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COLONIAL DEVELOPMENT

WHATEVER form Anglo-American co-operation may ultimately take after the War, there are certain fields in which some continuity appears to be inevitable. Notably this is true of a whole range of questions such as the future of agriculture in the United States and in the British Empire, questions of nutrition and raw materials and colonial development. Moreover, measures already undertaken, such as the establishment of a joint Canadian-American Defence Board in 1940, the first of a series of moves towards closer collaboration between the United States and its northern neighbour, like the long-term leasing to the United States of British bases in the Caribbean Sea and on the Atlantic seaboard, can scarcely be dropped, much less reversed, on the termination of hostilities with Germany. They must affect British colonial and imperial policy as profoundly as they are modifying the isolationist attitude of the United States which has characterized the last twenty-five years.

This is indeed foreshadowed in the fourth and fifth points of the Atlantic Charter, as Mr. Churchill has aptly termed it. These points deal with the questions of access to raw materials, and collaboration in the economic field ; and they make it quite clear that Great Britain and the United States will not be parties to a world regime in which countries could be held to ransom through lack of natural products. The experience of the past twenty years has made it quite clear that policies of national self-sufficiency cannot meet the needs of humanity. Man is fundamentally a social animal ; and the progress of civilization—indeed its very existence—has come to depend on active collaboration not only between men as individuals but also between the nations. Such collaboration in the economic field is laid down in the Atlantic Charter as a principal factor in the new world order which must follow the defeat of Nazism. A nation can no longer be allowed to disregard the effect upon its neighbours of its policy in the economic and other fields.

The way in which Canada compromises the isolation policy of the United States has been indicated by Mr. John MacCormac in his recent book "Canada : America's Problem"*, in which he also emphasizes the significance of Canada in imperial affairs, and the shifting centre of gravity of the British Commonwealth. The whole tendency of present events is to accentuate the importance of Canada in the Empire, and whether or not the solution to the problems of Anglo-American relations lies in some form of English-speaking union as Mr. MacCormac suggests, his assertion that if Anglo-American relations are ever to be given an enduring basis, Canada must be their keystone, is not easily challenged. The foresight shown by Bismarck when he asserted that the

* Pp. 256 (London : Jonathan Cape, Ltd., 1941.) 10*s.* 6*d.* net.

inherited and permanent fact that North America speaks English is the greatest political fact of modern times is emphasized by all the rapid developments in Anglo-American relations of the past twelve months.

These new oceanic pre-occupations of the United States are creating new ties and a fuller community of outlook between them and the loosely knit oceanic structure of the British Commonwealth of Nations. The recent American occupation of Iceland is only one of a number of developments tending to bring the two democracies closer together in this way. Among these are the developments to which Lord Moyne referred in his statement in the House of Lords on July 9, regarding progress which has been made under the Colonial Development and Welfare Act. Already twenty-four schemes under that Act have been approved, the largest of which involves an expenditure of £200,000 for re-afforestation in Cyprus. Thirty-four more are under consideration, and at least seventy others are soon to be submitted. Full use is being made of expert help. The great majority of the new proposals are the result of the work of the Comptroller of Development and Welfare in the West Indies, Sir Frank Stockdale, formerly agricultural adviser to the Secretary of State for the Colonies, and a member of the Committee on Nutrition in the Colonial Empire.

Further evidence that careful plans are being laid for the development of the new constructive policy in colonial administration is seen in Lord Moyne's announcement of the establishment within the Colonial Office of a small official committee, with Lord Hailey as chairman, to prepare the ground for the decisions which would be needed to plan Colonial economics under the new conditions after the War, and to collect the facts that would help that Committee to deal with many other post-war problems that will arise. Since the great African Survey associated with his name, Lord Hailey has already carried out two other inquiries in connexion with African colonies of Great Britain and their relations with those of Belgium and Free France. His appointment to this new committee is clearly in line with ideas expressed last year at the Eighth American Science Congress on the fundamental conception of a world resources board and planning bureaux to promote the conservation and utilization of natural resources for the welfare of all nations in the interests of permanent peace.

The developments outlined by Lord Moyne and referred to again by him in the House of Lords on August 16, and the Colonial Development and Welfare Act are aimed at securing the economic and social development of the colonial territories. The new policy, with its recognition of the Colonies as societies, the welfare and development of which should be the guiding principles of their economic organization, and its determination to raise so far as possible the standard of living of all those classes whose standards are at present below an adequate minimum, however, also facilitates co-operation with other countries to that end. In many fields such as nutrition and health, including the attack on pests and diseases, like the rinderpest, the tsetse fly and the locust, to which Lord Hailey referred, and also in the development of an economy of mixed farming and native industry or of a constructive system of social services, we have much to gain by pooling experience and knowledge with our Allies and partners.

The foundations for such scientific co-operation already exist, and Lord Moyne's statement should give further inspiration to workers in such fields. There are, however, even more powerful factors implementing such co-operation. The prosperity and future of the Colonies must be profoundly affected by the changes brought about by the War. Quota schemes for imports from various countries, and commodity schemes which ensure various producing countries a fair share of the world market, are rapidly superseding older systems of tariffs as a means of controlling the direction of trade. Government control would involve much more than the readjustment of surpluses, and the organization of export marketing already achieved with the Colonies of our Allies must be continued in some shape. This involves a co-ordinating authority on a world-wide, a regional, or a continental basis, and the new policy accordingly seems likely in practice to involve increased international co-operation, while its spirit assists such relations.

American opinion is clearly coming to face the possibilities of framing programmes relating to colonial areas, raw materials, shipping, migration and other questions so as to remove obstacles to the full use of the world's resources, as the *Fortune* round-table discussion showed. The handling of colonial problems in the spirit of wise and far-sighted generosity which informed Lord Moyne's statement cannot fail to invoke Anglo-American co-operation in this and in other fields. The crop purchase schemes and the much larger schemes under the agreements recently made with Australia and New Zealand for dealing with the surplus produce of the two Dominions during the War, and which are to be extended to South Africa and the Colonies, are not merely designed to prevent the worst forms of distress and keep the colonial producers going. The agreements are indeed an economic necessity to the Dominions if they are to make their contribution to the War and to maintain a healthy economic life, but at the same time

they are part of a great scheme of international reconstruction.

The building up of reserve stocks of food contemplated in the agreement is concerned not only with the possibility of a long war but also with the difficult food situation that must arise when the War ends. The agreement ensures that large reserves will be available when the War ends, and these reserves will be used, in part, according to the promise of the British Government, to relieve the needs of the occupied countries of Europe. Canada stands by these arrangements because her staple food product is wheat, which will be handled at an early meeting of the International Wheat Committee in Canada. The policy, however, will be extended to Canada and by that time, as a result of the work of the Willingdon Commission, some of the South American States may also come in. Moreover, the present agreement already involves co-operation with the United States, for example, in the supply of tin-plate for meat canning, of milk-drying plant to New Zealand, while it is expected that the United States will take some of Australia and New Zealand's surplus meat as shipping is available, sending Great Britain an equivalent amount over the shorter Atlantic route. Negotiations are also proceeding with the United States for the release of refrigerator ships to be used in carrying the surplus food stocks, and other work in this field is being carried out by the Leith-Ross Committee in regard to co-ordination of storage arrangements.

We have here the beginnings of an important policy for international co-operation in handling food stocks and primary products. It needs little imagination to see how with wise handling it could develop into a far-reaching attempt to raise standards of living in backward areas all over the world, and to translate minimum standards into ideal standards on a firm basis of scientific and social research. Vision and foresight will of course be required to see that developments out of these agreements continue to facilitate common action with the United States and the Latin American republics, and do not involve Great Britain in any exclusive imperial block. The moral obligations of economic leadership must be acknowledged by Britain and the United States, if only to enable them to solve their own problems of surplus food production and economic freedom. The major responsibility may indeed well rest with the United States, but the constructive international statesmanship required is not the affair of any one nation alone.

The prospects thus opening up before us are far from being limited to the simultaneous résumé of the primary producers and the starved populations of the world. The relief of hunger is coupled with the struggle against disease, the elimination of malnutrition and the application of the knowledge of nutrition to the building of a sounder social and economic order, the reorganization of transport and the return to civil life. Here, as Mr. Winant has recently reminded us, the International Labour Organisation is still making important contributions, and a firm basis already exists for that international co-operation which is imperative if we are to deal effectively with these problems. Out of that practical co-operation may well develop by degrees the framework of organization essential in a stable world order.

The primary importance of Anglo-American co-operation and leadership should not lead us to overlook the fact that co-operation of all the free peoples is required to build a new order in which the four freedoms for which we contend are firmly enshrined. It is doubtful whether we have even yet begun to utilize to the full the opportunities for mutual understanding and for co-operation in the essential research for the organization of a new order which are inherent in the presence in Great Britain of Governments representing so many of the submerged States of Europe. One suggestion which has been advanced is the establishment in London of a social research centre on the model of the Institut Solvay in Brussels, where officials of these Governments would meet to discuss their social problems. Equipped with a library and a staff able to give expert advice in the choice of books and on sources, such a centre might do much to promote the sympathetic understanding of our respective social systems, and to stimulate investigations and co-operation which would bear fruit in the work of the International Labour Organisation.

The suggestion is one that merits serious exploration, for it could undoubtedly clear away many misunderstandings and differences. Less spectacular than the Inter-Allied meeting at St. James's Palace on June 12, it could make an important contribution to unity and to the task of world reconstruction, if not indeed to the implementing of the war effort. The opportunities and possibilities which are already to our hands through the changes brought about by the War are already so great that only the grossest bungling can fail to use them as stepping-stones to an order worthy of the sacrifices now being made in defence of freedom Nowhere is this truer than in imperial and colonial affairs, where we can attest the sincerity of our ideals and of our conception of trusteeship. There we can explore the possibilities of co-operation with the United States and the other free nations to establish economic freedom in a new way and to eliminate some of the underlying causes of war; there, too, perhaps we may gain the experience out of which a new and adequate form of world order may emerge.

UNIVERSITY OF MICHIGAN EXPEDITIONS TO WEST GREENLAND

Reports of the Greenland Expeditions of the University of Michigan

Part II : Meteorology, Physiography, and Botany. William Herbert Hobbs, Editor. (University of Michigan Studies, Scientific Series, Vol. 6.) Pp. vii+288+47 plates. (Ann Arbor, Mich. : University of Michigan Press ; London : Oxford University Press, 1941.) 5 dollars.

THE more general reports upon the series of five expeditions to West Greenland undertaken by the University of Michigan between the summers of 1926 and 1933 are published in this volume. (Part I, which appeared in 1931, was limited to "Aerology, Expeditions of 1926 and 1927–29" ; the originally planned third and fourth parts will not be published.) The present part is predominantly meteorological, but the five papers which comprise it cover such a wide range of subjects that they seem best considered separately; nor are they of similar value, or necessarily concerned with the same geographical region.

(1) *Meteorological Studies*, by J. E. Church. The first part of this paper deals with "Climate and Evaporation in Alpine and Arctic Zones", the alpine zone being the Lake Tahoe Basin lying around lat. 39° N. and long. 120° W. in the central Sierra Nevada and the arctic one being the Holstensborg region near the arctic circle on the west coast of Greenland. Useful tables indicate the rates of evaporation of water, snow and ice under different conditions ; under comparable conditions in both regions these tend to be in the ratios 3, 2 and 1, though around melting-point the results are very variable and the last two figures may actually be reversed. Wind and temperature are the dominant factors in determining the rate of evaporation, which during the incidence of *foehns* may be extraordinarily rapid.

Progressing inland in the Holstensborg region the climate tends on the whole to become more continental in type, although (as in other northern regions) unusually favourable conditions are to be expected locally around the heads of the longer fjords, while on the inland ice the relative humidity is consistently greater and the temperature range sometimes lower than near the coast. Plant ecologists will note with interest that at one point well away from the coast, evaporation during the warmest two months of summer scarcely exceeded the rather low precipitation (including condensation), so that "the winter accumulation of moisture still remained in the humus and underlying blue clay as a source of growth". The protection of the soil by a "thick mat of tundra" reduced evaporation ("including that amount transpired by the tundra") to 63·1 per cent of what it was from open water, which "shows vividly the xerophilous . . . character of the Arctic tundra".

The second part of the paper deals with "Temperatures of Arctic Soil and Water", the studies indicating that inland in West Greenland "the soil rather than the icecap is the cause of the low water temperatures which prevail, aided somewhat by supercooling at night", for "frost . . . exists even at the end of the season at the depth of 16 to 23 inches beneath the surface". Seawater temperatures are variable locally, depending on currents (themselves affected by winds), proximity to the shore and to icebergs, etc., as well as on the season ; on the whole they are little lower in north-central than in south-central West Greenland.

(2) *Report of the Northern Division of the Fourth . . . Expedition*, 1930–31, by William S. Carlson. This paper is again in two parts, the first of which describes detailed aerological and meteorological studies made near the inland ice east of Upernivik (lat. 72° 47′ N.). Numerous pilot balloon flights showed that the mean monthly velocity of free-air wind increased steadily with altitude from 250 to 2,000 metres, this increase on the average totalling more than 100 per cent. At higher altitudes there were further, but less regular, increases until 8,000 m. was reached, and then a marked tendency to decrease around 10,000 m. Calms were very few above 250 m. and none was observed above 2,500 m. Wind direction also changes chiefly in the first 2,000 m. Detailed studies of four storms when correlated with published observations made synchronously in other parts of Greenland, at sea and abroad, bring to light remarkable local variations but further confirm the general belief that the 1,600-mile-long ice-cap of Greenland "exercises a dominant control in the weather of at least a part of the Northern Hemisphere", for "it impedes the natural progress of some storms, redevelops energy in others and is responsible for their inception".

The second part of the paper is on the geology and glaciology of Upernivik Fjord and the region northwards to Inugsulik Bay. It is based largely on observations made during travelling under winter conditions and is accordingly rather sketchy. It appears, however, that the fronts of some of the glaciers in this region have receded as much as 2,000 or even 5,000 ft. since the visit of Ryder in 1886–87, and that in this interval fresh nunataks have emerged. The large glaciers which come from the ice-cap, dissecting the ice-free coastal strip and calving actively into the sea, show the greatest rate

of flow around their centres, the velocity decreasing towards the sides. On the Upernivik glacier the much greater maximum velocity (67·44 ft. in twenty-four hours) observed in April 1931 than in April 1887 suggests that Ryder's claim in excess of 100 ft. in twenty-four hours might be exceeded during summer on this glacier nowadays, as the summer rate is liable to be considerably greater than the spring one.

(3) *Meteorological Report of the University of Michigan – Pan American Airways Greenland Expedition, August* 1, 1932–*July* 31, 1933, by R. L. Belknap. This was the fifth and last expedition of the series and also functioned as one of many units making investigations during the "Second International Polar Year". It was based on Nugssuak Peninsula, in the northern part of the region described in the last paper. The lowness of the average daily air temperature (less than 10° C. in all months) was attributed to the modifying effect of the inland ice near which the station was situated, although very rapid changes in temperature and pressure occurred especially in relation to storms when the wind sometimes exceeded 100 m.p.h. The results of previous expeditions were confirmed by the observations that "the southeast winds were the most frequent and were of the highest velocity", and that although storm effects were often remarkably local the major disturbances were in Greenland first observed in the extreme south, whence they apparently "traveled up the coast on both sides" without crossing the ice-cap.

(4) *Physiographic Studies in the Holstensborg District of Southern Greenland*, by R. L. Belknap. In this region, which is unusually dry, the ice-free marginal land is wider than elsewhere in West Greenland, being up to 110 miles in width although still dissected by fjords and valleys. The outer coast is rugged and mountainous but the country inland, which is uninhabited and less known, is of rounded hills and numerous lakes of all sizes. The topography appears to support the theory of fjord origin by glacial erosion guided by joint systems rather than by the enlargement of fractures chiefly by stream action. Shells of recent marine animals found on terraces more than 100 ft. above sea-level indicate a corresponding rise from the sea in relatively recent times. Previously this district, like other parts of Greenland, had been one of great submergence ; now there are some suggestions of slight submergence again. It is reported as "evident that the entire area as far as the present coast line has been covered by the icecap". Wind is an important agent of erosion and deposition ; it may considerably affect the shape of a boulder (rock not specified) in a single year. The importance of solifluxion is also noted but the "explanation of the formation of soil and rock polygons" was surely not "worked out" satisfactorily by the few authors cited.

(5) *The Vascular Plants of an Inland Region within the Holstensborg District of West Greenland*, by Carl O. Erlanson. This last and shortest paper is most disappointing. The area concerned is a limited one at the head of Söndre Strömjord, occupied chiefly by low, rounded hills of gneiss interspersed with small lakes. But the ecological notes on "Vegetational Aspects" are scrappy and studded with doubtful statements and unwise generalizations, while the "Systematic List" which comprises most of the paper contains many inaccuracies. We are even told on p. 265 of *Cassiope tetragona* that it "may become a dominant plant over large areas, sometimes to the entire exclusion of other species except mosses and liverworts" and on p. 273 that it is "Rare. A bog plant" (which it is not characteristically in any of a dozen arctic and subarctic regions known to the reviewer). There are other instances in which the citation of the habitat of a single gathering of a species in the systematic list is misleading, while a glance at any part of the paper will show that the nomenclature is badly out of date. A footnote informs us that this contribution was "prepared and submitted for publication in the spring of 1929". Since then arctic botany has advanced so enormously that a large proportion of the names used in this paper are wrong or doubtful and most of the records claimed as particularly significant are no longer so, if indeed they ever were. The result is a plethora of inaccuracies the majority of which would have been questioned by a competent plant taxonomist or phytogeographer.

One lays down the volume with rather mixed feelings. Obviously much useful fact is recorded in it, often for the first time ; obviously, again, the editing leaves much to be desired. The numerous photographs are usually good but their subject is not always significant. There are more than the apparently inescapable minimum of omissions and inaccuracies, as well as inconsistencies and unwarranted generalizations, while whole "lines" of literature were persistently neglected by the authors, including much that has been written about the Canadian side of Davis Strait and Baffin Bay. Had the investigators realized that central West Greenland is only a small part of the great arctic checkboard, many of their conclusions would have been less sweeping. The impression, then, is one of youthful enthusiasm rather than mature scholarship ; nor do the total results compare favourably with those obtained by some other recent northern expeditions which had much more limited resources in time, personnel and particularly money. NICHOLAS POLUNIN.

A NEW DEAL IN EDUCATION

Education for the People
By Dr. F. H. Spencer. Pp. vii+306. (London: George Routledge and Sons, Ltd., 1941.) 7*s.* 6*d.* net.

TOTAL war is accustoming us to the necessity for radical changes in the pattern of our society. After the War we shall not be able to go back to our old way of living. We may try to reinstate the old order, leaving it to the inevitable next cataclysm to teach us what the present one fails to do, or we can go forward with imagination and resolution to create a new order. The first few years after the War will be crucial. Will the resolution we are showing now be spent, or baffled, as it was after the War of 1914–18, or will it carry us on to the creation of a new pattern of living in which war will not be inevitable? The decision depends a good deal on people thinking now what we shall have to do. Some people are thinking now, and though we are not yet within sight of winning the War, it is not premature to be doing so. In the field of education, the officers of the Board of Education have their plan of reconstruction, but for not very convincing reasons it remains a secret plan. Dr. Spencer does a public service by making public now his plan for a 'new deal' in education.

It is symptomatic of the attitude of our people to education that the developments Dr. Spencer demands are so far-reaching that, if the experience of the years after the last War is a guide, we shall have to struggle very hard to secure them, and yet at the same time they are not nearly radical enough to meet the situation. Dr. Spencer's proposals are not revolutionary. He advocates courses of action which the better local education authorities, the teachers and others have been urging for years. We must, of course, see that nursery schools are available for all children of nursery age and not merely for a few thousands of them, and that enough teachers are trained to staff the schools. The size of classes must, of course, be reduced from forty or fifty and more to thirty or less. The Hadow reorganization, still left half done after fifteen years, must be rapidly completed. School buildings, eighty per cent of which Dr. Spencer asserts to be out of date, must everywhere be brought up to the more generous and efficient standards of our best examples. The school-leaving age must be raised—Dr. Spencer says to fifteen—and adolescents must make the transition to full-time employment through a period of half-time attendance at day continuation schools up to the age of eighteen. Every boy and girl whose potentialities can best be realized by education of the secondary school kind must be enabled to go to a secondary school without fee. Children must have the safeguard of a medical examination, not at intervals of several years but annually; the insurance companies know the advantages of this, the Board of Education, too, must see them.

These proposals are literally modest ones in relation to the reasonable needs of our children and our country. The case for them, argued so convincingly by Dr. Spencer, may be regarded as established, and their fulfilment is now urgent. In war-time we are carrying out far bigger schemes with far more urgency, and at a far greater cost than anything Dr. Spencer requires. To meet our immediate educational needs, Dr. Spencer requires mainly capital expenditure of £100,000,000 on new buildings in the next five or ten years, and a doubling of our present small annual expenditure on the maintenance of education to £100,000,000. He requires further that the President of the Board of Education should be "a first-rate statesman of real eminence and power". (The publication of Dr. Spencer's book, by the way, has not been speedy enough to keep pace with the changes in the presidency, and the "administrative grandfather" of his president is already a great-grandfather.) Other requirements are a real Board of Education with 'guts' and an active and informed local electorate.

It is a paradox that to many a man in the street this new order will seem visionary and impracticable, while to many who believe they discern the causes of our present discontents it will not seem a new order at all. The ignorant and the faint-hearted will consider education lucky if it gets so much; those who know that our society cannot merely be patched up will want to shape the things to come more boldly and more creatively than Dr. Spencer. They will, for example, think him somewhat timid in not raising the school-leaving age to sixteen for the boy of average ability, as it already is for his more intelligent fellows in the secondary school and his less intelligent ones in the special school. They will be unimpressed by the demand for juvenile labour, and will not consider the time necessary for the more intelligent to reach the modest standard of the School Certificate too long to prepare the less intelligent for the difficult and responsible business of living in a world of great social and economic as well as scientific complexity.

Dr. Spencer insists, and all students of education

and of society will agree that he rightly insists, that an educational system always shares the characteristics of the social system of which it forms part. He insists, and all democrats will agree that he rightly insists, on equality of opportunity in education. He does not make it clear that he sees there can be no equality of opportunity in education unless there is at least a much closer approximation than at present to equality of opportunity for the enjoyment of the goods of life which our society renders possible. The opportunity in which Dr. Spencer demands equality is the opportunity to be trained to take part in a highly competitive struggle which results in very unequal opportunities for security and the enjoyment of what life can offer. As long as the arena is open, the junior and even the infant schools will train their children for the scholarship examination, the secondary school will train its pupils for the privileged position which the School Certificate confers. The senior school may achieve parity of status with the secondary school, in the size of classes and the qualifications of teachers; but parents are not much interested in the size of classes or the qualifications of teachers; they send their children to the secondary school, if they can, because they know that that way lies a more secure, a better-paid and more socially esteemed kind of job. The implications of Dr. Spencer's two propositions, indeed, go deep. If we follow them without flinching we shall find that in our new deal we shall have to reshuffle the hands more thoroughly than Dr. Spencer suggests.

R. A. C. OLIVER.

TENDENCIES IN BIOCHEMISTRY

Annual Review of Biochemistry

James Murray Luck, Editor; James H. C. Smith, Associate Editor. Vol. 10. Pp. xi+692. (Stanford University P.O., Calif.: Annual Reviews, Inc., 1941.) 5 dollars.

IT has become increasingly difficult to escape from the War. Our daily life, our friends, the newspapers are full of it; it pops up in any book we get from the library, and our last random selection from our own shelves was the Trojan war on which, according to gossip, much of our strategy is still based.

The "Annual Review of Biochemistry" brought us a breath of fresh air from California. We were able to picture the Stanford University in its jewelled setting as we saw it, not bombed and in ruins in defence of freedom of thought and action. Even so, the editors complain of delays and irregularities and contributors are less international.

This is the tenth year of this valuable volume, and we have grown to wonder how we ever got on without it; perhaps because the output of papers was much smaller. Apparently nothing can now stop the publication of individual experiments as scientific papers, and the old-fashioned complete paper is a thing of the past. No one can keep up with the literature as a whole; someone has to write summary articles in each particular field; someone else has to write a section in an annual report. In these some degree of criticism and selection is exerted, whereas in the large dictionary-like compilations the editor puts in all he can find and leaves the reader to take his choice and select the grist from the chaff.

Before long it may be impossible to publish an abstract of every paper both on the ground of cost and unwieldiness. But nothing will stop the writer of scientific papers.

There is progress on every front in biochemistry. It is akin to the discovery of a new continent fertile with running streams: the covered wagons of investigation are well equipped. Progress is largely in detail, the great truths will emerge later when the ground is cleared. For example, a great deal has become known about biological oxidations and reductions, a subject which would be easier to understand if its followers wrote in English instead of shorthand. This, alas! must be a universal criticism.

More enzymes have been purified, but there has been little real progress. A lot more is known about the polysaccharides and, as was to be expected, now that a definite search is being made for these a very considerable number has been discovered. In a year or so it will be possible to say whether Nature, besides its main products of cellulose and starch, joins up the odds and ends as she listeth, or whether any definite relationship, as the polymerized molecule grows larger and larger, is to be observed. Much interest is attached to alginic acid, the polyuronide from common seaweed, which is likely to be of very considerable industrial importance, and may be eventually made on a large scale. The presence of the acid groups in the molecule gives the chance to make a range of salts of varied properties.

It is being realized that we do not know nearly enough on the chemical side of the amino acids and of the constituents of proteins. Such work is

laborious, and has been out of fashion, but it is being taken up again. Real progress is being made with the study of phosphorylase, the enzyme responsible for the reversible conversion of glycogen or starch into glucose. The reviews make little mention of the synthesis of starch from glucose phosphate in this way achieved by Hanes at Cambridge: it is the most outstanding piece of work of the last year or so.

Hormones and vitamins still cause the publication of thousands of papers: it is to be doubted whether Lord Woolton reads any of them. Here and there is progress, also much doubtful work; it will require another ten years work to see the plain where the trees once stood in this subject; the reports give them 150 pages.

Nutrition is the subject of greatest importance to-day and to-morrow, and there is just a chance that something of real value to the peoples of the world may come out of the work. There are good reviews on nutrition of man, animals and plants, including the burning questions of soil deficiencies and minerals. These are highly controversial questions, and the practical farmer does not always accept the conclusion of the scientific worker. If only the excreta of the petrol engine were of value to the land all would be well—otherwise, according to some, we must be prepared to return sewage to the land or find out how to make humus on the largest scale. There is need for many years of experiment and for critical examination of the results, but the subject is so important that both zealous workers and the necessary ample funds are likely to be available in many countries.

We have a final plea to the editors, namely, that the writers of each section of the report should preface it by a paragraph or two indicating the chief achievements and tendencies in the subject. Apart from easing the task of the reviewer, such would appeal to almost every reader of the sections in which he is not an active worker.

E. F. ARMSTRONG.

DEFICIENCY SYMPTOMS IN PLANTS

Hunger Signs in Crops

A Symposium prepared by George M. Bahrt, Bailey E. Brown, Arthur F. Camp, H. D. Chapman, H. P. Cooper, O. W. Davidson, Ernest E. De Turk, George N. Hoffer, Henry A. Jones, James E. McMurtrey, Jr., Edwin R. Parker, Robert M. Salter, George D. Scarseth, Joshua J. Skinner. Edited by Gove Hambidge. Pp. xii+327+79 plates. (Washington, D.C.: National Fertilizer Association, Inc., 1941.) 2.50 dollars.

UNHEALTHY growth of crop plants, apart from trouble induced by diseases or pests, is usually associated with physiological causes, which in some cases imply excess or deficiency of various substances utilized in the metabolism of the plant. The relative quantity of these substances is immaterial, as the plant suffers as much from a deficiency of an element such as boron, of which only a minute trace is required, as from a deficiency of a major element, such as nitrogen, required in large quantities. In practice it is deficiency rather than excess that is most likely to occur, and various signs and symptoms present themselves.

Only by careful and accurate observation and experiment is it possible to ascertain the meaning of these symptoms, and considerable experience with any one crop is needed before the observations can be systematized and set out for the guidance of the ordinary grower. Work on deficiency symptoms or "hunger signs" has been carried out by a large body of scattered observers on a considerable variety of crops. In the volume under review investigators with special knowledge of certain crops or groups of crops have epitomized the present state of our knowledge of the known deficiencies for those particular plants. Major and minor nutrients are all considered, and the symptoms, cause and ameliorating treatment are discussed.

The range of crops covers tobacco, cereals, potato, cotton, vegetables, deciduous fruits, legumes and citrus, thus giving a comprehensive survey of the position with regard to the chief world crops. Many illustrations are given in black and white and in colour. As is usual with colour photographs these need careful interpretation, for it is easy for a non-expert to be misled into attributing hunger signs to the wrong element, especially if a bias exists in favour of any particular nutrient. If this is borne in mind the illustrations provide an extremely useful guide and fill a want that has long been felt by workers in this field. A key to the plant nutrient deficiencies is given for most of the crops, which provides an excellent supplement to the illustrations. The citation of references is wisely restricted to a small number specifically associated with each crop.

Altogether, the committee on fertilizers of the American Society of Agronomy is to be congratulated on the production of a volume which will prove specially useful as a laboratory guide for all workers on plant deficiencies, as well as an illuminating text-book for growers and for students of plant life.

W. E. BRENCHLEY.

SCIENCE AND WORLD ORDER

By Sir Richard Gregory, Bart., F.R.S.

AT the Cambridge meeting of the British Association three years ago, a new Division for the Social and International Relations of Science was constituted. Since then the full forces and resources of science have been used to devastate the civilized world. Responsibility for the discovery of these powers of destruction must be accepted by men of science, but communities and Governments decide how they shall be used in purpose and policy. No limit can be seen to such powers, and no end to the horrors they present to human life, when exercised without regard for its sanctity.

Whether scientific knowledge is used for social betterment or to make civilization a mockery depends upon statesmen and not upon men of science, who, however, alone understand its possibilities. It may not be necessary to have intimate acquaintance with such knowledge in order to anticipate effects of its applications, but it is obviously desirable for statesmen and administrators to have full appreciation of its powers. Without such understanding and insight, no social structure can be made secure against disruption.

The Conference on Science and World Order, to be held at the Royal Institution, on September 26–28, will deal with a few relations of science to government, administration and other agencies concerned with constructive planning for the present and the future (see NATURE, September 13, p. 311 and p. 338 of this issue). In the main, the point of view will be that of world resources and human needs generally, and not those defined by geographical or political boundaries. Distinguished ambassadors and other leaders in close contact with governmental authority will participate in the conference, either as chairmen or contributors of papers. It is believed that the conference will thus promote social and international contacts of far-reaching consequence.

Science is responsible for the discoveries of these powers, and engineering for their applications. Knowledge of this kind, referred to use or action, determines the material shape of civilization. It is available to the whole world for work and thought; either to increase the amenities of human life everywhere or to bring misery and violent death to the peoples of the earth. We see to-day the devastating effects which scientific discovery and invention can have upon civilized life when their might is made the sole arbiter of right. The acceptance of this claim means the rejection of all ideals of human fellowship, and reversion to conditions of the jungle.

Schemes of social reconstruction naturally differ for different places and peoples; but they should all be capable of fitting into a world framework. This means planning in an international instead of a national spirit, while giving every nation or community full opportunities to develop in its own way, provided that the common end is the betterment of conditions of life.

When civilized peoples agree to unite in such a commonwealth in which each group is autonomous, without conflict of general purpose, we may hope that the world will be saved from the dangers which now threaten to destroy it. Man has shown himself capable of rising above his animal instincts by his activities in many directions, and, wisely guided, he can use the gifts of scientific knowledge as agencies of good instead of instruments of evil.

In the terrible conflict in which many nations of the world are now engaged, there can be no doubt as to the side upon which the true spirit of science is fighting. Men of science would be false to their traditions if they failed to defend their pursuit of knowledge from the forces which now assail it. They are united with all free citizens of the world concerned with progressive human development in resisting such attacks and eliminating the evil influences which make their achievements diabolic instead of divine.

The commonwealth of science is a true democracy, in which no distinctions of birth, race, or geographical boundaries are recognized. It cannot tolerate the use of force to exclude members of any communities from belonging to its fellowship, or to deprive any citizens of their fundamental human rights. The democratic principles of science are much the same as the scientific principles of democracy, and free men of science everywhere can subscribe to them.

A declaration of these principles will be made at the close of the conference. It accepts for science the world outlook embodied in the declaration of the rights of man of the Sankey Committee, advocated by Mr. H. G. Wells, and its spirit is the same as that of the momentous Anglo-American statement of peace aims, though it does not pretend to be of the same significance. The cause in which all such declarations are made is that of all humanity. It is the cause of progressive civilization and can be attained only by action in which wisdom is combined with knowledge.

PARACELSUS (1493-1541)

By Prof. J. R. Partington, M.B.E.

PHILLIPUS THEOPHRASTUS BOMBASTUS VON HOHENHEIM, who afterwards assumed the name Paracelsus to indicate that he believed himself as great a physician as Celsus, was born towards the end of 1493 at Einsiedeln in Switzerland, then part of Germany. His father was a practising physician of repute and his teaching laid the foundation of the medical career of the son. Of the early life of Paracelsus nothing is known beyond conjecture until 1526, when he appeared at Strasburg as a physician, described as doctor and admitted to citizen rights and to a Guild of Surgeons. He studied medicine, but it is not known how. In his writings he emphasizes that he got most of his useful knowledge from artisans and from the humbler assistants of the medical profession, whom he rates higher than the schools. On the other hand, he also once stated on oath that he had become a doctor of the University of Ferrara, and it is difficult to understand his short-lived official appointments unless he was properly qualified. Besides his medical knowledge, Paracelsus also says he had great experience for a long time with many alchemists and metallurgists, and he undoubtedly visited many mines and smelteries in his travels some time about 1514. These travels probably took in most European countries, including England, at various times, but those further afield are doubtful.

The information Paracelsus acquired from the miners and alchemists seems, from what he says of it, to have been fairly superficial and such as could have been picked up by almost anyone in conversation. It would, however, have suggested to him the possibility of using metallic preparations as remedies. If he did study in Italy this would have provided a direct source for some features of his teachings, since his so-called philosophy is a mixture of German folk-superstition with the thaumaturgic elements of Neo-Platonism, then popular in Italy by reason of its revival by Ficino. The view that Paracelsus himself was the originator of the use of chemical remedies is quite mistaken, since this had been gaining ground since the time of Arnald of Villanova, who died nearly two centuries before Paracelsus was born.

While at Strasburg Paracelsus must have enjoyed more than a local reputation as a physician, since he was sent for by Frobenius, the celebrated publisher of Basle, whose illness had resisted the attempts of the physicians of that town to effect a cure. Whatever else may be obscure in the life of Paracelsus it seems quite certain that he was able to relieve diseases the curbing of which was beyond the powers of the regular medical system. It also seems probable, and is directly asserted by Boerhaave, that Paracelsus's medical fame lay in his skill in surgery and in his daring use of remedies, including chemical remedies, which were outside the list of those permitted to the physicians of his time. He was able to effect at least a temporary cure of Frobenius, and by the influence of his patient, and of that of Œcolampadius (who was professor of theology at Basle) and of Erasmus, who was then staying with Frobenius, Paracelsus was appointed professor of medicine at Basle. There is no evidence that he lectured there on chemistry.

For various reasons the stay at Basle was a short one. Paracelsus gave offence by lecturing in German instead of Latin, by abusing the old medical authorities and ridiculing—even it is said publicly burning—their writings, and by litigation with influential persons about his fees. After two years he was forced to leave Basle in disgrace. Thereafter much of his life was spent in precarious circumstances and in moving from place to place. He seems, however, often to have been treated with respect and to have enjoyed the acquaintance and hospitality of prominent citizens, but he also experienced poverty and met with contumely and contempt, which he knew how to return in kind. His arrogance and violence are beyond doubt, but these should not influence us in forming an estimate of his ability or in seeking for evidence of his solid achievements. He constantly emphasizes the futility of mere professional ritual, and in contrasting the silk-clad doctor spending his time cultivating the benevolent interest of the influential, with the alchemist working in his laboratory in a leather apron, he pointed the way which so many since his time have found it necessary to tread if any real progress is to be made. His insistence on the experimental method as contrasted with reliance on tradition is clear, and he is justly regarded as one of the great reformers of medicine.

After his official position came to an end, Paracelsus seems to have spent much of his time writing, and several important works were published in his lifetime. After his death, what were regarded as his genuine works were collected and edited by Huser and published in ten volumes during 1589–1591. This edition is the basis of all later ones and was prepared with unusual care and skill.

The whole works have recently been edited by Sudhoff, the foremost authority on Paracelsus, and at least fourteen volumes of this edition have appeared. Besides his genuine works there are several, mostly of an alchemical or mystical character, which are regarded as spurious, and it is on the basis of these that many unfavourable estimates of his character and beliefs have been based. In his case, however, apparent contradictions in separate works have little weight in deciding their authenticity. Apart from editions of his works there has been a really tremendous literature on Paracelsus, and a Paracelsus Society was recently established in Germany. A summary of the literature on Paracelsus and an appreciation of his contributions to science have recently been given by Dr. A. F. Titley in *Ambix* (the journal of the Society for the Study of Alchemy and Early Chemistry; 1, No. 3; 1938).

The reasons for this great interest in Paracelsus are various. The historians of medicine turn to a study of the reformer, whose violent methods recall and were probably modelled on those of his contemporary and countryman Luther. The historians of chemistry are anxious to find some justification for the claims that Paracelsus was of importance in their science. Those wider circles interested in the occult and superstitious find in his chaotic writings, not excluding the spurious ones, much of interest in their field. The man himself has formed the subject of poetry and romance.

The genuine writings of Paracelsus which appeal especially to the historian of science are the "Archidoxa" (of which an English translation appeared in 1663) and the "De Natura Rerum", which contain much of interest but nothing which can reasonably be said to constitute a definite advance in scientific knowledge. They emphasize that the main task of alchemy is not to make gold and silver but to prepare powerful remedies, and this certainly had a good influence on the development of chemistry and pharmacy. Many new mineral remedies, such as preparations of antimony, appeared as a result of this redirection of effort, but it has been emphasized above that Paracelsus had precursors in this field. An important feature of his teachings was his insistence that from a large bulk of inert material there could be extracted some small potent quintessence or arcanum in which the virtue of the medicine is concentrated (a view which is emphasized in the "Alchymia" of Libavius in 1597), but this idea again is to be found in the works of Arnald of Villanova and in the treatises attributed to Raymond Lully. The great stewpans of broths and messes of the Galenic and Arabian medicine gave way after Paracelsus's time to the small stoppered phials of the chemical pharmacist, and if some of these, with their arsenical and mercurial contents, were to wreak havoc in the hands of less-skilled practitioners, the ultimate gain was real and permanent. Many of his younger followers were men of great ability and he certainly inspired much valuable and enduring work in chemical pharmacy.

The writings of Paracelsus are very difficult to read and more difficult to understand. They provide an excuse for the charge frequently made that he was a charlatan, but when allowance is made for his extraordinary style they reveal his sincerity and receptiveness. They abound in strange words, but the terminology of contemporary medicine was far from perfect or adequate. They contain much which is superstitious, and material concerned with magic, charms and amulets, which is not really a new feature but a sediment from long-established medical practice. There is little of scientific interest, apart from a few vague remarks on mining and metallurgy and a mention of zinc, all of which is miner's gossip. There is much hinting at wonderful new chemical remedies, but no intelligible accounts of experiments by which they were discovered or processes by which they were prepared. There is no indication that Paracelsus did make any experiments in chemistry on scientific lines, although tradition, some of it good, suggests that he did. The views that the chemical information in the works attributed to Basil Valentine is due to Paracelsus, and that some of the important views found in the writings of Van Helmont are really his, will not bear close examination. His writings contain a great deal of boasting and harsh judgments of the physicians. Some allowance must be made for this. Paracelsus was certainly ahead of most of his plodding contemporaries, and his eager reforming zeal irritated them into malicious attempts to undermine his authority and bring him to contempt. This must have exasperated a man with much less patience and restraint than he possessed, and in circles where so much bitter opposition was met a violent reaction is only to be expected.

Where so few actual scientific contributions can be found it is perhaps a fair estimate of Paracelsus's merit in science to say that he pointed the way along which fruitful progress could be made and showed that nothing can be achieved by reliance on tradition in itself. He gave hints which in the hands of his followers came to fruition. He is regarded as the originator in chemistry of the famous theory of the three "hypostatical" principles, mercury, sulphur and salt, which Boyle said were professed by the "vulgar spagirists" of his time. Of these three, two and the most important, mercury and sulphur, were very much older than Paracelsus's time, although they had not been regarded as so widely distributed as he assumed;

and his salt is such a vague entity that it can scarcely be said to have any value in chemical theory. Still, some link may be traced between this *tria prima* and the three 'earths' of Becher, which led in turn to the phlogiston theory, an important phase in the development of theoretical chemistry.

In calling to memory the death of Paracelsus at Salzburg on September 24, 1541, we can point to little which is definite in his scientific contributions, but his insistence that Nature has little regard for theoretical systems or cherished traditions is essentially scientific and certainly played a part in the progress which was to lead to the "Sceptical Chymist" of Robert Boyle, a work in which Paracelsus is respectfully quoted and criticized. It seems that much of the fame of Paracelsus (like much of the discredit which is attached to his name) rests on popular estimates, and his contributions are not nearly so important as those of men whose names are practically unknown. It is probably certain that but for his emphatic lead the advances in chemistry which followed him so closely would have been deferred, and he well deserves a place in the annals of science quite apart from his contributions to medicine.

P. S. PALLAS (1741-1811)

By Eng.-Captain E. C. Smith, O.B.E., R.N.

On September 22 occurs the bicentenary of the birth of Peter Simon Pallas, one of the greatest naturalists and scientific explorers of the eighteenth century. Though German by birth, he passed forty-two years in the service of the Russian Government, and the most fruitful part of his life was the six arduous years, 1768–1774, which he spent exploring the eastern parts of European Russia and the plains and mountains of Siberia.

The son of a surgeon, Simon Pallas (1694–1770), he was born in Berlin, and after studying at Halle and Göttingen graduated in medicine at Leyden. He then spent about a year in England examining and studying zoological collections and afterwards at The Hague published his first work on zoology. It was, however, not long before a more active career opened before him. In 1768, at the age of twenty-seven, he accepted the invitation of the Empress Catherine II to occupy a chair of natural history in the Imperial Academy of Sciences, St. Petersburg, and this led almost immediately to his appointment to an expedition being sent out, first to observe the Transit of Venus of 1769, and secondly to gather information about the peoples, plants, animals, climate and geography of the vast dominion of Siberia and of other little-known parts of the Russian Empire.

Scientific expeditions by land and sea under official auspices were a feature of the eighteenth century, and most of these expeditions were fostered by the Royal Society of London, the Paris Academy of Sciences and similar bodies. Among such expeditions was that made during 1733–1743 by Behring, J. G. Gmelin, G. F. Muller, S. Krascheninnikof and others for the Russian Government ; this added immensely to the knowledge of northern Asia from the Urals to Kamchatka. Two years after this expedition set out the Paris Academy of Sciences sent Bouguer, Godin and La Condamine to Peru to determine the figure of the earth, while others were sent to Lapland. The Transit of Venus of 1761 saw other expeditions. One of these was carried out for the Paris Academy of Sciences by the Abbé Jean Chappe D'Auteroche (1722–69), who observed the transit at Tobolsk, the capital of Siberia. When this astronomer published an account of his travels he made some remarks about the state of Russia which led Catherine, who had literary leanings, to reply in a brochure entitled "Antidote contre le voyage de l'abbé Chappe".

As the 1769 Transit of Venus approached, Catherine determined to arrange expeditions second to none, and the Imperial Academy of Sciences, most of whose leading members were foreigners, was asked to draw up full instructions. Altogether seven astronomers and five naturalists with several assistants were attracted by Catherine's offers. The Swiss astronomers, J. A. Mallet (1740–90) and J. L. Pictet (1739–81), were sent to Lapland ; the German scientific worker, W. L. Kraft (1743–1814), to Orenburg ; the Russian mathematician and geographer, S. Rumoffski (1734–1815), to the Pola peninsula ; and G. M. Lowitz (1722–74) to the Volga district. To the south-west of Russia were also sent the naturalists, S. G. Gmelin (1743–74), nephew of J. G. Gmelin, and J. A. Guldenstaedt (1745–80). Pallas himself left St. Petersburg in June 1768, spending the summer in the Russian plains and wintering at Simbersk on the Volga. He next visited Tartary, examined the shores of the Caspian, and in 1770 crossed the Urals to Catherinenburg. Having examined the mines in the district he went to Tobolsk and in 1771 visited

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the Altai mountains. Proceeding north, he reached Krasnojarsk, on the Yenisei, and then turned back to the frontiers of China and so in 1773 to Astrakhan, where he met Gmelin. After visiting the Caucasus, he reached St. Petersburg again in July 1774. Lowitz and Gmelin were not so fortunate, for in that year the former was murdered by rebels and the latter died through illness and imprisonment while still carrying out exploration on the shores of the Caspian.

Partly during the expedition and partly afterwards Pallas published in German his "Voyages in Different Parts of the Russian Empire, 1768–75". "Few explorers", said von Zittel, "have contributed such a vast wealth of geographical, geological, botanical, zoological and ethnological observations as Pallas has done in this justly famous work." Another result of his travels was his book on the formation of mountains, his views on this subject giving him a place beside de Saussure as one of the founders of geology.

In 1793, Pallas commenced a journey of two years duration in southern Russia and the Crimea, and liking the district well, in 1795 he settled there on an estate given him by the Empress not long before she died. Here at Simferopol he passed fifteen years, continuing his studies in natural history. In 1810, after the death of his wife, he obtained permission from Alexander I, whose tutor in science he had been, to return home, and he died at Berlin on September 8, 1811, within a few days of his seventieth birthday. Of all the many eminent men of science, such as Delisle, Euler, the Gmelins, Daniel Bernoulli, Lexell, Æpinus, Lehmann, Nicolas Fuss and John Robison, whom succeeding Russian rulers attracted to St. Petersburg, none did greater service for their adopted country than Pallas.

POULTRY AS FOOD CONVERTERS

By E. T. Halnan,
Animal Nutrition Institute, Cambridge

THE value of the egg as a constituent of war-time dietaries, particularly for children, has to some extent been overshadowed by the insistence placed on milk as a perfect food. In point of fact, milk is not a complete food, being deficient in iron and relatively low in vitamin D, although rich in calcium salts. Eggs, on the other hand, have a poor calcium content, but are rich sources both of vitamin D and iron.

Both products are of high biological value, and are in a sense complementary to one another, mixtures of these two forming a perfect diet for young growing animals. Thus De Sanctis[1] reports the case of a three-months-old infant failing to gain weight on a whole-milk dextrimaltose formula, but responding and giving 8–12 oz. gains weekly when one teaspoon of soft-boiled egg yolk was added daily. Tweddell[2] similarly got satisfactory responses in two infants aged eight and nine months respectively by the inclusion of one raw egg daily in their milk diet. Hess[3], in efforts to combat rickets in babies, used egg yolk with marked effect, and recommends the inclusion of the yolk of a raw egg daily in the milk formula of a three-months-old infant as good routine practice.

The essential point to note in these cases is the failure of milk to prove adequate in the diets of some infants, and the power of egg yolk to correct its inadequacy. Moreover, both eggs and chicken meat are easily digested and readily tolerated by those with weak digestions, consequently they form essential articles in the diets of those recovering from illness. In addition, the hæmoglobin-forming power of eggs in cases of war-wounded patients suffering from loss of blood should not be overlooked.

On dietetic grounds therefore, the maintenance of an adequate egg supply appears to be just as vital to the health of the nation as the maintenance of an adequate milk supply. If, however, the home food production policy of the Government is considered, it would appear that this fact has not hitherto received the consideration that it merits. The shortage of animal feeding-stuffs, particularly concentrates, led the Government shortly after the outbreak of war to assign an order of priority to various classes of farm livestock for such feeding-stuffs as were available. Several factors appear to have influenced the final decision, among which may be named the relative efficiencies of the various classes of livestock as converters of animal feeding-stuffs to human food, the need for maintenance of land fertility, the fact that the foods normally fed to pigs and poultry largely consisted of materials available for direct human use, and the fact that the Scandinavian and the Low Countries were then available as sources of supply for eggs and pig products. As the result of these and

possibly other considerations, the final order of priority was: (1) dairy cows (as milk); (2) sheep and feeding cattle; (3) pigs for meat production and poultry for egg production.

It may be as well to point out that the Government of 1918[4], faced with a similar situation, placed the order of priority as follows: (1) working horses; (2) dairy cows; (3) breeding stock. Some allowances were to be made to pigs and poultry and breeding ewes, but none to fattening sheep or fattening cattle. The present order of priority for feeding-stuffs has caused the false impression to arise that both pigs and poultry are wasteful converters of feeding-stuffs; moreover, statements have appeared in the Press to the effect that this is the considered opinion of men of science. It may, therefore, be as well to consider the available evidence on this point.

At the present time the main problem that appears to be facing Great Britain so far as food supply is concerned is a prospective shortage of food proteins, particularly those of high biological value. The most efficient use of animal feeding-stuff protein for the production of human food protein consequently appears to be called for, and our considerations may therefore be conveniently directed to this issue.

In 1939 I made a careful estimate of the relative efficiencies of the various classes of farm animals as converters of feeding-stuff protein to human food protein. In this estimate, 100 lb. of digestible feeding-stuff protein yielded the following amounts of food protein available for use by humans: (1) dairy cow (as milk, yield 600 gallons a year), 35·8 lb.; (2) hen (as eggs, yield 140 eggs a year), 31·6 lb.; (3) pig (as pork), 21·2 lb.; (4) hen (as meat), 18·0 lb.; (5) bullock (as baby beef), 7·8 lb.; (as Norfolk beef), 5·9 lb.; (as grass beef), 5·4 lb. Owing to the absence of adequate data no estimate of the value of the sheep as a converter of feeding-stuff protein was made; but the opinion was given that, whereas grassland sheep production should be encouraged, arable land sheep should be discouraged, since in the latter case the land required for sheep keep could be better utilized for the production of grain and vegetables for direct human consumption. This memorandum was submitted to the appropriate Government departments and doubtless received due consideration. More recently, Leitch and Godden[5] have presented a report on the point at issue, after consideration of all the available scientific data. Placing their results in order of priority so far as efficiency of conversion of feeding-stuff protein to human food protein is concerned, we get the following results: 100 lb. of protein equivalent yield (1) dairy cow (as milk, yield 2 gallons a day), 35·1 lb.; (2) hen (as eggs, yield 200 eggs a year), 26·4–29·8 lb.; (3) hen (as meat), 21·8–26·3 lb.; (4) pig (as pork), 19·0 lb.; (5) baby beef, 15·5 lb.; (6) sheep (as lamb), 13·2 lb.; (7) fat bullock, 8·7–8·9 lb.

Although arrived at by different methods of computation and from different sources, it is of interest to note that roughly the same order of priority is reached by these authors as by my earlier estimate, and gives confidence in the view that the order of priority so established is in accordance with actual fact.

Regarded strictly, therefore, from the point of view of efficiency of conversion of feeding-stuff protein to human food protein, the hen as an egg producer would appear to rank in order of priority next to the dairy cow, and judged on this ground alone the hen has a better claim to available food supplies than any class of farm animal other than the dairy cow. Moreover, the results obtained indicate that the decision of the Government in 1918 not to allot supplies of feeding-stuffs to fattening sheep or fattening cattle was justified.

[1] De Sanctis, A. G., *Arch. Pediat.*, **33**, 104 (1922).
[2] Tweddell, F., *Med. Record*, N.Y., **100**, 935 (1921).
[3] Hess, A. F., *J. Amer. Med. Assoc.*, **81**, 15 (1923).
[4] "Live Stock Policy of Board of Agriculture and Ministry of Food", *J. Bd. Agric.*, **24**, 1177–1180 (1918).
[5] Leitch, I., and Godden, W., Technical Communication No. 14, p. 46, *Imp. Bur. Anim. Nut.* (1941).

OBITUARIES

Sir Shah Mohammad Sulaiman

AS chief justice of the High Court at Allahabad for several years and as vice-chancellor of the Aligarh Muslim University over a considerable period, Sir Shah Sulaiman was a well-known public figure in India. During the last few years of his life he held the distinguished position of one of the three judges of the newly established Federal Court at Delhi. The news of his death early this year at the age of fifty-five came as an unpleasant surprise to his many friends and admirers, and elicited numerous well-merited tributes to his personality and career.

Sulaiman studied mathematics and physics at Cambridge, taking Part II of the Mathematics Tripos in 1909. During his subsequent career as a practising barrister and as a judge at Allahabad, he continued to retain a general interest in the progress of physical science. Later in life, the stimulus of contact with the University staffs at Allahabad and Aligarh led him actively to undertake the study of theoretical physics as a subsidiary pursuit.

Sir Shah's high position in public life secured for his writings and lectures on scientific topics the widest publicity in India, as also a sympathetic, though critical, reception from his academic friends and colleagues. His published papers indicate a marked reluctance to accept the ideas of the newer physics as expounded by the leading authorities on the subject. They largely consist of attempts to explain the facts of the newer physics on the basis of classical or semi-classical ideas aided by special hypotheses. It could scarcely be hoped that work on such lines would find general acceptance.

Sir Shah Sulaiman was the recipient of honorary doctorates from the Universities of Allahabad and Aligarh in recognition of his eminent public services and his deep interest in the cause of education and science. C. V. RAMAN.

Mr. W. A. Taylor, O.B.E.

THE death occurred on August 18 at St. Albans at the age of sixty-eight of Mr. W. A. Taylor, a former superintending examiner at the Patent Office.

After spending eight years at the railway works at Crewe, Taylor obtained a Whitworth scholarship and proceeded to the Royal College of Science, from which he entered the Patent Office as an assistant examiner in 1897, at the age of twenty-five. During the earlier part of his career, he dealt with inventions relating to gearing and clutches. In 1915 he was loaned to the Munitions Inventions Department where he was particularly associated with the early development of the tank and with experiments on body armour, including head protection by steel helmets.

Returning to the Patent Office at the end of the War, he was placed in charge of one of the examining divisions in 1925, and from 1927 until his retirement in 1936 was superintending examiner in charge of classification, during which time he made his main contributions to the work of the Office. Under his direction a separate classification division, akin to that existing in the United States Patent Office, was set up, and he was responsible for the amalgamation of the unclassified series of illustrated abridgments, which had appeared weekly in the *Illustrated Official Journal of Patents* from the time of Mr. Chamberlain's Patents Act of 1883, with the classified series which had been published at intervals from 1894 onwards. By this reform, the classified abridgments were issued sheet by sheet in forty group-volumes within a few weeks of acceptance of the specifications instead of after a period of many months. Another important duty undertaken by Taylor was the setting up of machinery for carrying out the extended search for novelty instituted by the Patents Act of 1932 by which United States specifications and other publications were brought into the field of search.

In the difficult and controversial subject of the classification and indexing of the subject-matter of inventions, Taylor was an advocate of the analytical method and favoured the collection of data relating to materials and machine elements of general application.

He took an active interest in the welfare of the staff and was for some years chairman of the Examining Staff Association. Apart from his activities in the Office, he had many interests in the realms of music, education, sport and travel, and his generous nature and human attitude to affairs gave him a wide circle of friends.

Mr. J. Duncan

THE death of John Duncan on July 28 will be regretted by the many engineers, all over the world, who have at some time been his students. He was seventy-two years of age and had for several years suffered severely, although in the end, the acute stage of his illness lasted only a few days.

Duncan went to Hutchinson's Grammar School in Glasgow, his birth-place, and his early training in engineering was received at the works of Messrs. Duncan Stewart & Co., Ltd. He studied at the Royal Technical College, Glasgow, and then in the University of Glasgow. From there he was appointed, in 1896, as lecturer in engineering at University College, Nottingham. In 1898, at the opening of the Municipal Technical Institute at West Ham, now the West Ham Municipal College, he was appointed lecturer in mechanical and civil engineering, and after a short time became head of the Department of Engineering. His organizing ability soon showed itself, for a set of empty rooms quickly became a department excellently equipped both in staff and machinery.

On the reconstitution of the University of London in the early years of the century, Duncan was made a 'recognized teacher' in the University in engineering, being one of the first so appointed. He served on the Board of Studies in Engineering in the University until his retirement from teaching in 1929, and on many occasions was examiner in the subjects of engineering.

Duncan's lectures and practical courses at West Ham were always the admiration of his colleagues, for as well as being thoroughly skilled in practice and draughtsmanship, he had a wide knowledge of theory and always spurred on his students in the mathematical side of their work. His clearness of exposition will always be appreciated where the many text-books that he contrived to write during his busy career are used.

WE regret to announce the following deaths :

Prof. A. G. Green, F.R.S., formerly professor of tinctorial chemistry in the University of Leeds, and director of research to the British Dyestuffs Corporation, on September 12, aged seventy-seven.

Mr. John Still, formerly secretary of the Ceylon Association in London and an authority on the antiquities and natives of Ceylon, on September 9, aged sixty-one.

Dr. Guy Wood, who had been honorary treasurer of the Marine Biological Association of the United Kingdom since 1934, on September 4.

NEWS AND VIEWS

British Association: Science and World Order

FURTHER information is now available concerning the conference on "Science and World Order" to be held under the auspices of the British Association (Division for Social and International Relations of Science) during September 26–28, at the Royal Institution (see p. 331 of this issue).

The First Session, under the chairmanship of Sir Richard Gregory, president of the British Association, will deal with "Science in Government". It will deal with the use of scientific men and scientific methods within departments of Government, and with the development of Government research. Prof. A. V. Hill will describe the use which has been made of scientific workers, and the way in which co-operation and collaboration has been secured in Britain and between Britain and the United States. Prof. J. D. Bernal will deal with the shape of scientific organization within Government service, and its possible future development. A French representative will be asked to deal with the organization of science in France before the War. It is hoped that the Chinese representative will deal with the development and encouragement of scientific organization behind the lines and under stress of war in China, and that a Russian representative will outline the important part which science has played in the development of the U.S.S.R.

The Second Session, under the chairmanship of the United States Ambassador, Mr. Winant, will deal with "Science and Human Needs". Sir John Orr will be dealing with food in terms of the advance in the science of nutrition, of the work which has been done in the form of surveys of food requirements of various countries, of the inadequacies, and of the means, which science offers, of raising the standard of nutrition throughout the world. Sir Harold Hartley, speaking on "Power", will discuss the development of the natural resources of the world to secure the maximum benefit. An American representative will probably deal with the harnessing of power to the new amenities of life.

The Third Session, under the chairmanship of the Russian Ambassador, Mr. Maisky, is concerned with "Science and World Planning". An American representative will deal with large-scale projects, such as the Tennessee Valley development, illustrate the plan behind it, and the future of such development. Prof. Sargant Florence will discuss the redistribution of the population, which has been made possible by electrification, but which, without planning, may equally lead to even greater concentration in conurbations. Other speakers will relate similar examples to the general need for large-scale planning in terms of world reorganization.

The Fourth Session, under the chairmanship of Dr. Benes, President of the Czechoslovak Republic, will deal with "Science and Technological Advance". It will be concerned with the new processes, new materials, and new production techniques, which have been made possible by science and have been accelerated by war, and which, under planning, can mean the release of abundance, and without planning, will mean economic chaos.

The Fifth Session, under the chairmanship of the Chinese Ambassador, Dr. Wellington Koo, will deal with "Science and Post-War Relief". Representative speakers will concern themselves with: (1) the risks of epidemic diseases through war exhaustion, and the measures to counter them; (2) the risks of famine and the distribution of surpluses which are now being accumulated throughout the world; (3) 'scorched earth' problems of soil-rehabilitation. Others will deal with the development of backward and neglected areas.

The Sixth Session, under the chairmanship of Mr. H. G. Wells, will deal with "Science and the World Mind". The major problem is how to make the peoples and nations comprehend the meaning of scientific development and the ways in which these can be used for human betterment and social security. At the end of the conference, the president, Sir Richard Gregory, will put forward a new Charter of Scientific Fellowship.

University of Birmingham: Chair of Zoology

THE appointment of Prof. L. T. Hogben, F.R.S., to the chair of zoology in the University of Birmingham, represents a serious loss to the University of Aberdeen where, in the course of a short but fruitful tenure of the regius chair of natural history, he had built up one of the most attractive and active departments in Great Britain. Both at Aberdeen and Cape Town, Prof. Hogben adapted the policy of his department to fit in with local biological interests and exploited to the fullest extent the natural resources of the neighbourhood. At Birmingham he will find ample scope for similar activity, and his greater proximity to London will enable him to attend meetings from which his absence has, too long, been felt.

Among academic zoologists Prof. Hogben is distinguished for his well-known analysis of the pigmentary effector systems of vertebrates, particularly those of the amphibia; he has also made very important contributions to genetics. In both these fields he has had numerous students in Great Britain and elsewhere. In much wider fields Prof. Hogben is known as the author of "Mathematics for the Million" and "Science for the Citizen". Both of these books show not only a very remarkable width of vision but also a profound belief in the intelligence of the average man. At Birmingham, Prof. Hogben will find a fertile field, well tilled by his predecessor, Prof. H. Munro Fox, F.R.S. (NATURE, June 28, p. 800), and of the abundance of the crop he will reap there can be no doubt.

The Generic Names Fenestella and Fenestrellina

Dr. G. E. Condra and M. K. Elias, of the University of Nebraska, have sent a notification to the Editors of NATURE of a proposal to preserve the generic name Fenestella. The following is an abstract of the document :

The International Commission on Zoological Nomenclature is asked to suspend the Rules of Zoological Nomenclature in the case of *Fenestella* Lonsdale, the well-known genus of late Palæozoic Cryptostomatous Bryozoa, and retain this name as a *nomen conservandum*. The history is as follows : *Fenestella*, Bolten, 1798, for a Lamellibranch Mollusc ; synonym of *Anomia* Linnæus, 1758 ; *Fenestella*, Lonsdale, 1839, for a Cryptostome bryozoan ; genotype *F. plebeia* McCoy ; *Fenestrellina* d'Orbigny, used by Bassler for the pre-occupied name *Fenestella* Lonsdale. But the genotype of *Fenestrellina* d'Orbigny is *Fenestella crassa* McCoy, which is not congeneric with *Fenestella lebeia* McCoy. Therefore a new name is needed for the genus *Fenestella* Lonsdale *non* Bolten, unless the Rules of Zoological Nomenclature are superseded, and *Fenestella* Lonsdale is conserved. In order to avoid a new name, and because it is in every way desirable to conserve the well-known, widely adapted, and long-established Bryozoan genus *Fenestella*, it is asked that the Rules of Zoological Nomenclature be suspended in this instance, and *Fenestella* be kept as a *nomen conservandum* for the Bryozoan genus.

The University of London

THE report of the Principal on the work of the University of London during 1940–41 is distressing testimony to the wanton destructiveness of modern warfare. The wisdom of the policy of dispersal, which at one time aroused criticism, has been fully borne out by the widespread damage that many of the University buildings have sustained from air raids. This damage has already been described in NATURE. The teaching staff of the University has lost the services of eighty-six professors and readers, who together with many other teachers are now engaged in various forms of war work. Owing to the claims of national service the roll of internal students in the second year of war is expected to show a fall of about 40 per cent. Nevertheless, in spite of all difficulties, the essential work of the University has been carried on in a most remarkable manner. Except for certain readjustments necessitated by war conditions, no significant changes have been made in the curriculum, and examination standards have been fully maintained.

The complete range of external examinations was carried through under the scheme of decentralization. In the first year of war, external examinations were held in some forty centres overseas, and more than 1,200 students were examined. Although this operation involved the distribution of very many printed papers, and the collection of some thousands of scripts only two scripts were lost as a result of enemy action. The work of the University for its External Students has been fully maintained, in fact, in certain directions the University has extended its activities. Some hundreds of students now serving in different branches of H.M. Forces have received assistance in continuing their work for degrees. Educational contacts have been established with Allied personnel now in Great Britain, and through the Red Cross even prisoners of war in Germany have been enabled to keep their intellectual interests alive.

Among several benefactions received during the year, the University was given an endowment by the Clothworkers' Company for a William Gilles fellowship for research in science, to the value of £220 for one year, to be awarded biennially. Dr. T. H. Sanderson-Wells has provided funds for the endowment of an occasional Sanderson-Wells Lecture, on human ailments with special reference to soil fertility. Mrs. E. L. Hamilton has presented to the London School of Hygiene and Tropical Medicine £1,500 to be used in the prevention of disease in the tropics. Developments in educational policy and organization are of necessity in abeyance, but in one direction at any rate useful preparatory work has been done, for an influential advisory board has been set up to report on the co-ordination and extension of Colonial studies and researches, for which support may be forthcoming from the Colonial Office as part of the Government plans arranged early in 1940.

Plastic White Lines for Roads

THE majority of the white lines applied to road surfaces for aiding traffic flow are prepared with white paints made from pigmented solutions of Manila resin in alcohol ; such paints are the subject of Specification BS/ARP 38. Attention has recently been given to alternative white-line materials by the Paint Research Station and the Road Research Laboratory. According to *Roads and Road Construction* of September, one of the most promising alternatives is a thermo-plastic material applied hot to the road surface as a thin layer which sets hard on cooling. This type of material has the advantage that its set does not depend on evaporation of a volatile constituent ; it hardens rapidly, allowing traffic to pass over it within a few minutes of application. It has good wear resistance and maintains a reasonably white colour. Thermoplastic materials of a proprietary type have been subjected to road tests during the past two years and in some instances have given satisfactory results. The composition now described is suitable only for open- and medium-textured road surfaces which provide a certain amount of key or mechanical grip. It may be applied to an existing road surface without insetting. A specification has been drawn up for the manufacture and application of the composition.

During the past year, trials have also been made with a number of compositions based on a light-coloured binder compounded with a white filler and a high proportion of a light-coloured sand or other fine aggregate. The filler is a mixture of equal weights of finely divided silica and the pigment titanium oxide. The binder consists of 80 per cent by weight of rosin, the remainder being crude wool grease. This composition can only be applied during spring and

summer months, in warm, dry weather. The composition is now under test; it is in satisfactory condition after five months on a busy trunk road and after ten months on a by-road, and from the results of these and other tests, a useful average life of at least six months may be expected. The colour, while not so white as that of newly painted white lines conforming to BS/ARP 38, nevertheless gives a good contrast with the road surface when observed during day- and night-driving and does not degenerate appreciably.

Health of Southern Rhodesia

IN his recently published annual report for 1939, Dr. Andrew Paton Martin, medical officer of health for Southern Rhodesia, directs attention to the decrease in the birth-rate, the increase in venereal disease and the infiltration of tuberculosis in the colony. There has been an appreciable decrease in scurvy in the mining natives, but the methods of feeding the employees are still far from satisfactory. Of the tropical diseases prevalent in Southern Rhodesia malaria is the most serious, as it caused 10 per cent of the deaths in 1939. Bilharziasis followed it close, and leprosy is a big problem, but trypanosomiasis seems to be absent.

Earthquake in Turkey

A SERIOUS earthquake with its epicentre near Agri, some 70 miles east of Erserum in Turkey, was reported on September 12. Full details are not yet available, but it is feared that the death roll may amount to 500. It will be remembered that the most severe earthquake ever experienced in Turkey took place on December 27, 1939 (see NATURE, January 6, 1940), in Anatolia, and serious aftershocks have occurred at intervals since that time. It may be that large fault blocks in the area have not yet attained their final position of equilibrium, and that parts of the subcrustal layers may still be under some elastic strain.

Earth Tremor in Scotland

ON September 6 an earth tremor shook the Stirling district in Scotland. Furniture was moved by the shock in the villages of Cambus Barrow and Whins o'Milton, but no damage is reported. Stirling district experienced a previous tremor on the night of February 2–3, 1940 (NATURE, February 10, 1940).

Bequests to the University of Sydney

THE University of Sydney has recently received a bequest of £60,000 from the estate of the late Sir Hugh Denison. This bequest is particularly valuable as it is for general scientific research, and unconditional.

The McGarvie Smith Institute of Sydney has made a grant of £9,000 in addition to earlier grants for the extension of the equipment facilities of the Animal Husbandry Farm which bears its name, and which forms an important part of the equipment of the Faculty of Veterinary Science of the University.

Awards of the Medical Research Council of Ireland

THE Medical Research Council of Ireland has made the following awards during the half-year ended June 30, 1941: *Training grants:* Miss D. A. Kilbride for one year from August 1, 1941, to carry out an investigation of iodine absorption by means of balance experiments; and Miss E. O'Donovan for one year from June 1, 1941, to assist in the investigation of the goitre problem by studying the retention of iodine under varying conditions of diet, the work in both instances to be done in the Department of Chemistry, University College, Cork, under the direction of Prof. J. Reilly and Dr. E. M. Mason; *Whole-time grant:* Dr. Cecil Mushatt for four months from March 1, 1941, to enable him to continue his research work at the Johns Hopkins Hospital; *Grants-in-aid:* Dr. James Deeny for six months from July 1, 1941, to investigate the relationship of vitamin C to the formation of complement and the relationship of both to immunity; Dr. D.K. Malley, to investigate the effects of the cortical hormone on a case of pre-adolescent type of adrenocortical syndrome; and Dr. J. G. Waugh, towards the expenses of his research work on sulphonamide therapy in the School of Physic, Trinity College, Dublin. The following grants have been renewed for one year: Dr. T. E. T. Bradshaw (from March 1, 1941) and Prof. Hans Sachs (from May 1, 1941). Prof. J. B. Gatenby and Dr. R. G. Cross have relinquished their grants.

Announcements

THE medal of the U.S. Society of Chemical Industry has been awarded to Dr. Elmer K. Bolton, chemical director of the E. I. du Pont de Nemours and Company, in recognition of his work in connexion with the development of Neoprene, Nylon and synthetic rubber.

DR. JEROME C. HUNSAKER, head of the department of mechanical engineering in the Massachusetts Institute of Technology, has become co-ordinator of research and development for the U.S. Navy. He will be assisted by a special board, to be composed of representatives of the chief of naval operations and the commanding officers of the Bureaux of Ships, Ordnance, Aeronautics and Yards and Docks.

PROF. WILLIAM F. DURAND, emeritus professor of mechanical engineering at Stanford University, has been appointed a member of the U.S. National Advisory Committee on Aeronautics. He succeeds Dr. Robert E. Doherty, president of the Carnegie Institute of Technology, who resigned his membership on July 3 to become chairman of the Production Planning Board of the Office of Production Management.

THE following appointments have recently been made in the Colonial Service: D. U. Peters, agricultural officer, Northern Rhodesia; H. A. M. Thompson, agricultural officer, Sierra Leone; C. O. Flemmich (assistant conservator of forests, Malaya), conservator of forests, Fiji.

LETTERS TO THE EDITORS

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

"The Philosophy of Physical Science"

THE correspondence on this subject provides a most enlightening example of the present transition in scientific philosophy from the view that science is a description of an objective external world to the view that it is a formulation of the relations found between experiences. Thus, to Sir James Jeans[1], taking the older view, light is an objective entity the velocity of which is either finite or infinite, while Sir Arthur Eddington is interested only in the fact that, since our experiences could be correlated equally well or ill by postulating an infinite or an immeasurably large finite velocity, the possibility of the former can be ignored. It is not surprising that, as Sir James rightly complains, Sir Arthur has not answered his objections. They are meaningless in Sir Arthur's philosophy, and he cannot reply in applicable terms.

I have long been convinced that the view which Sir Arthur now accepts is necessary to make sense of modern (or even older) physics, and have ceased to regard the question as a controversial one. Nevertheless I am equally convinced that Sir Arthur has not grasped the true implications of the new conception, and that Sir James's objection, though stated in terms meaningless to Sir Arthur, is both valid and unanswerable. If we can imagine an alternative experience to that which a law requires, then that law is not logically necessary. There is no escape from that, and if the unexpected should happen, we have to decide between giving up the law and denying the experience. There is no question which is the scientific choice.

It is, however, most desirable to locate the fallacy in Sir Arthur's reasoning. His programme for science is as follows: (1) Construct a scheme of pure reason based on a few *a priori* postulates. (2) Make observations and describe them in terms of those postulates. (3) Draw up a table of correspondences between the elements of the rational scheme and the observations: since the scheme is logically coherent, the corresponding observations must then be logically necessary if the original postulates really lie "at the bottom of things". Hence (4) find criteria for determining that the postulates are so basic. Those criteria having been found, the logical necessity of experience is assured.

The fallacy is, I think, that such criteria cannot exist, because, "in our limited view, at the bottom of things" lies not necessary postulates but experience, and experience is not yet complete. Take any "law of Nature" (for example, the law of gravitation). Deduce where Jupiter will be observed at some instant next year, and suppose that, when the time comes, Jupiter is seen elsewhere. If the law is *a priori* inviolable, Sir Arthur's only explanation can be that observations of Jupiter are not the experiences to which it applies. But if there are criteria for establishing the correspondence between law and observation, he is denied this explanation. What, then, is left to him?

Sir Arthur may be right in believing that his "epistemological" method is a short cut to discovery. Many a theory fundamentally unsound has given valuable guidance to knowledge, and it is certainly to be hoped that "structuralism" will do so. But that is trivial compared with its truth or falsity. As Sir James says, if Sir Arthur's theory is right "its consequences are tremendous—to physics, to philosophy and to humanity". No effort can be too great to clear the matter up, and if, as I believe, Sir Arthur is profoundly wrong, no protest can be too strong against an illusion which would destroy the very fundamentals of science and throw us back intellectually (and therefore socially, since ideas determine the state of our social life) into the dark ages.

It may be added that Sir James Jeans is incorrect in saying that the finiteness of the speed of light is an essential part of the theory of relativity. If that speed had been infinite the truth of the theory would never have been doubted; we should not have expected optical experiments to reveal the Earth's speed. The difficulty was to reconcile the null result of the Michelson-Morley experiment with the *finiteness* of the speed of light. But if that speed will not perform the service which Sir James asks of it, it provides us with a very convenient way of contrasting the alternative viewpoints. Sir Arthur Eddington says: "It is *a priori* necessary that the velocity of light is finite; therefore our observations of Jupiter's satellites could have been predicted and could not have been otherwise." Sir James Jeans says: "It is a fact of Nature that the velocity of light is finite; therefore Jupiter's satellites appeared in the positions which Römer explained". The scientific statement I hold to be this: "Jupiter's satellites were observed in certain positions. Therefore, if we attribute the observations to light travelling from the satellites to us, and assume that the satellites move according to Newton's laws, we must assign a finite velocity to that light".

HERBERT DINGLE.

Imperial College,
London, S.W.7.

[1] NATURE, 148, 140, 255 (1941).

MAY I first correct a slip in my last letter? In contrasting the actual and imagined results of the Michelson-Morley experiment, I absentmindedly interchanged them. I should have written, "It is a logical impossibility that the experiment should give other than a null result in the conditions *described*; but . . ."

Prof. Dingle asks us to imagine Jupiter seen away from its predicted place. Is it not simpler to substitute Uranus, for which this experience actually occurred? Adams and Leverrier rejected both of Dingle's alternatives. They neither gave up the law of gravitation nor denied the experience. They inferred that the system *pointed out* to the observer was not the system *described* to the calculator, a planet present in the former being omitted in the latter. Or, in Dingle's phrase, they amended the table of correspondences. His argument seems to me to fail because it assumes that when the unexpected happens only two courses

are open, surprisingly omitting the third course, which is the course a scientist usually follows. When an object gives an unexpected reaction, he does not rail against the laws of Nature; he concludes "Then it cannot be the object I thought it was."

The sources of gravitation (mass, momentum and pressure) are defined in the rational scheme by the tensor $G_{\mu\nu}-\frac{1}{2}g_{\mu\nu}(G-2\lambda)$, and it is an easy mathematical deduction that Einstein's law of gravitation and the laws of motion are necessarily and universally true; a failure of prediction can only mean that some gravitational source has been overlooked. This is non-controversial; but it is only a preliminary to a more disputed question, Would such a law be admitted as a law of physics, without an additional condition implying some special relevance to experience? My answer, which shocks many people, is that I cannot find that modern physics imposes any such condition of relevance on the laws which it accepts as fundamental. If there is a criterion, it should apply to all the fundamental laws. When we consider gravitation alone, a criterion of "simple application" suggests itself. However arbitrary may be the motion of the planets, Einstein's law will give a corresponding distribution of gravitational sources; but the actual sources in the solar system are few and discrete, and this unforeseen simplification makes long-range prediction possible. Ought we not to take cognizance of the fact that the law of gravitation has a much simpler application to experience than the formal theory suggests? I do not think we can; because the other fundamental laws have not this simple relation to experience. If we want a simple application of them, the experimenter must set his wits to work to create the necessary conditions. We can scarcely accept a criterion of fundamentality which is a function of the technical skill of the experimenter.

The widespread impression that the accepted laws are peculiarly fitted to actual features of experience is, I think, due to too much stress being laid on the historical development of science. Naturally the great advances are made when we find or contrive to create exceptionally simple conditions, so that disentanglement becomes relatively easy; thus the laws become historically associated with an artificial simplicity of experience which is by no means typical. Properly to understand the law of gravitation, we must forget the lucky circumstances of dynamical astronomy which probably accelerated its discovery by hundreds of years, and suppose that it has, for example, been patiently sorted out from an analysis of earthquake waves. In rejecting the criterion of simple application we must reject also the criterion of utility, which is evidently closely connected.

Another objection is that gravitational sources generally betray themselves by emitting or reflecting radiation; so that if Einstein's law indicates a source which we cannot find by radiation tests, something has probably gone wrong. But the finding of such a contradiction presupposes that we are treating gravitation and radiation disconnectedly. In unified theory the scheme of fundamental laws forms an interdependent whole, and we can only recognize agreement or disagreement (correct or incorrect correspondences) with the set of laws as a whole. The congruence of gravitational and radiative sources forms a difficult and technical part of the problem of unification; and it was not until I felt that I had cleared up the physical questions involved that I reached in my own mind the view under discussion.

I think then that the only necessary condition is that the fundamental laws shall form a single scheme, applicable to experience in the sense that all varieties of knowledge gathered by the methods of physical science can be formulated in terms of it. The choice is not limited by considerations of simplicity of application, utility, or appropriateness to the actual state of the universe, and is therefore left open to be determined by the *a priori* considerations described in my last letter. Dingle defends my view (up to a point) as "necessary to make sense of modern . . . physics". That expresses precisely the limits of what I am trying to do—not to make sense of experience, but to make sense of the assertions of modern physics. And the sense which I make of one set of assertions is that they are not assertions about experience at all. The continuation of Dingle's argument is obscure to me because I am unable to ascertain his orientation. In my "frame of reference" experience is at the top, and the physicist has been working his way down to so-called fundamental concepts at the bottom. Dingle upsets my frame by bluntly saying that experience is "in our limited view, at the bottom of things"; what is at the top of things is not stated.

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"The Relations between Science and Ethics"

I WOULD like to make a reply to some of the very interesting comments on my article[1] on the relations of science and ethics. I will try to be brief although some of the questions raised are probably due to the brevity of the original discussion. I will not allude to all the points of agreement, which are actually more numerous than some of the writers suggested. Thus I entirely agree with Dr. Matthews that ideas affect societies; in fact I supported this point by a quotation from Engels.

There are two major issues: whether ethical principles are founded on our experience, and the problem of free will. In the former connexion the arguments of my opponents have been stated by Prof. Joad in a form which is so nearly a *reductio ad absurdum* that much of my work has been done for me. "I cannot understand", he writes, "how anything can be measured without a ruler which is external to and other than what it measures." By this he certainly does not mean merely that no system of mensuration is possible with less than two objects; for after all I am not suggesting that an ethical system involving different degrees of good would be engendered by a universe consisting of a single indivisible act. Nor, I presume, does he refer to the fact that our units of measurement, though roughly specified by the nature of the world, are in detail defined arbitrarily. His remark only provides a basis for his subsequent argument if it is taken to mean that we determine the relative sizes of objects by reference to some transcendental foot-rule reached down from beyond the boundaries of space and time. This, as we know from the theory of relativity, is untrue. The space–time framework is a function of the material objects lying within it. I might indeed have expressed my main contention by saying that, just as space–time issues from the material world, so the ethical system could be logically derived from our experiences. I may assure the Dean of St. Paul's that I am not urging that we should immediately

reject all ethical principles which we cannot in practice trace back to biological and sociological data, any more than I suggest that we should all learn enough mathematics to convince Sir Arthur Eddington that we fully understand the logical structure of an inch. I am merely concerned to show that the validity of ethical principles can be accepted even if we reject any criterion imported from outside the perceptual universe.

Joad again reduces to absurdity the view that there is an ethical criterion independent of experience by his statement that we all know (innately is implied by his argument) that "we ought to live very much as Christ enjoined". There are a thousand localities, from Dachau to Dahomey, where it is impossible to assert this with any plausibility. We prefer the ethical intuitions of Christ, Buddha or Socrates to those of Hitler or Rosenberg not because they are more mystical but because they seem more likely to carry society forward in the direction it has already taken. I see no grounds for rejecting the view which I put forward on the basis of psychological and anthropological evidence, that our tendencies towards sympathetic behaviour, although of sufficient strength to have enabled man to develop a degree of social existence, are nevertheless merely one of the general drives towards various unspecific forms of behaviour by which his conduct is affected.

The argument given above must serve, in the space available, as a reply to Prof. de Burgh, who demands an unconditional validity for my example of an ethical scientific statement, but is apparently willing to forgo it for the contrasted 'Thou shalt not kill', the ethical nature of which he would not deny.

The widespread disagreement with my argument about evolution is a continuation of the same dispute. In the first place, I am glad to find that the course of evolution has been revealed, not only to myself and Herbert Spencer, as Prof. Ritchie suggested, but also to Prof. Huxley; surely the attempt to repudiate the normally accepted evolutionary sequence on the grounds that certain primitive animals still exist is a forlorn crusade. But the crux is my statement that the direction of evolution is good simply because it *is* good. By that I meant that if the ethical system is to be derived from the nature of the experiential world, we must pay attention to what that world is like; and one of the most important data is the scientifically ascertained course of evolution. The remark about fatalism which followed was intended to indicate that the general trend may suffer temporary set-backs. Just as loss of structure due to parasitism, as in Sacculina, does occur but is not typical of the greater part of evolutionary change, so social regressions, of a spatially or temporarily limited nature, are easily conceivable. This point was expanded by Prof. Huxley, with whose remarks both here and in his valuable essay "The Uniqueness of Man" I am in substantial agreement.

Prof. Stebbing attacks an outlying bastion of my position in this field; not my actual discussion of evolution so much as my comments on T. H. Huxley's remarks about it. My "three different answers" to Huxley's argument were answers to three different questions. The first was a rejection of his description of its *methods*, the second of its *results*. In the third I countered the possible objection that, logical though my derivation of the good might at first sight appear to be, I had actually identified it with something which no one had ever dreamed of calling by that name. I was arguing that my conception was not only self-consistent but also not unrelated to the conventional meaning of "good".

A more difficult point is raised by those who suggest the possibility of a general and persistent regression, for example, by the operation of the classical second law of thermodynamics. I think that the difficulty, if it should at any future time actually arise, could only be got over by a theory of levels of ethics. One could distinguish a social good, dependent on a good derived from human individual biology, which again would be dependent on the effective principles of change in the physico-chemical world; and one would have to be content to deduce that a continual increase in physical good gives rise to an undulation in the development of biological good. But difficult though the problem undoubtedly is, that difficulty does not arise only on my theory of ethics; how can it be surmounted if ethical values are attributed to a beneficent deity?

The other fundamental disagreement, which relates to the problem of free will, was raised explicitly by the Dean of St. Paul's and Prof. de Burgh, and implicitly by several others. I confess myself unable to offer a satisfactory reconciliation of materialistic determinism and the efficacy of the human will; but again the problem is not one for my theory alone, and I shall be agreeably surprised if my commentators are in a much more comfortable logical position. I can only make one suggestion, with the greatest tentativeness. First, I suggest that it may be more profitable, in discussing this matter, to picture the human mind not as a simple mechanism of stimulus and response, but as containing a set of drives (each, figuratively speaking, a complicated motor) one or other of which can be set in motion by pressing the appropriate switch. In the decision whether, say, the sex or the nutritive drive becomes activated, the external stimuli not only reach directly for the switches, but also bring into play internal systems whose functions are also to affect the choice of which drive is selected. It may be that the sensation of an effort of will is no more than the conscious symptom of the activity of one of these internal systems, perhaps the super-ego or some part of it. If this part of the mind is, owing to the way in which it has been derived from the external world, normally effective in the direction taken by the evolutionary process as a whole, then could it not be argued that its conscious correlate is in fact indicative of a good impulse, quite independently of whether strict causation is violated or not? The peristaltic action of our bowels, although not under much conscious control, is good on my definition; may not the sensation of a deed well done be just as valid, on a higher plane, as the sensation of physical well-being after exercise and a bath?

C. H. WADDINGTON.

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Sept. 9.

[1] NATURE, **148**, 270 (1941).

DR. WADDINGTON's interesting essay which was published in NATURE of September 6, p. 270, suggests that he is still wavering between the theory that when you have explained a thing you have explained it away, and the fundamental but usually unspoken postulate of science that everything has an explanation, even though this implies an infinite series of causation. In Dr. Waddington's opinion, Marxists

say that ethical systems are epiphenomena which may be left out of account when we are considering the mechanism of social development. T. H. Huxley invented the word 'epiphenomenon' to mean a mental event caused by physical events, but not in its turn causing physical events. I believe that in the long run science has no room for such loose ends. Certainly Marxism has not. "It would be totally absurd", wrote Lenin in "Materialism and Empirio-criticism", "that materialism should maintain the 'lesser' reality of consciousness." Marxists hold that mind is real, but secondary to matter because matter existed before mind. Similarly, they think that economic and social structure largely determines the ethical system. "Thou shalt not commit adultery" is meaningless in a society with no marriage. "Thou shalt not steal" is replaced by "Thou shalt not waste" as property becomes socialized.

Given such a point of view, ethics must be fitted into our world picture, though we cannot yet see how in full detail. It is clear that ethical practices and ideas have a history, both in the development of communities and of individuals. Marxists have stressed the former process, Freudians the latter. This fact does not mean that ethics are arbitrary or baseless. England is real enough though it was once under the sea ; vision is real though human embryos have no eyes. It does mean that we cannot act as rightly as possible without a study of contemporary history, which shows us what is alive and growing and what is vestigial in current ethical systems. Perhaps the careful attempts to isolate university staffs from the impact of history, if they have been advantageous to abstract speculation, have disqualified them from valid judgments on the highly concrete problems of right and wrong. The technique of modern warfare, which has broken down this isolation, may lead them to more realistic thinking on ethics.

A fuller study of the literature of Marxism might, I think, not only have shown Dr. Waddington that Engels stressed the importance of unconscious motivation before Freud, but also have made him more sympathetic to T. H. Huxley's thesis in "Evolution and Ethics". Stated in dialectical terms, it is that the cosmic process, which was responsible for human evolution, negates itself by generating the ethical process. The problem then arises of how man is to continue evolving if the congenitally weak are not killed off. Hitler's solution is substantially to abolish ethics. The correct solution will not be so simple. There is a real contradiction, which will be resolved when men not only realize, as eugenists do, that they ought to control their own evolution, but also possess, as they do not at present, the knowledge and technique necessary for this control.

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THE nine contributions to NATURE of September 6 on science and ethics seem to show by their extreme diversity how far thinking men may still be from an understanding of the scope and method of science.

Science is concerned with what a man (or a thing) must do, ethics with what he thinks he should do. Until the contrary is proved, therefore, we must suppose ethics to be derivable from science. How it is to be derived is a question on which scientific men cannot yet be expected to agree. But its historical relationship with the subject-matter of science, with the material conditions of society, is surely a commonplace. The one undergoes evolution, so does the other ; and by evolution we mean the irreversible succession of changes which seem to be characteristic of all integrated systems. Take the Christian ethic. It has suffered three major recensions on its journey from the Sea of Galilee to the City of London, each of them well suited to the social and political conditions in which it has in fact proved fit to survive. Meanwhile other systems have arisen outside our own by revolution, and proceeded afterwards by an evolution faster than any we have known. As Prof. Julian Huxley has suggested, some of these systems may have sacrificed the credit of permanent adaptability for the cash of immediate advantage. That is a question which events are now deciding. In doing so these events have already displayed the somewhat Hobbesian principle which would be too obvious to repeat if it were not so often avoided, namely, that individuals will serve the State in proportion as they believe that the State will serve them. This is true at any given moment with little regard to whether that State's government is inherited, elected, or imposed, or all three together.

How the State is to serve the individual most efficiently will therefore depend, under rapidly changing conditions, on the adaptability even more of its ethical than of its political system ; and our conditions are changing very rapidly. Evolution is no longer a hypothesis. It is happening on our doorstep. Now in all evolution there is a lag in the adaptation of one part of the organism to changes in another. The more extensive and more highly integrated the organism, the greater the lag. Our society is both extensive and highly integrated, and even the horrors of the industrial revolution in the North scarcely disturbed an ethical system emanating from the comfortable South. Now, however, the situation is different. We are faced, as before, with changing internal conditions. But our system is also in conflict with a second divergent system and at the same time in combination with a third, equally divergent.

It might be supposed that such a crisis is more likely to be resolved by empirical action than by analytical thought. That would be a mistake. Already during the present War political expediency has led to violent changes in the relations of the individual to society, changes which scientific method could have directed long ago and without any such compulsion. Why then should we not prepare for any worse emergencies by applying scientific method before they arise ?

It may be objected that these questions for which a scientific solution is offered are not ethical but political. On the contrary, they are both ethical and political : the distinction lapses as soon as both are subjected to scientific treatment. What a man must do and what a man should do are always the same for the man himself at the moment he does it. In such measure as men submit to scientific discipline that sameness becomes extensible to the whole commonwealth. For universal agreement at successive levels of analysis is not merely the aim of science. It is an aim which experience shows has always been attained.

Science is therefore bound to be the foundation of the ethics of the future and of a system of ethics with some expectation of that universality which has hitherto failed mankind.

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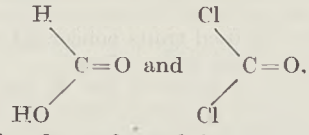
The Carbonyls

IN his recent Liversidge Lecture[1], Prof. Sidgwick has referred to the carbonyls as a "very peculiar group", but I would suggest that this is another problem which may well be approached through the medium of organic chemistry[2]. Thus we find that the capacity of a singly bound carbon atom for triple union with another atom does not extend beyond carbon and nitrogen to oxygen. Moreover, when carbon monoxide accordingly yields



the *two* new bonds are formed, in one case by acceptance, and in the other by a donation, of electrons on the part of the carbon atom. It must then be regarded as significant that those metals or ions which are actually able to participate in carbonyl formation are also usually, by reason of an incomplete inner electronic shell, equipped to fulfil this double function, and that in nickel carbonyl the nickel-carbon bonds are found to have a large amount of *double* bond character[3]. Further, it is presumably the result of the donor function of the central atom "that in nearly all the carbonyl compounds the effective atomic number of the central atom adds up to that of an inert gas"[4].

College of Technology, J. KENNER.
Manchester.
Aug. 27.

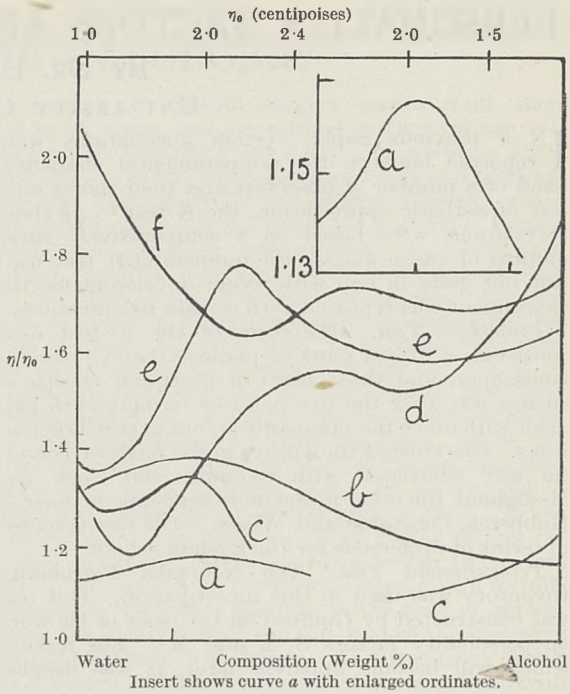
[1] *J. Chem. Soc.*, 438 (1941).
[2] Kenner, NATURE, **147**, 482 (1941).
[3] Brockway and Cross, *J. Chem. Phys.*, **3**, 828 (1935).
[4] Sidgwick, *loc. cit.*; Sidgwick and Bailey, *Proc. Roy. Soc.*, A, **144**, 521 (1934).

Viscosity of Suspensions and Solutions

IT was pointed out earlier[1] that the ratio η/η_0, where η is the viscosity of a suspension of finely divided solid particles in a liquid of viscosity η_0, is variable with η_0, being smaller for liquids of lower viscosity. The explanation in brief appears to be that during flow the solid particles become orientated more quickly in a thinner liquid, so causing less eddying by lying less across the stream of flow.

It is of interest to know that the same viscosity behaviour has been found both with solutions of colloids and crystalloids; if the above explanation holds good, then solvated ions are asymmetric, and during the flow of salt solutions and colloidal dispersions the particles become orientated.

When water and ethyl alcohol are mixed, there is an increase in viscosity reaching a maximum in the neighbourhood of 45 per cent by weight of ethyl alcohol, and it will be seen from the figure that the ratio η/η_0 for (*a*) sodium chloride, 10 gm./100 ml., (*b*) aluminium chloride[2], (*c*) potassium oleate[3], (*d*) tannic acid[4], (*e*) kaolin,[5] and (*f*) mica[5] dispersed in the binary mixture, increases with increase of η_0, the position of the maximum being affected by the dispersion changes.



Insert shows curve *a* with enlarged ordinates.

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[1] NATURE, **145**, 970 (1940); *Trans. Far. Soc.*, **36**, 1007 (1940).
[2] Dolian and Briscoe, *J. Phys. Chem.* **41**, 1129 (1937).
[3] Bircumshaw, *J. Chem. Soc.*, **123**, 91 (1923).
[4] Mardles, *J. Chem. Soc.*, **125**, 2244 (1924).
[5] Mardles, *Trans. Far. Soc.*, **36**, 1189 (1940).

Nomenclature of Pituitary Principles

I AGREE with Dr. F. W. Landgrebe[1] that the suffix *trophic* is inappropriate in application to all the known pituitary principles, but I cannot accept the argument that the hitherto accepted suffix *tropic* is unsatisfactory. It is true that τρέπω means *turn*, but the meanings *direct* or *change* also exist and provide a satisfactory basis for the use of the suffix *tropic* as descriptive of those pituitary principles which control or change other tissues or glands. The multiplication of names in a field in which the terminology is already plethoric is bound to lead to confusion, and I would urge that we retain the original suffix *tropic* as a general one to denote those pituitary substances which influence or change other tissues, irrespective of their mode of action. The growth of our knowledge of the nature and action of these substances will no doubt necessitate terminological reclassification, but perhaps in the future, as well as at the present time, the suffix *tropic* may be retained as a general one denoting those hypophyseal principles which influence, in a general manner, other glands and tissues.

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Aug. 7.

[1] NATURE, **148**, 85 (1941).

PERSONALITY FACTORS AND PREFERENCE JUDGMENTS

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IN a previous paper, certain correlations were reported between the temperamental characteristics of a number of observers and their scores on a test of æsthetic appreciation, the *K* test.[1] As these correlations were based on a comparatively small number of cases, and as the temperament test used was not quite in line with recent developments, the experiment was repeated with certain modifications.

Preference Test. The form of the *K* test used consisted of fifteen pairs of pictures (twelve pairs of landscapes, and three pairs of portraits) chosen in such a way that the two pictures forming each pair dealt with much the same subject, but in two different ways. One treated the subject in the modern, colourful way associated with Cezanne, van Gogh and Modigliani, the other in the more academic manner of Hobbema, Constable and Wilson. The test is scored in terms of preference for the modern school.

Temperament Test. The Nebraska Personality Inventory was used in this investigation. This test was constructed by Guilford on the basis of his work on personality factors *S*, *E* and *M*[2]. For reasons which will become apparent later, it was decided not to use Guilford's scoring key, but rather to derive a scoring key from a re-analysis of the original correlations on which Guilford's personality factors are based. (I am very much indebted to Prof. Guilford for his kindness in sending me his original data and other material, without which such an analysis would not have been possible.)

Observers. The observers taking part were university students, W.E.A. students, and 'middle-class' people unconnected with academic life. Their ages ranged from seventeen to around fifty; sexes were distributed roughly equally. (I want to record my gratitude to Dr. P. E. Vernon, who very kindly gave the tests to a number of Scottish students.)

Results. Most modern workers seem to regard some such general dichotomy as introversion–extraversion as definitely established in the temperamental field. Guilford's analyses, which revealed no trace of such a general factor, were therefore received with some surprise. It would appear that the explanation of the absence of a general factor of this kind lies in the method of analysis he adopted; by using Thurstone's principle of rotation even a very strong general factor is invariably obliterated. In fact, the situation seems to be exactly parallel to that which prevails in the analysis of cognitive tests, where also the existence of a general factor is disputed by the adherents of Prof. Thurstone.

In the field of cognition it has been shown that the use of Prof. Burt's group-factor method makes it possible to arrive at a compromise between the claims of the 'general factorists' and the 'group factorists'[3]; this method enables us to assess quantitatively the relative importance of these various factors. It appeared reasonable to expect that an application of this method to the data collected by Guilford would lead to a similar compromise between those who claimed to have proved the existence of a general factor of introversion–extraversion, and those who favoured analysis into group-factors only. When an analysis by means of Burt's formula was carried out, a comparatively strong general factor appeared which accounted for 9·5 per cent of the variance and could easily be identified with introversion–extraversion; in addition, three group factors were extracted which accounted for 3·9, 6·4, and 3·5 per cent of the variance respectively. These group factors resembled closely Guilford's personality factors *S*, *E* and *M*.

(A similar result appeared when another research of Guilford's was re-analysed[4]. Here, because of a great deal of overlap, Burt's group-factor method did not seem applicable, and his general-factor method was used. A general introversion–extraversion factor was found to account for 14·8 per cent of the variance, while two other factors accounted for 8·7 per cent and 5·5 per cent respectively. The first of these factors opposed traits characteristic of *depression* and of what Guilford calls *rathymia*; the second factor opposed traits concerned with *thinking* and traits concerned with *feeling*.)

The correlation between the *K* test and extraversion, as tested by those items in the Nebraska Inventory for which scores could be derived from our analysis, was highly significant, being more than five times its probable error. For fifty observers it was $0{\cdot}43 \pm 0{\cdot}08$. This confirms the results reported earlier.

Only one of the correlations between the *K* test and the three group factors *S*, *E*, and *M* even approaches significance (according to Fisher's test of significance for small samples, a correlation of 0·27 would be significant). These correlations are: *K* and $S = -0{\cdot}26$; *K* and $E = -0{\cdot}05$; and *K* and $M = 0{\cdot}08$.

The observers were asked whether they were conservative or radical politically; it was found that radicalism correlated with the *K* test to the extent of $0{\cdot}34 \pm 0{\cdot}08$, which is definitely significant, and also supports a previous finding[1].

One further point may be worth noting. Dr. P. E. Vernon, who had quite independently found evidence for a factor of the kind described earlier[1] found that those observers who had 'good taste' in painting tended to prefer the modern works, while the others tended to prefer the older artists. The observers in this experiment were asked if they were very much interested in art, interested in art, or not at all interested in art. The average scores of these three groups in the *K* test were respectively 8·8, 5·9, and 4·0, thus indicating that those who were very much interested in art tended to prefer modern art, and that lesser degrees of interest in art were accompanied by less liking for modern art. It cannot be maintained, of course, that those who say that they are very much interested in art are *eo ipso* those who have good taste, but so far as we can deduce anything at all from these results, they would seem to bear out Dr. Vernon's observation.

Conclusions. It has been confirmed that the *K* test correlates positively with extraversion and with radicalism. No significant correlations were found with personality factors *S*, *E* or *M*, although a negative correlation with *S* approached significance. Preference for modern art tended to be associated with general interest in art.

[1] Eysenck, H. J., *Brit. J. Psychol.*, **31**, 262 (1941).
[2] Guilford, J. P., and Guilford, R. B., *J. Psychol.*, **2**, 109 (1936).
[3] Eysenck, H. J., *Brit. J. Educ. Psychol.*, **9**, 270 (1939).
[4] Guilford, J. P., and Guilford, R. B., *J. Abn. Soc. Psychol.*, **34**, 21–36 (1939).

RADIO TECHNIQUE IN SURGERY

ALTERNATING currents of radio frequency, while used very largely for radio communication, broadcasting and navigation, also find extensive application nowadays in the hands of the physician and surgeon. Diathermy treatment by means of high-frequency currents has long been practised by the medical profession, but, more recently, other applications of radio technique have been developed. Two of these applications are referred to in considerable detail in the September issue of the *Wireless World*.

The first is described in an illustrated article by A. W. Lay entitled "Electrosurgery", and deals with the use of a high-frequency arc for surgical operations. In such an operation the high-frequency current passes between a specially shaped electrode held by the surgeon, and the patient, who is efficiently earthed by means of an electrode of large area applied in close contact to a smooth part of the body. The cutting effect depends upon the intense concentration of heat in a minute arc, which is struck and maintained at a point of the operating electrode during the course of the cutting stroke, which is controlled by the surgeon. An important feature of the use of this method is that raising the temperature of the blood to about 40° C. accelerates its coagulation and so checks bleeding. A high degree of skill is necessary on the part of the surgeon, as the active electrode must not be allowed to dwell at any point in the course of the cut; otherwise the resultant clotting is too deep, the tissue becomes charred and healing will not follow or will be seriously delayed. Should the electrode unavoidably sever a large blood-vessel, this may be closed by a pair of special forceps, through which a more intense current may then be passed to stop the bleeding.

The high-frequency energy required for cutting operations in general surgery varies from about 30 to 80 watts, and the critical cutting voltage is in the range 220–230 volts R.M.S. At voltages above 250 the arc is too fierce and then there is a tendency for the divided tissue to become charred, which, as already mentioned, must be avoided. Further research is needed to determine the exact process by which the heat disintegrates the molecular structure of the tissue; but if current of suitable value and character is applied, a very clean cut is obtained and the healing compares very well with the effects following the use of the surgeon's knife.

The second reference in the journal mentioned above, is a note referring to a communication in the *Lancet*, describing a radio-frequency probe for locating metallic particles, such as bullets and shell-splinters, in the human body, an instrument of obviously great utility at the present time. A low-power radio frequency oscillator has a tuning coil fitted into a sterilizable porcelain probe, 10 cm. long and 1 cm. diameter. If this coil approaches a metallic substance, such as a splinter, in the area of application, the inductance of the coil, and so the frequency of the oscillator, will change. This frequency change is detected audibly by means of a second reference oscillator, and a detector, amplifier and loud-speaker combination. The apparatus is in general equally sensitive to all metals, and can detect quite small particles, but naturally all metal instruments within a certain radius must be removed while the probe is in use.

The same application of radio frequency currents has been used previously for detecting nails in timber and for other similar purposes, where the location of metallic particles embedded in insulating material is required.

POSTGLACIAL UPLIFT AND THE MOBILITY OF THE EARTH'S INTERIOR

B. GUTENBERG of the Pasadena Seismological Observatory, California, has recently completed a study of the above problem ("Changes in Sea Level, Postglacial Uplift, and Mobility of the Earth's Interior", by Beno Gutenberg, *Bull. Geol. Soc. Amer.*, 52, 721–72; May 1, 1941). The author has examined carefully the records of tide gauges throughout the world, and finds that these indicate that sea-level generally is rising at an average rate of about 10 cm. a century. In particular, maps have been constructed to show the rate of uplift in Fennoscandia and North America. A discussion of the new material and historic evidence appears to indicate that the uplift is a consequence of isostatic readjustment of the equilibrium disturbed by the postglacial melting of the ice. The remaining uplift is about 200 m. in Fennoscandia and possibly more in North America, where the present rate of uplift has its maximum of about 2 m. per century in the region of Hudson Bay. Simultaneously with the glaciation in Fennoscandia, the British Isles were covered by ice with a centre in the Hebrides where the postglacial uplift exceeded 30 m., decreasing towards Scotland; the zero isobase for the recent millennia intersects northern Ireland and northern England. There is some indication that the zero isobase at present lies south and west of Great Britain. Originally, the time needed to reduce the defect in mass to one half under the regions of uplift was less than 10,000 years, but it has been increasing with time and now exceeds 20,000 years.

Theoretical investigations on the plastic flow in the interior of the earth connected with the uplift have been critically discussed and extended by the author. According to Gutenberg, the movements affect the whole interior of the earth below the regions of uplift; their amplitudes decreasing slowly in the upper 1,000 km. If one assumes a strong lithosphere with a thickness of about 70 km., and below that the asthenosphere with a viscosity of the order of 10^{22} poises, and but little or no strength to prohibit plastic flow, there is no disagreement with observations related to isostasy or deep-focus earthquakes. Tectonic processes connected with isostatic anomalies larger than those in the regions of postglacial uplift are judged to be connected with plastic flow at least down to the core. Gutenberg suggests that defects of mass producing only relatively small gravity

anomalies are able to produce plastic flow if sufficient time is available. The lower limit, below which the processes stop, is important. The *Polfluchtkraft* probably produces stresses of the order of one hundredth of the stresses in Scandinavia stated to be large enough to maintain plastic flow. If the *Polfluchtkraft* is large enough to maintain plastic flow, then we should not be surprised to see continents being shifted by subcrustal flow during the history of the earth under the action of such small *but persistent* forces.

RESEARCH IN GEOPHYSICS

THE annual report of the director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, published in December 1940, is an important record of achievement carried out under difficulties caused by war. It describes the initiation of several fresh experimental projects, the continuance of the previous programme of field observations, the reduction of existing data, the organization of and participation in several important congresses, and the publication of a large number of scientific papers.

With the aid of a cascade high-pressure bomb, hydrostatic pressures in excess of 200,000 atmospheres were attained at the Geophysical Laboratory. This apparatus renders possible the investigation of the magnetic properties of materials at pressures comparable with those actually existing in the earth's interior. For a specimen of cadmium-magnesium-iron-spinel under a pressure of 10,000 atmospheres, a shift in the Curie temperature of as much as 5° C. was observed. These measurements necessitated the development of an alternating-current bridge capable of responding to changes in inductance as small as $1/10^{10}$ henry.

One of the outstanding problems in atmospheric electricity arises in connexion with the 'supply current', which in an undetermined manner supplies negative electricity to the earth at a rate of about 1,800 amperes, and so maintains a negative charge on the surface in fair-weather areas. The actual current flowing from air to earth in such areas depends to some extent upon meteorological and other more or less local factors, which have to be taken into account in arriving at a measure of the supply current.

In connexion with the volcanological investigations planned by the Institution, a series of earth resistivity measurements were carried out with the view of determining the thickness of the extensive deposits of volcanic ash occurring in Guatemala. Depths extending to 600 miles were recorded.

Laboratory work in nuclear physics centred around the high-voltage electrostatic generator, which was induced to yield tensions up to 3–6 million volts, and the installation of a 60-in. cyclotron. Measurements were made on the scattering of slow and fast neutrons by collisions with protons, on the resonance scattering of protons by helium nuclei, and on the splitting of the deuterium nucleus into a proton and a neutron by high-energy gamma radiation.

It is proposed to employ the cyclotron, when completed, in connexion with work of a biological and chemical character, utilizing the radioactive isotopes of ordinary elements as tracers for following various reactions. A scheme for the adequate shielding of those operating the cyclotron from the powerful radiations generated by it has been worked out.

FORTHCOMING EVENTS

[*Meeting marked with an asterisk is open to the public.*]

FRIDAY, SEPTEMBER 26

BRITISH SOCIETY FOR INTERNATIONAL BIBLIOGRAPHY (at the Institution of Electrical Engineers, Savoy Place, London, W.C.2), at 2 p.m.—Joint Discussion with the Library Association and the Association of Special Libraries and Information Bureaux on "The Preparation of Indexes to Volumes of Periodicals" (Opener: Dr. S. C. Bradford), and "Listing Titles of Periodical Publications" (Opener: Mr. E. Lancaster-Jones).

FRIDAY–SUNDAY, SEPTEMBER 26–28

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at the Royal Institution, Albemarle Street, London, W.1).—Discussion on "Science and World Order".*

FRIDAY, SEPTEMBER 26

Morning Session: "Science in Government" (Chairman: Sir Richard Gregory, Bart., F.R.S.). Afternoon Session: "Science and Human Needs" (Chairman: Hon. J. G. Winant).

SATURDAY, SEPTEMBER 27

Morning Session: "Science and World Planning" (Chairman: Mr. I. M. Maisky). Afternoon Session: "Science and Technological Advance" (Chairman: Dr. E. Benes).

SUNDAY, SEPTEMBER 28

Morning Session: "Science and Post-War Relief" (Chairman: Dr. Wellington Koo). Afternoon Session: "Science and the World Mind" (Chairman: Mr. H. G. Wells).

APPOINTMENTS VACANT

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

LECTURER IN PHARMACEUTICAL SUBJECTS, and a DEMONSTRATOR IN PHARMACEUTICS—The Principal, College of Technology and Commerce, Leicester (September 27).

ASSISTANT LECTURER IN PHARMACEUTICAL CHEMISTRY—The Registrar, University College, Nottingham (September 29).

LECTURER IN ELECTRICAL ENGINEERING AND ALLIED SUBJECTS—The Principal, County Technical College, Worksop, Notts. (September 30).

SENIOR LECTURER (MALE) IN EDUCATION—The Principal, Training College for Teachers, Collegiate Crescent, Sheffield (September 30).

CHIEF INSTRUCTOR with experience as Head of Engineering Branch of Technical Education, a SPECIALIST IN PHYSICS, and TWO SENIOR and TWO JUNIOR LECTURERS who should be Physicists or Specialists in Mechanical Engineering, for the training of Ordnance Mechanical Engineers in India—The Secretary, Military Department, India Office, London, S.W.1 (October 1).

HEADMASTER of Stockport Grammar School—The Clerk to the Governors, Stockport Grammar School, Mile End, Stockport (October 15).

LECTURER IN ENGINEERING SUBJECTS in the Rotherham College of Technology and Art—The Director of Education, Education Offices, Rotherham.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Department of Scientific and Industrial Research: Road Research Laboratory. Wartime Road Note No. 1: Recommendations for Tar Carpets and Surface Dressings. Pp. 12. 6*d*. net. Wartime Road Note No. 2: Sources of Naturally-coloured Chippings in Great Britain. Pp. 14. 6*d*. net. (London: H.M. Stationery Office.) [99

Other Countries

Universidad Nacional de La Plata. Publicaciones de la Facultad de Ciencias Fisicomatematicas. No. 137: Cuarta Reunion Anual de Caminos, Vol. 1. Pp. 350. No. 138: Cuarta Reunion Anual de Caminos, Vol. 2. Pp. 300. (La Plata: Universidad Nacional de La Plata.) [278

National Research Council of Canada. Review of Activities for the Year ended March 1940. (N.R.C. No. 976.) Pp. 155. (Ottawa: National Research Council of Canada.) 75 cents. [278

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