atoms of helium, which have received the energy they require from the heater (the cloak-room); and those that are uncloaked will represent the super-fluid helium atoms. Unfortunately, the analogy is far from complete, seeing that the atoms of helium in the state of zero entropy pass by their fellows who are in the normal state without any interaction, while those people who have not yet obtained their cloaks could not manage in any circumstances to keep moving through the crowd without frictional resistance.

The theory explains also why the leakage of helium through a narrow opening produces a temperature difference. Helium in the super-fluid state passes through the opening more easily than helium in the normal state. Thus there occurs a peculiar type of filtration. In the liquid which has passed through there is a greater concentration of super-fluid helium, and this corresponds with such a concentration as would presume the attainment of a certain lower temperature.

In many ways experimental work, quantitative as well as qualitative, is in agreement with the theory. Some phenomena are unexplained as yet. The theory indicates that there should be simultaneously two different speeds of sound in liquid helium. There is at present no proof of this experimentally, and, moreover, the theory does not account for the critical speed which is actually observed. Further work on the elucidation of the strange phenomena of helium II is likely to prove of considerable interest.

G. STANLEY SMITH.

[1] Kapitza, P., *Nauka i Zhizn* (*Science and Life*), No. 3, 13 (1944).
[2] Kapitza, P., *Nature*, 141, 74 (1938).
[3] Tisza, L., *Nature*, 141, 913 (1938).
[4] Landau, L., *Zhur. Eksper. Teoret. Fiziki*, 11, No. 1 (1941); *Phys. Rev.*, 60, 356 (1941).

OBITUARIES

Prof. Hans Sachs

PROF. HANS SACHS died in Dublin on March 23; with him ends the direct line of great serologists which arose under P. Ehrlich. Sachs was born in Kattowitz, Upper Silesia, in 1877. After completing his medical training he went in 1900 to the Institut für Experimentelle Therapie at Frankfort-on-Main, where he soon proved to be a most able worker on problems of serum-hæmolysis and allied studies.

When Ehrlich's chief interest shifted to cancer research and chemotherapy Sachs continued in his original field of investigation, of which he soon was the acknowledged authority. He became professor and head of the Department of Experimental Biology at the Frankfort Institute, of which, after Ehrlich's death, he was for a time deputy director. In 1920 he went to the University of Heidelberg as professor of immunology and serology and director of the scientific department of the Institute for Experimental Cancer Research. The wide esteem in which he was held was manifested in the work entrusted to him on the serodiagnosis of syphilis for the League of Nations' Commission.

In 1908 Sachs was one of four who founded and edited the *Zeitschrift für Immunitätsforschung*. His association with this journal, now in its eighty-sixth volume, was terminated by State policy in 1935, and he also ceased to hold his post at Heidelberg. Then the Irish Medical Research Council and the hospitality of Trinity College, Dublin, enabled him to continue his work in the School of Pathology there. In addition to valuable contributions of a practical nature—the Sachs-Georgi reaction is known throughout the world as one of the first simple and reliable flocculation tests for the diagnosis of syphilis—he and his fellow-workers carried out a long series of important investigations on the antigenic properties and specificity of tissue constituents, especially those which can be extracted by alcohol (lipoids). The work appeared mainly in the *Zeitschrift für Immunitätsforschung*. The antigenic specificity of different structural components of organs was proved, for example, in the case of the central nervous system. Also, it was demonstrated that the serum of rabbits may be caused to yield a positive Wassermann reaction by injecting the animals with a mixture of alcoholic extract of rabbit's tissue along with a foreign protein such as pig's serum, the latter being necessary to act as a 'carrier' on the analogy of Lansteiner's observations. Further researches illustrated strikingly how an antigen might be 'masked' in tissues or might fail to develop antibodies owing to the 'competition' of another antigen present along with it. *Inter alia* it was shown that an animal might come to produce antibodies to tissue constituents of its own species. The implications of those attractive observations in connexion with pathology have not yet been fully explored.

The distribution and properties of the antigens associated with the human blood groups were also extensively examined by Sachs; and his communication to the Royal Academy of Medicine in Ireland in 1939 (*Irish J. Med. Sci.*, April 1940) is a most comprehensive and readable account of knowledge on the subject up to that date.

Sachs was a man of genial outlook whose appreciation of the work of others was exercised without respect of academic or racial distinction.

C. H. BROWNING.

Miss Phyllis Kelway

THE death of Phyllis Kelway on April 14 at the comparatively early age of thirty-nine comes as a shock to those who knew her as one of the small band of naturalists interested in British mammals, in particular the smaller species, such as the mice, voles and shrews. It was her probably unique distinction to have bred that smallest of living mammals, the lesser or pigmy shrew, *Sorex minutus*, in confinement; also that tiny mammal, the harvest mouse, *Micromys minutus*. She kept and studied most of the British mammals, having marked success with that delightful but difficult species, the red squirrel, *Sciurus vulgaris leucourus*, her pets "Jennifer" and "John" mating and bringing up a litter of young ones. It is noteworthy that Miss Kelway failed to get the red squirrel and the grey squirrel to take any interest in one another, her experiments supporting the view that they never fraternize, still less hybridize.

Miss Kelway wrote several books setting forth her observations and experiences, "Swift Movement in the Trees" telling of squirrels, shrews and many other creatures; while in her last book, "The Ark", she dealt with another theme, the difficulties of a smallholder in war-time. She illustrated her writings both in the Press and in book form with photographs from her own camera, for she was a skilled and charming photographer. She was born in Somerset, but lived in Yorkshire, at Almondbury near Huddersfield.

FRANCES PITT.

WE regret to announce the following deaths:

Dr. K. J. W. Craik, director of the Applied Psychology Unit of the Medical Research Council, on May 7, aged thirty-one.

Prof. Thomas J. Nolan, professor of chemistry since 1932 at University College, Dublin, on March 12, aged fifty-six.

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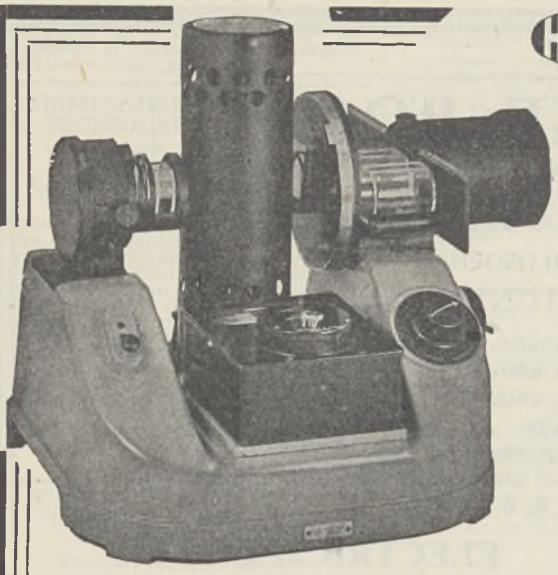

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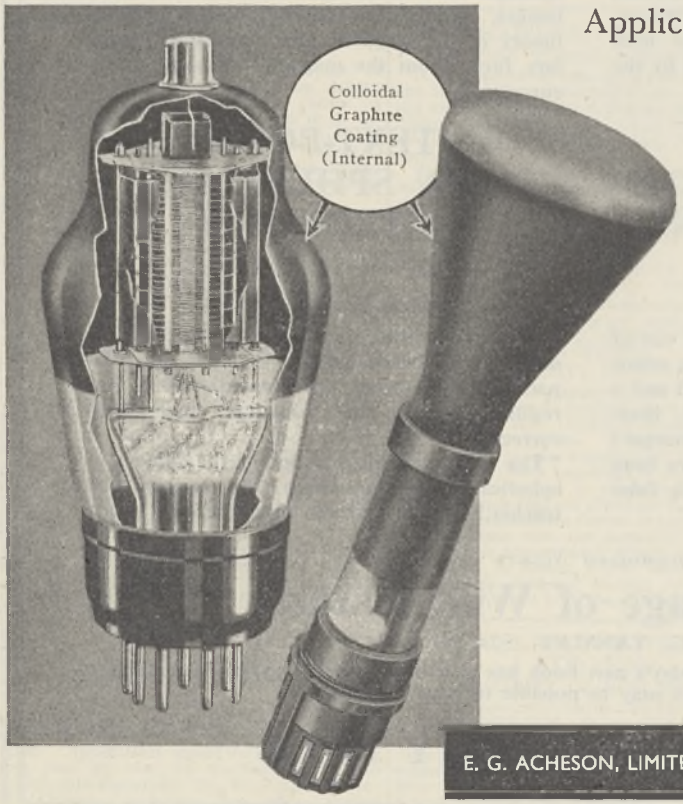

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NEWS and VIEWS

Geological Survey of Great Britain : Sir Edward Bailey, F.R.S.

SIR EDWARD BATTERSBY BAILEY, who has just retired from the directorship of the Geological Survey and Museum, joined the Scottish Branch of the Survey in 1902, at the age of twenty-one, and rapidly established an international reputation as a leading authority on the tectonics of the Scottish Highlands. He served with distinction throughout the War of 1914–18 and after the conclusion of hostilities became in 1919 district geologist in charge of the West Highland and Ayrshire work. An outstanding achievement during his tenure of this post should be mentioned, namely, the preparation of the classic memoir on the Tertiary igneous rocks of Mull (1924). In 1929 he resigned, on his appointment to the chair of geology at the University of Glasgow; but he returned to the Survey as director in 1937.

The short period from 1937 to the outbreak of the present War saw the inception of comprehensive plans for field-work to accelerate the mapping of districts urgently requiring revision. Sir Edward's directorship will, however, be remembered chiefly for the notable part he and his colleagues played in aiding the war effort, especially during the early critical years. When the events of 1940–41 made it necessary to develop the country's mineral resources to the utmost, he threw himself with characteristic energy into the task of carrying out an immediate investigation into the available supplies of such essential raw materials as iron ores, bauxite, limestone, lead, zinc, tin and copper ores, feldspar, mica and silica sands suitable for optical glass. He also extended and amplified the Survey's investigations into underground water supplies throughout Great Britain, and carried through the preparation of a large series of war-time pamphlets in which the results of Survey work were made easily and rapidly accessible. In addition, Sir Edward and his staff were able to give assistance in many engineering projects directly connected with the war effort, such as the siting of aerodromes, camps and emergency hospitals, the provision of underground storage, and the selection of localities suitable for opencast coal production. He has also collaborated closely with Government departments concerned with post-war reconstruction and industrial development. All these varied activities he has pursued with energy and success, and the results may be said to have demonstrated anew the importance of the part which geology and geological research can play not only in the economy of a country at war, but also in the no less difficult problems of the years of peace ahead. Dr. W. F. P. McLintock, deputy director, is at present in charge of the work of the Geological Survey and Museum.

Sir Howard Florey, F.R.S. : Lister Medallist

THE Lister Medal for 1945 of the Royal College of Surgeons of England, which is awarded in recognition of distinguished contributions to surgical science, has been granted to Sir Howard Florey, professor of pathology in the University of Oxford, for the outstanding importance to surgical science of his work on penicillin and its application. He will deliver the Lister Memorial Lecture later in 1945. This is the eighth occasion of the award, which is made by a committee representative of the Royal Society, the Royal College of Surgeons of England, the Royal College of Surgeons in Ireland, the University of Edinburgh and the University of Glasgow.

Treatment of Leprosy

A NEW treatment of leprosy reported from Madagascar (*Brit. Med. J.*, 338, March 10, 1945; and *Lancet*, 357, March 17, 1945) suggests that it is, in some respects, a considerable advance in the fight against this ancient and terrible scourge of mankind. Drs. Boiteau and Grimes extracted, so long ago as 1937, a new glucoside from the umbelliferous plant *Hydrocotyle asiatica*, which gave encouraging results when it was tried for the treatment of leprosy; but it was too toxic. In 1938 Bontemps, working at Antananavivo, isolated another new glucoside which he called 'asiaticoside', and this was not only active against leprosy but was also much less toxic. It was insoluble in water, slightly soluble in alcohol and very soluble in pyridine. Later Boiteau obtained a solution of it suitable for injection, and Devanne and Razafimahery have studied its chemical constitution. Boiteau and Grimes think that it acts by dissolving the waxy covering of *B. leprœ*, so that the bacillus then becomes very fragile and may easily be destroyed by the tissues or by some other drug. The results of injections of the solution prepared by Boiteau are reported as being remarkable. Leprosy nodules are broken down, diffuse infiltrations disappear, perforating ulcers and lesions on the fingers heal and, most remarkable of all, eye lesions are rapidly cured if treatment is given before the posterior chamber of the eye is involved. If fuller reports of trials on a larger number of patients substantiate these claims, and if asiaticoside can be prepared in sufficient quantity, mankind will owe a great debt of gratitude to the discoverers of this remedy. If the view that it acts by dissolving the waxy coating of the bacillus is correct, it is not inconceivable that it may show the way towards the control of infections with other bacilli which have a waxy envelope, such as the bacillus of tuberculosis.

Historic St. Andrews and its University

THE year 1754 gave promise of being an important one in the annals of Scotland, for it saw steps taken to found the Edinburgh Society for the Encouragement of Arts, Sciences, Manufactures and Agriculture. Within a decade, however, the Society had metamorphosed into a Society for Promoting the Reading and Speaking of the English in Scotland, which led to a fate justly deserved. But according to Prof. John Read, in the second edition of his pamphlet "Historic St. Andrews and its University" (W. C. Henderson and Sons, Ltd., St. Andrews, 1945), 1754 also saw a more enduring and certainly much more influential society formed by twenty-two "Noblemen and Gentlemen, being admirers of the ancient and healthful exercise of the Golf", namely, the Royal and Ancient Golf Club—legislative authority of the game. By that time, however, the University of St. Andrews, junior only to Oxford and Cambridge in Great Britain, was more than three centuries old, with a tradition and setting that make St. Andrews "at once the Canterbury and the Oxford (or Cambridge) of Scotland".

It is not surprising, then, that we learn from Prof. Read that the tomb of the founder of St. Salvator's College, erected in 1458, is "probably the finest specimen of mediæval work in Britain" and that the silver gilt College and Faculty maces are "older than

even the oldest of the English maces", and that the Natural Philosophy (*anglicé* Physics) Department houses the finest extant Elizabethan scientific instrument, Humphrey Cole's great astrolabe (1575). At their best, Scottish professors of chemistry have been men of erudition, and Prof. Read, present director of the Chemical Research Laboratories at St. Andrews, maintains that valuable, if passing, tradition. Not a few who have never heard of terpenes may be inspired by his pamphlet, if they are fortunate enough to see it, to make a post-war pilgrimage to the "little city, worn and grey".

Relation of Meteors to Short-Wave Radio 'Whistles'

A NOVEL explanation of some peculiar whistles audible under certain conditions in short-wave radio receivers is put forward by S. R. Khastgir (*Indian J. Phys.*, 17, 239 ; 1943). Weak short-lived whistles of rapidly descending pitch have been noticed at the Delhi receiving station of All-India Radio when a receiver is tuned to the carrier wave of the nearby short-wave transmitters. Two possible explanations are offered, in both of which the phenomenon is attributed to the entrance of a meteor into the earth's upper atmosphere. In the first, the meteor is supposed to produce a rapidly moving mass of ionized air at its head. This local Heaviside layer scatters the incident radiation from the transmitter, the rapid descent causing a Doppler change in the frequency of the scattered waves. These then interfere with the ground waves reaching the receiver, and an audible beat note is produced. As the descent is retarded by atmospheric resistance the Doppler shift lessens, and the pitch of the whistle drops. On a carrier wave of 7 Mc./s. a whistle starting at 3,000 c./s. would be caused by a meteor with a maximum velocity component of 64 km./s. towards the receiver—not an unreasonable value.

The second hypothesis supposes that the retardation of the meteor in the ionosphere produces, in some way, an electrical impulse similar to audio-frequency static. The Fourier components of this impulse, transmitted at different velocities through the ionosphere, will reach its lower fringe in succession (the shorter waves first) and will modulate the scattered carrier waves at a frequency which is a function of time. A receiver tuned to the carrier will thus reproduce a whistle descending in pitch at a rate which should depend on the ionization. Test experiments will no doubt distinguish between these hypotheses, but there seems no doubt about the observed facts—that the whistles frequently coincide with observed meteors, and that they occur most often in the early morning, when the number of meteors is a maximum. They are thus likely to be of fundamentally meteoric origin whatever may be the details of their production.

Polish Science and Learning

THE fourth number of *Polish Science and Learning*, the series of booklets edited by the Association of Polish University Professors and Lecturers in Great Britain, is a specially educational issue. Several preliminary articles are contributed by American and British writers. Dr. Maxwell Garnett's theme is English education in relation to international problems. The makers of the Paris Peace, a quarter of a century ago, he says, took no account of education and little of economics, but relied on political pacts, unsupported by the thoughts and feelings of average citizens. All will agree that we must do better this time, though all may not agree with the details of Dr. Garnett's way of doing it. Prof. Powicke's article, though written for a different occasion, is wisely included, because of its explanation of Oxford's peculiar contribution to English life, the claims of mere learning being subordinated to the service which learning can render to English society. We may be amateurs, but we are not pedants.

The main body of the booklet, contributed by Polish authorities, makes sad reading, because every aspect of education is necessarily treated from the pre-war and the post-war points of view. In other words, the writers describe what has been ruthlessly and completely destroyed, and proceed to describe the immense task of reconstruction which faces the Poland of the future. No aspect of education seems to have been omitted by the editorial committee. Among the subjects of the articles are elementary schools, secondary education, the training of teachers, technical schools, university education, scientific and technical research, books and libraries, adult education, art education and physical education. The concluding "Chronicle" is a useful addition to a very comprehensive report on the educational situation of Poland.

Blind Workers in Industry

CERTAIN occupations such as basket-making, massage and telephone-exchange operations have been assumed to be almost the only possibilities for the blind, and the normal factory environment has been dismissed as unsuitable. Since the need for labour during the War, many firms have experimented with a few blind workers, and a study of 215 blind workers employed in different firms has been made by Dr. K. G. Fenelon, of the University of Manchester. The industries included, among others, general electrical engineering, aircraft, metal ware, wood-working. 104 of the workers were trained by the firms themselves on the factory premises, 53 by the Institute for the Blind, 2 by an education committee, 8 in their own homes, while 48 had no specific training but obtained their experience on the job. The firms who have experimented with blind workers report that, while some fall short of the production obtained by the fully sighted workers, yet some are quite up to normal standards and also that they are no more liable to accidents than other workers. Some jobs involve the provision of special aids, but others can be undertaken by them with the ordinary machinery. They are particularly successful in work where delicacy of touch compensates for ability to see. It is therefore important that the jobs selected for them should be suited to their particular abilities. Their concentration on the job in hand is good, and they are in general keen and industrious. One difficulty is that they are apt to get irritated by any hold-up of material. It seems clear even from this limited survey that there is a case for a comprehensive research into the possibilities for the blind. Quite apart from their potential value as workers, it will be an advantage to them to form part of an ordinary community.

Rickettsiasis in Brazil

THE January issue of the *Boletín de la Oficina Sanitaria Pan-Americana* contains an interesting review of this subject by Dr. Otávio Magalhães, member of the Pan-american Typhus Committee.

Most of the information concerns the State of Minas Geraes, Brazil, where Rocky Mountain spotted fever has apparently existed for some time. There are four clinical forms of the disease: inapparent, mild, malignant and fulminating. It seems that there is only one virus, but probably there are various strains which may be differentiated by proper tests. The epidemiological nature of the infection in some regions of Minas Geraes is quite different from that of Rocky Mountain spotted fever in the United States.

Tables of Bessel Functions

THE Committee on Mathematical Tables of the U.S. National Research Council was advised that there was a great need for a modern "Guide to Tables of Bessel Functions", as there is scarcely a single field of applied mathematics in which these functions are not used. After more than a year of preparation, this "Guide" was compiled by Profs. H. Bateman and R. C. Archibald, using material on which the former had been working for many years, and has been published as a special number, occupying 104 pages, of the journal *Mathematical Tables and other Aids to Computation* (1, 205; 1944. Washington, D.C.: National Research Council. 1.75 dollars. London: Scientific Computing Service, Ltd. 10*s*.). There are two parts, one in which tables and graphs are listed with their authors, and another consisting of an alphabetical bibliography of the authors. In some places there are important formulæ with explanations of how to use them. The notation has been chosen so as to agree so far as possible with that used by English authors. In addition to giving full references to all published tables of Bessel functions, the authors endeavoured to add details of every known unpublished table, but unfortunately the comprehensive Liverpool "Index of Mathematical Tables" prepared by A. Fletcher, J. C. P. Miller and L. Rosenhead was not available, even in proof, until it was too late to give more than a cursory reference, and it was then found that the "Index" referred to more than thirty manuscript tables unknown to the "Guide". The second edition of Watson's "Bessel Functions" appeared too late to be mentioned. A valuable feature of the "Guide" is the information concerning all known errors in the tables mentioned. A number of errata lists appear in print for the first time.

Radiant, Dielectric and Eddy-Current Heating

A PAPER on the place of radiant, dielectric and eddy-current heating in the process-heating field was read recently in London before the Institution of Electrical Engineers by Messrs. L. J. C. Connell, O. W. Humphreys and J. L. Rycroft, in which the authors maintain that if the fullest advantage is to be gained from the rapid developments which have taken place in connexion with radiant and high-frequency methods of heating, care must be exercised in the selection of the applications for which they are recommended. Although many processes can be carried out more effectively by the new methods, there is still a very real place for contact and convective heating. The purpose of the paper is to facilitate this selection. The paper first reviews the various methods of heating, indicating the physical laws and practical considerations by which they are governed and the rates of heating which may be obtained. The types of application for which each process is best suited are then classified in terms of their technical requirements. Finally, several applications are considered in some detail, and it is shown that processes having superficial similarity may nevertheless possess features, not at first apparent, which are of sufficient importance to warrant the use of different methods of heating.

The Earthquake at San Juan, January 15, 1944

HORACIO J. HARRINGTON, professor of geology at the University of Buenos Aires, has described some of the effects of this earthquake ("El Sismo de San Juan del 15 de enero de 1944", *Cienciae Investigación*, Jan. 1945). The shock occurred at 19h. 46m. 29s. without any previous warning and attained a maximum intensity in a few seconds, ending suddenly about 15 seconds after the first shock. The first shock was from below upwards, and in a few seconds afterwards a new shock took place in a horizontal direction and of an undulatory nature, from west to east. When the tremors had ceased, some 90 per cent of the buildings in San Juan had been totally or partially destroyed. The depth of focus was 14 km., with a probable error of 3 km., and the epicentre included the zone extending north from San Juan to Chimbas and Albardón. The intensity of the San Juan earthquake was ix on Sieberg's scale, and so was not excessive; nevertheless the destruction was very much greater than would have been expected. Out of a total population of seventy to eighty thousand, about eight thousand were killed and twelve thousand injured; the disproportion between the intensity of the earthquake and the destruction effected is obvious. The loss of life in the San Juan earthquake was due to the buildings being made with unbaked bricks of clay; these should be avoided in reconstruction. In addition, many of the cities of the country are built at the foot of high mountain ranges, and zones of fracture render their existence more or less precarious.

Announcements

SIR JACK DRUMMOND, chief scientific adviser to the Ministry of Food, has been appointed to the post of director in charge of the whole of the scientific research of Boots Pure Drug Co., Ltd. Sir Jack Drummond has resigned the chair of biochemistry at University College, London, which he has held since 1922, but he will not take up his new appointment until the food situation has improved.

THE Council of the University of Sheffield has accepted a gift of £1,000 from Dr. S. B. Bagley, chairman of the Glass Delegacy, to provide a fund for research purposes within the Department of Glass Technology.

The Medical Research Council has offered to establish a Biochemical Research Unit in the University under the direction of the professor of biochemistry, and the University Council has accepted the offer.

The Council has made the following appointments: Dr. B. M. Laing, at present lecturer in charge of the Department of Philosophy, to the newly instituted chair of philosophy; Major F. W. Shotton, to the chair of geology in succession to Prof. W. G. Fearnsides, on the retirement of the latter; Mr. A. M. Woodward, at present lecturer in charge of the Department of Ancient History, to be reader in ancient history and archæology, and head of the Department of Ancient History.

LETTERS TO THE EDITORS

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

Application of the Chemiluminescence Test for Hæmatin to Plant Tissues

CYTOCHROMES and other catalysts capable of yielding hæmatin are widely distributed in living tissues. It is, therefore, possible *a priori* that many tissues will give a positive reaction in the luminescence test with *o*-amino phthalic acid cyclic hydrazide ('luminol') when treated in some way which will lead to the formation of hæmatin. However, in the forensic application of the test it has generally been found that vegetable matter, either fresh or rotting, gives a negative reaction[1].

The confirmation by Keilin and Wang[2] of the hæmoprotein nature of the red pigment of the root nodules of leguminous plants, and their identification of this pigment as a hæmoglobin, prompted an examination of the chemiluminescence reaction of nodular tissue.

The reagent was made by dissolving 100 mgm. luminol and 5·0 gm. Na_2CO_3 in 100 ml. water and adding 20 ml. H_2O_2 (10 vol. approx.) just before use. The very faint inherent luminescence of this solution was not regarded as sufficient to interfere with the reactions now described.

Solutions for test were then prepared as follows: (*A*) 4 ml. water + 1 ml. 5 per cent NaOH. (*B*) 50 mgm. fresh root nodules (*Trifolium hybridum*) ground with 1 ml. 5 per cent NaOH and diluted with 4 ml. water. (*C*) 50 mgm. fresh leaf tissue, from the same plant, ground with 1 ml. 5 per cent NaOH and diluted with 4 ml. water. (*D*) 50 mgm. fresh nodules, also from the same plant, dried in the steam oven and then extracted by grinding with 5 ml. water.

3 ml. portions of these test solutions were then added in the dark to 5 ml. portions of the reagent in test tubes. The reactions were as follows: (*A*) No reaction. On adding extra NaOH solution, no change. (*B*) An intense and vivid whitish-blue luminescence. This faded gradually, but addition of extra alkali gave a perceptible brightening of the fading luminescence. (*C*) A faint increase over the inherent luminosity of the reagent, the colour being altered somewhat by the presence of chlorophyll derivatives. Little, if any, change on adding extra alkali. (*D*) A strongly positive reaction, similar to that given by solution (*B*) but not nearly so intense. On adding extra 5 per cent NaOH to the fading solution, the luminescence increased so as to become much stronger than initially. Fading did not seem so rapid as in the case of solution (*B*).

The observations were then extended to solutions of (*E*) 50 mgm. stem tissue and (*F*) 50 mgm. root tissue, also from *T. hybridum*, and of (*G*) 50 mgm. potato tuber, each being ground with 1 ml. 5 per cent NaOH and diluted with 4 ml. water. These solutions reacted to the test in the same way as the leaf tissue solution (*C*), except that secondary addition of alkali decreased luminescence. A water extract of fresh nodules (*H*) behaves in the same way as the water extract of dried nodules (*D*).

These observations are consistent with the hypothesis that the most powerfully reacting compound in the plant tissues examined is the hæmoglobin of the root nodules, and that other compounds capable of yielding hæmatin are present in concentrations too minute to afford amounts of hæmatin capable of giving a strong reaction under the specified conditions. The results of tests (*D*) and (*H*) are consistent with the hypothesis that hæmatin formation during grinding with water or drying is too small to give a really intense reaction, but that subsequent addition of alkali splits off the prosthetic group of the hæmoglobin from the protein moiety and leads to the production of hæmatin so as to give a stronger reaction than initially.

It is possible that the chemiluminescence test may be of use as a rapid sorting test for locating in plant tissues unusual concentrations of substances capable of yielding hæmatin, or for the demonstration of hæmoglobin in leguminous root nodules where adequate spectroscopic equipment is not available.

I wish to thank Prof. D. C. Harrison for his advice on various possible interpretations of the reaction.

R. H. COMMON.

Department of Agricultural Chemistry,
Queen's University,
Belfast.
March 13.

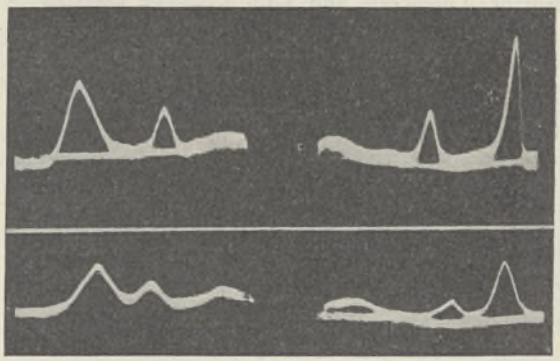
[1] McGrath, J., *Brit. Med. J.*, 156 (1942).
[2] Keilin, D., and Wang, Y. L., *Nature*, 155, 227 (1945).

Electrophoretic and Enzymatic Fractionation of Casein from Human Milk

SOME years ago I examined electrophoretically casein from cow's milk. It was established that this protein is not homogeneous[1]. The electrophoretic diagram showed three different boundaries which were assumed to correspond to three casein fractions, α-, β- and γ-casein. The fastest moving of these, the α-fraction, was isolated, and on analysis its nitrogen/phosphorus ratio was found to be higher than that of total casein.

It has been considered worth while, especially in view of the importance of the organically bound phosphorus for breast-fed babies, also to examine *human* milk casein for the existence of electrophoretically separable fractions and their phosphorus content.

As may be seen from the accompanying record, the electrophoretic pattern of human milk casein is similar to that of casein from cow's milk. Three



Descending ← → Ascending

ELECTROPHORETIC PATTERNS OF CASEIN FROM COW'S MILK (ABOVE) AND HUMAN MILK (BELOW); *p*H 7·62 (PHOSPHATE BUFFER), IONIC STRENGTH 0·15 (PHOSPHATE 0·10 + SODIUM CHLORIDE 0·05). THE PHOTOGRAPHS WERE TAKEN AFTER MIGRATION FOR 105 MIN. (ABOVE) AND 165 MIN. (BELOW) AT 5·70 VOLTS/CM. PROTEIN CONCENTRATION 1 PER CENT.

peaks are shown. The two which move quickest no doubt represent two definite fractions of the casein. The third peak might, at least in part, be due to a δ-effect. The same may also be true of the γ-fraction of cows' casein. As is shown in Table 1, its mobility is very low in different buffers. The α-casein from human milk also shows a higher phosphorus/nitrogen ratio than the original casein (Table 2). Thus, casein from human and from cow's milk is similar in this respect. However, the difference in phosphorus content between α-casein and the original casein is more pronounced for human milk casein.

TABLE 1. ELECTROPHORETIC MOBILITIES, IN cm.² V.⁻¹ sec.⁻¹ × 10⁵, OF THE FRACTIONS OF CASEIN FROM HUMAN MILK AT DIFFERENT *p*H (PHOSPHATE BUFFER). IONIC STRENGTH 0·1. TEMPERATURE 0·0°.

*p*H	α-casein	β-casein	γ-casein (?)
7·64	− 5·2	− 3·7	+ 0·9
7·40	− 5·0	—	+ 0·7
7·10	− 4·7	− 3·2	+ 0·9
6·72	− 4·7	− 2·9	± 0·0
6·46	− 4·1	− 2·4	± 0·0
5·92	− 3·3	− 1·8	± 0·0
5·64	− 3·0	− 1·5	± 0·0
5·42	− 2·8	− 0·9	—

TABLE 2. ANALYTICAL DATA FOR CASEIN FRACTIONS.

	% N	% P
Casein 1	15·14	0·46
Casein 2	15·11	0·47
α-casein 1		0·95
β-casein 2		0·87

Trypsin- and pepsin-resistant fractions of casein (from cow's milk) with relatively high phosphorus content have been isolated by several authors[2]. In order to find out whether this ferment-resistant fraction of casein is identical with, or a part of, the α-casein (which might be expected from the high phosphorus content of the ferment-resistant fraction) the progress of pepsin and trypsin digestion on casein from human and cow's milk respectively has been followed electrophoretically. It has been found that the α-component disappeared even during pepsin hydrolysis, and no demonstrable component of higher mobility was formed. Following the method of preparation of Damodaran and Ramachandran, it has also been possible to prepare enzyme-resistant phosphopeptone from human milk casein. In the barium salt of this, the phosphorus content was 4·28 per cent and the nitrogen content 6·57 per cent.

OLOF MELLANDER.

Department of Medical Chemistry,
University of Uppsala.

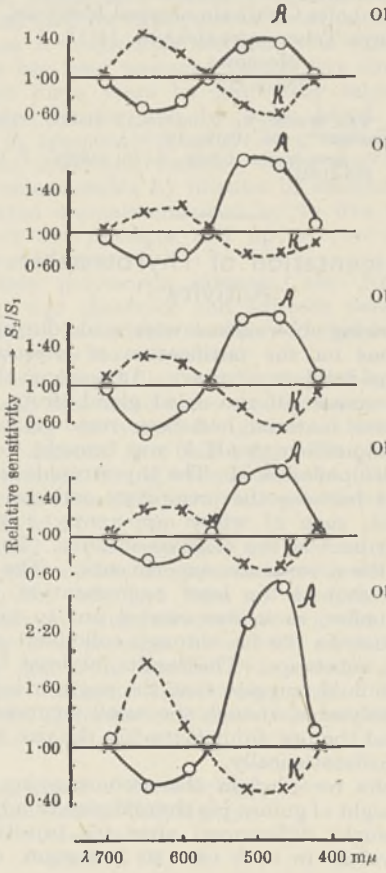
[1] Mellander, *Biochem. Z.*, 240 (1939).
[2] See, for example, Damodaran, M., and Ramachandran, B. V., *Biochem. J.*, 35, 122 (1941).

Electrotonus in Colour Vision

DURING the past year, we have studied the influence of a weak constant electrical current upon the foveal (colour) sensitivity of the human eye. The foveal sensitivity was measured in respect of monochromatic lights of different wave-lengths. Two silver electrodes were used. The indifferent one was put on the observer's hand, the second—the different one—being applied to the contralateral eyeball of the observer or (in some control series) on his temple near the lateral angle of the eyelids. The current used always had a strength of 0·2 mA. Our experiments, in which we determined the threshold values for foveal sensitivity, were carried out during 50–60 minutes of dark adaptation. At about the thirtieth minute of dark adaptation, when the foveal sensitivity reached its maximal stationary level, we switched on the current and allowed it to remain on for 4–5 minutes. During that period of electrical stimulation we determined the thresholds of the foveal sensitivity two or three times.

The sensitivity was calculated as the reciprocal of the transparency of the corresponding part of the absorbing photo-wedge used to alter the intensity of the monochromatic light stimuli. The sensitivity changes under the influence of applied constant current were indicated by the ratio S_2/S_1, where S_2 is the foveal (colour) sensitivity of the eye found at the third minute of electrical stimulation, and S_1 is the same sensitivity determined just before the current was switched on. Five persons with normal colour vision took part in our experiments as observers. The data obtained are plotted on the accompanying graph. The values of S_2/S_1 are shown as ordinates, the wave-length of stimulating light, in mμ, as abscissa. *A*-curves relate to the readings made when the positive electrode was in contact with the eyeball (anelectronus); the *K*-curves indicate the changes in sensitivity found in the case when the negative electrode was on the eye (cathelectrotonus).

From the graphs, it can be seen that under the influence of anelectrotonus and cathelectrotonus the changes in foveal (colour) sensitivity of the eye are of quite an opposite character. In the case of anelectrotonus, the sensitivity for the blue-green rays of the spectrum heightens, while the sensitivity for the orange-red rays of the spectrum diminishes. In



the case of cathelectrotonus, the sensitivity for orange-red rays is heightened and for the blue-green rays lowered. In both cases there are three regions in the spectrum which have shown no changes at all in response to the electrotonic stimulation used in our experiments. These regions are the two ends of the spectrum, red and violet, and the zone of yellow near 570 mμ.

After switching off the stimulating current we observed, as a rule, changes of foveal sensitivity, which were the inverse of those found while the stimulating current was on. After four or five minutes of electrotonic stimulation, the sensitivity of the eye continued to be different for about twenty to thirty minutes.

The effects described above can be explained on the basis of the well-known ionic changes in the living tissues caused by a constant current, namely, the relative heightening of the potassium ion concentration near the negative pole and the relative heightening of the calcium ion concentration at the positive pole. It is also well known that potassium and calcium are in many physiological respects as antagonistic. At the same time, the action of potassium ions resembles the stimulation of the parasympathetic part of the autonomic nervous system, whereas the action of the calcium ions is like stimulation of the sympathetic nerve[1]. Thus, our experimental observations relating to the dependence of our colour vision on electrotonus may also suggest its dependence on the autonomic nervous system as recently suggested by one of us[2].

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Moscow.
Nov. 25.

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Augmentation of Thyrotrophic Activity

THE following observations were made during pilot investigations on the purification of thyrotrophin from acetone-dried ox pituitary. An aqueous alkaline (*p*H 9–10) extract of the dried gland (from which some inactive material had been removed by isoelectric precipitation at *p*H 5) was brought to *p*H 2 with salicylsulphonic acid. The thyrotrophic activity was divided between the precipitate and the supernatant fluid, each of which apparently contained 100–200 per cent of the original activity. This was shown in three separate experiments. The third experiment showed the least augmentation, which was unfortunate, as it was carried out to test the effects of dialysis (20 hr. through collodion) on the augmenting substance. The results, at least for the supernatant fluid, suggest that the augmenting substance is dialysable, though the small augmentation observed and the few animals used in the test do not establish this statistically.

The results recorded in the accompanying table show the weight of guinea pig thyroid glands (adjusted for body-weight differences) after the injection of doses equivalent in each case to 300 mgm. of the original dried pituitary. The tests were carried out on groups of three animals according to the method of Rowlands and Parkes[1].

Expt.	Wt. of thyroid gland ± s.e. (mgm.)		
	Original Extract	Salicylsulphonic acid	
		Supernatant	Precipitate
1	30 ± 3	61 ± 5	65 ± 9
2	30 ± 2	63 ± 10	58 ± 6
3 : normal	28 ± 4	35 ± 5	27 ± 6
dialysed	28 ± 2	26 ± 3	26 ± 3

Weight of thyroid in 11 uninjected animals = 15 ± 2 mgm.

We have had no opportunity of investigating this matter any further, but assume that the augmentation is caused by delayed absorption from the injection site, since such effects of contaminants have been reported for many other biologically active substances. The effect, whatever the cause, must obviously be taken into account when impure thyrotrophic extracts are assayed by methods using subcutaneous injection.

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Structure of Wharton's Jelly

Bacsich and Riddell[1] have recently discussed the nutrition and structure of Wharton's jelly of the umbilical cord. Their letter was prompted by the description by Barcroft *et al.*[2] of a non-vascular circulation through the cord from placenta to fœtus. Bacsich and Riddell compare the avascular nature of cornea, cartilage and Wharton's jelly and suggest that their nutrition must be similar; they conclude that the non-vascular circulation may contribute to the nutrition of Wharton's jelly itself. They point out that cornea, cartilage and Wharton's jelly all contain similar metachromatic substances and say, "It appears justifiable to suppose that the substance responsible for the specific (metachromatic) staining reaction is either heparin, which is a mucoitin polysulphuric acid or a chemically allied substance because only these substances give a metachromatic staining reaction with toluidine blue".

We would like to direct attention to the work of Meyer and his colleagues[3,4,5,6] in America, and McClean and his colleagues[7,8] in Great Britain, who have shown that the acid polysaccharide, hyaluronic acid, is at least a major component of Wharton's jelly. This polysaccharide, which is apparently composed of equimolar parts of *N* acetyl glucosamine and glucuronic acid[3], is widely distributed as a constituent of synovial fluid[4], cornea[6], vitreous humour[3], skin[5,9], muscle[10], the cumulus cells and corona radiata of the unfertilized ovum[11] and the capsules of certain groups of streptococci[12,13,14]. Meyer and Chaffee[6] state that the hyaluronic acid of the cornea and skin exists as the sulphuric acid ester. It is known that hyaluronic acid forms an insoluble complex with toluidine blue; but according to Meyer and Chaffee it does not stain metachromatically whereas the sulphuric acid ester does. We would also direct attention to the exhaustive studies of Lison[15] on metachromatic

stains and their reactions; he showed that metachromatic staining depends primarily upon the presence of sulphuric acid groups attached to compounds of sufficiently high molecular weight. We have found that, owing to its solubility, hyaluronic acid is removed from tissues during fixation by ordinary histological methods, and, in order to prevent this, it is probably necessary to use some such fixative as Carnoy's fluid. It is therefore probable that the hyaluronic acid had been removed from the specimens of umbilical cord examined by Bacsich and Riddell and that the metachromatically staining substance described by them was chondroitin sulphuric acid, which Meyer and Palmer consider is a constituent of the connective tissue of the cord.

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Bacsich and Riddell[1], in their letter of March 3 on the structure and nutrition of the cornea, cartilage and Wharton's jelly, suggest that the metachromatic staining of the cornea with toluidin blue may be due to heparin or some other related compound. Jorpes, Holmgren and Wilander[2] briefly reported that a substance prepared from cornea which had the properties of a mucoitin sulphuric acid showed only a very weak heparin activity. They thought that this activity was due to the small amount of heparin extracted from the mast cells at the limbus, and that the general metachromasia was due to the mucoitin sulphuric acid. Meyer and Chaffee[3] have since isolated a mucoitin sulphuric acid from ox cornea and shown that it is the mono-sulphuric acid ester of hyaluronic acid, the sulphate-free polysaccharide which Meyer and Palmer[4] had isolated from Wharton's jelly and vitreous humour. They found that it is present in the cornea in a concentration of at least 1·8 per cent. They failed to isolate mucoitin sulphuric acid from the sclera, which shows no metachromasia.

A sample of ox cornea mucoitin sulphuric acid (ester sulphur 4·1 per cent) was very kindly tested for heparin activity for me by Dr. MacIntosh and found to be inactive. MacIntosh[5] compared the anticoagulant activity of various heparins and other sulphur-containing polysaccharides with their reaction with toluidin blue. He found that the two properties ran roughly parallel, mucoitin sulphuric acid having a negligible heparin activity and a colour value with toluidin blue of about 1 per cent that of the purest heparin. In spite of the relatively weak reaction between toluidin blue and mucoitin sulphuric acid, the concentration in the cornea is ample to account for the diffuse metachromasia. A 0·003 per cent solution of ox cornea mucoitin sulphuric acid gives an easily visible purple colour with dilute toluidin blue. There seems therefore no need to invoke heparin or some unknown substance to explain the metachromatic stain of the cornea substantia propria.

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Spontaneous Transmissible Tumours in the Syrian Hamster

SINCE 1930 a large number of Syrian hamsters have been bred in the Hebrew University, mainly for work on kala-azar. All the animals originated from a single family and have been distributed to laboratories to various parts of the world. A record of spontaneous tumours in Syrian hamsters is therefore of general interest.

During the last seven years, we have noted thirteen instances of spontaneous tumours among a thousand animals, which were carefully examined since they had been used for experimental work on leprosy. In one case a polymorph sarcoma was found. This tumour has been passaged twenty-five times during the last three years by grafts, by inoculation of macerated tumour and by heart blood. It metastases in lymphatic glands, liver, spleen, kidney, stomach, intestines, muscles, testes and ovary. It is not transmissible by filtrates of macerated tissue. Inoculated animals survived up to five months in the first ten passages and up to two months in subsequent ones.

Another polymorph sarcoma, also freely metastasing, was observed, and thirteen passages have been noted in sixteen months. Inoculated animals survive up to three months.

A carcinoma was discovered embedded in pancreatic tissue and was found to be readily transmissible and metastasing in lymphatic glands, kidneys, testes, spleen, pancreas, liver and lungs. Six passages have been obtained during twenty months. The majority of inoculated animals survived up to five months but a few lived up to one year.

Cortical hypernephromas (in the adrenals) have been observed in ten animals during the last seven years; but only two have proved transmissible by subcutaneous and intraperitoneal grafts. From one tumour five passages have been obtained in four years, and from another two passages in eighteen months. Minute metastases were found in the pancreas, lymphatic glands and suprarenals but longevity was not affected.

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A Hitherto Undescribed form of Adult Axis in the Genus *Batrachospermum*

THE genus *Batrachospermum* has always attracted interest as one of the few freshwater members of the Florideæ and on account of its distinctive appearance. Notwithstanding a general familiarity with the external form and early development of *Batrachospermum*, it has not been recognized previously that the old axes of some species may appear 'solid' in transverse section, either all or almost all trace of the primary central filament of cells being lost. Such a condition has been found to exist in three species of this genus (Fig. 1), and there is no reason for doubting that subsequent investigation may show it to occur in other non-ephemeral species. The three species mentioned have not been identified with certainty as comparison with type specimens has been impossible in present circumstances, but two undoubtedly belong to the Helminthoidea section of the genus. Only male plants of the third species, the one here illustrated, have been seen and hence its affinity remains in doubt.

Detailed study of one of the three species has shown the steps by which this 'solid' structure is attained, and these are to be described fully in a subsequent publication. Briefly, they are as follows: branches from the filaments which corticate the central filament from quite an early age actually penetrate the cells of this central filament in a manner similar to a parasitic fungus penetrating the host. Once inside, these invading filaments grow, branch and ultimately fill the upper part of the cell completely, as is shown in Fig. 1. In Fig. 2, which is a photograph of the same cell at a slightly lower level, the cell is almost full of invading filaments cut transversely. There may be so complete a disintegration of the cell wall at the upper end that all trace of it is lost. The diameter of the basal end of the cell is always much greater than at the apical end and there the wall may remain intact or else considerable remnants are to be seen as well as a space representing the area of the original lumen of the cell, traversed by a few filaments (Fig. 3). Filaments invading the central cells may pass from cell to cell in a longitudinal direction or they may enter at one side and directly pass out at the other side.

This secondary development in the centre of the axis is usually accompanied by a proportionately greater production of secondary branches of limited growth, resulting in an evenly cylindrical thallus. These axes may be stronger than the primary ones and hence may be of biological importance to the species.

The similarity of the general appearance of this secondary condition of the uniaxial type to the primary condition of the multiaxial type of construction in the Florideæ, such as is found in *Nemalion*, is so obvious that it needs no stressing: but the fundamental ontogenetic difference between the two types remains.

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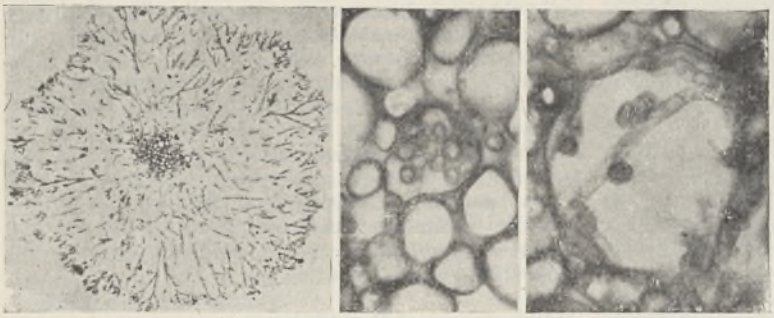
March 6.



1 2 3

(1) TRANSVERSE SECTION OF THALLUS OF *Batrachospermum sp.* NEAR APICAL END OF CENTRAL CELL (× 32). (2) AND (3) TRANSVERSE SECTIONS OF SAME CENTRAL CELL AS IN (1), THE FORMER BEING IN THE UPPER HALF OF THE CELL AND THE LATTER NEAR THE BASAL END (× 400).

Insect Transmission of the 'Swollen-Shoot' Virus in West African Cacao

DURING 1943–44, exploratory experiments were carried out at Tafo, Gold Coast Colony, to determine which insects might prove to be vectors of the well-known 'swollen-shoot' virus disease which is causing widespread destruction of native-grown cacao (*Theobroma Cacao* L.) in certain parts of West Africa, notably in the eastern province of the Gold Coast. Four recognizable 'strains' of the virus were tested, separately, in the experiments, namely:

I. Virulent strain. Characterized in the infected plant by the development of pronounced swellings in the recent ligneous growth; by a typical mosaic in the foliage especially noticeable in the newest leaves (flush) appearing after infection; and by death within a period rarely exceeding eighteen months in the case of plants infected when less than two years old.

II. Non-virulent strain. Swellings only, or at most an indeterminate chlorosis, not always present, in the foliage.

III. Non-virulent strain. Mosaic (mottling) only, of a pattern distinct from that shown by I, above.

IV. Non-virulent strain. Mosaic ('feather' type), quite distinct from the mosaics shown by I and III, above.

The following Hemipterous insects, all common on *Th. Cacao*, were used in the experiments:—Aphidæ: *Toxoptera aurantii* Boyer; Psyllidæ: *Mesohomotoma tessmanni* Aulm.; Coccidæ: *Ferrisiana virgata* (Ckll.), *Pseudococcus exitiabilis* Laing, *Pseudococcus citri* Risso.

All phases of the work, except the identifications of the coccids, for which I am indebted to specialists, were carried out by me personally. Prof. G. F. Ferris kindly determined *F. virgata* and *Ps. citri*, the identifications of other material of these species being confirmed by Dr. W. J. Hall; while Mr. F. Laing has been good enough to describe the new species of *Pseudococcus*, which appears to be indigenous on various forest trees and shrubs in the region, under the name *exitiabilis*.

Successful transmissions were obtained: (*a*) using the mealybugs, *F. virgata* and *Ps. exitiabilis*, with strain I of the virus; (*b*) using *Ps. exitiabilis* with strain II; and (*c*, *d*) using *Ps. citri* with strains III and IV, separately.

Numerous experiments with the aphid and the psyllid, conducted under precisely similar conditions to those with the mealy-bugs, but using much larger numbers of individuals, consistently yielded negative results. These results are given in the accompanying table, in which the signs + and − indicate positive or negative results, respectively, in an adequate series of experiments :

Species of insect	Strain of virus			
	I	II	III	IV
Ferrisiana virgata	+	−	−	−
Pseudococcus exitiabilis	+	+	−	−
Pseudococcus citri	−	−	+	+
Toxoptera aurantii	−	−	−	−
Mesohomotoma tessmanni	−	−	−	−

The selective results suggest that more than one distinct virus may be concerned in the complex. This is also to some extent confirmed by their effects on the plant (*vide supra*).

The earliest recognizable symptoms appeared in the experimental plants five weeks after transfer of insects from infected plants. In the course of numerous experiments, it was discovered that strain I could be transmitted by one individual female of *Ps. exitiabilis* ; also by this mealy-bug in its young larval ('crawler') stages. In one instance transmission occurred using females of this species, which were known to have lived on the infected source-plant for not longer than forty-eight hours. To ensure transmission, however, a minimum of ten females, preferably with accompanying larvæ, is advised, and proof is required that some of them have fed on both the infected source-plant and the uninfected experimental plant.

The work was carried out as part of a research programme financed by the Colonial Development and Welfare Fund. It is hoped to publish a full paper elsewhere at an early date.

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Unification of the Physical Fields

SCHRÖDINGER has stated[1] "At the back of our striving for a unitary field theory, the great problem awaits us of bringing it into line with quantum theory". With this, one may venture to differ, in two respects.

(1) Eddington answered Schrödinger's "great problem" by bringing space-curvature into line with quantum theory. He remarked[2] : "In the theory of relativity energy and momentum are coefficients of curvature in space-time ; in quantum theory they are characteristics of wave-functions in flat space. It is a big step towards unification of physics if we can find the precise connexion between these two ways of representing the same thing." He demonstrated that energy-momentum, usually expressed in terms of curvature, can become expressed in terms of probability distribution, and thence in terms of wave-functions as in quantum theory.

(2) The problem is rather one of bringing quantum theory into line with space curvature.

The two ways of representing energy-momentum can be coalesced into a space-curvature representation. The steps are the inverse of Eddington's ; probability distribution (wave function) is expressible in terms of space-curvature. In this way the inverse of Schrödinger's problem can be answered ; but in spite of this, he has to be content to realize[1] that he is ignoring "such features in the conventional description of the physical fields as are concerned with their quantum character".

My own theory of indeterminate space-time[3] is wholely inverse to Eddington's. Like Schrödinger, it uses the mathematics of relativity, and the axiom of the unsymmetrical affine connexion. Schrödinger is anxious to provide two mathematical entities in addition to the Einsteinian gravitational tensor, which are to be representative of the so-called meson field and the electromagnetic field respectively. Eddington has shown that the meson field is only an apparent but really non-existent range of the non-Coulombian interaction of two particles. My main purpose in using unsymmetrical affinity was to give the *uncertainty idea* a place in the primary axiom. For this purpose a number of components of affinity additional to those employed by Einstein was required. These additional components were to carry latent in them all the potentialities of discontinuity, so necessary in connexion with quantum characteristics. By suitable provision at the commencement, energy-momentum, and *uncertainty*, appear as coefficients of curvature ; in quantum theory they are all three characteristics of wave-functions.

My treatment stipulates that the additional components of the unsymmetrical affinity have to be *indeterminate*. Indeterminacy has a plain connexion with uncertainty. This stipulation calls forth certain repercussions elsewhere. A most important one is the non-appearance of a meson field entity. If desired, one can use the extinction of the Schrödinger meson-field entity as a necessary condition, discovering what the consequences are for the components of the affinity. Whichever way is chosen, the disposable components are indeterminate, and uncertainty unifies with the nature ascribed to space-time. This puts the meson field right out of the picture, in agreement with Eddington.

It is evident from Prof. Schrödinger's work that by omitting my primary stipulation, there is obtainable a perfectly determinate space-time system, within which uncertainty, and therefore quantum theory, can find no place. (Neither does it appear that a true electromagnetic system is possible in that case, because that requires indeterminate potentials.)

Eddington distinguished between the abstract geometrical origin and the "physical origin" (arrived at by averaging the scatter of blurred physical landmarks), and from his studies arose a number of corrections of an elementary statistical character, on current inaccurate views. One such statistical inaccuracy accounts for the apparent range of the really non-existent meson field.

Indeterminate space-time retains Eddington's "physical origin" and co-ordinate system, and works with it, relegating uncertainty (scatter) to a place in the space-curvature. He called such a system "Sigma-metric". Schrödinger works with what Eddington called the abstract geometrical system. Our *physical* system cannot be compared with an academic, abstract geometry—in particular the commutative properties of second partial derivatives in the one has only an indirect relation to the other, because the former is the subject of mathematical physics, whereas the latter is pure mathematics. It is these special commutative properties, to which I

refer, that have a direct bearing on quanta (that is, discontinuity). In my theory they give me the quantal part of the unification; in Schrödinger's, nothing, because they are in no way unusual.

A requirement in all electromagnetic problems is the proper statement of boundary conditions. So it is in respect of the energy of uncertainty. Once the boundary conditions are specified, the energy quanta become determinate. The boundary conditions for the quantal part of the problem and for the electromagnetic part are, not unnaturally, found to be the same in my analysis. This is where indeterminate theory links the indeterminism of electromagnetic potentials with the uncertainty principle of Heisenburg.

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Isomorphic Relationship between Rubidium and Thallium in Igneous Minerals

V. M. GOLDSCHMIDT[1] has been able to demonstrate that the radius of an ion is a fundamental factor in regulating isomorphic behaviour, ions of like size being capable of replacing each other isomorphically within a crystal lattice. The application of this law of crystal chemistry to a study of the distribution of the elements in the earth's crust has yielded fruitful results; in particular, the behaviour of many of the rarer elements during the fractional crystallization of a magma is now reasonably well understood. For example, Goldschmidt[2] has pointed out that, since the radii of Rb^+, Tl^+ and Cs^+ (1·49, 1·49 and 1·65 A., respectively) are similar to that of K^+ (1·33 A.), these elements are commonly found in potassium-rich minerals, particularly those of late pegmatitic phases.

As a result of the identity of the radii of Rb^+ and Tl^+, it was decided to investigate whether these two elements were quantitatively associated in igneous minerals, that is, capable of entering crystals of various types with the same facility. In all, seventy-two analyses of lepidolite (the richest mineral in both rubidium and thallium), zinnwaldite, amazonite, potash feldspars other than amazonite, phlogopite, muscovite and pollucite, have been carried out, and the analyses reveal a very close relationship between rubidium and thallium, the maximum variation of the ratio Rb_2O/Tl_2O being 35–450, that is, $10 \times 1{\cdot}3$, with an average ratio of 135. The concentration range covered in these analyses is about a thousand, and throughout there is no apparent change in the ratio, the only apparent factor influencing the ratio being the relative initial paucity or richness of either element in a particular source.

Graphically, a plot of log per cent Rb_2O v. log per cent Tl_2O reveals that a straight line of unit slope accommodates these points most satisfactorily, that is, Rb^+ and Tl^+ enter crystal lattices and replace K^+, and in the case of pollucite Cs^+, with exactly the same facility. In contrast, analytical data on rubidium and cæsium show that although these two elements are invariably associated, the ratio Rb_2O/Cs_2O is very variable and tends to decrease with differentiation as a consequence of the larger radius of the cæsium ion.

Direct evidence of the analogous isomorphic behaviour of Rb^+ and Tl^+ has been furnished by the analyses of more than one mineral from the same pegmatite, the ratio Rb_2O/Tl_2O remaining exactly constant.

This identity in the isomorphic behaviour of Rb^+ and Tl^+ during differentiation furnishes a striking and elegant example of the manner in which ionic size determines isomorphic behaviour and thus assists in regulating the distribution of the rarer elements.

All the analyses embodied in the above investigation were carried out spectrographically.

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Distribution of Wars in Time

A STATISTICAL regularity in the dates of wars has been brought to notice by the following numerical process. A list was prepared of wars in the world as a whole. Each calendar year was thereby characterized by the number, $x = 0, 1, 2, 3, 4, \ldots$, of wars which began in it. Next, the number, y, of years which had each such character was counted. A similar procedure was applied to the beginnings of peace. Here are some results:

	x =	0	1	2	3	4	>4
War, y =		63	35	9	2	1	0
Peace, y =		62	34	13	1	0	0
$110\ e^{-\mu}\mu^x/x!$ =		62·0	35·5	10·2	1·9	0·3	0·0

where $\mu = 63/110$. The formula is the Poisson law of improbable events. Other phenomena, known to be described by the Poisson law, include the distribution in time of the alpha particles emitted from radioactive substances[1], or of deaths by kick from a horse[2].

This impersonal account of the beginnings of war and of peace contrasts with the personal details in the newspapers and history books. In somewhat the same manner the statistics of marriage contrast with a love-story in a biography. The Poisson law is statistical in the sense that it does not predict the date of any future peace or war.

The particular set of wars summarized in the above table are fatal quarrels, which caused from $10^{3.5}$ to $10^{4.5}$ deaths, and which ended from A.D. 1820 to 1929 inclusive[3]. But the Poisson law, with other constants, also describes the beginnings of wars from A.D. 1500 to 1931, as set out in Prof. Quincy Wright's list[4].

A more critical account of these regularities has been accepted for publication by the Royal Statistical Society.

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[2] Bortkewitsch, quoted by Pearson, K., "Tables for Statisticians", (Cambridge University Press, 1914), lxxvii.
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CIVILIAN CONTRIBUTION TO EDUCATION IN H.M. FORCES

THE report of the Central Advisory Council for Adult Education in H.M. Forces for the six months ending September 1944 presents further evidence of the remarkable growth of education in the Services and of the inestimable contribution made by civilians. During the period under review 59,023 single lectures, 2,955 short courses (average number of meetings 5), 2,358 classes (average number of meetings 9), and 348 intensive schools, leader's courses and conferences, are known to have been arranged through the agency of regional committees. Besides these activities, other classes were arranged by local education authorities direct with the Services, while many other informal meetings are difficult to represent statistically. By far the greatest quantity of work was done for the Army, especially the Anti-Aircraft Command; but a considerable amount was done for the Navy, the Royal Air Force, and the United States Forces. Since much of the educational work is co-educational, it is difficult to show how much advantage was taken by the Women's Services of regional committee facilities; but the amount of all-women activities was approximately one-sixth of the whole.

Analysis of the subjects taken shows that, as usual, current affairs accounted for the greatest demand in lectures and short courses. Of the classes, handicrafts and languages were most popular. An illuminating comment on the work as a whole is that the number of handicraft classes continued to show substantial increases, despite the all-round tightening in the supply of tools and materials. There was an increased demand for single lectures on science topics, and a considerable rise in the number of classes in 'non-vocational' science. This interest in science was undoubtedly stimulated by those regional committees which made deliberate attempts to provide facilities and to make them widely known. The response was particularly encouraging where it was possible to cater for voluntary audiences. It is unlikely, however, that any great demand for science will be forthcoming until there are far more science lecturers and teachers who will pay at least as much attention to the presentation of their subjects as to their content.

In music, the demand continued to be for general talks and discussions, and piano and gramophone lecture-recitals, although many analytical lectures and classes in the history and appreciation of music were also held. Wherever suitable lecturers were available, the demands for drama were more than enough to keep them fully occupied. A number of play-reading circles and speech-training classes were formed, while drama festivals were organized and assisted. Much was also accomplished at music and drama week-end schools, which are extremely popular as a voluntary activity with members of both men's and women's Services. On the arts side, the main task was in the raising and maintaining of standards, the development of creative work, and the widening of the range of crafts practised on many sites, rather than the expansion of pioneer work. Among the various informal activities undertaken, a gardening advisory service, which was arranged by one regional committee, invites comment. This service supplied notes on food production, as well as personal advice. 95,000 plants raised in the university botanic gardens were distributed to units taking advantage of the advisory scheme last season. These included vegetables, shrubs, herbaceous plants, alpines and annuals, in addition to gift boxes of American vegetable seeds. Figures of produce yields are not available; but the quality of cultivation was said to be high.

Of the 348 intensive schools provided by the regional committees, 101 were residential and more would have been if accommodation had been available. Towards the end of the summer, several committees planned to provide residential hostels to be used solely for their Service work, and, during the autumn, one hostel in England and another in Scotland were opened. It would be impossible here to describe adequately the different courses held; but the following may be regarded as illustrative examples. One regional committee arranged a series of seven voluntary week-end courses in music, drama, the film, art, science, literature, and the art of living. About sixty students attended each week-end, and there were waiting lists of up to a hundred for each course. To assist in the training of teachers for the Release Period Education Scheme (*Nature*, **154**, 525; 1944), five regional committees serving an Army Command arranged a series of courses, each of a fortnight in duration, in science, history, geography, literature and economics.

Perhaps the most astonishing feature of the report as a whole is that it was possible to carry on so many educational activities during one of the major climacterics of the War. For many of the committees, the period was a difficult one owing to the uncertainty of the demand from week to week. The slight decline in the number of single lectures and short courses was more than counterbalanced by the increase in the total number of classes. In many ways this was an advantage, and one committee reported that: "Education in the Services has probably approached more closely to civilian peacetime adult education than before. Previously we had to maintain an uneasy balance between keeping the units amused and encouraging them to think for themselves, and since the lecturers who can do both are rare, the sheer volume of demand in the past obliged us to use (more frequently than we liked) the 'popular' lecturer for pioneer work. With a smaller demand, we have been able to use lecturers of a considerably higher standard". The Central Advisory Council, the regional committees, and all the civilians who have helped in this richly consequential work deserve the warmest commendations of a democratic country.

Service men and women at home have shown their gratitude for the work done for them by these civilians, and, to a lesser extent, those serving abroad are now being given an opportunity to share in the facilities. Recently, a scheme was started whereby prominent civilians make tours abroad to lecture to H.M. Forces. Some of these visits have been concluded with memorable results. It is pleasant to note that, during the next few months, some well-known men of science are to take part in this overseas' lecturers scheme. With lessening demands on them for purposes of war, perhaps more of them will be freed to take part in this valuable work.

The report was issued by the Central Advisory Council for Education in H.M. Forces (secretary, Dr. Basil A. Yeaxley) at Rewley House, Oxford.

THE DURHAM COALFIELD

THE fuel technologist, the mining engineer and the geologist will find material of interest in the Regional Survey Report on the Durham Coalfield*. The pressing needs of war have revealed serious defects in the organization and technical efficiency of British coal-mining, and the Minister of Fuel and Power has wisely decreed that the basis of any attempt to create an efficient and prosperous mining industry is a national stock-taking of the already depleted coal resources of Great Britain.

At an early stage in the report it is made clear that this coalfield has made, and will continue to make, a vital contribution to the national economy. Durham coals vary much in character; but this area is justly renowned for its coking and gas coals, described as "probably the best in Europe". In West Durham certain of the seams yield coal which produces an excellent metallurgical coke, hard in texture and low in sulphur and phosphorus—a coke in great demand for foundry and general metallurgical work. Emphasis is very properly laid on the fact that the seams yielding the best coking coals have but a limited life, and it is estimated that, at present rates of production and consumption, the total coking coal reserves will be extracted within seventy years. The conservation of these resources of coking coal is clearly a matter of first importance, and the report makes a significant reference to the considerable export trade prevailing in this class of coal in normal times. Almost the whole of the coalfield produces gas coals of good quality. Much of the coal required by the gas works of London and the south coast comes from Durham, and prior to the War, Durham coal was shipped to many of the European gas works.

There has been much speculation as to the probable life of the British coal seams; but it is certain that the regional surveys will provide data for reasonably accurate estimates. Since previous attempts to arrive at the coal reserves of Great Britain much information has been compiled by the Geological and Fuel Research Surveys, while the financial transaction involved in the nationalization of mineral royalties necessitated the preparation of proposals for working during the next thirty years, with an estimate of the reserves remaining in 1972. With certain reservations, the estimated reserves of the Durham Coalfield are given as 3,000 million tons. It appears that this is a conservative estimate; many thin and low-quality seams are not included in the figure, and it is also probable that there are further substantial reserves of under-sea coal. In 1938, the output was approximately thirty-three million tons, so that at this rate of production much of the Durham Coalfield will be exhausted in the next hundred years. Nevertheless, coal will continue to be produced from this area for a much longer period; seams not now regarded as a commercial proposition may well prove workable in the years ahead, "providing, as it were, a second harvest".

The conditions prevailing in the under-sea areas are of great importance to the coalfield. It is disappointing to read that there are deteriorations in certain seams as they pass seawards. The Durham Coalfield is apparently affected in the same way as the East Midland Coalfield, which suffers a marked deterioration in the seams underlying its eastward extension. Exploration has been carried to a small distance beyond the three-mile limit, but it is expected that one or two of the better seams will be workable for a distance of six miles or more out to sea.

An astonishing feature of the report is the statement that some 738 million tons of coal have been sterilized for one reason or another. The bulk of this coal has been left in order to avoid damage to buildings by mining subsidence, and the report states that if arrangements could be made for supporting the surface by stowage, some 468 million tons of this sterilized coal might well prove economically workable. Since sterilized coal has not been included in the estimate of total reserves, and represents about 25 per cent of the latter figure, it is clear that the introduction of modern methods of stowage would result in a considerable addition to the resources of the coalfield. To obviate further undue sterilization of Durham coal, care is needed in the selection of sites for future houses and buildings.

The industrial life of this area is based on its high-quality coal seams, and any consideration of future prospects must take into account the possibilities of using coal as a basic raw material. Included in the report is a short account of the findings of the Coal Processing Industries Panel of the North-East Chemical and Allied Industries Development Committee. It is made clear that the establishment of new coal-processing industries will involve a very large capital expenditure, and that the success of any project of this nature will be dependent on adequate co-ordination. "The Gas-Grid Scheme, the extraction of olefines, methane and other gases, the production from these of chemicals and plastics, the conversion of coke to petrol, Diesel oil and other hydrocarbons, are all inter-related, and part of one comprehensive coal processing project."

The remainder of the report deals with the possibilities of de-watering a large tract of flooded coal in south-west Durham, the question of increasing productivity by further mechanization of the mines, and the housing requirements of the mining community. As a guide to the present position and future of the coalfield, the report is a document of major importance, of interest to all who believe that the future of Britain is dependent on the proper use of our remaining coal resources.

H. HARTLEY.

* Ministry of Fuel and Power: Durham Coalfield Regional Survey Report (Northern "B" Region). Pp. 48. (London: H.M. Stationery Office, 1945.) 1s. net.

REFORM OF THE PATENT LAW IN BRITAIN

DURING the past few years, there have been many allegations that monopoly rights created by patents for inventions are being used contrary to the public interest by large industrial corporations. One suggestion which has been mooted in Great Britain for rectifying this alleged abuse is that each patent shall be granted subject to the condition that any person may obtain a licence to work the invention on terms to be agreed with the patentee or, in case of disagreement, to be settled by the Comptroller-General of Patents. This suggestion, in its original form, has not met with general acceptance, and a modification of it is put forward by Prof. M. Polanyi in a pamphlet reprinted from the *Review of Economic Studies*, entitled "Patent Reform: a Plan for Encouraging the Application of Inventions".

Prof. Polanyi expresses the opinion that to grant all patents subject to compulsory licensing on terms

to be settled by the Comptroller would produce practically the same results as if patents had been abolished altogether; he suggests an alternative system under which licensing is supplemented by Government rewards to patentees on a level ample enough to give general satisfaction to inventors and their financial promoters. In operating the system, patents would be granted by the Patent Office in accordance with the present law and, shortly after the patent had been granted, the Comptroller would lay down obligations to be fulfilled by licensees. These obligations would have only one purpose, namely, to ensure the assessment of the economic values created by the invention. Licensees would have to make returns to patentees on certain technical points designated to them and, on these returns, patentees would base their own assessment of the economic value created by the invention. The Government would undertake to pay annually to patentees a fixed fractional part—perhaps one-tenth to one-third—of the approved total of assessed values created by the invention during the previous year. It is an integral part of the system that public rewards should be so adjusted as to make them sufficiently attractive to inventors and backers of inventions in general. In many cases, the process of assessing the economic value of the invention for purposes of rewarding the patentees might be carried out directly by Government inquiry, to the exclusion of any reports by licensees to patentees.

It is claimed by Prof. Polanyi that under the existing system the presence of the attributes of novelty, utility and subject-matter in each invention leads to serious abuses of legalism and to consequent inequitable remuneration of inventors, and that his system would provide an equitable reward for each of the investigators taking part in the production of a patentable invention. He foresees, however, two dangers, though he is of opinion that each can be avoided. In order to obviate the danger of corruption and arbitrary oppression, which is never far removed from the grant of Government subsidies, the whole procedure of their assessment should be made fairly rigid, by requiring the returns on which they are based to include only data endorsable by accountants' certificate. Further, in his opinion, the fact that considerable sums of public money would be required under his system, in order to pay rewards to patentees, cannot be held against it because the burden would be more than offset by the benefits accruing to the public.

It is possible that in respect of each of these dangers Prof. Polanyi is too optimistic. The reluctance of the British Government to provide public money to produce benefits that cannot be readily shown to be due to the money so used is well known; and it is not at all certain that a Government would provide an amount of public money that would be accepted as adequate by patentees and their financial backers, and at the same time be recognized by the public as justifiable.

Further, experience has shown that the danger of corruption and arbitrary oppression is not easily avoided. One outstanding example of direct government rewards to inventors is the system at present in operation in the U.S.S.R. There, a special form of patent protection was established in 1931 which entitled the inventor to receive certain fixed compensation and various living or social privileges, and which contained elaborate provisions for the testing and exploitation of inventions. On March 5, 1941, the Council of People's Commissars of the U.S.S.R. promulgated a decree introducing a new "Inventions Statute" and repealing the former one dated April 9, 1931. The following extract from *Pravda* of April 15, 1941, stated its objects:

"The main object of the revision is to establish a definite procedure for examining and consummating inventions and technical improvements and to give a number of privileges to inventors to protect them from bureaucrats and procrastinators.

"The Statute establishes definite periods within which offers of inventions and technical improvements must be accepted or rejected, or definite tests inaugurated. The reason for these rigid regulations is that we have not yet got rid of our bureaucrats, who beat off inventors like importunate flies. There are inventors who for five years have been sitting on the doorsteps of commissariats, trusts, newspaper offices and complaints offices in a vain endeavour to get an answer as to the fate of their proposals".

Even if Prof. Polanyi's hope of avoiding these dangers is realized, it is not clear how his system will overcome the fundamental difficulty raised by compulsory licensing of all patents. So far as Great Britain is concerned, after an inventor has obtained the grant of a patent, either he or his financial backers must provide the capital necessary to work the invention in this country on a commercial scale if it is desired to retain the monopoly. If the monopoly is lost by compulsory licensing, the difficulty of providing this capital will be increased; for not many inventors or their financial backers will be prepared to erect plant for the commercial exploitation of an invention with the risk that it may be a failure, if their competitors are at liberty to obtain a licence should it be a success.

CAROTENE AND SUGAR CONTENT OF CARROTS

THE nutritional value of carrot roots is due largely to their contents of carotene and sugar, and both these constituents are most abundant in the phloem. It is of interest to note, therefore[1], that although the phloem constitutes more than 60 per cent of the root the proportion is greatest in young roots, although carotene content increases with maturity but is least in 'large strain' carrots[2]. Carotene content is influenced by manuring, but carotene losses during storage are negligible until the stored roots sprout in the spring. Although sugar content is often a good index of 'quality', the correlation between desirable taste and refractive index of the juice is often upset by the presence of an unidentified bitter constituent[3].

Maintenance of high quality (that is, high sugar stocks) may be difficult, as these roots when replanted for seed production often rot and so fail to produce a satisfactory crop of seed[4]. Seed production, too, may be complicated by the temperature requirements of the carrot[5], H. S. Sakr and H. C. Thompson reporting that the initiation of flower primordia is inhibited at temperatures in excess of 70° F. although doubtless the critical inhibiting temperature is influenced by the previous history of the carrot.

Not less important than the taste and sugar content is the shape of the roots, and traditionally carrots are grown on land "manured for a previous crop", fresh animal manure being thought to induce

branching or forking of the roots. G. J. Raleigh[6] reports, however, that with carrots in sand culture supplied with a complete nutrient solution, the addition of cow manure free from urine did not increase the amount of root branching, but cow or horse urine did cause forking. Attempting to discover what substances were responsible for this effect, Raleigh found that urea, ammonium hydroxide and ammonium carbonate all induced root branching, but a variety of growth-substances tried were without effect.

[1] Werner, H. O., *Proc. Amer. Soc. Hort. Sci.*, 38, 267 (1941).
[2] Pepkowitz., L. P., Larson, R. E., Gardner, J., and Owens, G., *Proc. Amer. Soc. Hort. Sci.*, 44, 468 (1944).
[3] Brown, H. D., Miller, M. K., Alban, K., Schulkers, R., and Murmane, C., *Proc. Amer. Soc. Hort. Sci.*, 44, 465 (1944).
[4] Ellis, M. K., *Proc. Amer. Soc. Hort. Sci.*, 40, 536 (1942).
[5] Sakr, H. S., and Thompson, H. C., *Proc. Amer. Soc. Hort. Sci.*, 41, 343 (1942).
[6] Raleigh, G. J., *Proc. Amer. Soc. Hort. Sci.*, 41, 347 (1942).

FORTHCOMING EVENTS

Saturday, May 19—Monday, May 21

ASSOCIATION OF SCIENTIFIC WORKERS (at the Beaver Hall, Garlick Hill, London, E.C.4), Annual Council Meeting.

Saturday, May 19

At 2–6 p.m.—Address by Prof. P. M. S. Blackett, F.R.S. (president), and discussion on future policy for science.

Sunday, May 20

10 a.m.–6 p.m.—Education policy. Debate on a proposal to initiate a political fund. Report on industrial work, negotiations with employers, etc. Motions on the Trades Disputes Act and the National Health Service.

Monday, May 21

10 a.m.–1 p.m. Relations with scientific organizations overseas.

Tuesday, May 22

INSTITUTION OF ELECTRICAL ENGINEERS (RADIO SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Discussion on "Non-Ferrous Contact Springs" (to be opened by Dr. H. G. Taylor and Dr. L. B. Hunt).

QUEKETT MICROSCOPICAL CLUB (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 7.30 p.m.—Mr. E. R. Newmarch: "Fluid Mounting, with special reference to Narcotizing and Fixing Polyzoa".

Wednesday, May 23

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. Paul Adorjan: "Wire Broadcasting" (Thomas Howard Lecture).

PHYSICAL SOCIETY (at the Royal Institution, Albemarle Street, London, W.1), at 4 p.m. Presentation of Duddell Medal to Dr. F. W. Aston, F.R.S.

Prof. E. N. da C. Andrade: "The History and Future of the Physical Society" (Presidential Address).

Annual General Meeting.

Thursday, May 24

INSTITUTION OF ELECTRICAL ENGINEERS (at the Institution, Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. J. C. Read: "High-Voltage Steel-Tank Mercury-Arc Rectifier Equipments for Radio Transmitters"; Mr. P. A. T. Bevan: "The Application of High-Voltage Steel-Tank Mercury-Arc Rectifiers to Broadcast Transmitters".

ASSOCIATION FOR SCIENTIFIC PHOTOGRAPHY (at Caxton Hall, London, S.W.1), at 7.0 p.m.—Annual General Meeting. At 7.30 p.m.: Mr. S. H. Thorpe: "Photography applied to Research in the Steel Industry".

Friday, May 25

ROYAL COLLEGE OF SURGEONS (at Lincoln's Inn Fields, London, W.C.2), at 4 p.m.—Prof. Arnold Sorsby: "Blindness in Great Britain: the Structure of the Blind Population and the Causes of Blindness".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5 p.m.—Sir Geoffrey Taylor, F.R.S.: "The Internal Structure of Turbulent Fluid Flow".

APPOINTMENTS VACANT

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

SENIOR TECHNICAL OFFICER in the War Department Power Plants (Mechanical) Branch, Military College of Science, School of Tank Technology, Chertsey, Surrey—Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia Street, London, W.C.2 (quoting Reference No. C.2558.A) (May 22).

LECTURER IN MECHANICAL and/or ELECTRICAL ENGINEERING SUBJECTS at the Technical College, Cardiff—Director of Education, City Hall, Cardiff (May 22).

LECTURER IN THE CERAMICS DEPARTMENT, North Staffordshire Technical College, Stoke-on-Trent—The Principal (May 26).

LECTURER IN ELECTRICAL ENGINEERING at Aston Technical College, Birmingham—Chief Education Officer, Birmingham Education Committee (May 28).

SENIOR LECTURER IN AERODYNAMICS at the Royal Aircraft Establishment Technical School, Farnborough—Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia Street, London, W.C.2 (quoting Ref. No. C.2571.A) (May 28).

RESEARCH POMOLOGIST at the Department of Agriculture and Horticulture, University of Bristol, at Long Ashton Research Station—The Secretary and Registrar, University, Bristol, 8 (May 31).

PROFESSOR OF AGRICULTURE AND DIRECTOR OF THE COLLEGE FARM at the University College of North Wales, Bangor—Acting Registrar (May 31).

PROFESSOR OF MATHEMATICS at the University College of North Wales, Bangor—The Acting Registrar (May 31).

LECTURER IN ANTHROPOLOGY with special reference to West Africa, TUTOR IN COLONIAL WELFARE PROBLEMS, LECTURER IN ECONOMICS, and LECTURER IN INTERNATIONAL RELATIONS at the London School of Economics and Political Science—The Acting Secretary, London School of Economics, The Hostel, Peterhouse, Cambridge (May 31).

AN ASSISTANT CHIEF ENGINEER (MECHANICAL) (Ref. No. C.2589.XA), and an ASSISTANT CHIEF ENGINEER (CONSTRUCTION) (Ref. No. C.2590.XA) at the Tata Iron and Steel Co., Ltd., Jamshedpur, India—Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia Street, London, W.C.2 (quoting appropriate reference number) (May 31).

LECTURER IN GEOGRAPHY at King's College, University of London—The Secretary, King's College, Strand, London, W.C.2 (June 1).

LECTURER IN ELECTRICAL ENGINEERING, with knowledge of MECHANICAL ENGINEERING, at the Ipswich School of Technology—The Chief Education Officer, Education Department, 17 Tower Street, Ipswich (June 1).

DIRECTOR OF THE SCHOOL OF LIBRARIANSHIP, University of London——Academic Registrar, University of London, Richmond College, Richmond, Surrey (June 1).

PROFESSOR OF GEOGRAPHY at the London School of Economics and Political Science—The Academic Registrar, University of London, Richmond College, Richmond, Surrey (June 4).

LECTURER IN PHYSICS at Loughborough College, Leics.—The Registrar (June 7).

DEMONSTRATOR and also TECHNICIAN IN THE CHEMISTRY DEPARTMENT, Guy's Hospital Medical School, University of London—Prof. C. S. Gibson, F.R.S., Chemistry Department, Guy's Hospital Medical School, London Bridge, S.E.1 (June 16).

TWO UNIVERSITY LECTURERS IN MATHEMATICS at Cambridge—The Secretary of the Appointments Committee (Dr. R. Stoneley), Pembroke College, Cambridge (June 30).

DEMONSTRATOR IN METALLURGY in the University of Cambridge—The Secretary of the Appointments Committee of the Faculty of Physics and Chemistry (Dr. F. B. Kipping), University Chemical Laboratory, Pembroke Street, Cambridge (July 2).

READER IN ANTHROPOLOGY at the London School of Economics and Political Science—The Academic Registrar, University of London, Richmond College, Richmond, Surrey (July 9).

PROFESSOR OF BACTERIOLOGY at University College Hospital Medical School—The Academic Registrar, University of London, Richmond College, Richmond, Surrey (Sept. 24).

A LECTURER IN GEOGRAPHY and a LECTURER IN BIOLOGY at Avery Hill Training College, London—Principal, at Sandy Mount, Crosland Moor, Huddersfield.

LECTURER IN BOTANY at Birkbeck College, University of London—Clerk, Birkbeck College, London, E.C.4.

LECTURER IN MATHEMATICS at Woolwich Polytechnic, London, S.E.18—The Secretary and Clerk to the Governors.

RESEARCH ASSISTANT (female) with Biological or Zoological qualifications at the Christie Hospital and Holt Radium Institute, Withington, Manchester 20—The General Superintendent.

TEACHERS OF MATHEMATICS, CHEMISTRY, METALLURGY, MECHANICAL ENGINEERING at the County Secondary School and Cumberland Technical College, Workington—The Principal.

SENIOR ASSISTANT IN THE DEPARTMENT OF METALLURGY, two LECTURERS IN THE DEPARTMENT OF ELECTRICAL ENGINEERING, LECTURER IN BUILDING SCIENCE, LECTURER IN PHARMACEUTICAL SUBJECTS (temporary) at the Birmingham Central Technical College, Suffolk Street, Birmingham—The Principal.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Reports of the Council and Auditors of the Zoological Society of London for the year 1944. Pp. 101. (London: Zoological Society, 1945.) [284

Institution of Gas Engineers. Copyright Publication No. 270: The Estimation of Small Quantities of Nitric Oxide. Pp. 4. (London: Institution of Gas Engineers, 1944.) [284

The Physical and the Human Geography of the British Isles, with a map in eight Colours. (In English and Polish.) By Dr. Zofia Holub-Pacewicz. Pp. 38. (Glasgow: Książnica Polska, 1944.) [284

Geological Survey of Great Britain. Wartime Pamphlet No. 42: Economic Geology of Canonbie Coalfields (Dumfriesshire and Cumberland). By B. Hilton Barrett and Dr. J. A. Richey, assisted by W. E. Graham; with Appendices by Dr. A. E. Trueman and Dr. R. Crookall. Pp. 54. (London: Geological Survey and Museum, 1945.) 2s. 6d. [284