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CONTENTS

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MAN IN THE MODERN WORLD

MR. MUMFORD'S aim in the series of volumes that opened with "Technics and Civilization" was to give a rounded interpretation of the development of modern man, and to show what changes in his plan of life are necessary in order to enable him to make the most of the vast powers that are now at his command. The third volume, which has now appeared*, deals with the purposes and ends of human development. Whereas in his former volumes Mr. Mumford was concerned with the effect of technical and social factors on the condition of man, he is here concerned with that of symbols, or what he terms the 'idolum' which complements man's natural environment. By this term he understands a symbolic milieu of images, sounds, words, fabrications, and even natural objects to which man has attached a representative value. The ability to write symbols and respond to symbols, he says, is an essential difference between the world of brutes and the world of men. Communication, communion and co-operation, the three essential attributes of human society, all depend upon the acceptance of common symbols to which the same meanings, functions, and values are attached. They are not substitutes for experience but a means of enhancing it and enlarging its domain ; and ritual, art, poetry, drama, music, dance, philosophy, science, myth and religion are all as essential to man as his daily bread. It is through the effort to achieve meaning, form and value that the potentialities of man are realized, and his life raised to a higher potential ; and this survey of the condition of man attempts accordingly to emphasize those aspects of man's life that are usually neglected : his dreams, his purposes, his ideals, his utopias.

From this point of view, Mr. Mumford sets out to survey in its social setting the whole history of the mind of man from ancient Greece to Nazi Germany ; to describe the conditions of life, material and spiritual, in which thinkers and philosophers arose ; to characterize and evaluate their teachings, and, finally, to find a fresh answer to the age-long questions : What is man ? What meaning has his life ? What is his origin, his condition, his destiny ? Mr. Mumford seeks to determine whether any regular trends are to be found in human history and whether these throw any light on future possibilities. But while he attempts no study of ethical ideals, of the purposes which men ought to pursue, he makes many excursions into philosophy, and enters judgments in that field which are at least provocative and may be irritating, though it is argument and not contradiction that in the main he will stimulate.

The task Mr. Mumford has set himself is immense and may seem unmanageable ; but a strong sense of historical continuity informs his attempt at synthesis. Sometimes this leads him to oversimplify the issues, to concentrate on the history of ideas and to neglect the task of delineating the conditions in which men actually lived. "The Culture of Cities" may indeed correct the impression of unity and coherence in

* The Condition of Man. By Lewis Mumford. Pp. x+467+16 plates. (London : Martin Secker and Warburg, Ltd., n.d.) 25*s*. net

some of his descriptions in the present book, for Mr. Mumford is here apt to concern himself too much with the spiritual side of the history of Western man ; and his dramatic bias, as indicated in his chapter titles, tends to accentuate the weakness. He gives too much of the impression of a closed chapter to each epoch, rather than of continuous development. Nevertheless, the fundamental theme of the book is that man is a continually changing animal ; his growth is not completed by biological fulfilment as mate and parent or by death ; his nature is self-surpassing and self-transcending ; his utmost achievements are always beginnings and his fullest growth leaves him still unsatisfied, while above his instinctive and automatic activities lies a whole stratum of purpose and meaning. Mr. Mumford has attempted, not to trace lines of development, but rather to discover in each period of human history the forces which tend to encourage or thwart the realization of personality. In dealing with each age he weaves into a single pattern all that is known of its religion and art, as well as of its social and political organization. He often challenges accepted beliefs and opinions, but even when he fails to substantiate his own views sufficiently, he demonstrates the resources of the reservoir of human creativeness to be found in history.

So far as scientific workers are concerned, they may feel that the contribution of science is insufficiently stressed by Mr. Mumford, and may be tempted to compare his book to its disadvantage with Whitehead's "Adventures of Ideas". But while Mr. Mumford has been over-careful to avoid repeating the argument of "Technics and Civilization", he does justice to Bacon and Newton ; and one of the most suggestive passages of the book is that in which he discusses the relation between science and the universities at that time, and the way in which science came to acquire a moral authority that had once been pre-empted by the Church.

When dealing with science and its implications, Mr. Mumford is in fact at his best. In the last three chapters of his book, which are much the best written and most lucid, if not indeed also the most stimulating, he passes in review the nineteenth century and seeks to disclose the roots of the dangers threatening Western civilization and to formulate a basis for renewal. Here is indeed a sombre picture of societies dominated by intensified nationalism, of the triumph of the machine over human personality and of moral weakness rationalized with the help of theories in which brute impulse is given priority over reason.

A formidable mass of reading, not all of equal value, is represented by the bibliographies appended to his books ; but it is in the writings of a man of science, Patrick Geddes, that Mr. Mumford finds the clue to the basis of renewal. Geddes' emphasis on the evolution of a more finely attuned and more complexly balanced expression of both personality and community, and his philosophy of life in which mechanism had constant place as the servant of life but never as its master, led him to an expression of citizenship akin to that which Mumford has already indicated in "The Culture of Cities". Geddes accepted social responsibility in his life and work, and interrelated scientific investigation with social need ; but the basic change he advocated was the unification of all the processes of life, the subjective and the objective, and the equal cultivation of the sciences, the arts, and the humanities.

Mumford's tribute to the work and teaching of Geddes is deserved, but while Geddes expressed Mumford's own view that the sundered fragments of the modern world will be unified, not by returning to their original simplicity but by advancing to a more highly developed synthesis and a more inclusive pattern of action, open always to the test of fresh action, to the challenge of fresh experience, and the incursion of fresh ideas and ideals, Mumford's final chapter has much in common with General Smuts' conception of holism. None the less, this final chapter, if not exhaustive in its analysis and rather deficient in the delineation of the ways in which the needs of personality and those of the community are to be fulfilled in due balance, is perhaps the most stimulating in the whole book. It is full of pertinent comments as we face the tasks of a post-war world, and is less sombre than most of the book, for Mr. Mumford faces the future with hope. We are moving, he thinks, from an age of expansion to an era of stabilization, which will present an opportunity for a proper balancing of functions, and therefore for a richer development of personality. To make greater use of our vitalities and energies we must re-assert the primacy of the person.

Mr. Mumford points out that every gain in power, every mastery of natural forces, every scientific addition to knowledge has proved potentially dangerous because it has not been accompanied by equal gains in self-understanding and self-discipline. Here he seems to be paraphrasing Smuts' own words to the British Association ; but the last ten years abundantly attest the truth of his further observation that science which disclaims all interest in human values, except the satisfaction of curiosity and the increase of manipulative skill, cannot be useful even in its own limited sphere when the general dissolution of values leads to a contempt for science and a deliberate perversion of its values. The watchwords of the new culture must be cultivation, humanization, co-operation and symbiosis. Many of our present mistakes are due to statesmen, industrial leaders and administrators attempting to apply the ideology of the age of expansion to a social organization with entirely different requirements—an organization in which the careful timing and spacing of activities, the proper diversification of opportunities and the balancing and interlocking of functions must take the place of spectacular one-sided advances.

While the conditions for stabilization have appeared, the institutions that will turn this process to the advancement of society have not yet been developed. For working out the new social order an active knowledge of the social environment, and of the behaviour of men in social partnerships, their needs, their drives, their impulses, their dreams is just as indispensable as reading, writing and arithmetic for those trained to capitalize. The art of politics and the arts of enlightened behaviour and orderly communica-

tions must become the main field of new inventions, and here Mr. Mumford enters a plea for a world language.

The great gains made in technics during the last few centuries have been largely offset by a philosophy that either denied the validity of man's higher needs, or sought to foster only that limited set of interests which enlarged the power of science and gave scope to a power personality. Hence Mr. Mumford puts first among our tasks of post-war reconstruction, not the physical re-building, but the laying in every department of our culture of the foundations for a new set of purposes, a radically different mode of life. "Civilizations," he observes, "do not die of old age : they die of the complications of old age," and the task for our age is to decentralize power in all its manifestations. Our first need is not for organization —nor for the mobilization of organization that has become inflexible—but for re-orientation, a change in direction and attitude. There are new organizations, large and small, set up under stress of war, on which we can draw, but we must bring to each activity and every plan a new criterion of judgment : how far it seeks to further the process of life-fulfilment, and how much respect it pays to the needs of the whole personality.

There is no easy formula for this renewal, and the ideal needs further analysis. The question whether the age of expansion is ended should be explored more deeply if by expansion we mean increasing control over the forces of Nature, including human nature. But if Mr. Mumford is sometimes incomplete he is always suggestive, and his book is one to be pondered by all concerned with the trend of civilization. As already indicated, it is not free from faults : historically, Mr. Mumford tends to defeat his own object by dramatizing episodes in a way that masks the continuous development of human culture, and his strong Socinian bias mars his presentation of Christianity. But as a social philosopher he has the confidence and forward-looking mentality of the Mannheim school, and the whole weight of the book is thrown in support of an adequate programme of social research in the true sense of the word. He comes out also in support of the planning school ; but he is too balanced to be led into excess, and his emphasis is on freedom to be achieved only when the new ordering of our environment has permitted the development of personalities capable of drawing upon our immense stores of energy, knowledge and wealth without being demoralized by them. Above all at the present moment it is for its note of hope, the confidence with which, surveying the disintegration of civilization, he summons us to the task of re-integration, that Mr. Mumford's work is most welcome and should be studied, particularly by scientific workers, whose contribution to the task he recognizes as freely as he stresses its limitations. This is the voice of a prophet and interpreter, calling us to seek the way rather than declaring it plainly ; and, though the message is not new, the world picture is clearer, more coherent and more relevant to post-war tasks than that General Smuts drew for the centenary meeting of the British Association.

PRIMITIVE PERSONALITIES

The People of Alor

A Social-Psychological Study of an East Indian Island. By Cora Du Bois ; with Analyses by Abram Kardiner and Emil Oberholzer. Pp. xi+654+32 plates. (Minneapolis, Minn. : University of Minnesota Press ; London : Oxford University Press, 1944.) 45*s*. 6*d*. net.

DR. DU BOIS received her training in anthropology at the University of California. Her subsequent field-work among American Indians on the west coast of America led her to realize the dangers of supposing that we can deduce what individuals are from the institutions under which they live : "psychological orientations and techniques" need to be employed for this purpose ; and analytic psychology appeared to her "to offer the greatest number of concepts with which the anthropologist could operate, although much of its theory, particularly in the field of social phenomena, seemed inept". Thus it came about that in 1935 she spent a year, as a U.S. National Research fellow, in exploring "the bearing of various psychiatric approaches to personality formation within our own society", and that in the spring of 1936 and 1937 she collaborated with Dr. Abram Kardiner in his seminar at the New York Psychoanalytic Society. Together, they reached the conclusion that field-work alone could test the validity of the procedures which these seminar discussions had indicated. Aided by funds contributed by Dr. Kardiner, the Social Science Research Council of Columbia University gave Dr. Du Bois the financial support which enabled her to carry out such field-work.

Dr. Du Bois's choice fell on Alor, a remote island north of Timor, fifty miles long and thirty miles broad, in the (then) Dutch East Indies. There she arrived in 1938 and at once built herself a house, among some six hundred mountain people, in a district called, from the name of its largest village, Atimelang, and comprising four other villages. The Atimelangers, Dr. Du Bois tells us, are predominantly Oceanic Negroids, with Oceanic Mongoloid admixture and with perhaps a strain of pygmy origin. About ten thousand of the coastal people of Alor are Mahommedans ; the rest are pagan. In Atimelang she stayed for eighteen months, returning to New York in the winter of 1939–40.

This book, the principal fruit of her expedition, is divided into four parts. The first is introductory. The nine chapters of the second part, styled "psycho-cultural synthesis" (in which thirty-one pages of excellent photographs are inserted), deal with infancy, childhood, adolescence, marriage, sex, adults and institutions, some psychological aspects of religion and some personality determinants in Alorese culture. The third part, by far the longest, comprises more than 360 pages and contains the autobiographies of eight Alorese, four men and four women, who, the author believes, "represent, on the whole, average Atimelang adults". These autobiographies were recorded with the help of a native interpreter ; about fifteen interviews, of an hour each, were accorded to each of these eight informants. The fourth part of the book describes the results of the four psychological tests she applied—the Porteus Maze tests (scored and briefly commented on by Dr. Porteus himself), word associations, children's drawings and the Rorschach test (evaluated by Dr. Emil

Oberholzer, an enthusiastic expert on this test). They were applied respectively to 55, 36, 52 and 37 Alorese, and must be regarded as tentative, exploratory efforts.

To Dr. Du Bois's presentation of 'the problem' in her first chapter Dr. Kardiner adds an 'elaboration' (as she terms it) of somewhat greater length. To the second part he also contributes its last chapter; and to each of the eight autobiographies he appends an analysis of the personality and a diagram of the 'character structure' of each informant, adding a final chapter in which he surveys the biographies as a whole and compares them individually. The contributors of these biographies received payment for each of their attendances. "It was understood," Dr. Du Bois states, "that each session would begin with dreams of the preceding night," and sometimes she had doubts as to the genuineness of these dreams. Sometimes, too, the interference, and indeed the very presence, of the interpreter acted as an obstacle to securing the complete confidence and truthfulness of the informant. Nevertheless, these autobiographies reveal striking individual differences in personality, and they contain an abundance of ethnographic material which would probably have been unobtainable by any other, less novel, method; and when Dr. Du Bois felt compelled to intervene in the narratives, these occasions are meticulously indicated in the text. Few psychoanalysts, if any, will quarrel with Dr. Kardiner's interpretations of this material: care and caution characterize his analyses. But such phrases as "the tonicity of the super-ego", "inflation of the parental imago" and "weak libidinal ties" must prove deterrent to those who, like the reviewer, are less familiar with Freudian terminology than he is. His reasonable concept of 'basic personality' (or 'modal personality', as Dr. Du Bois prefers to term it) recurs throughout the book. It implies "the psychic unity of mankind"—arising from "the interplay of fundamental physiologically and neurologically determined tendencies and experiences common to all human beings being acted upon by the cultural milieu, which denies, directs, and gratifies these needs very differently in different societies". As Dr. Kardiner observes, "no two individuals subjected to exactly the same cultural influences will utilize them in exactly the same manner". But in each society there is a 'central', or 'modal', tendency.

When, on her return to America, Dr. Du Bois presented her material for discussion at the Columbia University seminar, Dr. Kardiner, we are told, employed a certain technique and reached certain conclusions. But, he says, Dr. Oberholzer, to whom the Rorschach test material was submitted, "was acquainted neither with the technique that I pursued nor with its conclusions, nor did I know what the conclusions of the Rorschach tests were likely to be. When these conclusions were finally presented, the correspondence between characteristics common to all Alorese and the reconstruction of the 'basic personality structure' was truly remarkable. Furthermore, the differences between Alorese and Western man demonstrated by the Rorschach tests were equally striking". The reviewer, however, is not impressed by the closeness of correspondence between Dr. Kardiner's and Dr. Oberholzer's descriptions of the personalities of *individual* Alorese whom they each analysed.

"It is not the purpose of the present account," Dr. Du Bois explains, "to give a thorough ethnographic description" of the Alorese. This is obvious, and such details, which "must await separate publication", will receive a hearty welcome. Her present work is a serious attempt to effect collaboration between modern anthropology and so-called 'depth psychology', in the field of social studies. It is, as Dr. Ruth Benedict observes, "a pioneering contribution to the study of personality in an alien culture".

C. S. MYERS.

THE SCHOOL CURRICULUM

The Content of Education

By J. A. Lauwerys. Pp. 24. (London: Association for Education in Citizenship, 1944.) 4*d*. net.

Science in Childhood Education

By G. S. Craig. Pp. 86. (New York: Bureau of Publications, Teachers' College, Columbia University, 1944.)

READERS of the *Spectator* will recall a recent article bearing the challenging title "Teaching the Wrong Things", and they will probably agree that the writer of the article made out a good case, to say the least, for a revision of our notions of what should be taught in our schools. The call for revision does not come directly from the teaching profession itself, partly because teachers are too much occupied with the social side of their work to think about departures from the traditional curriculum, and partly because their noses are kept to the grindstone by the requirements of external examinations.

That the problem is in the air, however, and that it is receiving attention by people who take an active part in schemes of thinking and planning for the future, is well exemplified by Mr. Lauwerys' pamphlet "The Content of Education". The writer is well aware of the difficulties of the job he has so courageously tackled. There are some who say that it does not matter what you teach so long as the children are kept busy and happy; others who say that it does not matter so long as children are put through the mill of strict mental discipline; and still others who seem to agree with the famous headmaster quoted by Mr. Lauwerys, that it did not matter much what was taught in his school, provided the boys loathed learning it. In his well-packed pamphlet Mr. Lauwerys first reviews the actual content of the existing curriculum and then proceeds to ask how it has all come about. Then follows an exposure of the failure of the curriculum to meet the needs of the children, as those needs are seen from the sociological point of view. Finally, definite proposals for reform are summarized, following the lines laid down by the Association for Education in Citizenship.

Mr. Lauwerys refrains from dealing radically with the usual list of 'subjects'—a word which has much mischief to answer for, but which cannot be dispensed with. The most significant of the reforms suggested comes under the head of social studies. "For a long time progressive teachers of history and geography have tried working at combined courses in their two subjects. Some feel that this proposal needs extending." They desire that there should be courses in social studies consisting of "material taken from history, geography, politics, economics, anthropology, social psychology". Such courses are being successfully given both in Britain and in the United States. They deal with problems studied under such headings in such a way that when the treatment

is taken to a higher level they "tend to crystallise out into these subject-divisions".

The work entitled "Science in Childhood Education", by the professor of natural sciences in Teachers' College, Columbia University, shows that dissatisfaction with the present 'content of education' exists in the United States no less than in Britain. The question discussed in this work is the position of science in the education of children. Though, says the editor of the series to which this book belongs, science in some form has a widespread influence on our day-by-day living and thinking, yet it has made very little headway in schools for children of less than fourteen years of age. The lag seems to be due to the inclination to look at science only in terms of 'specialised fields', that is, of the 'subjects' which trouble Mr. Lauwerys. One cannot teach "physics, chemistry, biology and the others" to children, and no satisfactory scheme has been devised to meet the needs of children who are assailed on every hand by the marvels wrought by modern science.

Prof. Craig's work has been inspired, not by a desire to defend science as a vested interest, but by a "concern for aiding children to use scientific procedures and information as a means of dealing with problems they encounter and of understanding their environment". He has performed his task with admirable thoroughness; but the teachers of American children must not expect to find the book easy reading. It is, however, an interesting confirmation of our own concern for meeting the real needs of twentieth-century children. T. RAYMONT.

ELECTRICAL TRANSMISSION FREQUENCIES

High Frequency Transmission Lines

By Dr. Willis Jackson. (Methuen's Monographs on Physical Subjects.) Pp. vii+152. (London: Methuen and Co., Ltd., 1945.) 6s. net.

DURING the early stages of the industrial applications of electricity, direct current held sway in both telecommunication and power transmission. Under the influence of Kelvin and Edison, direct current continued to be used for the latter purpose, long after the practical superiority of alternating current had been fully demonstrated. At present, all the most important power transmission is done at frequencies of 50–60 cycles per second. There are, however, great difficulties in the way of extending alternating current power transmission over distances exceeding say 400 miles, and much thought is being given to reversion to D.C. for projects such as the transmission of powers of the order of a million kW. The wheel has therefore turned almost full circle.

In telecommunication, the trend has been from the D.C. or zero frequency telegraphic systems towards radio frequencies of the order of 10^9 cycles/second. High-frequency transmission lines have been used extensively for telecommunication purposes during the last five years, and have improved the efficacy of channels to a remarkable extent. This improvement has involved revolutionary changes in sending and receiving apparatus, and in the form and constitution of the interconnecting cables. Short-wave radio-type equipment does the transmitting and receiving over or through special channels, the best known of which is the coaxial cable. The cable must be constructed in such a way that there are no abrupt changes in its capacity or inductance per unit length, and the dielectric losses in the insulation must be as low as possible. Great success has been attained, and it is possible to transmit as many as forty-eight messages simultaneously over a single channel, with high efficiency.

As literature of this revolutionary development is for the most part confined to specialized technical journals issued by the great telecommunication corporations, Prof. Willis Jackson has supplied a real need by providing a convenient and reasonably comprehensive monograph on high-frequency transmission.

Power transmission engineers will be attracted by the title, but they will find little in the book which seems to relate to their everyday work of transmitting powers of the order of 100 MW. and above over distances up to say 200 miles, unless they are prepared to go through the author's exposition in detail. If they do so, they will learn much that is of service in connexion with their more intricate problems, such as those involved in stability calculations, and in determining the effects of impressed voltage surges.

Telecommunication engineers, who must perforce remain acquainted with the 'telegraph equations', will be more at home with the author's methods, and should have little difficulty in bringing themselves up to date in the new field.

Prof. Jackson's method of exposition is essentially spartan. He gives only cryptic indication of what is actually achieved by the use of high-frequency transmission lines, and evidently expects that his readers should be satisfied to plunge into abstract study without being tempted by a recital of practical achievements. This omission will, in the reviewer's opinion, materially and unfortunately reduce the circulation of a valuable book. It should, however, be noted that among the miscellaneous applications mentioned by the author are metallic insulators for supporting circuits carrying very high frequency currents of constant frequency, a non-contact short-circuit, and a condenser which will pass direct currents. These are sufficiently startling to arouse interest in all thinking electrical engineers.

After an introductory chapter on applications of transmission lines at very high frequencies, the subject is developed in five main sections, namely, the basic equations for transmission lines propagating in the principal mode; the propagation characteristics of lines; the behaviour of terminated lines; resonant lines; impedance transformation—the use of the circle diagram technique.

Free use is made of differential equations and hyperbolic functions as a means of avoiding ponderous explanations, but clear and interesting physical explanations and comments are provided, wherever they are required.

Forty-four diagrams are included. Most of these are simple sketches such as might be drawn by a lecturer on a blackboard, and are of little permanent service. Those relating to the circle diagram are, on the contrary, clear and complete, and are potentially of great practical service, since accurate basic data are given to enable a serious reader to construct his own diagrams for definite applications. The style of writing is clear and interesting, but it is marred by an excess of 'verys' and phrases such as 'on the other hand'. The book is of convenient pocket size, and is a worthy addition to an excellent series.

COAL IN RELATION TO ATMOSPHERIC POLLUTION*

By DR. A. PARKER

Director of Fuel Research, Department of Scientific and Industrial Research

IN 1912, following an international smoke abatement exhibition in London, there was appointed an Advisory Committee on Atmospheric Pollution under the Meteorological Office. Later, in 1927, the work of this Committee was taken over by the Department of Scientific and Industrial Research. Under the guidance of the Atmospheric Pollution Research Committee of the Department, and with the co-operation of many local authorities, methods of measurement of different forms of atmospheric pollution have been improved and new methods devised, and systematic records of the extent of pollution in many parts of Britain have been obtained. The results of this useful work have been published in a number of annual reports of the Committee. Over a period of three years just before the War, an intensive survey of atmospheric pollution in Leicester was undertaken under the guidance of the Research Committee and a full report of this work is now in the press.

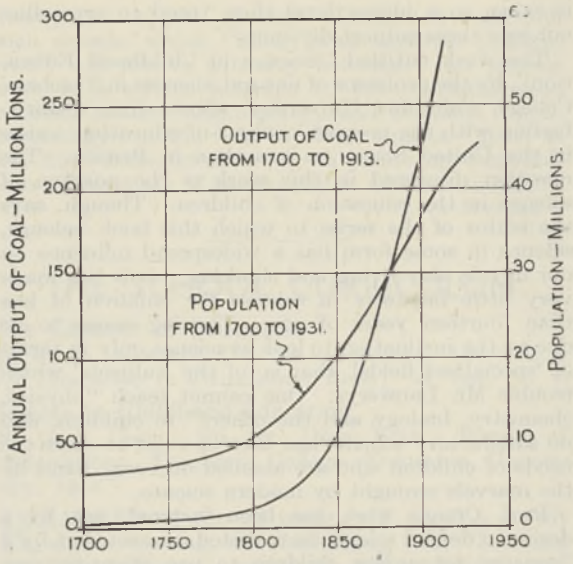
There is no doubt that all these activities have played their part in bringing about during the last fifty years a gradual but very definite improvement in many areas. There is much truth in the statement that the old type of London fog is now almost unknown. Much still remains to be done, however, before the air of our towns will be reasonably clean and free from smoke and other forms of pollution; and the ultimate goal will not be achieved except on the basis of intensive scientific research in several directions.

Quantity of Coal Used in Relation to Population

Before discussing the nature and the quantity of the polluting substances discharged into the atmosphere from the use of coal for different purposes, let us consider what changes have occurred in Great Britain since the beginning of the eighteenth century in the rate of production of coal, and in the relationship between the rate of production and the size of the population. This period is chosen because it was during the eighteenth century that there were the first signs of the beginning of the enormous developments in the use of coal which took place in the nineteenth century, particularly in the second half of that century. Great Britain has been fortunate in possessing reserves of coal of good quality and of many types. Early recognition of the possibilities in the use of coal for the generation of heat, power, and light, and the skill and enterprise of our scientific men, engineers and industrialists of 100–150 years ago, gave Great Britain a good lead in the industrial developments that followed.

The rapid rise in the use of coal was accompanied by a marked increase in the population. The great changes which occurred are indicated by the accompanying curves, which are plotted from estimates of the population and of the annual outputs of coal from the year 1700 to the early years of the present century.

* Substance of a Chadwick Public Lecture delivered on March 13.



The important changes in Great Britain during the last 140 years have thus included an increase in the annual output of coal from roughly 10 million tons to about 200 million tons, and a great increase in the population from roughly 10 to 45 millions, and the crowding of masses of people in large towns. Most of the coal brought to the surface in Great Britain is used in this country. If there had not been considerable improvements in the methods of using coal, atmospheric pollution from this source would certainly have been very much worse than it is to-day.

Efficiency of Use of Coal

In Table 1. figures are given to show the principal inland uses of coal in Great Britain and the quantities in millions of tons a year for the three-year period 1936–38.

TABLE 1. SOME USES OF COAL IN GREAT BRITAIN (ANNUAL AVERAGES FOR 1936–38).

	Purpose for which coal is used	Quantity in millions of tons
1	General use, including 40–45 million tons for domestic purposes	98
2	Electricity power stations	14
3	Coke ovens	20
4	Gas works	19
5	Railway locomotives	13
6	Collieries	12
7	Ships' bunkers, foreign and coastal	12
	Total	188

With what efficiency is the coal used for the various purposes mentioned above, and can the efficiency be increased? Unfortunately it is not possible from available data to do more than give very rough estimates of the efficiency of utilization of coal for the many purposes for which it is employed. The rough estimates that can be made, however, do serve as a useful guide.

Of the quantity of 98 million tons given in the first item of Table 1, approximately 40 million tons is used for domestic heating and cooking and 60 million tons by various industrial undertakings for such purposes as heating furnaces and raising steam for processes and for power. Though the efficiency of generation of steam in large boiler installations of the most modern type is often as high as 80 per cent, this high efficiency cannot be maintained unless the

equipment is kept in first-class condition and is operated under close scientific supervision. In the past, coal has been relatively cheap, and in large numbers of industrial undertakings little attention has been given to equipment such as boilers and furnaces. Far too much heat, which could have been usefully employed in several ways, has been carried away in hot gases and liquids, and large quantities of steam have been wasted. With many furnaces of the kind used for heating metals, not more than 4–5 per cent of the heat value of the coal is put to useful purpose. It is difficult in furnaces of this kind to obtain high efficiency, but there is no doubt that appreciable improvement is practicable in many cases. As an overall figure, it is unlikely that the efficiency of use of the 60 million tons of coal included in the first item of Table 1 for industrial purposes exceeds 50 per cent.

On the domestic side, the overall efficiency of the open coal-fire under average household conditions is not more than about 20 per cent. The corresponding figure for the general purpose appliance in which coal is used for space heating, provision of hot water, and cooking is somewhat greater because of the heat taken up by the water, but it is probably not more than 25 per cent. Here is considerable room for improvement. Much effort is now being expended in designing open fires to provide not only radiant heat, but also convected heat derived from air which is heated by passage through ducts adjacent to the fire; the warm air is discharged into the room in which the fire is placed, or into other rooms. The probability is that with systems of this kind the average householder would obtain an efficiency of 30 per cent in place of 20 per cent with the ordinary open fire.

During the past twenty-five years there has been great expansion in the use of electricity and a great increase in the efficiency of generation. The quantity of coal consumed annually during 1936–38 at electricity power stations was 14 million tons; this is more than twice as much as during the years 1921–23, and in 1943 the amount was about 23 million tons. In 1921 the average quantity of coal consumed to produce one unit of electricity was 3·4 lb., whereas in 1938 it was only 1·4 lb. This means that the efficiency of generation was two and a half times as great in 1938 as in 1921. Even with this great improvement, the heat equivalent of the electricity generated was only about 20 per cent of the heat value of the coal burned under the boilers. Allowing for losses in transmission, the efficiency of generation and distribution in 1938 was about 18 per cent. Though the efficiency of generation is low the efficiency of utilization is usually high; for example, it may be taken as practically 100 per cent for the electric fire; this means an efficiency in relation to coal used at the generating station of 18 per cent.

Before the War the efficiency of carbonization of coal in coke ovens and at gas works had reached the high average of roughly 75 per cent. Further improvement is probable but it clearly cannot be very great. From each ton of coal carbonized there is produced about 14 cwt. of coke, 60–80 therms of gas, 10–15 gallons of tar, and ammonia equivalent to about 25 lb. of ammonium sulphate. At gas works, some of the coke is used to make water gas, heat the retorts, and generate steam and power, so that the quantity of coke available for sale is roughly 9 cwt. per ton of coal. At coke ovens, a large proportion of the coal gas is used to heat the ovens. The coke is used mainly for blast furnaces and other furnaces, though some is sold for other industrial purposes and sometimes for domestic use. Much of the surplus gas is sold to gas works.

It is difficult to give an estimate for the efficiency of use of coke for the many and varied industrial purposes for which it is employed. Though it can be used with high efficiency in industrial boilers and for making producer gas, the efficiency with many furnaces is low. It is unlikely that the overall average is more than 50 per cent.

With coke for the open domestic fire with a grate suitable for burning this fuel, the efficiency under average conditions is roughly 25 per cent, and it could no doubt be increased to about 30 per cent, as with the open coal fire, if provision for heating by convection as well as radiation were included. In closed stoves and boilers (with hot-water radiators) of the usual domestic type, the efficiency of using coke is in the region of 50 per cent.

The efficiency of gas appliances in general is higher than with appliances using coal or coke. Modern gas fires have an efficiency of 40–50 per cent under average conditions.

In considering these figures for coke and gas, which are intended to represent overall average, not test, conditions, it should be remembered that in order properly to compare them with the figures for coal, they should be reduced to allow for the fact that heat is used and lost in making coke and gas from coal. If the efficiency of production is taken as 75 per cent, the efficiency in use should be multiplied by 0·75 to give the 'coal economy efficiency'.

Though much attention has been given to fuel economy by railway undertakings, the overall efficiency of use of coal for power for locomotives is necessarily low. Including shunting operations, the overall average is well below 10 per cent, and is probably not more than about 5 per cent.

Nature and Amount of Pollution

Of the various products of combustion or partial combustion, those which give rise to pollution of the atmosphere are mentioned in Table 2.

TABLE 2. POLLUTING SUBSTANCES FROM COAL AND PRODUCTS.

(*a*) Solid.	Particles of carbon causing black smoke and particles of mineral matter or ash carried forward with the gaseous products.
(*b*) Liquid carbonaceous material.	Fine particles of liquid tarry matter causing yellowish or brown smoke.
(*c*) Unburned and partially burned gases.	Gaseous hydrocarbons and carbon monoxide.
(*d*) Sulphur oxides.	Sulphur dioxide and some sulphur trioxide which with water forms sulphuric acid.

It is not easy to assess the amounts of those forms of pollution produced by the various fuels with their different methods of use, and only approximate estimates can be given. It is worthy of note, however, that the methods of measuring amounts of pollution are steadily being improved. For example, during recent years considerable attention has been given at the Fuel Research Station of the Department of Scientific and Industrial Research to the measurement of the quantity of smoke emitted from domestic fires and industrial boilers using coal; and a satisfactory method has been devised. A detailed description of the method is being prepared for publication. It is based on measurements of the amount of light absorbed by the smoke-laden gases when a beam of light under standard conditions is passed through a layer of the gases: many difficulties had to be over-

come before a technique of sufficient accuracy and reliability was devised. As a result of this work, the figures now available are much more reliable than those previously obtained. Though the quantity of smoke emitted from the domestic fire is high, this latest investigation has shown that it is not so great as has often been stated.

In Table 3, approximate estimates are given, on the basis of the best available information, of the total amount of pollution produced annually from the use of coal in Great Britain under the conditions during the few years preceding the War.

TABLE 3. NATURE AND QUANTITY OF POLLUTION FROM COAL IN GREAT BRITAIN.

Type and use of fuel	Quantity of coal (millions of tons per annum)	Pollution produced (millions of tons per annum)		
		Smoke	Ash	Sulphur dioxide
Coal:				
Domestic grates	42	1·1	0·1	1·0
Electricity power stations	14	small	0·1	0·4
Railways	13	0·4	0·1	0·4
Collieries and various industrial uses	68	0·8	0·2	2·4
Coke and Gas:				
Coke ovens and use of coke	20	small	small	0·5
Gas industry at gas works	19	small	small	0·1
in using gas		nil	nil	small
in using coke		nil	small	0·2
Total	176	2·3	0·5	5·0

From the figures in this table, the weight of tarry and carbonaceous matter in the smoke produced is 2–2½ million tons a year, or roughly 1¼ per cent of the weight of the coal used. Approximately one half of this weight of smoke is derived from domestic grates, which use only about one quarter of the coal. The total pollution by oxides of sulphur is about 5 million tons a year, and the weight of the grit or ash discharged into the atmosphere is roughly 0·5 million tons. Not more than one fifth of the sulphur and grit arises from domestic appliances burning raw coal.

Reduction in Pollution

In the present state of knowledge and of development of fuel-burning appliances, it is not practicable entirely to prevent the pollution of the atmosphere through the use of coal and its products. It is practicable, however, to effect a considerable reduction in the amount of the pollution caused by smoke and grit, though it is much more difficult to reduce the amount of pollution from sulphurous gases. How can such an improvement be effected ? There is no one method. Developments and changes in several directions are necessary.

In the first place, all practicable steps must be taken at the colliery to clean the coal before delivery to the consumer. A reduction in the adventitious mineral matter will reduce generally the solid matter to be removed when the coal or coke is burned, and the quantity of sulphurous gases discharged into the chimney. It is apparent also that as the best coal seams are gradually worked out the need for efficient cleaning will become greater.

The next important step is to ensure that the coal and its products, coke, gas and electricity, are used as efficiently as is economically practicable, and that the heat and power developed are not wasted. Efficient use of fuel can only be achieved as a result of skilled and intelligent operation, maintenance of fuel-using appliances in good condition, development of better appliances, and the judicious application of insulating materials to reduce waste of heat. In Great Britain insufficient attention has been given to the training of fuel technologists and operators, and little attention has been given to the possibilities of insulating buildings with the object of conserving heat.

With large modern boiler installations equipped with mechanical stokers, little or no smoke need be produced ; but installations of this kind with forced draught carry appreciable quantities of ash or grit into the chimney gases. Most of the grit can be removed from the chimney gases by the use of efficient grit-catchers such as have been installed at the largest electricity generating stations. There might well be extension of the application of this method to other boiler and furnace installations. At certain of the largest electricity power stations in thickly populated areas of Britain, coals containing not more than 1 per cent of sulphur are selected for firing the boiler furnaces. In addition, these power stations are equipped for the operation of processes which remove most of the oxides of sulphur from the chimney gases before discharge to the atmosphere. These processes of treatment to remove sulphurous gases, however, are not easily operated and are expensive ; their cost on pre-war prices was 2–3*s*. per ton of coal burnt. There is required some efficient but cheaper method of reducing the quantity of oxides of sulphur discharged, suitable not only for the largest but also for smaller boiler installations. This difficult problem is being studied, but there is no immediate solution in sight.

It has not been possible in the past, with the large numbers of hand-fired boilers at numerous industrial works, to avoid the emission of smoke, particularly for a time after stoking. As a result of extensive work by the Fuel Research Station during the last few years, equipment has been developed to replace the doors of marine and Lancashire boilers, whereby the emission of smoke can be practically eliminated. The equipment is simple to construct and very simple to operate. It provides at the right time and in the right way the extra air required to burn the smoky volatile matter evolved from the fresh coal for the necessary period after stoking. This equipment is already in satisfactory use on many hundreds of marine boilers, and its value has been fully demonstrated ; not only does it greatly reduce the amount of smoke, but also it assists in maintaining high efficiency in utilizing the heat value of the coal.

The domestic open fire produces more smoke per ton of coal burned than any other appliance in general use ; it has already been mentioned that about one half of the smoke pollution arises from domestic appliances, though they consume less than one quarter of the total coal used, or less than one third of the coal burnt direct and not submitted to such processes as carbonization. Though the problem has been studied by many investigators, there is no immediate prospect of designing an open fire which will burn bituminous coal without producing any smoke. There are designs of open fire, however, which will bring about a reduction in the amount of smoke to about one half of that with the open fire of usual type, but they have not yet been tried out in general use by the average householder. The emission of smoke during the early stages of burning up after lighting seems to be unavoidable.

There is at present no method of reducing the amount of pollution by sulphurous gases from each ton of solid fuel burnt in domestic appliances,

whether the fuel is coal or coke; the proportion of sulphur in coke is roughly the same as in the coal from which it is made.

Pollution by grit from the burning of coal and coke in domestic appliances is not easily prevented, though fortunately it is not very great.

Substitution of gas for solid fuel would avoid pollution by smoke and grit and would reduce pollution by sulphurous gases to a negligible amount. The use of electricity in place of solid fuel avoids the production of smoke, but would not prevent pollution by grit and sulphurous gases unless the generating stations are equipped to remove the grit and sulphur from the chimney gases. In general, however, gas and electricity are too expensive for continuous heating in the average house, but they have advantages in many circumstances for short-period intermittent heating and for cooking.

So far as domestic appliances are concerned it would seem that encouragement should be given to the use of coke, gas, and electricity in place of coal, so far as is economically practicable, if atmospheric pollution is to be greatly reduced. But the changes suggested could only take place gradually, if the demands for the various fuels and forms of energy are not to overstep the supply; and there must be a suitable balance if the resources of the different types of coal are to be used to the best advantage in the broad national interest. It should be pointed out that all the possibilities have not been covered: for example, the possibilities of communal central heating and district heating have not been discussed. It is hoped, however, that this broad review will serve to indicate the general lines along which progress can be made.

COAL MINING IN GREAT BRITAIN

IT would be difficult to exaggerate the importance of the Report of the Technical Advisory Committee on Coal Mining, presumably to be known as the Reid Report*. For almost a century, coal mining in Great Britain and its special aspects have been the subject of inquiry for royal commissions and departmental committees, and in the past few months much has been written on the reorganization of the industry. However, the Reid Report is without parallel. Seven distinguished mining engineers have examined the present lamentable position, and have set out in detail their proposals for the creation of a prosperous and efficient industry. Mr. Reid and his colleagues have expressed their views with complete frankness, and have criticized impartially mine-owner, mining engineer and workman. If ever the term 'blue-print' could be applied to a document, then this report is a blue-print for the post-war mining industry in Britain.

The approach to the problem is historical, and Part 1 includes a revealing comparison of the coal industry of Britain with those of the principal Continental nations. If two nations are mining coal under approximately similar natural conditions, then the output of coal per man-shift worked can be regarded as a measure of the efficiency of mining. Similarly, records of output per man-shift over several years will provide evidence of improvement or deterioration in the mining situation of a particular nation. In any comparison of statistics of output per man-shift careful account must be taken of the natural conditions under which the coal is worked. In the United States, mining conditions are greatly superior to those prevailing in Britain, and in Poland mining is carried on under the best natural conditions in Europe. However, in Holland and on the Ruhr, conditions are certainly no better than those of the British coalfields. Although useful conclusions can be drawn from the statistics of American mining, for a fair comparison we must turn to our Continental neighbours, and particularly to Holland and the Ruhr.

Those who desire an account of the vicissitudes of the British coal trade must refer to the report itself. The most significant period is that between the years 1927 and 1939, and it is sufficient here to say that, in spite of the introduction of several thousand mechanical coalcutters during the years 1913–27, output per man-shift showed little improvement from the 20·32 cwt. of 1913 to the 20·62 cwt. of 1927. Some progress was made in the years 1927–36, when the output increased by some 14 per cent to 23·54 cwt., a maximum for the period between the Wars. Small as the increase appears, it was achieved only as a result of intensive mechanization—the tonnage of coal mechanically cut increased from 58·5 to 142·2 million tons between 1927 and 1939, while the tonnage carried on face conveyors increased from 28 millions in 1928 to 134 millions in 1939. Taking Great Britain as a whole, the situation in the coal mines left little room for complacency.

In 1914 Britain was able to dominate the seaborne coal trade of the world, and substantially retained this position until 1925, when Poland and Germany first assumed the position of serious competitors. To compare British and Continental progress the Committee has adopted as the basic year that in which each country attained the 1913 level of output per man-shift, and the following table is extracted from the report.

Country	Basic year	Output per man-shift in basic year cwt.	Output per man-shift in 1936 cwt.	Percentage increase
Poland	1927	23·44	36·20	54
Holland	1925	16·48	35·94	118
The Ruhr	1925	18·62	33·66	81
Britain	1927	20·62	23·54	14

Comparison with the United States would be unjustified, but it should be noted that the output per man-shift in the American bituminous mines amounted to 93·8 cwt. in 1939.

Many reasons are advanced for this failure to attain, or even approach, Continental standards of output. The British industry has long lacked the financial resources to undertake major long-term improvements, and considering the low average profit per ton—7*d*. during the years 1929–38—this is not surprising. Conditions of mineral ownership have proved a disastrous handicap to the mines of Britain. Until 1942 the minerals were privately owned, and there remains a legacy of small and awkwardly shaped leaseholds, worked by an excessive number of mines, many of which are of low capacity. On the Continent the amalgamation of undertakings has resulted in the concentration of production in large well-equipped mines. In 1938 the Ruhr mines were of an average capacity of 778,000 tons per year;

* Ministry of Fuel and Power. Coal Mining: Report of the Technical Advisory Committee. (Cmd. 6610.) Pp. ix+150. (London: H.M. Stationery Office, 1945.) 1*s*. net.

the twelve mines of Holland averaged 1,200,000 tons per annum. Britain, too, has mines of large capacity, but there are many small mines. In 1943, 90 per cent of the output came from 816 mines owned by 353 separate undertakings. The average yearly output per mine was 228,000 tons.

Relevant as are the above and other important conclusions, the recommendations on the details of practical mining form the backbone of the report. The hidden complexities of underground mining make the discussion of this section no easy task, and it is proposed to emphasize two fundamental operations —those of getting and transporting the coal. In Britain, most of the coal seams are worked by the 'longwall advancing system' of mining—some 74 per cent of the collieries are so laid out. Less popular, but giving good results under certain conditions, are the 'room and pillar' and 'longwall retreating' systems.

The room and pillar system was an early development in British mining practice. Here the seam is first divided into pillars of side 20–50 yd., by driving two sets of roads at right-angles. Developed a century ago in the coalfields of Northumberland and Durham, the method gives best results in shallow seams of a suitable thickness, say, 5–6 ft. When, however, attempts were made to work the deeper seams by room and pillar, many difficulties were encountered. Because of the great pressure on the pillars, there was an excessive 'crush' on the workings, the pillars tended to disintegrate, and the roads to close in. Pillar extraction, a normal and safe operation at shallow depth, was made difficult and often impossible. The system also proved unsuited to the working of thin seams, and there was thus a gradual change over to the 'longwall' system of working. However, the room and pillar system is almost universal in the United States—with the important difference that the workings are highly mechanized. Since 1941, American methods of production have been studied by British engineers, and it is considered that a proportion of the British output could, in future, be won from mechanized room and pillar workings. Experimental lay-outs have been equipped on American lines, and the results are sufficiently encouraging to suggest that the system will find a useful, if limited, application in Britain. The outstanding feature of American methods is that a very high proportion of the workers is engaged on actual coal production, and this accounts in some measure for the high output per man-shift.

Natural conditions in Britain have proved most suited to the 'longwall advancing' system. In its modern application a straight wall of coal or 'face', say, 200 yd. long, is prepared. Two mechanical conveyors are laid along the face, each feeding on to a main conveyor in the centre and at right-angles to the face. The coal worked is filled on to the conveyors, and loaded on to 'tubs' (small wagons) at a loading point at the end of the main conveyor. An average rate of advance is 5 ft. per day—that is, a block of coal 200 yd. long, of height equal to the thickness of the seam, and 5 ft. in depth is removed. The whole of the equipment and supports must thus be advanced 5 ft. per day. More important, the empty space, or goaf, left behind the advancing face, must be partially packed with debris, and roads must be prepared and maintained through the goaf. This is unproductive work, inherent in this system of mining, and absorbs the labour of substantial numbers of underground workmen. Nevertheless, the method has many technical advantages, and will long find an important place in British mining practice.

The 'longwall retreating' system combines, in some measure, the advantages of the other two systems. Roads, known as headings, are driven in the seam to a pre determined boundary to form a pillar, say, 300 yd. long and 100 yd. wide. This pillar is then extracted back towards the main road from which the headings were started. So far, the system has not been widely used in Britain, but there are reasons to believe that, with the use of modern machinery for intensive development, longwall retreating could well be applied in many British mines, with a consequent reduction in the proportion of unproductive labour.

The Committee thus recommends a complete reconsideration of established mining methods. Mechanized room and pillar should be applied where conditions are sufficiently favourable. Since this will by no means be generally applicable, consideration should be given to the use of longwall retreating methods, and finally the longwall advancing system should be applied to those circumstances in which the other two systems are unsuitable.

In the nineteenth century, practically the whole output of British mines was won by means of the hand pick. Now some 80 per cent of the coal is undercut by mechanical coalcutters. After undercutting, holes are bored in the coal, and these charged with explosive and fired, so leaving the coal in a suitable condition for hand filling by means of a shovel. In 1939, on every working day, nearly 1,000,000 tons of coal came from the shovels of the British miners. If the operation of loading could be mechanized, there are clearly possibilities of a tremendous saving in labour. For room and pillar work there are excellent machines of British and American manufacture, used for lifting the broken coal from the floor to a conveyor or tub. Loading machines of a different type are required for longwall faces, and the design of a suitable machine is a difficult technical problem. Nevertheless, British manufacturers have produced loading machines of distinct promise, and these are in use in experimental installations. That the Committee attaches the greatest importance to their further application is clear from the statement "that development in mining technique must be directed, first and foremost, to a reduction in, and ultimately to the practical elimination of hand loading".

A mechanical loader, however efficient, has one important limitation—a coalcutter must first be used to prepare the coal for loading, and the use of explosives may also be necessary. The Committee envisages the use of machinery which will be capable of simultaneously cutting and loading the coal. At least one machine of this type has been used, and the prototypes of other machines are nearing completion.

Traditional haulage practice provokes the keenest criticism. In British mines there is apparently a serious wastage of labour in hauling the coal from the working face to the shaft bottom. One haulage worker is required for every 50 tons of coal produced in the United States, for every 20–25 tons in Holland, and for every 5 tons in Britain. There is evidently much to be learned from a study of American and Continental haulage methods.

Wire-rope haulage is standard practice in British coal mines. Conveyors may be used to bring the coal to a loading station, and from there the tubs

are hauled to the shaft by means of wire ropes driven by stationary engines. In an old or badly laid-out mine, the coal may be hauled by a succession of such engines, each haulage requiring its complement of attendants. Conveyors could be much more widely used to transport the coal to well laid-out loading stations, so eliminating the wasteful use of labour on subsidiary haulage systems.

In the United States and on the Continent, locomotives are widely used underground. But the use of locomotives requires roads which are level, or nearly so, and the present lay-out of most British mines is such as to prohibit their widespread installation. Roads have been driven in the coal seams, and in general the gradients are unsuited to the use of locomotives. Continental seams are more inclined, and the practice there is to drive level roads through the solid strata, these serving as the main arteries of the mine along which the locomotives operate. Reorganization for locomotive haulage will require the preparation of great lengths of graded roadways, and if the full advantages of locomotive haulage are to be realized, mine cars of a high capacity will be required. The capacities of the tubs used in British mines range from 3 to 28 cwt.—the average is probably 12 cwt. For use with locomotives, mine cars will be required each capable of holding several tons of coal.

No details of mining practice are passed over in this unique survey. Standards of mine lighting, the Committee considers, could be materially improved with advantage to production, safety and health. Illumination at the coal face is now provided by portable self-contained lamps, but it is recommended that power-fed lighting should be installed at the coal face. Recent research has shown that the 'cold' cathode discharge lamp may well prove a safe and efficient means of illuminating underground workings.

In an interesting paragraph the appearance of colliery premises is discussed. It is true that in the past little or no attention has been paid to this point, and the "disorder and dilapidation" so often associated with colliery premises must have its psychological effects on the workmen and adversely influence public opinion on the state of the industry. An architect should be consulted when plans are being prepared for a new mine or for remodelling an old mine.

It is apparent that reform on the lines suggested in the Reid Report will require major changes in the organization of the coal-mining industry in Britain, and this is discussed under "Conditions of Success". There will need to be amalgamation of many of the smaller undertakings to form productive units of a much greater capacity, and many existing mines will become redundant. There is a note of warning to the workmen and their leaders: that if existing wage-levels are to be maintained, then there must be a considerable increase in output per man-shift, and that a rebuilt industry may have to dispense with substantial numbers of unskilled workers.

In the past, the layman may have formed the view that Britain's coal problem was that of utilizing her abundant resources of coal. This report puts first things first—the fundamental problem is that of mining the coal efficiently, and any plans for the utilization of coal depend primarily on the availability of large quantities of cheap coal. Finally, those with no special knowledge will read the report without difficulty, assisted by a most useful glossary of mining terms.

H. HARTLEY.

SCIENCE AND ART AT THE ROYAL ACADEMY, 1945

By DR. A. T. HOPWOOD
British Museum (Natural History)

IT is a commonplace of criticism that a painting is not only the result of the artist's competence and temperament, but also of his country and period. Thus a Titian could arise nowhere else than in Italy; neither could a Vermeer be found elsewhere than in the Low Countries. The former reflects the warm colouring of the south, and the patronage of opulent, semi-pagan princes and prelates, whereas the latter echoes the cooler skies of the north, and the solid worth of prosperous burgherdom. Some years ago, Frank Rutter, following an earlier suggestion by Sir Michael Sadler, pointed out that, from the commencement of the present century, art in the hands of its more advanced exponents became more and more violent until, in the last years before 1914, men like Kandinsky and Wyndham Lewis were painting pictures of which the themes were connected in some way or another with war.

This prophetic aspect of the psychology of art can best be realized after study of pictures extending over some years, and it may be that the six war-time exhibitions of the Royal Academy do not constitute a long enough series; but one point in particular has attracted my attention, and to add emphasis I propose to illustrate it by reference to pictures painted by academicians, or associates, that is, to the work of men who, traditionally, are not included among the most advanced members of the craft.

Consider, first of all, Algernon Newton, who in 1942 exhibited bright and sunny scenes of London's canals. As the years have passed, his sunshine has gradually become less bright and more gloomy until in the present exhibition, even in pictures of the countryside (Nos. 348, 352, 363), it has achieved that blackish quality which gleams out fitfully before the storm, and in the town has become so dramatic as almost to be theatrical (No. 68). Sir Alfred Munnings is another whose sunshine is sometimes gloomy (No. 140) and whose skies are often sad (Nos. 136, 140). On the other hand, Edward Wadsworth has two longshore scenes (Nos. 711, 715) of a type sufficiently advanced to satisfy any but the most perfervid worshipper of 'isms'. His colours are strong and the first impression is one of stimulus akin to that of a cocktail, but the stimulus soon passes and a vague feeling of malaise, as it were a sense of the malevolence of the inanimate, remains. These might be thought a curious sequence and combination to occur as a long and hard-fought war drew slowly to a victorious close, but they are not unintelligible when considered in relation to the gradual realization of the thorny problems which would beset the peace-makers.

A painter's problems are exemplified by the work of James Fitton. "Woman Reading" (No. 61) and "Country Interior" (No. 602) belong to a group of works which he has shown during the last few years, and which are chiefly exercises in the management of red, perhaps the most difficult of all colours except purple, of which more later. These two canvases show, as they were bound to do, how the primary colour, red, tends towards its secondaries (orange and purple) and the secondaries towards the tertiaries; or, if this theory of colour be considered too old-

fashioned, they may be regarded as essays in the harmony of orange and red, and the employment of suitable contrasts and discords. So far as one may judge from the background of "Reclining Figure" (No. 678), the artist himself would prefer the latter theory.

Purple in its lighter tones has ruined many acres of canvas in pictures of the 'sheep-among-the-heather' type, but in its deeper tones it is rich and magnificent, though still dangerous. The State portraits by Gerald Kelly (Gallery III) are noteworthy for the skill with which the imperial purple is rendered, a skill which cannot be fully appreciated without the realization that instead of the usual foils of green and brown these great masses of colour are displayed in a setting of parian coolness, and yet never for one stroke of the brush does the colour get out of control. True, the gold embroideries are a help in achieving this end. but they are by no means the whole of the story.

On an adjacent wall in the same gallery, "Dr. Clive Forster-Cooper, F.R.S., Director of the Natural History Museum", by Meredith Frampton (No. 165), blends complete mastery of the painter's materials with consummate draughtsmanship. For the former, reference may be made to the contrast in texture between the surfaces of the dog's jaw in the left lower corner and of the series of plaster models of some upper molars of primitive mammals scattered over the table in seeming disarray, while the drawing is summed up by the open book in which is epitomized a whole course of perspective and line. Another excellent portrait hangs in the far corner of the same room. It is L. Campbell Taylor's portrait of "The Rt. Hon. the Lord Macmillan, G.C.V.O., LL.D." (No. 205), whose voluminous black robes, set against deep green curtains, are relieved by an edging of silver lace. A more intimate type of portraiture is "Professor A. G. Tansley, F.R.S.", by W. G. de Glehn (No. 302), in which the sitter is shown, pipe in hand, in the quiet of a book-lined study.

Of the war pictures, "Torpedoing of the *Tirpitz* by Midget Submarines" by Richard Eurich (No. 569) gave me most pleasure. No minefields, even in the clear waters of the Norwegian fiords, were ever so visible as these—never was there such a whelk as crawls on the bottom of this sea, yet all have their place in this picture, and no one would wish them away. Whether or not we have here an echo of the Futurist 'plastic interpenetration of matter' I neither know nor care ; drawing, design and painting are all good, and the picture pleases me.

As usual, the sculpture is a very mixed lot. To the zoologist the more or less naturalistic works such as "Tarka", by P. E. Norman (No. 1248), "Leopard" by Hermon Cawthra (No. 1281), and "Rhesus Monkey" by Josephine Hunt are the most attractive, and he will probably find that most of the horses are better than usual. On the other side of the account he will put "Long-nosed Hedgehog" (No. 1293), if only on account of the unpleasant colour of the marble, as well as the lumpy "Messenger" (No. 1359) and the brutish "Infant Dionysus". One cannot complain of the stone in which the two last are worked ; it successfully conceals the sculptures.

The architectural exhibits are fewer than last year. In the main they are pleasantly uninspired, but two of them call for particular comment. "Durham City Replanned", by Thomas Sharp (No. 1201), is ambiguous. If the new buildings in the foreground are really meant to be of the boot-box style, then the incongruity between them and the castle and cathedral in the background is so violent as almost to be bad manners and not merely bad art ; if, on the other hand, they are mere symbols to indicate where new building will be necessary, one must defer judgment until the designs for the actual buildings have been produced. The other doubtful case is Sir Giles Gilbert Scott's design for the new Coventry Cathedral, of which the interior does not strike one as suitable for an ecclesiastical building, neither does it appear to be in keeping with the exterior.

Taking the exhibition as a whole, it is lively, varied, and of good quality. To expect it to indicate a definite trend in any particular direction, or in favour of any one school, is unreasonable, since to do so would be to upset the general balance of the whole ; but any visitor with some knowledge of the development of European art during the past fifty years will say of the Royal Academy, as was said of another body on an earlier occasion, "E pur si muove".

OBITUARY

Sir Napier Shaw, F.R.S.

SIR NAPIER SHAW, whose death occurred on March 23, was born on March 4, 1854, in Birmingham, the son of Charles Thomas Shaw, manufacturing goldsmith and jeweller. He was the sixth child in a family of eight, four brothers and four sisters. He married in 1885 Sarah Harland, lecturer in mathematics at Newnham College and daughter of Dr. Thomas Harland of Salford.

Shaw received his school education at King Edward's School in his native city, and throughout his long life retained a lively interest in his old school, serving on its governing body for many years. In 1872 he won a scholarship to Emmanuel College, Cambridge, and went into residence with the avowed intention, as he often told his friends, of entering the Indian Civil Service. He read mathematics, coaching under Routh, and was 16th Wrangler in the Tripos of 1876. Later in the same year he obtained a first class in the Natural Sciences Tripos, with distinction in physics. In the following year the College elected him to a fellowship and that seems to have been the end of the suggestion to embark on an administrative career in India. Cambridge was to be his home for the next twenty-two years apart from a short time spent in Berlin, working under Helmholtz.

Shaw soon made his mark in college and university. Lord Rayleigh appointed him demonstrator at the Cavendish Laboratory, jointly with R. T. Glazebrook, and to that combination we owe the "Practical Physics" which became a standard text-book in schools and colleges up and down the country wherever experimental work formed part of the physics course. He gave up the demonstratorship in 1887 to become University lecturer in experimental physics and in 1898 was appointed an assistant director of the Cavendish. His early scientific work was along lines that have little connexion with what was to become his life work. His first published paper (*Proc. Cambridge Phil. Soc.*, 1879) dealt with experiments with mercury electrodes, and was followed a few years later by one in the *Philosophical Magazine* on the atomic weights of silver and copper. Miscellaneous papers on various subjects followed. Ventilation was

a subject in which he took an early interest which persisted throughout his life. In the course of his career he was asked to advise on the ventilation of many public buildings, among them the House of Commons, the Stock Exchange and the Metropolitan poor-law schools.

The first contact Shaw made with official meteorology came in the form of a request from the Meteorological Council to prepare reports on the performance of evaporimeters in current use and on the more general question of hygrometric methods. The latter report was published in the *Philosophical Transactions* in 1888 and was the first contribution from Shaw's pen to the Royal Society's publications. His reputation in the scientific world was advancing steadily and was recognized in 1891 by election to the fellowship of the Royal Society. He was a frequent attendant at the meetings of the British Association. In his later years he was to act as president of Section A in 1908 and of Section L in 1919.

While at Cambridge, Shaw took a very active part in the affairs of college and university. At Emmanuel he held the offices of steward, tutor and senior tutor (1890–99), and a long list of pupils has to thank him for kindly guidance and wise advice. Two important achievements in the University organization stand to his credit. In 1892 he was the prime mover in inducing a group of colleges to combine their scholarship examinations and thus abate the competition for the most promising candidates which had become a source of embarrassment to tutors, school-masters and candidates alike. His second opportunity came towards the end of his time at Cambridge. As tutor, Shaw had repeatedly come up against the difficulty his pupils experienced in getting a start in life after taking their degrees. Apart from an agency which confined itself to scholastic appointments, there was no machinery for helping them. There was an obvious opportunity for beneficial work for an office or agency that would make it its business to find out what openings were available in commerce, industry or Government service, and on the other hand would inform itself as fully as possible of the qualifications and competence of young graduates seeking employment. A certain amount of crusading to induce prospective employers to take graduates lacking *ad hoc* business experience into their service was also a promising field of activity. Shaw set out to enlist support for a scheme on such lines both within and outside the University. On the commercial side he received valuable assistance from the late Nathaniel Cohen, a member of the London County Council, whose wide business connexions enabled him to suggest many useful lines of approach. As a result of these efforts, a Cambridge Appointments Association was started in 1899. It was eventually formally incorporated as part of the official organization of the University under the name of the Cambridge University Appointments Board.

Shaw left Cambridge towards the end of 1899 to become secretary of the Meteorological Council, which post was about to become vacant through the retirement of R. S. Scott. The change involved some financial sacrifice, but his early work for the Council had aroused his interest, and in 1897 the Royal Society had appointed him a member of the Council. When Shaw took charge, the Meteorological Office was at a low ebb. Strachey and Buchan, the two most active members of the Council, were advanced in years, and the drive which they and men of the calibre of Stokes and Galton had put into the scientific work had spent itself. The staff consisted largely of middle-aged and elderly men who had been attracted to the subject as youngsters, but now found themselves carrying on their routine on salaries that were certainly not generous and with no superannuation to look forward to. Nevertheless, Shaw soon gained the unstinted loyalty of his staff and rekindled their interest. One of his first administrative tasks was to bring into operation a superannuation scheme for the clerical staff, even though it had to comply with the Treasury's instruction that if the Council felt it must make some provision for staff who had long and faithfully served them, it, like other employers, should see what it could do from its available resources. Recruitment of new staff also required much thought. Great care was exercised in the selection of junior clerks as vacancies arose, and gradually new posts were created that could be offered to graduates. By the time Shaw left the Office it had a considerable graduate staff.

In 1905 Shaw secured an overhaul of the constitution of the Meteorological Office. The Council, which had been responsible to the Royal Society, was replaced by a committee directly responsible to the Treasury, with himself as chairman of committee and director of the Office. The design of the new premises in Exhibition Road, South Kensington, to which the Office moved in 1910, took up much time during the following five years. It must have been a source of regret to Shaw that the building on which he had lavished so much thought and embellished at some personal expense should so soon prove inadequate to house all the activities of the Office. At the time of its design the top floor, to be occupied temporarily by the administrative staff of the Science Museum, seemed to offer ample space for expansion.

Under Shaw's vigorous guidance and the pressure of events, the activities of the Office increased rapidly. On the climatological side the network of voluntary stations that supplied reports to the Registrar-General and also those associated with the Royal and the Scottish Meteorological Societies came under the control of the Office. Summaries for all stations were included in the *Monthly Weather Report*, which thus became an index of the climatological information available in Britain month by month. Later on, but not until 1919, the British Rainfall Organization was absorbed. Kew and Eskdalemuir Observatories were transferred and with them came responsibilities for terrestrial magnetism, atmospheric electricity and seismology. The demands of aviation for meteorological help were beginning to press. With R. T. Glazebrook (the close co-operation, started in the early days at the Cavendish, continued up to the time of Glazebrook's death) Shaw started the Advisory Committee for Aeronautics, which brought much grist to the mill. With J. S. Owens's assistance, the work of the Committee on Atmospheric Pollution was got going. In the sphere of international meteorology Shaw also became a figure of importance. His election to the International Meteorological Committee on becoming head of the Office was little more than a matter of form, but in 1906 he succeeded Mascart as president of the Committee, an office he was to hold until 1923.

Despite the pressure of administrative work and of calls incidental to his position, Shaw found time for authorship and for making his contribution to the science of meteorology. In 1911 appeared the first edition of "Forecasting Weather", in which he

set himself the task of bringing together the physical laboratory and the daily weather. His contributions in the form of papers and articles covered most aspects of the subject and are too numerous for individual mention here, but we may perhaps single out "The Life History of Surface Air Currents", in which the method of using synoptic charts to construct trajectories and so trace different air supplies to their origins was developed. It led up to the modern ideas of air-mass analysis which have yielded such valuable results, both theoretical and practical, through the labours of the Norwegian school of meteorologists.

Shaw's influence went far beyond the immediate output of his pen. He was a great advocate of a rational system of units, and never tired of ventilating the subject. If some of his efforts in this direction, such as the use of the absolute or tercentesimal scale of temperature which he introduced into the "Observatories' Year Book" and followed in his later scientific writings, have found few imitators, he had the satisfaction of seeing the millibar, first advocated by V. Bjerknes, find wide acceptance. After Shaw had introduced it in the British *Daily Weather Report* in the issue of May 1, 1914, other services followed suit, and its use is now firmly established in the international exchange of synoptic data and in upper air work.

The need for investigating meteorological problems on a world-wide basis led to another of his successful crusading efforts. Backed by the late Sir Norman Lockyer, he induced the International Committee to form a "Reseau Mondial Commision", and what is perhaps more important, he managed to arrange for the Meteorological Office to act for the Commission and collect monthly summaries on a basis of two stations to each square of 10° of latitude and longitude and publish them in annual volumes, thus providing raw material for investigations on seasonal forecasting and kindred problems by many workers. About the turn of the century, when Shaw took charge of official meteorology in Britain, the investigation of the upper atmosphere by means of kites and balloons was opening up a new field of research and turning meteorology from a two-dimensional into a three-dimensional science. Shaw saw to it that Britain played its part in the new field. Much of his work was done in association with the late W. H. Dines, whose home, transferred successively from Oxshott to Pyrton Hill and thence to Benson, became more or less a branch establishment of the Office. Not least among Shaw's gifts must be reckoned his power to interest others in his work. To that we owe the contributions of men like C. J. P. Cave and P. Y. Alexander to upper air research.

All these activities were rudely interrupted by the outbreak of war in 1914. It was not long before the Fighting Services felt the need for meteorological help, and new and unexpected demands were made on an Office struggling to maintain its essential routine. A greatly increased staff had to be recruited and hurriedly trained, and that raised a difficulty of its own. There was no suitable text-book on which to base the training. The writing of a comprehensive manual of meteorology had long been one of Shaw's ambitions and from time to time he had discussed ways and means with the Committee and found them sympathetic; but leisure for starting the work had been lacking. The desire had now become an urgent need, which the Committee met by suggesting that Sir Henry Lyons should take over the day-to-day administration, as acting director, thus setting Shaw free for the labours of authorship. The arrangement came into operation early in 1918, the Treasury having given its consent and marked its approval by appointing Shaw scientific adviser to H.M. Government on meteorology. To meet the most urgent demands work was started on Part 4 of the full scheme, which prosently appeared, though not until after the cease fire had sounded, under the sub-title "The Relation of Wind to the Distribution of Atmospheric Pressure". Lyons retired from the acting directorship soon after hostilities ceased and Shaw had to resume full control up to the time of his own retirement in September 1920, and so it fell to his lot to carry through the transfer of the Office to the Air Ministry. In anticipation of rather earlier retirement he had consented to become president of the Royal Meteorological Society for the two years 1919 and 1920, a post he had consistently refused when asked to serve during the earlier years of his directorship.

Shaw left the Meteorological Office to become the first professor of meteorology in the Imperial College of Science and Technology. It had always been his ardent wish that universities in Britain should take part in the teaching and development of meteorology, and for some years he had been reader in meteorology in the University of London. The new post went considerably further in meeting his desire. True, it was not a full professorial chair, but it was at any rate a beginning. He held it until 1924, when he was succeeded by Sir Gilbert Walker.

His teaching post was not the only call on his time. The Atmospheric Pollution Committee pressed him to continue to act as its chairman, and the Ministry of Agriculture invited him to preside over a committee it appointed to foster agricultural meteorology. Even more exacting were the calls of international work. Meteorologists were among the first to get together again after the War of 1914–18. An open conference was held in Paris in the autumn of 1919, and Shaw was the obvious person to act as president. The conference reappointed a permanent committee with Shaw as president. He was re-elected in 1921 despite the fact that he was no longer director of a national service. His release from the office did not come until 1923. The Upper Air Commission also insisted on Shaw becoming its president and that offered further opportunities for impressing his ideas—or should it be ideals?—on meteorology. Among the tasks which the Commission sets itself is the publication of data collected on a world basis on 'international days'. Before the War of 1914–18 the issue of this publication was in German hands. It was decided to resume operations by printing the information available for 1923. Shaw presented it in *de luxe* style. He intended his volume to serve as a model of what the Commission should aim at. Unfortunately, *editions de luxe* are expensive. The Commission was able to print the data for 1924 in somewhat similar form, but for subsequent years Prof. Hergesell, who again became president after the Commission met in Leipzig in 1927, fell back on the expedient of setting it out in code.

Shaw's work for the Upper Air Commission also gave us the tephigram, a diagram for plotting the data from balloon ascents in which entropy and temperature are used as co-ordinates. It lends itself to rapid plotting, and the resulting graph, considered in relation to the grid, shows up regions of poten-

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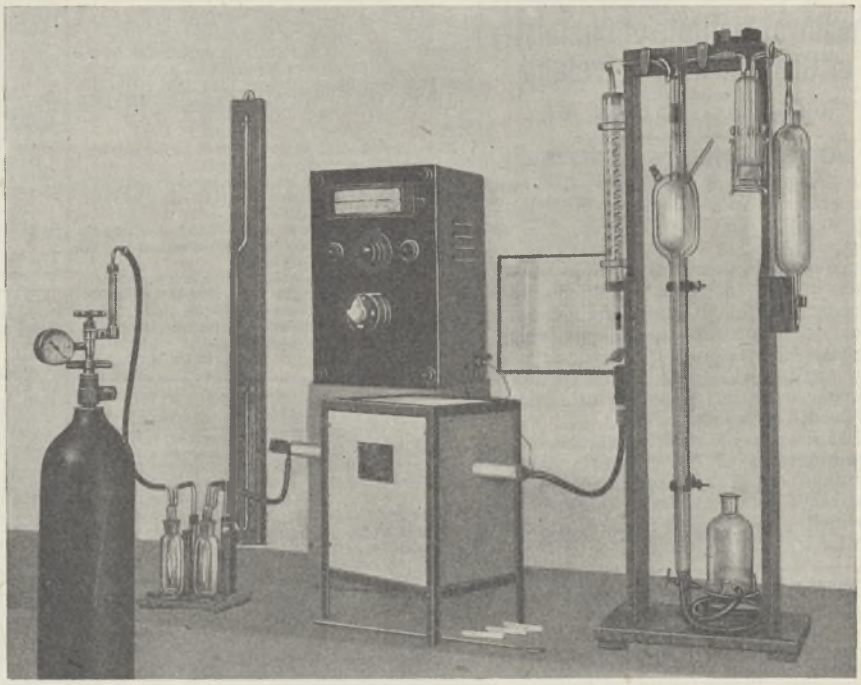

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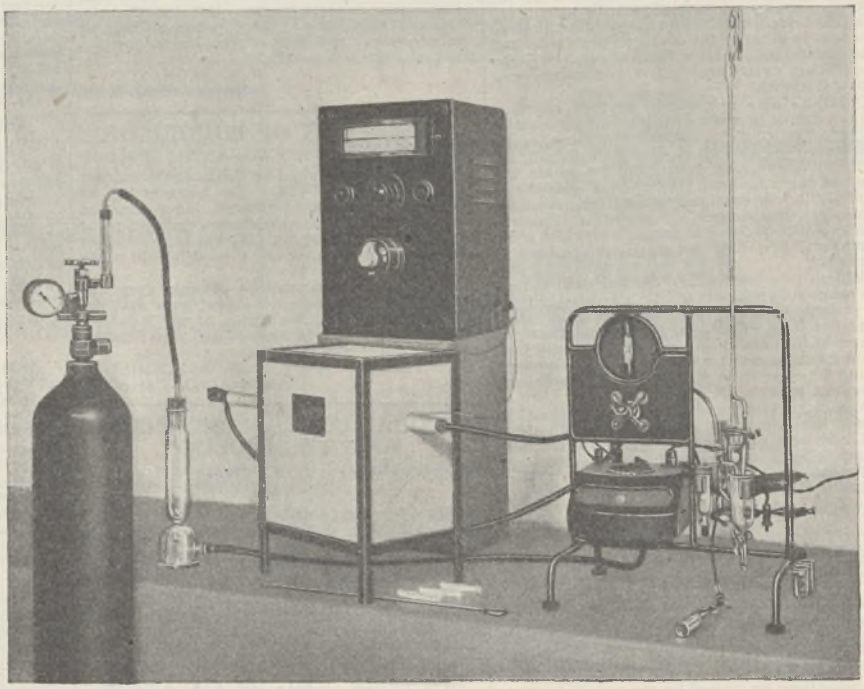

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The vacancies advertised in these columns are available only to applicants to whom the Employment of Women (Control of Engagement) Orders, 1942-3, do not apply.

The Royal Institute of Chemistry of Great Britain & Ireland

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

APPOINTMENTS REGISTER

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

Particulars of the Regulations and Examinations of the Institute can be obtained (free), on application to The Registrar, the Royal Institute of Chemistry, 30 Russell Square, London, W.C.1.

COMMONWEALTH OF AUSTRALIA

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

DIVISION OF RADIOPHYSICS

APPOINTMENT OF RESEARCH STAFF

Vacancies exist on the Research Staff of the Council's Division of Radiophysics, Sydney.

Applications are invited for appointment to these vacancies to assist in the development of radio and radar equipment, and for basic research in radio propagation, circuit theory and applications connected therewith.

QUALIFICATIONS: University degree in electrical engineering, or in science with physics as a major subject; also a good mathematical training.

SALARY: Dependent on qualifications and experience, commencing salary will be within the range of either Research Officer (£A560–£A640 p.a. actual) with four equal increments, first automatic, remainder discretionary, or Assistant Research Officer (£A396–£A540 p.a. actual) with eight equal increments, first four automatic, remainder discretionary.

Subject to a satisfactory medical examination, the successful applicants will be appointed initially on probation for a period of twelve months, but thereafter, if confirmed in their appointment as officers of the Council, will be eligible to contribute to, and receive benefits from, either the Commonwealth Superannuation Fund or the Commonwealth Provident Fund.

Application, stating date of birth, nationality, present employment, particulars of qualifications and experience, accompanied by copies of not more than four testimonials, should reach the Secretary, Australian Scientific Research Liaison Office, Australia House, Strand, London, W.C.2, not later than July 2, 1945.

(Signed) G. A. COOK,
Secretary.
Council for Scientific and Industrial Research.
314 Albert Street,
East Melbourne, C.2, Victoria, Australia.

UNIVERSITY OF BIRMINGHAM

APPOINTMENT OF LECTURER IN DEPARTMENT OF CIVIL ENGINEERING

Applications are invited for the post of Lecturer in Civil Engineering. Commencing stipend at the rate of £500 per annum.

Candidates must hold a University Degree and have had practical experience. They must be prepared to undertake research.

Three copies of application, with testimonials or references, must be sent on or before June 23 to the undersigned, from whom further particulars may be obtained.

C. G. BURTON,
Secretary.
The University,
Edmund Street,
Birmingham, 3.

(Public Notices)

UNIVERSITY OF EDINBURGH

Admissions—Session 1945–46

FACULTY OF MEDICINE

Entrance to the Faculty will be limited and candidates for admission in October, who have not already applied, must submit an application to the Dean of the Faculty of Medicine on a form to be obtained from him—not later than July 1, 1945.

FACULTIES OF ARTS (including COMMERCE and SOCIAL STUDY), SCIENCE, LAW and MUSIC.

The number of admissions to Courses in these Faculties will probably be limited.

Application should be made by July 15 on a form to be obtained from the MATRICULATION OFFICE, OLD COLLEGE.

Information regarding the conditions of admission to these Faculties may also be obtained at the MATRICULATION OFFICE.

All admissions will be subject to any regulations made by the Ministry of Labour and National Service.

A stamped addressed envelope (1d.) should accompany postal requests for forms.

W. A. FLEMING,
Secretary to the University.

CITY OF LEICESTER EDUCATION COMMITTEE

LEICESTER COLLEGE OF TECHNOLOGY AND COMMERCE

Principal: L. W. Kershaw, O.B.E., B.Sc., A.M.Inst.C.E.

APPLICATIONS are invited for the post of full-time LECTURER IN PHYSICS.

Applicants must be Honours Graduates and research or industrial experience will be considered an additional qualification.

Salary will be in accordance with the new Burnham Scale, with allowances for approved industrial, research and teaching experience.

Applications, together with copies of two recent testimonials and names of two persons to whom reference may be made, should be sent to the Principal, College of Technology and Commerce, The Newarke, Leicester, not later than June 23, 1945.

Further particulars of the appointment may be obtained from the Principal upon the receipt of a stamped addressed envelope.

H. S. MAGNAY,
Director of Education.

UNIVERSITY OF EDINBURGH

LECTURESHIP IN SOCIAL ANTHROPOLOGY

Applications are invited for this newly-established Lectureship. Salary £750. The Lecturer will be required to join the Federated Superannuation Scheme. The date of appointment, during Session 1945–46 or at October 1, 1946, will be determined by general circumstances and the availability of the selected candidate.

Further particulars may be obtained from the undersigned to whom applications, with evidence of qualifications and the names of not less than three referees, should be sent not later than September 30, 1945.

W. A. FLEMING,
Secretary to the University.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF MATHEMATICS AND MECHANICS

With effect from October 1, 1945, several junior appointments in this Department will be made in the grades of Assistant Lecturer (Scale £350 : £375 : £400) and Demonstrator (£250 : £275 : £300), with F.S.S.U. membership; tenure limited to three or four years.

Applications to The Secretary, Imperial College, London, S.W.7.

IMPERIAL BUREAU OF HORTICULTURE AND PLANTATION CROPS

Immediate vacancy occurs for graduate as senior assistant at Imperial Bureau of Horticulture and Plantation Crops, East Malling Research Station, near Maidstone, Kent. Chief requisites: (1) knowledge of horticulture, especially of tropical plantation crops or scientific training and background in botany and allied subjects, and (2) ability to abstract in English from technical foreign, especially Dutch, Spanish and Portuguese originals. Salary £450—25—£600, plus war bonus. Application forms from Bureau.

UNIVERSITY OF ABERDEEN

LECTURESHIPS IN THE DEPARTMENT OF PHYSIOLOGY

The University Court will shortly proceed to the appointment of two Lecturers in the Department of Physiology, to commence duty on October 1, 1945, or a date to be arranged.

One Lecturer will require to have special knowledge of Experimental and Human Physiology, the other to have training and experience in Biochemistry.

Salary according to qualifications and experience. Scales of salaries are: Grade I, £650 to £800; Grade II, £500 to £650.

Persons desirous of being considered for either office are requested to lodge their names with the Secretary to the University on or before July 7.

The conditions of appointment and Form of Application may be obtained from the undersigned.

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

UNIVERSITY OF ABERDEEN

APPOINTMENT OF UNIVERSITY ASSISTANT IN CHEMISTRY

Applications are invited for the post of Assistant in the Department of Chemistry. The Assistant will require to have a special knowledge of Physical or Inorganic Chemistry. Salary £300 to £350 according to qualifications, and the Assistant will take up duty on October 1, 1945.

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

CAMBRIDGE UNIVERSITY

The Vice-Chancellor gives notice that the Appointments Committee of the Faculty of Engineering will shortly proceed to appoint a University Demonstrator in Engineering. The appointment will be subject to the Statutes and Ordinances of the University.

Candidates are requested to address any inquiries, and to send their applications with particulars of qualification and experience to Dr. R. D. Davies, Secretary of the Appointments Committee, Engineering Laboratory, Cambridge, on or before Monday, July 2, 1945. Consideration will also be given to names submitted by the friends of those who are not in a position to communicate with the Secretary themselves.

BATTERSEA POLYTECHNIC

LONDON, S.W.11

The Governing Body invites applications for the full-time post of LECTURER IN MATHEMATICS, to commence duties in September. Candidates must have a good honours degree in Mathematics, preferably with special interests in Applied Mathematics. Further particulars may be obtained from the Clerk to the Governing Body, to whom applications should be sent not later than June 11, 1945.

UNIVERSITY COLLEGE OF WALES ABERYSTWYTH

Special Lecturer in Biochemistry for a period of three years in the first instance, at an initial salary up to £800 according to qualifications and experience. The person appointed will be required to participate in the research programme of the Department of Animal Health and to take some part in the teaching of his subject in the Department of Chemistry. Six copies of application to be forwarded, not later than July 15, to the Registrar, from whom further particulars can be obtained.

WOOLWICH POLYTECHNIC, S.E.18

Applications are invited for the post of Chief Laboratory Steward in the Chemistry Department. Some knowledge of Chemistry and general laboratory technique is essential. Wages (up to £5 weekly plus present bonus of 28/- (men) and 15/6 (women)) according to experience.

Application forms and particulars of the post may be obtained from the Clerk to the Governors.

ROYAL HOLLOWAY COLLEGE

(UNIVERSITY OF LONDON)

Appointment of a Lecturer in Physical and Inorganic Chemistry.

The Governors invite applications for the above post, which is open to men or women. Applications are required not later than June 18. Full particulars may be obtained from the Principal, Royal Holloway College, Englefield Green, Surrey.

ESSEX EDUCATION COMMITTEE

SOUTH-EAST ESSEX TECHNICAL COLLEGE AND SCHOOL OF ART
SCIENCE DEPARTMENT

Applications are invited for the post of Lecturer in Biology, duties to commence September next or as soon thereafter as possible. Candidates should have an Honours degree in Zoology, and preferably Physiology as subsidiary subject. Research experience an additional qualification.

Salary: Burnham Scale for Technical Colleges with Special Responsibility Allowance for a suitably-qualified and experienced candidate.

Further particulars and forms of application obtainable from the Clerk to the Governors at the College, Longbridge Road, Dagenham, to whom they should be returned by June 20.

B. E. LAWRENCE,
Chief Education Officer.

County Offices,
Chelmsford.

Botanist required for the Intelligence Section of the Plant and Animal Products Department of the Imperial Institute. Candidates must have a University degree in Botany (not lower than 2nd Class Hons.), or its equivalent. The duties of the post will include the preparation of statements concerning the cultivation, uses and marketing of Empire raw materials. Age limit 30 years. Salary: £275 per annum with annual increments of £18 plus war bonus (at present £60 per annum). Appointment temporary with a view to permanent pensionable employment. Further information from Establishment Officer, Imperial Institute, London, S.W.7.

University of London. The Senate invite applications for the Chair of Physiology tenable at King's College of Household and Social Science (salary not less than £1,100). Applications must be received, not later than first post on June 26, 1945, by the Academic Registrar, University of London, Richmond College, Richmond, Surrey, from whom further particulars should be obtained.

Student's Microscope. Ross "Eclipse" in case, 1 eyepiece. Lens ⅛ and ⅙. Fixed stage. Offers to 25 Clegg Avenue, Cleveleys, Blackpool.

Two Technical Officers required by the Ministry of Food to supervise factory production of dehydrated vegetables. Biochemical training is necessary, and experience of factory work would be an advantage. Initial salary £400 to £500 per annum (depending on qualifications and experience) plus war bonus £60 per annum. Write, quoting F.3854.A, to Ministry of Labour and National Service, Central (T. & S.) Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2, for application form which must be returned completed by June 20, 1945.

Two Chemists (Technical Officers) required by the Infestation Division of the Ministry of Food. Graduates in chemistry up to honours standard or equivalent. The work is practical in nature and is concerned with the supervision and chemical check on pest control operations: some advisory work is also involved. Candidates should have had practical analytical experience, preferably in food and drugs, and some training in zoology is also desirable. Salary (for men) £400 on scale £400–£600 plus war bonus £60. Write, quoting F.3374.A, to Ministry of Labour and National Service, Central (T. & S.) Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2, for application form which must be returned completed by June 20, 1945.

Laboratory Assistant required, in Electrical Laboratory of Midland firm, to undertake special tests and research on magnetic core materials, at power and audio frequencies. Knowledge of oscillators, amplifiers and bridge measurements essential. Salary £350–£400 p.a.

Applications, which must be in writing, stating date of birth, full details of qualifications and experience (including a list in chronological order of posts held) and quoting Reference No. 812 should be addressed to the Ministry of Labour and National Service, Appointments Office, 237 Broad Street, Birmingham 1.

Microscope: Watson's "H Edinburgh", also Zeiss objectives; Watson's Universal condenser and other microscopical accessories for sale. Books on the microscope and Natural History, with coloured plates. Write for list and prices to J. T. Orme, 51 Rawcliffe Lane, Clifton, York.

Instructor and Lecturer on Industrial Chemistry required for National Fire Service College, near Brighton. Post would carry Senior Company Officer rank. Salary £450 p.a. plus £50 Instructor's allowance. Person appointed will be required to lecture on elementary physics and chemistry, the chemistry of fire; to study and in due course lecture on (1) special fires involving inflammable solids, liquids, gases; (2) storage of hazardous commodities; (3) the application of science in connection with Fire Service Equipment. A general knowledge of building construction, etc., including the interpretation of architects' plans will be an advantage. Write, quoting F.4165.A, to Ministry of Labour and National Service, Central (T. & S.) Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2, for application form which must be returned completed by June 20, 1945.

Science Editor. Well-known firm of Educational Publishers requires full-time services of Graduate to prepare Science and other textbooks for the printer. Some teaching experience desirable; knowledge of proof reading and printing processes essential. Permanent post entailing residence in Cambridge. Write, stating qualifications, age and salary required, to Box 218, c/o John Hart & Co., 22 Northumberland Avenue, London, W.C.2.

Senior Technical Personnel are required for Research and Analytical posts by well-known firm specializing in food manufacture in the Manchester area. Applicants should be 30 to 40 years of age, honours degree in chemistry and of wide practical and administrative experience. For the Analytical posts preference will be given to applicants holding the Fellowship of the Royal Institute of Chemistry (Branch E). Salary to commence £650 p.a. or more according to qualifications and experience. Write, quoting F.4187.XA, to Ministry of Labour and National Service, Central (T. & S.) Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2, for application form which must be returned completed by June 21, 1945.

Physicist, B.Sc., A.R.C.S., with varied experience in electrical industry, seeks post where youth, initiative and enterprise are not a handicap. Box P.112, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

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tial instability very clearly. The form is now in regular use in the forecast service of Great Britain and other countries.

During the years that followed his retirement from the Meteorological Office, the newly formed International Union of Geodesy and Geophysics also made calls on Shaw's time. He became president of its Meteorological Section and acted in that capacity at the meetings in Rome (1921), Madrid (1924), Prague (1927) and Stockholm (1930).

When he retired from his professorship, what Shaw himself regarded as one of his most important tasks still lay before him, the completion of the "Manual". A serious illness in 1928 threatened to prevent the fulfilment of his hopes but he lived to see all four volumes completed. The last, a revised and enlarged edition of Part 4, now with the more concise title "Meteorological Calculus : Pressure and Wind", was signed for press on March 31, 1931, when Shaw had entered on his seventy-eighth year. Even then his capacity for writing was not exhausted. In 1933 he gave us "The Drama of Weather", a fascinating book addressed to the general reader rather than the specialist. Three years later a revised edition of Vol. 2 of the "Manual", bringing up to date the statistical information, was called for. He signed the preface to this on March 4, the eighty-second anniversary of his birth. Two years later, when a second edition of the "Drama" was required, he still had the vitality to make considerable additions.

Shaw was the recipient of many honours. He was knighted in 1915. Honorary degrees were conferred on him by the Universities of Aberdeen, Edinburgh, Athens, Dublin, Harvard and Manchester, and foreign membership by the Academies of Boston, Oslo, Rome and Stockholm. His gold medals included the Symons Medal of the Royal Meteorological Society (1910), the Buys Ballot Medal of the Dutch Royal Academy (1923) and a Royal Medal of the Royal Society (1923). He was an honorary fellow of the Royal Society of Edinburgh and of Emmanuel College, Cambridge. He was made Commander of the Order San Tiago da Espada (Portugal) in 1921.

R. G. K. LEMPFERT.

NEWS and VIEWS

Prof. C. Leonard Huskins

PROF. C. LEONARD HUSKINS, professor of genetics in McGill University, has been appointed professor of botany in the University of Wisconsin, in succession to Prof. C. E. Allen, who is retiring. Prof. Huskins' appointment takes effect from September 1. Prof. Huskins was born in Walsall, England, in 1897 ; he went to Canada with his parents at the age of ten, and was educated at Red Deer, Alberta, and the University of Alberta, Edmonton, obtaining the degrees B.Sc. Agr. in 1923 and M.Sc. in 1925. As Overseas Scholar of the Royal Commission for the Exhibition of 1851, he went to the University of London (King's College) during 1925–27, when he obtained a Ph.D. in botany. He was then research cytologist at the John Innes Horticultural Institute until 1930. In 1930 he was appointed associate professor of botany in McGill University. Then he established the Department of Genetics and was appointed professor of genetics in 1934. Prof. Huskins has worked chiefly on the cytogenetics of cereals and liliaceous plants, the origin of species through polyploidy and on chromosome structure. At the University of Wisconsin his teaching and research will be devoted mainly to cytology.

Academy of Sciences of the U.S.S.R. : Anniversary Commemoration

THE Academy of Sciences of the U.S.S.R. celebrates this year the 220th anniversary of its foundation by Peter the Great. At first the Academy was not only a learned society and centre of research, but also a university or public school where Russian youths were trained for various vocations and even crafts. The first scientific debate was held at the Academy in November 1725, when Newton's theorem on the spheroidal shape of the earth was discussed. In 1745, that is, twenty years after its foundation, Mikhail Lomonosov, famous chemist, geographer and poet, whose work had an important bearing on modern science in most varied fields of knowledge, was elected to the Academy, where he founded a chemical laboratory. Peter the Great gave the Academy his private library, which formed the basis of the present library, now numbering about ten million volumes. The Academy also received Peter's famous "Kunstkammer" with its great collection of fossils, mineralogical specimens and curios, which in time developed into the present geological, zoological, mineralogical and palæontological museums. Almost on his deathbed, Peter drafted a plan for an expedition to Kamchatka to discover whether Asia and America were connected by land. The exploration of Russia and the study of its mineral, plant and animal resources played a large part in the scientific activities of the Academy at its inception. Its geographical department produced a series of maps of Russia and Siberia.

To commemorate the anniversary of its foundation, the Academy held a special session during May 25–June 6. The programme included meetings in Moscow and Leningrad, visits to various research institutes, and sight-seeing expeditions. More than a thousand guests from at home and abroad were invited. The session was opened by the President of the Academy, Vladimir Komarov, who spoke on the growing importance of the Academy. Papers were read on the history of Russian science in various fields and on the part played by Russian scientific workers during the War, and the contribution which they hope to make towards rebuilding the world. The geographical and geological expeditions of the Academy were the subject of special reports, as was the work of Russian men of science in the fields of organic chemistry, aerodynamics, mechanics and physiology. The problems now under investigation in the twelve departments of the Academy were discussed. The programme provided for a visit to the site of the famous Pulkovo Observatory, which was destroyed by the Germans. There was an exhibition of standard works printed by the Academy or written by its professors and published elsewhere. Some interesting manuscripts and other documents illustrating the history of the Academy were reprinted for the anniversary.

Journal of Meteorology

ONE result of the War has been such an increase in the number of meteorologists in the United States that the American Meteorological Society has decided that the moment has arrived when a financial success can be made in America of what is described as "a technical journal of the highest caliber in the field of meteorology". The recently reorganized Society has recognized the need to serve both the professional and amateur meteorologist, and it is for the professional that the new journal under the title *The Journal of Meteorology* is mainly intended (American Meteorological Society, Milton 86, Mass.). It is to be a quarterly journal eventually, but owing to the difficulty of starting a new publication, especially in war-time, it was considered best to have only two issues in the first volume, dated 1944, and the copy of the first issue that we have received, dated September 1944, is accordingly described as vol. 1, Nos. 1 and 2. The journal is edited by Prof. Victor P. Starr, of the University of Chicago, and there are four associate editors, among whom is J. Bjerknes. The print is larger than that usually used in scientific journals at the present time, and both it and the diagrams are very clear; the paper cover is a bright yellowish-orange. There are four articles, dealing respectively with the theory of the genesis and movement of cyclones, the determination of normal regions of atmospheric heating and cooling, the changes of temperature during the formation and dissipation of stratus cloud on the Californian coast, and lastly, the relationship between the major changes in the paths of tropical storms and the upper wind-field. The journal has certainly made a very promising start, and we wish its editors every success.

Planning Regional Electricity

IN devoting its April issue to "Electricity in its Regional Setting" the *Architectural Review* has rendered a real public service. The review of the whole situation, including recent public inquiries at Durham and Lincoln, the work of the Electricity Commissioners, the Central Electricity Board and the newly formed North of Scotland Hydro-Electric Board, which the Association for Planning and Regional Reconstruction has produced for this issue is admirably presented and is not only of particular interest to the scientific worker but also to every citizen concerned with the development of national resources and the preservation of amenities. Taken as a whole, it explores the shallowness of the pretensions of hydro-electric schemes for the Highlands to have anything in common with the ideas and procedure of the Tennessee Valley Authority, and it is strong indictment of the Government's persistent refusal to deal with the question of a real central planning authority.

The survey puts the case for a plan for electricity in its wider regional setting from various points of view and shows how profoundly unsatisfactory is the present situation. There has been no published survey, on the national and on the regional scale, of existing facilities and resources, and there is no evidence that the development of the electricity "Grid" has been anything but piecemeal. No published plan has seriously attempted to link together the ascertained physical facts—mineral resources, rainfall, communications and transport, population, consumption, etc. —with the proposed extensions and development. The Tummel scheme, as Lord Malcolm Douglas-Hamilton shows, is a glaring example of this omission. Again, apart from the national and regional aspects, the siting of both thermal and hydro-electric power stations, their design and appearance has consistently been unintelligent; while finally, the preparation of such schemes in secret and their issue by instalments amounts almost to a deliberate misleading of the public.

Among the articles included in this number is a severe but reasoned criticism of the Central Electricity Board by Mr. Hugh Quigley which shows convincingly the dangers as well as the opportunities inherent in its structure and its lamentable failure to insist on a national approach, to foster research and development and to elaborate a national plan to which all other interests must be subservient. Those by Lord Forrester on "Industry and its Environment", by Dr. E. F. Armstrong on "Electrochemistry and Metallurgy", by Dr. R. Gilmour on "Electrotechnical Industry and the Highlands", by the late Prof. F. C. Baily on "Small Hydro-electric Stations", by Prof. C. H. J. Daysh on "Siting of Industry—The Regional Approach", by J. A. Dempster on "The Design of Industrial Buildings" and by G. A. Jellicoe on "Power Stations in the Landscape" and the anonymous article on "The Load Factor" are of most interest to scientific workers as such; but the whole number is a sombre indictment of the present position and of Government negligence, as well as of the Central Electricity Board or the Electricity Commissioners, which is the more impressive because of the restraint with which the evidence is presented.

Atomic Particles from the Sun

OBSERVATIONS during the solar cycle just completed have shown that a close correlation exists between solar flares—transitory patches of enhanced emission visible in hydrogen and calcium light near spots on the solar disk—and terrestrial magnetic storms. Great magnetic storms and auroral displays tend to occur about a day after the appearance of a brilliant flare, and it has been suggested that they are due to charged particles emitted from the sun simultaneously with the visible radiation. If the geometrical conditions are suitable, it is suggested, these particles begin to reach the earth 20–26 hours later, and cause disturbances of the magnetic traces which may last for a day or more. Nearly twenty years ago, Milne gave theoretical reasons for believing that atomic particles might be ejected from the sun at a speed of about 1,600 km./sec., which corresponds to a time of travel of 26 hours. Soon afterwards, Chapman suggested that a comparison should be made between solar spectra at times of magnetic quiet and of magnetic disturbance. The annual survey of the year's work at Mt. Wilson (Adams, *Pub. Ast. Soc. Pacif.*, 56, 213; 1944) now states that solar spectrograms taken in the ultra-violet region during magnetic storms give some indication of two very shallow absorption bands beginning near the centre of the lines *H* and *K* and extending about 12 A. towards shorter wave-lengths. Their maximum depth is only 1 per cent of the background continuum. Maximum velocities of the order of 1,000 km./sec. and mean velocities of about 600 km./sec. are indicated. Control spectrograms taken during magnetic calm show no such absorption. This is the first direct observational evidence of the presence in interplanetary space of calcium ions approaching the earth from the sun at speeds comparable with those predicted both theoretically and by inference from geophysical observations.

Phenomenology and Physics

AN article under this title by H. Margenau appears in the current issue of *Philosophy and Phenomenological Research*. It sets out to expound to the student of physics the main concepts of Husserl and his school; in addition, some consideration is given to the point of view which a physicist interested in methodology might take about the doctrines of phenomenology. At the outset the author is at pains to stress the special meaning attached to the word 'phenomenology'. Far from representing something superficial (that is, associated with 'mere' phenomena) this discipline is the most all-embracing matrix in which, so to say, all experience can be embedded. The paper is in three sections: (1) general thesis of phenomenology; (2) epistemology of physics; (3) the notion of certainty in phenomenology. It seems likely that, of the two types of facts recognized by Husserl, contingent and necessary, the latter are being gradually worn down by a process of attrition as scientific knowledge progresses. Thus a natural question to ask is whether or not the tendency will stop before all *eidetic* (that is, form-like) truth has become contingent. To Husserl, for example, Euclidean geometry appeared "immediately evident and therefore indubitably correct". Here indeed is an example of the rapid strides made by modern science since his day towards contingency. The caution towards ontological problems which phenomenology is forced to observe wrung from Husserl his famous "epoché" or abstinence, sometimes called bracketing. It implies, even if it does not absolutely require, the waiving of all existential judgments.

With this in mind, we are led to distinguish sense data from 'constructs', and to consider the rules of correspondence relating them. The inadequacy of ordinary language is the cause of much difficulty in making the necessary distinction between percept and correlate. Hallucinations cannot be dismissed too easily, for they are part of the 'given' in nature, but their spurious character is apparent by reference to constructs. Broadly, science is conceived as self-corrective, a property in which phenomenology is lacking. So long as the latter subject is without a discriminant between the infinite variety of forms which inner experience can take, it is likely to remain somewhat unproductive. It seems doubtful whether this disadvantage can be overcome without doing violence, to some part at least, of Husserl's thought.

Swiss Contributions to Western Civilization

UNDER the title "The Swiss Contribution to Western Civilization", Dr. Raphael E. C. Armattoe has set forth an account of the cultural achievements of Switzerland which, as Dr. Julian Huxley suggests in his foreword, most people may well find surprising (Dundalk: W. Tempest Dundalgan Press. Pp. 91. 5*s*.). As the record shows, Switzerland has sent out many from its free institutions to play their part elsewhere, while its universities have attracted many notable men from abroad. It has provided asylum for a number of distinguished workers anxious to avoid tyranny or persecution in their own countries, and Switzerland was almost the only centre of science, learning and culture in Europe which was able to remain out of the War. Its part in the reconstruction of European civilization may well be out of all proportion to its size. Dr. Armattoe seeks to distinguish from the outset a few sources of the Swiss contribution; but he makes no claim to be comprehensive, especially in dealing with music and the physical sciences. Chemists will note, for example, that while D.D.T. is mentioned, there is no reference to Engi's work, and the reference to the work of P. Karrer and L. Ruzicka is very brief. Besides the sections dealing with the Swiss contribution to biological sciences, the mathematical and physical sciences, agriculture, research in climatology and meteorology, and such special fields as climatic treatment of lung complaints, and Jungfraujoch Alpine research, with its humanitarian contributions, there are notes on the Swiss educational system, vocational and industrial education, industry and commerce, Swiss cultural life and so forth.

Public Health and the Museum

IN 1942, authorities of the South Australian Museum, at the request of the Council for Scientific and Industrial Research, examined the River Murray billabongs and seepage areas for Mollusca which might act as secondary hosts for the trematode worm parasites known to be present in the internees of the Loveday Internment Camps. Crustacea and edible fish—together with Cephalopoda taken from the stomachs of the latter—were also examined. The result of this work was a report strongly recommending that the internees should not be allowed in the vicinity of the river, since there was danger of their excreta infecting local fauna, with the possible consequence that the parasites would be introduced into the Australian population (see Report of the South Australian Museum, Adelaide, for 1942). The report for 1944 shows further work of high social value and importance. During last year the research activities of the Museum were turned towards the microscopic study of insects, the Acarina (particularly the Trombiculinæ), which are associated with the occurrence of scrub typhus in Australia and New Guinea. This work was carried out in collaboration with the Medical Section of the Australian Army, the Scrub Typhus Commission of the U.S.A., as well as with officers of the U.S. Navy. It has resulted in making the South Australian Museum the recognized centre for the identification of these mites; and the Museum's collection of these is now probably the largest in existence.

Consider the Calendar

BHOLA D. PANTH has produced a book with the above title, published by the Bureau of Publications, Teachers College, Columbia University, 1944 (pp. 138), which supplies an excellent account of the calendar, and also shows the great difficulties that beset the path of those who desire calendar reform. Details concerning the basic concepts of ancient calendars among the Babylonians, Egyptians, Hebrews, Mohammedans and others will prove helpful to many, more especially as such information is no longer supplied in every issue of the *Nautical Almanac*. Chapter 4 is devoted to a consideration of various proposals for calendar improvement. Reference to some of these proposals has been made in *Nature* (**153**, 229; 1944), and it is unnecessary to deal further with the different suggestions made to simplify our calendar. The Special Committee of Enquiry into the Reform of the Calendar of the League of Nations in 1926, in Geneva, received 185 plans from 33 different countries, and although this was evidence of keen interest in the subject, it also showed that a certain amount of opposition is inevitable whatever plan be adopted. It does

not seem highly probable that the nations of the world are yet prepared to accept any particular scheme, though some reform on the lines indicated in this book would certainly simplify matters in many ways. At the end of the book there is a short table which enables the reader to determine the day of the week by the Julian Calendar, A.D. 1–2099, or by the Gregorian Calendar, A.D. 1582–2099.

Lung Cavities in Pulmonary Tuberculosis

DR. ALFONSO R. SIMS contributes a paper on the spontaneous healing of cavities in tuberculosis of the lungs to *Aparato Respiratorio y Tuberculosis*, No. 3, 1944, published in Santiago De Chile, in which he gives the results of investigations carried out during the period 1937–42 at the Laenec Sanatorium, when 1,130 cases were dealt with. Males only were admitted—adolescents and adults—and it was found that spontaneous cures amounted to only 8·71 per cent. The importance of the size of the cavity was recognized and cures were not effected in cases where the diameter of the cavity exceeded 4–5 cm. It is remarkable that cavities in the left lung showed a greater tendency to heal spontaneously than those in the right lung. Schminke's classification of the cavities as primary, secondary and tertiary, the first having three and the second two subdivisions, was adopted, and it was found that by far the greatest number of spontaneous cures took place with the first class. Infra-clavicle cavities provided the greatest percentage of spontaneous cures, and those at the apex seldom provided any. It is pointed out that great care is necessary before taking any risks in the treatment of pulmonary tuberculosis, and in all cases the patients should be dealt with while they are confined to bed, or at least under the best possible conditions of repose.

Influenza Epidemics in the United States

ACCORDING to Selwyn D. Collins, head statistician of the United States Public Health Service (*Public Health Rep.*, 59, 1483 ; 1944), in the eighteen major or minor epidemics of influenza that have occurred in the United States since the beginning of 1918, there has been great variability in the age curve. In the recent outbreak, the curve was in general similar to that of 1928–29 except for a very high incidence among children less than ten years of age. Pneumonic incidence in the current epidemic was far below that of 1918–19. Among persons less than twenty-five years of age the pneumonic rate was less in the current epidemic than in any of the others, but above twenty-five the rates corresponded closely to those recorded for the epidemic of 1928–29. The percentage of the total cases which were complicated by pneumonia in the 1943–44 epidemic was far below the figure for any other epidemic for which figures were available. In most of the epidemics the rates for influenza were consistently higher for females than for males, particularly adult females, with the exception of the 1918–19 epidemic and the minor outbreak of 1940–41, in which there were no obvious sex differences.

Cooper Centenary Fellowships for Veterinary Parasitology

THE Veterinary Educational Trust announces that Cooper Centenary Fellowships have been awarded to Mr. J. F. A. Sprent and Mr. J. Hobart. The Fellowships were established with the Trust by Messrs. Cooper McDougall and Robertson to assist in the development of veterinary parasitology, and also as a mark of the centenary of that Company. They are normally tenable for one, two or three years, depending upon satisfactory progress in the research undertaken. Mr. Sprent qualified as a veterinary surgeon at the Royal Veterinary College in 1939 and took a B.Sc. degree in zoology with first-class honours at Birkbeck College in 1942. Since then he has been a veterinary research officer in the Colonial Veterinary Service, stationed at Vom, Nigeria, where he has carried out important investigations upon helminth infestation of cattle in that country. He hopes to continue to work upon helminth infestations of domestic animals with particular reference to host resistance and the development of a host immunity. Mr. Hobart took a B.Sc. degree in zoology with first-class honours in 1943 at University College, London. He has been a demonstrator in zoology at the University College of North Wales, Bangor, and has carried out research upon the ecology of adult sheep blowflies in North Wales. His field work has comprised the trapping of flies in the field and the study of the Dipterous succession in small carcases. This work was commenced in collaboration with the Entomological Unit of the Agricultural Research Council. Mr. Hobart proposes to continue his field work in North Wales and to work upon the physiology of insects at the London School of Hygiene and Tropical Medicine.

Comets

A TELEGRAM from Dr. Harlow Shapley announces the rediscovery of Comet Pons Winnecke on May 3, its magnitude being 14. A definitive orbit for this comet was computed by Mr. J. G. Porter and members of the Computing Section of the British Astronomical Association, and an ephemeris is given in the "Handbook" for 1945. The correction to the computed perihelion is + 2·6 days, and the result must be considered very satisfactory as the comet passes just over 0·6 unit from Jupiter, suffering considerable perturbations. Dr. Shapley has also announced the rediscovery of Comet Kopff on May 7d. 9h. 10m., U.T., its magnitude being 13. An orbit and ephemeris were computed by Messrs. W. E. Beart and W. P. Henderson and are given in the "Handbook" of the British Astronomical Association for 1945. A correction of about −8 m. in R.A. to the ephemeris is indicated from the observation.

Announcements

THE Catherine Wolfe Bruce Medal (commonly called the Bruce Medal) for 1945 of the Astronomical Society of the Pacific has been awarded to Prof. E. A. Milne, Rouse Ball professor of mathematics in the University of Oxford, for "distinguished services to astronomy". The medal is awarded on the recommendation of the directors of six observatories, of which two are in Europe. Previous British holders of this Medal have been Gill, Huggins, Dyson, Eddington, Turner, A. Fowler and J. S. Plaskett.

PROF. N. R. DHAR, formerly professor of chemistry in the University of Allahabad, has given the University of Calcutta an endowment of approximately one lakh of rupees (about £7,500) for "perpetuating the memory of Acharya Sir Prafulla Chandra Ray and in furtherance of establishing a University College of Agriculture". Prof. Dhar states that he hopes to make a further donation of similar amount at a later date.

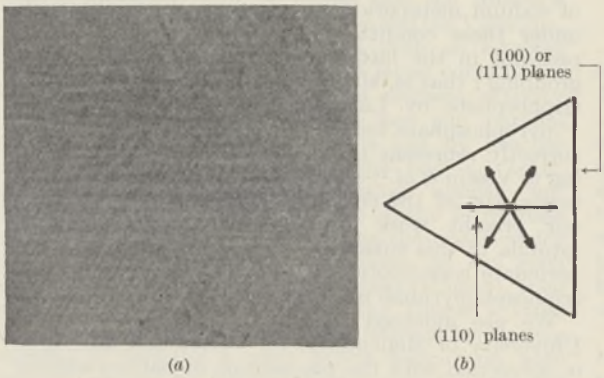
LETTERS TO THE EDITORS

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

Striated Structure of Age-hardened Alloys

IT is well known that age-hardening of alloys is related to a transformation of the crystal lattice, which takes place inside the crystal: this transformation precedes and prepares the formation of the precipitate from the over-saturated solid solution.

The microscopical examination of the crystal surface in the earlier stages of age-hardening shows the existence of one or several systems of parallel striations (see refs. 1, 2 for aluminium-copper alloys (5 per cent Cu); refs. 3, 4 for copper-beryllium alloys (2 per cent Be); ref. 5 for aluminium-zinc alloys, etc.). These striations appear on the sample surface after polishing and convenient etching (see illustration); but they may also appear in another way. If the quenched sample is first polished, then age-hardened, the metal surface becomes spontaneously striated: in the case of copper-beryllium alloys, for example, the depth of the striations is very noticeable.



(*a*) Copper-beryllium, aged 4 hr. at 315°, after electrolytic polishing.
(*b*) Direction of crystallographic planes, determined by X-ray pattern.

What is the origin of these striations which follow on age-hardening? Opinions are widely divergent. According to some, they are the trace of glide planes on the sample surface, gliding being due to mechanical stresses produced by the lattice transformations accompanying the age-hardening. On the other hand, Wassermann[6] attributed the striated structure not to glide-planes, but to mechanical twinning resulting from quenching stresses. A third explanation which has been proposed is the following: the striations are due to the presence of a very fine-grained precipitate, the size of the crystallites being below the resolving power of the best microscopes. The formation of lines of determined orientation are due to the plate-shaped form of the initial grains of precipitate, which has been demonstrated by X-ray-scattering patterns. But this explanation is not consistent with the spontaneous appearance of striations on an alloy surface polished before age-hardening and not etched.

A way of deciding between these hypotheses seemed to us to be the determination of the orientation of the striation in relation to the crystal axes. Then, if the striations are due to gliding, they must be parallel to (111) planes (in the case of aluminium and copper alloys); but if they are due to some precipitation, it might be expected that they would be parallel to (100) planes, since the crystals of the precipitate are flat and directed along those planes[1,3].

We have carried out this experiment with very coarse-grained samples, in the case of copper-beryllium and aluminium-copper alloys. The crystal axes were determined by back-reflexion Laue patterns. We found that all observed striation systems are *parallel to the intersection of some* (110) *planes with the examined surface*. But each (110) plane does not give rise to a striation system. Thus the striated structure of age-hardenod alloys is neither related to ordinary glide-planes nor to precipitation planes.

The following explanation accounts for our observations. In the two alloys examined, the solid solution transformation begins by the gathering of the solved atoms in small areas of some (100) planes. Further, the local enrichment in foreign atoms of these planes produces variations of the interplanar (100) spacings. In the case of copper-beryllium alloy, for example, the parameter of the cell decreases from 3·6 A. (solid solution lattice) to 2·7 A. (precipitate lattice): then the domain where the beryllium atoms are gathered undergoes a great diminution of volume, which produces the observed depressions upon the metal surface. We may assume that the dislocations between beryllium-rich domains and undisturbed crystal regions take place along (110) planes: for these planes are normal to base planes of the precipitate and are very important both in the solid solution and precipitate crystals. The result is that the striations, which are the limits between depressions of different value, are parallel to (110) planes.

In the case of aluminium-copper alloys, the difference between the volume of solid solution and precipitate is much less than for copper-beryllium alloys; and it is observed, in fact, that the striations are much less pronounced.

A. GUINIER.
P. JACQUET.

Laboratoire d'essais du Conservatoire des Arts et Métiers, Paris;
et Laboratoires de "Le Matériel Téléphonique".

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[2] Gayler, M. L. V., and Parkhouse, R., *J. Inst. Metals*, **66**, 67 (1940).
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[5] Chandron, G., Herenguel, J., and Laamb, P., *C.R. Acad. Sci.*, **218**, 404 (1944).
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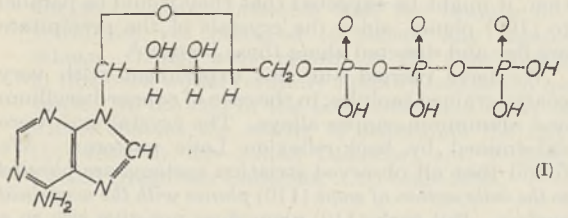
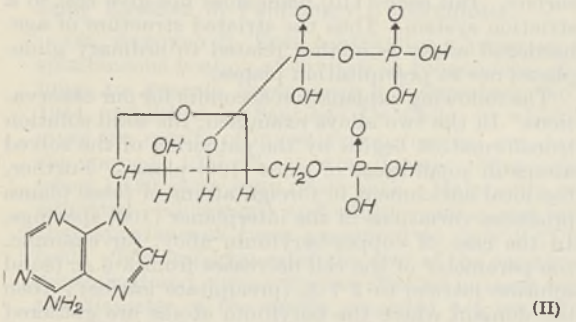
Structure of Adenosine Di- and Tri-Phosphate

DEFINITE proof of the constitution of adenosine diphosphate and adenosine triphosphate, desirable because of its significance both for the structure of the co-dehydrogenases and of the intrinsic interest of the adenosine polyphosphates, has not hitherto been presented. The usual formulation of adenosine triphosphate as adenosine 5′-triphosphate (I) (Lohmann[1]) is in doubt only as regards the mode of attachment of the labile phosphoryl groups to the 5′-phosphoribofuranoside residue; the formation of muscle adenylic acid (adenosine 5′-phosphate) on hydrolysis of adenosine triphosphate and of inosine triphosphate by deamination virtually excludes the location of these phosphoryl groups elsewhere in the molecule.



(I)



(II)

Structure (I) finds strong support in the careful work of Lohmann[1] on the alkaline titration of adenosine di- and tri-phosphate; he found that the latter contains three primary and one secondary, and the former two primary and one secondary acidic groupings. Other workers (Satoh[2]; Barrenscheen and Jachimowicz[3]) have, however, claimed that it is possible using certain enzyme preparations to remove the acid-stable (5′) phosphate residue from adenosine triphosphate, leaving the acid-labile residues intact. This claim is incompatible with the Lohmann formula and, if substantiated, would indicate that the acid-labile phosphate groupings are attached to a second hydroxyl of the ribofuranoside as, for example, in (II).

A decision between (I) and alternatives of type (II) is clearly possible given a test capable of detecting unambiguously the presence of an α-glycol grouping; the Klimek-Parnas test[4] (formation of a deep blue copper complex) and the Boeseken boric acid reaction were both found positive for adenosine triphosphate[1]; but while this supports structure (I), the tests are not considered decisive in view of the complexity of the molecule. We have recently shown[5] that the structure of certain nucleosides and nucleotides can be determined by titration with sodium metaperiodate in the manner described for the simpler O-glycosides by Jackson and Hudson[6]; thus adenosine and muscle adenylic acid each containing one α-glycol grouping were found to consume 1 mol. metaperiodate, while yeast adenylic acid (adenosine 3′-phosphate), in which one of the α-glycollic hydroxyls is esterified with phosphoric acid, was unaffected by this reagent. We have now extended the method to the study of adenosine triphosphate and find that this substance consumes almost exactly 1 mol. metaperiodate. Details of the experimental procedure follow.

Barium adenosine triphosphate prepared from rabbit muscle by the method of Barrenscheen and Filz[7], and purified according to Kerr[8] until the P/N ratio was constant, was washed with absolute alcohol and dried *in vacuo* at room temperature over calcium chloride. The purity of this material was shown by determination of the atomic ratio acid-labile P/total P/N = 1·99/3·00/5·00; the theoretical value is 2/3/5. Inorganic phosphate present was less than 1 per cent of the total phosphate. Phosphorus determinations were carried out colorimetrically by the method of Allen[9], nitrogen by micro-Kjeldahl.

451·6 mgm. of this material was dissolved in a cold mixture of 2 c.c. water and 2 c.c. *N* hydrochloric acid, 5 c.c. water containing 0·65 gm. $Na_2SO_4.10H_2O$ added, and after 5 minutes the solution was neutralized (*p*H 6·8–7·2) with 2 c.c. *N* caustic soda. Barium sulphate was centrifuged off, washed with water, and the supernatant liquid and washings combined and made up to 50 c.c. with water. Aliquots of this solution were assayed (in duplicate) for phosphorus and nitrogen with the following results: Inorganic P, < 1 per cent of total; acid-labile P, 0·624 mgm./c.c.; total P, 0·938 mgm./c.c.; acid-labile P/acid-stable P, 1·99/1; N, 0·744 mgm./c.c. The solution was thus 0·104 (± 3 per cent) *M* in adenosine triphosphate. To the major portion of the solution (40 c.c.) 5 c.c. of 0·2536 *M* sodium metaperiodate and 5 c.c. water were added, and the mixture set aside at 19°, aliquots being removed at suitable intervals for estimation of unchanged periodate by titration with *N*/10 sodium arsenite. After 48 hours no further uptake of oxidant took place, 0·440 millimol. having been consumed, corresponding to 1·06 mol. per mol. adenosine triphosphate.

We regard the consumption of 1 molar proportion of sodium metaperiodate by adenosine triphosphate under these conditions as conclusive proof of the presence in the latter of an unsubstituted α-glycol grouping; that is, structure (I) ascribed to adenosine triphosphate by Lohmann, and the corresponding 5′-pyrophosphate formula for adenosine diphosphate correctly represent these substances. Since, according to Vestin *et al.*[10] an adenosine diphosphate residue forms part of the cozymase molecule, the results of our present work support the usually accepted formula of this substance. Experiments to test the periodate consumption of cozymase and the related triphosphopyridine nucleotide are at present in train.

We are indebted to Dr. L. P. Kendal, of the University of Manchester, for advice and assistance in connexion with the preparation of barium adenosine triphosphate.

B. LYTHGOE.
A. R. TODD.

University Chemical Laboratory,
Cambridge. March 24.

[1] Lohmann, *Biochem. Z.*, 254, 381 (1932); 282, 120 (1935).
[2] Satoh, *J. Biochem.* (*Japan*), 21, 19 (1936).
[3] Barrenscheen and Jachimowicz, *Biochem. Z.*, 292, 350 (1937).
[4] Klimek and Parnas, *Biochem. Z.*, 252, 392 (1932).
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[6] Jackson and Hudson, *J. Amer. Chem. Soc.*, 59, 994 (1937); 61, 1530 (1939); 65, 64 (1943).
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[8] Kerr, *J. Biol. Chem.*, 139, 121 (1941).
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Lecithin and Venom Hæmolysis

IT is well known that different species of erythrocytes exhibit wide variations in their susceptibility to venom hæmolysis. Some, such as those of the sheep, the goat and the ox, are totally resistant, while others, like those of the guinea pig and the dog, are very susceptible. Venoms also vary greatly in their hæmolytic activity. Those obtained from the Colubridæ class are hæmolytic in varying degrees, while the Viperidæ species of snakes yield venoms which are mostly non-hæmolytic. In the

presence of a trace of lecithin, however, all species of erythrocytes susceptible or refractory lyse very readily with all venoms irrespective of their nature.

Since the discovery of this remarkable venom-activating property of lecithin, the mechanism of the direct hæmolytic action of a native venom upon a susceptible species of red blood corpuscle has been supposed to be the same as that of its indirect hæmolytic action in the presence of extracellular lecithin, the lecithin in the former case being assumed to be supplied by the corpuscles concerned (Kyes and Sachs[1]). The difference in the susceptibility of various species of erythrocytes, however, was supposed to depend not on their respective total lecithin contents but on the extent to which this intracellular lecithin was free or available for venom activation.

As to the nature and mode of formation of this hæmolysin, Kyes[2] believed it to be a synthetic product resulting from a combination of a venom and a lecithin quota (lecithid), while Coca[3] and others regard it simply as one of the split products of lecithin, namely, desoleolecithin, or lecithin from which one molecule of fatty acid has been removed by the enzymatic action of the venom lipase.

Roy and Chopra[4], and again Roy[5], from a comparative study of some of the biochemical properties of venoms obtained from the cobra and the Russell's viper, as representing the Colubridæ and the Viperidæ, found that the former contained both an esterase (butyric) and a lecithinase, but the latter contained a lecithinase but no esterase. The esterase activity of cobra venom, however, does not run parallel to its hæmolytic activity, as it is lost by heating the venom solution to 56° C. for half an hour, the hæmolytic activity remaining almost unimpaired by this treatment. But if the lecithinase activity of a venom is regarded as the criterion for determining its hæmolytic behaviour, as has been assumed even by some recent workers (Huges[6]), then we are unable to explain why the Russell's viper venom, which contains a fairly strong lecithinase capable of forming a very active hæmolysin with lecithin, should be non-hæmolytic even towards the susceptible species of red blood corpuscle.

The presence of free or 'available' lecithin in the large majority of the species of erythrocytes, therefore, seems to be highly improbable; and the mechanism of the direct hæmolytic action of a native venom seems to bear no relation to its lecithinase content, and it is entirely different from that of its indirect activation in the presence of extracellular lecithin.

Since the venoms obtained from all species of snakes contain lecithinase A (Contardi and Ercoli)[7] which splits up lecithin only in a particular manner, namely, into a molecule of oleic acid and desoleolecithin (lysolecithin), and since the latter is capable of dissolving even the most resistant species of red blood corpuscle, their universal lytic action on these corpuscles in the presence of lecithin is self-evident.

Another point of difference between the action of a native venom and that of the lysolecithin it forms in the presence of lecithin is, that while the former does not lyse an emulsion of cholesterol, the latter dissolves it freely. The formation of lysolecithin is also attended with a remarkable lowering in the surface tension of the solution. It appears probable that with lysolecithin the process of hæmolysis is initiated by a solution of the corpuscular membrane cholesterol; and when the corpuscular structure is thus somewhat loosened, the sudden change in the surface tension of the solution effects a rapid separation of the stroma-hæmoglobin union. There is reason to believe (to be reported later on) that bile salt hæmolysis is brought about in a similar manner.

As the cholesterol solvents are usually those which also materially lower surface tension, it may be stated as a general proposition that substances which dissolve cholesterol will hæmolyse all species of red blood corpuscle, though the converse is not true. This, however, leaves the mode of the direct hæmolytic action of a native venom still unexplained.

A detailed account of the work will be published elsewhere.

A. C. ROY.

School of Tropical Medicine,
Calcutta.

[1] *Ber. Klin. Woch.*, **40**, 21, 57, 82 (1903).
[2] *Ber. Klin. Woch.*, **40**, 956, 982 (1903).
[3] *Z. Immunität.*, **12**, 134 (1912).
[4] *Ind. J. Med. Res.*, **26**, 241 (1938).
[5] *Ind. J. Med. Res.*, **26**, 249 (1938).
[6] *Biochem. J.*, **29**, 437 (1935).
[7] *Biochem. Z.*, **61**, 275 (1933).

Aliphatic Acids, Fungi and *Mycobacterium tuberculosis*

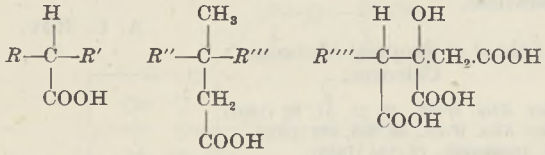
THERE is no doubt that long-chain aliphatic acids are intimately connected with the metabolism of *Mycobacterium tuberculosis*. Anderson[1] has isolated a number of such acids, including a long-chain hydroxy-acid, from the fatty envelope of this organism. Adams[2] has shown that acids of the type *RR'*CH.COOH (containing 16–18 carbon atoms) are, to a certain extent, bactericidal towards *M. tuberculosis*, and Robinson[3] has synthesized acids of the type $R''R'''C(CH_3).CH_2.COOH$ (containing 16–18 carbon atoms) which also showed bactericidal activity against this same organism.

So long ago as 1910, Vaudremer[4] observed that tubercle bacilli were modified by maceration in extracts made from *Aspergillus fumigatus* and *Penicillium glaucum*. A filtrate from a medium on which *Aspergillus fumigatus* had been grown has been found by Soltys[5] to have an antibiotic action towards *M. tuberculosis*; a similar observation with regard to an *Aspergillus* strain has recently been made by Kallós[6]. Extracts obtained from the culture media of *Penicillium notatum* have been shown by Smith and Emmart[7] to exhibit "*in vitro* marked activity at certain concentrations", and Miller and Rekate[8] have observed an inhibition of growth of tubercle bacilli by suspensions of a mould which probably belonged to the genus *Penicillium*. It is thus clear that the metabolic products of certain species of *Penicillium* and *Aspergillus* are antibacterial towards *M. tuberculosis*, and it may be noteworthy (see below) that fungi belonging to these genera are well known for their ability to produce citric acid.

Agaric acid—obtained from a Basidiomycete, *Polyporus officinalis*, Vill.—has been employed for many years in the treatment of night-sweats of phthisis. That a fungus-product should have been used for the alleviation of a condition due to *M. tuberculosis* is a curious coincidence, and more especially so, since agaric acid is known to be a long-chain homologue of citric acid (*n*-hexadecyl-citric acid[9,10]). Agaric acid is, however, said to act pharmacologically as an anhidrotic.

The production of bacteriostatic substances by the larger Basidiomycetes has been investigated[11] by Wilkins and Harris, who state that their "results indicate that the larger Basidiomycetes are among the more promising fungus groups which produce antibiotics. . . ." These authors, however, base their opinion on the results of tests made mainly on *B. coli* and *Staph. aureus*.

There is a certain structural relationship between agaric acid and those synthetic acids which have been shown to be active against *M. tuberculosis* :



Total number of C atoms in molecule :

(Adams)	(Robinson)	Agaric acid
16–18	16–18	22

The coincidences are too many to be overlooked, and in my opinion warrant (*a*) a determination of the antibacterial activity of agaric acid towards *M. tuberculosis*, and (*b*) an investigation of the synthesis and chemotherapy of related compounds. Both aspects of this investigation are in progress.

JOHN C. ROBERTS.

Department of Chemistry,
University College,
Nottingham.

[1] Anderson, *Chem. Rev.*, **29**, 225 (1941).
[2] Adams *et al.*, *J. Amer. Chem. Soc.*, **51**, 1261 (1929).
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[10] Passerini and Banti, *Chem. Z.*, 1, 1432 (1931).
[11] Wilkins and Harris, *Ann. Appl. Biol.*, **31**, 261 (1944).

Acid Salts of Organic Acids as *p*H-Standards

MANY monobasic organic acids form crystalline acid sodium or potassium salts (for example, potassium hydrogen benzoate, $KC_7H_5O_2.HC_7H_5O_2$). A solution of such a compound is equivalent to one of the acid half neutralized with a strong base, and it constitutes a buffer solution that is very readily prepared and that has a *p*H-value approximately equal to, but slightly lower than, *p*K ($= -\log K$) for the acid. Their general usefulness is limited by the low solubilities of most organic acids, and by the comparatively restricted range of dissociation constants among acids otherwise suitable.

Preliminary measurements at 20° show that *M*/50 potassium hydrogen benzoate has *p*H = 4·15 and *M*/30 potassium hydrogen phenylacetate *p*H = 4·23, the *p*H values being on the scale recommended by Hitchcock and Taylor[1]. These solutions are suggested as possible *p*H-standards, and they are being further investigated from this point of view, together with other similar systems.

Potassium hydrogen phthalate has long been recognized as a *p*H-standard, but this compound is not strictly analogous to those now suggested. Phthalic acid is dibasic; the buffering capacity of phthalic acid – caustic potash mixtures is actually at a minimum for the composition corresponding to $KHC_8H_4O_4$: and there is appreciable buffering only because pK_1 and pK_2 differ by not more than $2\frac{1}{2}$ units. On the other hand, borax, which in solution is stoichiometrically equivalent to $NaBO_2.HBO_2$, gives a true buffer solution, and is an acid salt of the type discussed above.

J. C. SPEAKMAN.
NEVILLE SMITH.

Chemistry Department,
The University,
Sheffield, 10.
March 26.

[1] *J. Amer. Chem. Soc.*, 59, 1812 (1937) : 60, 2710 (1938).

Molar Polarization and Radius-Ratio of Ions

THE interionic distance in the crystalline state is not exactly additive for the radii of the constituent ions. Fajans[1] explains it in terms of polarization. Pauling[2], on the other hand, neglecting the effect of polarization, explains these deviations from additivity as the effect of the radius-ratio, ρ, of the constituent cation to anion. In this communication a set of empirical equations concerning molar volumes and molar refractions of alkali halides will be first presented. Making use of these empirical equations, I am able to assign definite values to polarization and obtain a function of ρ which, though different in form from Pauling's function, $F(\rho)$, gives identical values.

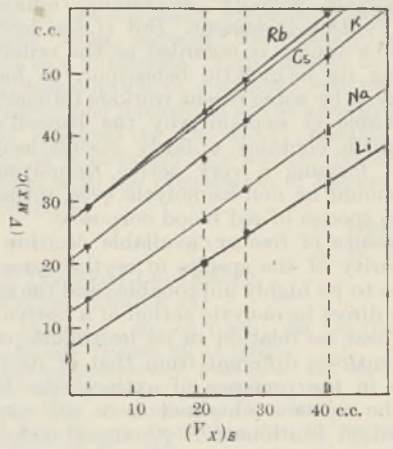

Fig. 1.

In plotting the molar volume[3], $(V_{MX})_C$, for halides of each alkali in the crystalline state against the volume of halide ions in solution of infinite dilution, $(V_X)_S$[4,5], as shown in Fig. 1, a set of straight lines is obtained which can be expressed by the general equation :

$$(V_{MX})_C = a_1 + b_1 (V_X)_S, \quad . \quad . \quad . \quad (1)$$

where a_1 and b_1 are characteristic constants for each cation.

I have previously shown[6] that the volume, $(V)_S$, of ions in infinitely dilute solution is a linear function of the volume, V, calculated from Pauling's radii. Therefore $(V_{MX})_C$ bears a linear relation with the volume of anions, V_X.

$$(V_{MX})_C = a_2 + b_2 V_X \quad . \quad . \quad . \quad (2)$$

Taking the volume of ions in solution of infinite dilution as reference, one may consider a_1 in equation (1) as the volume of cations in crystals under the loosening influence of anions and $b_1(V_X)_S$ as the polarized volume of anions.

The molar refraction[7] of alkali halides, $(R_{MX})_C$, in crystals can be also expressed as a linear function of the refraction of gaseous anions $(R_X)_G$.

$$(R_{MX})_C = a_0 + b_0 (R_X)_G \quad . \quad . \quad . \quad (3)$$

The graph is similar in shape to Fig. 1.

Ionic polarization. If we subtract from each side of equation (1) the molar volume of MX in solution, $(V_{MX})_S$, we get

$$\Delta V_{MX} = (V_{MX})_C - (V_{MX})_S =$$

$$[a_1 - (V_M)_S] - (1 - b_1)(V_X)_S = L - P(V_X)_S. \quad (4)$$

Similarly for molar refraction,

$$\Delta R_{MX} = (R_{MX})_C - (R_{MX})_G =$$

$$[a_0 - (R_M)_G] - (1 - b_0)(R_X)_G = L' - P'(R_X)_G. \quad (5)$$

This relation is shown in Fig. 2. Equation (4), if plotted, will give a similar set of lines.

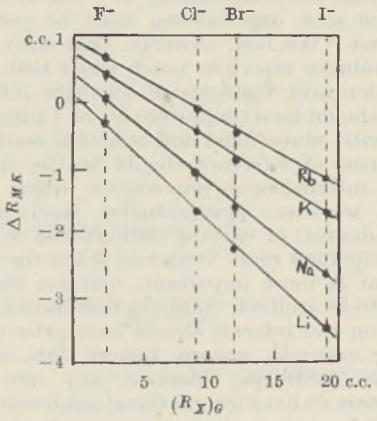

Fig. 2.

The terms L and L' can be called, following the concepts of Fajans[1], the loosening constants of cations; while P and P' are the polarizing strength of cations. Fig. 2 shows that the polarizing strength decreases in the order lithium, sodium, potassium and rubidium. Ionic polarization is the combined result of these two factors, L and P.

Function of radius-ratio of ions. Starting from equation (2) and making use of the classical equation expressing the interionic distance D in crystals in terms of molar volume V, $D = 0{\cdot}936V^{1/3}$, one gets

$$D = 0{\cdot}936\,(a_2 + 4/3.N\pi b_2 r_X{}^3)^{1/3},$$

where r represents Pauling's ionic radius. Then Pauling's function of radius-ratio can be expressed in the form

$$F(\rho) = \frac{D}{r_M + r_X} = \frac{0{\cdot}936(m\rho^3 + n)^{1/3}}{\rho + 1}, \quad (6)$$

where

$$\rho \equiv \frac{r_M}{r_X}, \; m \equiv \frac{a_2}{r_M{}^3}, \; n \equiv \frac{4}{3} N\pi b_2.$$

In Fig. 3, the smooth curve is Pauling's function, $F(\rho)$, and dots represent the values calculated from the new function as shown on the right-hand side of equation (6).

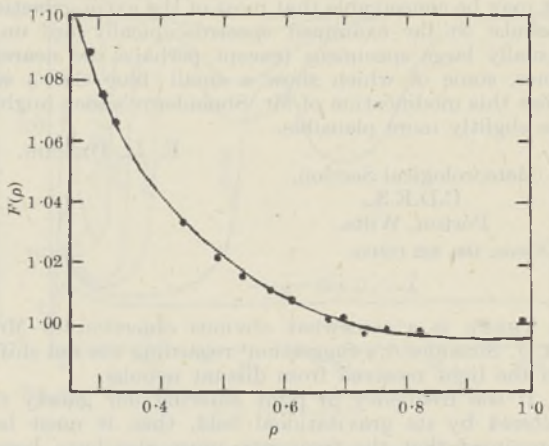

Fig. 3.

In conclusion, the interionic distance D in crystals is shown to be calculable from an equation, equation (6), derived from the equation of polarization and at the same time related to a function of the radius-ratio. A more detailed presentation will appear in the *Journal of the Chinese Chemical Society* (11, No. 2).

Reprints of this letter can be obtained from the British Council Cultural Scientific Office in China, via the British Council, Science Department, 3 Hanover Street, London, W.1.

F. H. LEE.

Department of Chemistry,
University of Nanking,
Chengtu, China.

[1] Fajans, K., *Chem. Phys.*, **9**, 291 (1941).
[2] Pauling, L., "The Nature of the Chemical Bond" (Cornell Univ. Press, 1940).
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[5] Lee, F. H., and Sie, *J. Chinese Chem. Soc.*, **9**, 134 (1942).
[6] Lee, F. H., *J. Chinese Chem. Soc.*, **9**, 46 (1942).
[7] Fajans, K., and Joos, *Z. Phys.*, **23**, 1 (1924).

Red Shift in the Anagalactic Nebulæ

MR. A. J. SHNEIDEROV, in his letter[1] putting forward an explanation of the 'red shift', appears to have overlooked, in examining the effect of gravitational attraction on the frequency of a photon, the fact that the nebula from which the photon originated would exert a contrary effect on the photon to that exerted by the galaxy. If the nebula were of equal mass to the galaxy, then the two effects would balance and no frequency change result.

To explain the red shift in this way would therefore require the galaxy to be much more massive than the great majority of the spiral nebulæ so far examined spectroscopically. I believe this is not in accordance with the latest views on the comparative masses of the galaxy and the spiral nebulæ.

Furthermore, Mr. Shneiderov's formula for the observed energy of a photon originating 'out of the blue' attributes a lower energy to the photon after it has realized on its initial gravitational potential energy than it had at first. The opposite would appear more reasonable. Were this so, no change in frequency would again be expected in the case of equality of mass of radiator and receiver. If, however, the galaxy were smaller than the great majority of the spiral nebulæ, a red shift would be expected.

It may be conceivable that most of the extra-galactic nebulæ so far examined spectroscopically are unusually large specimens (except perhaps the nearer ones, some of which show a small 'blue shift') so that this modification of Mr. Shneiderov's idea might be slightly more plausible.

E. L. DEACON.

Meteorological Section,
C.D.E.S.,
Porton, Wilts.

[1] *Nature*, **155**, 332 (1945).

THERE is a somewhat obvious objection to Mr. A. J. Shneiderov's suggestion[1] regarding the red shift in the light received from distant nebulæ.

If the frequency of light entering our galaxy is altered by its gravitational field, then it must be presumed that the frequency must also have been altered by the gravitational field of the galaxy in which the light originated, but in an opposite sense, so that the two effects would tend to neutralize each other. Also the shift would vary according to the part of the distant galaxy in which the light originated, which does not appear to be the case.

The choice of explanations of the red shift would appear to lie among the following: (i) An increase in distance with lapse of time (Doppler effect). (ii) An increase in the frequency of the atomic oscillators with lapse of time. (iii) A decrease in the velocity of light with lapse of time. (iv) A change in the frequency (wave-length) of the light in its passage through space.

Our choice is limited by our definitions of length and time, which serve to eliminate two of the four possible explanations, or which impose two conditions which the explanation must satisfy.

The first three explanations cover familiar ground, but the fourth is also perhaps deserving of consideration. Recent theory has tended to lay special emphasis on quantum effects, but there would seem to be the possibility that the absorption of light in intergalactic space containing molecules, atoms and electrons might be connected with a slight change of frequency.

K. E. EDGEWORTH.

Cherbury, Booterstown,
Co. Dublin. March 23.

[1] *Nature*, **155**, 332 (1945).

Breeding of the Harvest Mouse in Captivity

THE harvest mouse, *Micromys minutus*, is easy to keep in captivity, this tiny beast flourishing in a roomy cage as many naturalists have proved. One of mine lived with me for nearly four years and died apparently of senile decay. But it has rarely been bred in confinement; indeed I believe that until quite recently the late Miss Phyllis Kelway's achievement of breeding a litter of harvest mice was unique. I say until "quite recently" because two females in my possession have just produced a litter each. The first family two thirds grown was out and running about on May 12 and the second litter came out, being but half-grown, on May 15. An accurate count was difficult for the small animals kept running in and out of the straw, hay, etc., in their quarters; but my provisional estimate was three in litter number one and four in litter number two. This may have to be modified.

This establishment consists of one old male and two old females. These, and eight other harvest mice domiciled in another cage, came to me last year through the kindness of Mr. W. B. Atlee from Romsey in Hants. Those in the more crowded cage have not shown any signs of breeding. I attribute the success of those in cage number one to roomy quarters and except for being fed and watered—they are most thirsty little animals—to being left undisturbed. They are fed on grain, occasional apple, bread dipped in milk and nuts. They also eat a considerable amount of green food, that is, grass, etc.

FRANCES PITT.

The Albynes, Bridgnorth.
May 16.

Regional International Universities

THE leading article[1] on Dr. Joseph Needham's article on "An International Science Co-operation Service" is opportune. We regret that Prof. G. W. Keeton's book, "The Case for an International University", is at present not available to us; but it is obvious that some such organization must be permanently established. We feel, however, that such a service should embrace activities much wider than the mere distribution and exchange of scientific information.

There should be a committee of the United Nations to deal with educational and scientific matters. One of its terms of reference should be the creation of regional international universities where teachers, research workers, postgraduates (and eventually undergraduates) of varying nationalities would work under a common roof. It should select the personnel and, what is most important, indicate the type of subjects to be studied. Subjects that have a universal application and interest should have prior consideration; for example, science, history, law, economics, preventive medicine; likewise, any new problem that appears to have international implications should be included.

Such international universities could supplement existing national universities, but should in no way interfere with their autonomy.

W. C. W. NIXON.
W. LAQUEUR.

Istanbul University.

[1] *Nature*, **154**, 497 (1944).

Kinematical Relativity and the Nebular Red-Shift

PROF. MILNE[1] has not met my objection. I have read his mathematics, and it does not explain how a real, objective effect (the red-shift) can be "due to recession" which, according to kinematical relativity, is a subjective cause which can be transformed away by an act of thought. Prof. Milne's claim that an absurdity must be accepted unless one can locate a flaw in the argument leading to it seems to me to call for further comment.

HERBERT DINGLE.

Imperial College,
London, S.W.7.

[1] *Nature*, **155**, 511 (1945).

[We regret there is no space to continue this discussion.—EDITORS.]

PHOTOMETRIC RECORD OF THE MODE OF ACTION OF SULPHONAMIDES AND PENICILLIN

By DR. P. BONÉT-MAURY and R. PÉRAULT
Institut Alfred Fournier (Service de Chimiotherapie) and Institut du Radium, Paris

WE have obtained these records with the 'différentiel bio-photomètre' recently built by Bonét-Maury and Walen[1] in the Radium Institute, Paris; that apparatus automatically records the variations of opacity of six bacterial suspensions. The growth of the micro-organisms is carried out at 37° C., in special 2-ml. flasks, mechanically shaken during the whole experiment while exposed to the beam of light.

The growth of *Staphylococcus aureus*, in glucose peptone broth, gives, for increasing inoculates, parallel curves (Fig. 1). The standardization of the photometer with bacterial suspension of known

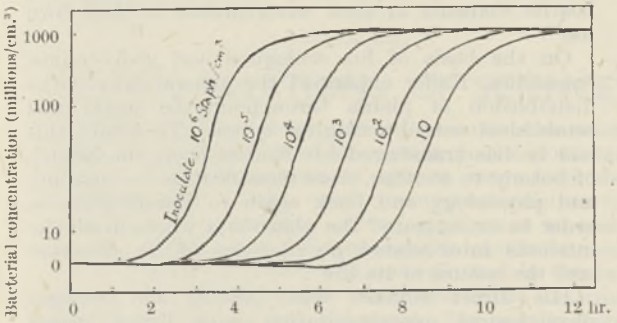

Fig. 1. NORMAL GROWTH OF STAPHYLOCOCCUS, WITH DIFFERENT INOCULATES.

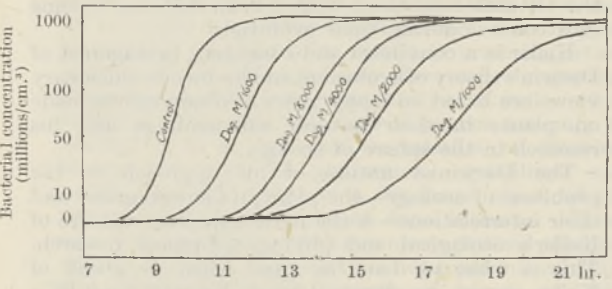

Fig. 2. DAGENAN AND STAPHYLOCOCCUS. CONTROL INOCULATE, 10^6 STAPH./CM.³.

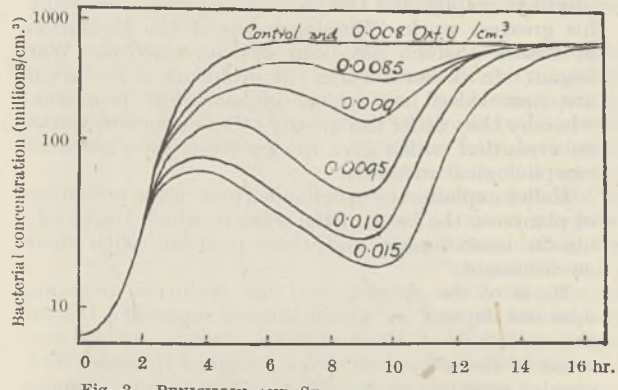

Fig. 3. PENICILLIN AND STAPHYLOCOCCUS INOCULATE, 5×10^6 GM./CM.³.

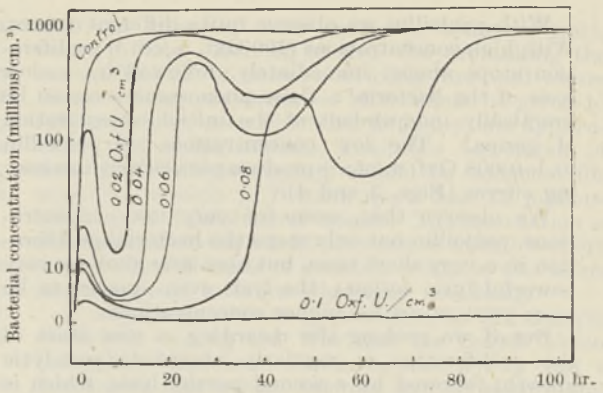

Fig. 4. PENICILLIN AND STAPHYLOCOCCUS. INOCULATE 5×10^6 GM./CM.³.

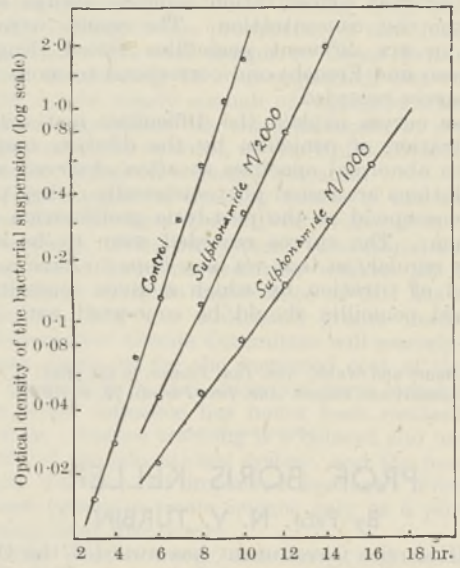

Fig. 5. SULPHONAMIDE (1162 F.) AND *B. coli*. LOGARITHMIC LAW IN SYNTHETIC MEDIUM.

potency enables one to plot these curves on semi-logarithmic paper; parallel straight lines are then obtained showing that the growth of *Staphylococcus* follows indeed a regular logarithmic growth.

With sulphonamides (Dagenan, 1162 F) in the same broth, it is found by the same graphic means that the curves obtained always indicate logarithmic growth, but the higher the concentration of sulphonamide the slower is the rate of growth (Fig. 2). With *B. coli* in synthetic medium, without any anti-sulphonamide agent, the same curves are observed (Fig. 5). Everything is exactly as if, at each bi-partition, the culture treated with sulphonamide was retarded by a given quantity when compared with the test culture, so that the distance between the two curves regularly increases with time. Thus we can explain why the action of sulphonamide appears to be stronger when it acts on a poor inoculate than on a high bacterial concentration.

It seems to us, from those results, that the sulphonamides, for the concentrations usually reached in the organism, do not stop but just delay the proliferation of the pathogenic micro-organism. In summing up, sulphonamides act on the bacterial proliferation like a fall of temperature, by a slackening of the reaction of synthesis.

With penicillin we observe quite different curves. With high concentrations (100 Oxf. u./cm.^{3}) proliferation stops almost immediately, followed by a slow lysis of the bacteria[2]; these phenomena seem to be practically independent of the initial concentration of germs. The low concentrations of penicillin (0·1–0·008 Oxf. u./cm.^{3}) produce particularly interesting curves (Figs. 3 and 4).

We observe that, even for very low concentrations, penicillin not only stops the bacterial proliferation in a very short time, but also later shows a very powerful lytic action; the lysis even appears to be more pronounced for higher concentrations.

But if we prolong the recording, a new start of the proliferation is regularly observed (post-lytic growth) followed by a second partial lysis, which is finally followed by a second post-lytic growth. The latter does not appear to be normal, because the final bacterial concentration remains always lower than the test concentration. The results were the same for six different penicillins tested (English, American and French) and correspond to more than fifty curves recorded.

These curves explain the difficulties met with in the titration of penicillin by the dilution method, and the abnormal opacities so often observed when the dilutions are tested photometrically; they probably correspond to the post-lytic proliferation phenomenon. The curves recorded seem to be sufficiently regular, so that we may hope to have a new method of titration by which a given quantity of standard penicillin should be connected with each curve.

[1] Bonet-Maury and Walen, *Ann. Inst. Pasteur*, in the press.
[2] Nittl, Fossaert and Faguet, *Ann. Inst. Pasteur*, **70**, 80 (1944).

PROF. BORIS KELLER

By PROF. N. V. TURBIN

THE Soviet Government has awarded the Order of the Red Banner of Labour to Prof. Boris Keller as a mark of appreciation of his many years of scientific and pedagogical work. Keller was one of the first Russian botanists to make an ecologo-physiological study of the vegetation of the Russian steppes, deserts and semi-arid regions. He aimed at obtaining concrete information on the ways and means by which the evolution of plants takes place in Nature and which lead to their adaptation to differing ecological conditions. He also studied these regions with the view of using them for agricultural purposes.

In studying the flora of the semi-arid regions he made use of his own method of 'ecological series' to study plant associations in connexion with their environment; the method is now widely employed for all phytogeographical work. Keller introduced the conception 'semi-arid region' into the science of phytogeography and was guided by the agrarian peculiarities of these regions as well as by natural and historical features. He compiled one of the best classifications of the steppes and was a pioneer in producing a theory of plant communities, one of the most important divisions of the science.

These investigations are recorded in Keller's works: "In the Semi-Arid Zone", "Botanico-Geographical Research in the Zaisan district of Semipalatinsk Region", "In the Valleys and Mountains of the Altai", "Flora of the Russian Steppes, Deserts and Semi-Deserts" (1923) and others which are still used in Russian universities as classic examples of phytogeographical research in Russia.

All of Keller's investigations pursued the same object: the all-round study of the plant and the dynamics of its relations to its environment. His ecologo-physiological researches form the complement of his physiogeographical field work.

His work on the imperviousness of plants to droughts and salification have become well known. He regards halophytes and xerophytes as examples of the ability of plants to adapt themselves to extreme forms of life. Keller revealed the physiological nature of this adaptation in halophytes and xerophytes and produced a picture of the evolution of these ecological forms.

A group of peculiar fleshy halophytes not only thrives in salified soil but also a certain amount of salt in the soil is necessary to enable them to attain full growth and to protect them against unfavourable factors in the environment; this is a confirmation of the theory propounded by Prof. K. A. Timiryazev —to the effect that "plants are capable of converting hostile elements in their environment to their own use".

On the basis of his ecological and geobotanical researches, Keller explained the general laws of the distribution of plants throughout the world and established actual ecological types. To attain this end he has transferred his studies from one branch of botany to another, from classification to anatomy and physiology and back again to classification in order to investigate "the plant as a whole in all the intricate inter-related peculiarities of its structure and the nature of its life".

His direct contact with Nature and ecologo-physiological experimentation with living plants strengthened his conviction of the changing nature of plants and the connexion of their properties with the natural conditions with which they have come into contact during their evolution.

Keller is a convinced and consistent protagonist of Darwin's theory of evolution, and his own evolutionary views are based on many years of observations made on plants in their natural surroundings and his research in the sphere of ecology.

The Darwinist nature of his approach to the problems of ecology—the plant, its environment and their interrelations—is the most important feature of Keller's ecological and phytogeographical research. This is what we have in mind when we speak of Keller as an important Russian botanist and Darwinist; this is true of his work in the sphere of phytogeography and the ecology of plants, especially his greatest work, "Fundamentals of the Evolution of Plants", which has been written since the War began. In Keller's works the problems of evolution are first raised as ecologo-physiological problems, whereby they differ from many other important works on evolution which give the greatest importance to morphological methods.

Keller explains the specific features of the evolution of plants on the basis of the ways in which the plants obtain nourishment and their relations with their environment.

He is of the opinion that the evolution of plants does not depend on casual, isolated mutations but on the selection of those regular changes which first occur in the individual development of the plant as a regular reaction of its adaptive faculties to changes in living conditions and internal relations in the

plant itself, which then bring about a reconstruction in the progeny in the direction indicated. Environment, therefore, is at once a selective and a formative factor; in these circumstances the formation of a species "as a rule embraces simultaneously many, frequently a very large number of individuals, which are then reformed under the influence of a changing environment or when the plant or a whole family is transferred to a different region".

During recent years Keller has been putting his ideas on the evolution of plants and his conceptions of the fundamental problems of ecology into practice in the Moscow Botanical Gardens of the Academy of Science of the U.S.S.R. which are being built in accordance with his plans.

Prof. Keller is a member of the Academy of Sciences of the U.S.S.R. and the Lenin Academy of Agriculture, director of the Moscow Botanical Gardens and president of the Turkmen Branch of the Academy of Sciences of the U.S.S.R. He takes an active part in public affairs and is a member of the Central Trade Union Council of the U.S.S.R. and of the Executive Committee of the Moscow Regional Soviet.

SOCIAL RELATIONS OF SCIENCE*

THE advent of peace has led to much discussion on the proper place of science in the post-war world. Different currents of opinion range from the extreme view of the need to suppress science on account of the dangers of its application to war, to that which considers that scientific activities need to be greatly increased and co-ordinated in the interests of providing better conditions of life in Great Britain and throughout the world. Not only is there no agreement as to the amount of science needed, but also considerable divergence of opinion on how science should be organized. Some think of science as "a proper occupation for the leisure of an English gentleman", and consider that it is more important that it should be completely free and unorganized than that it should be adequately endowed; while others feel that the full value of science can only be reached if it is organized in relation to practical human activities of production, agriculture and health, and can draw on a far larger share of the national income than it has done hitherto. Those who hold the older views have never realized that the relation of science to society is not fixed but continually changes with the growth of science and the increase of complexity of society: what did well in ancient Greece or Victorian England is not appropriate to the needs of to-day.

Science is not a simple thing; it eludes definition. It is at the same time a professional activity, a body of knowledge, a way of solving problems and an influence on the way in which everyone looks at the world and deals with it. Society is fully entitled to demand that science should be used in solving the problems of providing us with a better standard of living. It would be a very stupid society, however, that attempted to do this without considering the feelings and ideals of scientific workers and the unity of scientific knowledge, which is such that almost any part of it may turn out to bear on almost any other. The Nazis tried to do this: they discouraged fundamental science and generalized thinking and thus, in spite of their enormous technical start, failed in war. Men of science who are taking the responsibilities of science seriously are well aware that a proper proportion of effort must be given to fundamental science which has no immediate application. Out of £24 millions, which the Association of Scientific Workers suggests should be budgeted for scientific research in Britain, more than £2 millions would go to fundamental science. The Association is also aware that the actual direction of scientific effort must be in the hands of scientific workers, who alone are competent to know what they are doing.

It is quite possible to plan science, as the example of Britain during the War and the Soviet Union before the War, have shown, in such a way that a continuous link is kept between applied science and fundamental science with a two-way flow of ideas—of new ideas coming from fundamental science to be applied, and of problems coming from the applied field, leading to the production of new fundamental theories. The real danger to Great Britain is not that science will be over-organized, but that there will not be nearly enough of organized science. We spend only about one third as much, in proportion, and one tenth in total, as the United States and the Soviet Union on scientific research.

The immediate limiting factor is the number of scientific workers who will be available in the post-war years. With our present educational output, we can never produce scientific workers in adequate numbers; but the importance of this has not been realized, and the additional grants made to the Universities' Grants Committee will scarcely do more than make up for the increased cost of living.

Science is in this situation very largely because its wider influence has never been realized by the public. Science teaching is a belated and unwelcome part of the educational system, and the new Education Bill has not improved matters. Further, the Press generally treats science only as a purveyor of sensational discoveries.

The War, however, has shown millions of people in the Services and the war factories how important science can be. The very demands which are now being made for adequate food, housing and health are known to be based on scientific studies. The new standards can be achieved only by the application of science. Beyond that, we are beginning to see that not only these problems but also many political and social problems depend on science for their solution. With this realization we may hope will come an increasing emphasis on the balanced development of science, on its increasing use in satisfying social needs and on the spread into ordinary life of a scientific way of thinking and acting.

* Substance of the Trueman Wood Lecture delivered by Prof. J. D. Bernal, F.R.S., before the Royal Society of Arts on May 16.

ISLAND FLORA OF THE GULF OF GUINEA

THE three Portuguese islands, S. Tomé, Principe and Annobon, which form the subject of this work* lie, together with Fernando Po, in the Gulf of Guinea. All are of comparatively recent volcanic origin and have a typical equatorial climate with considerable rainfall and very high humidity. Geological evidence and the insular character of their

* Catalogue of the Vascular Plants of S. Tomé (with Principe and Annobon). By Arthur Wallis Exell, and other members of the Department of Botany. Pp. xi+428. (London: British Museum (Natural History), 1944.) 30s.

floras both point to the three islands never having had any land connexions with each other or with the continent. The islands have been visited many times by botanists and their flora is fairly well known, but Mr. Exell was able, during a three months visit in 1932–33, to add thirty-one new species, and considers that the mountain forest region in St. Thomas and Principe is still by no means exhausted.

The vegetation of St. Thomas, the largest and most diversified of the three islands, is divisible into four regions. The littoral region consists of sand dunes or mangrove swamps. The lower-lying ground up to 800 m., originally occupied by rain forest, is now almost entirely under cultivation. The plantations are mainly devoted to cocoa, coffee, bananas, oil-palms and coco-nut palms. The mountain rain-forest region between 800 m. and 1,400 m. is remarkable for its richness in Rubiaceæ and Euphorbiaceæ, and for an equally striking absence of Leguminoseæ. Epiphytes and lianes are well developed, and the profusion of ferns both as to species and individuals is probably unsurpassed in any other part of Africa. At still higher elevations up to the summit of Mt. Pico (2,024 m.), there is developed a mist-forest region, determined by the cool climate, very heavy rainfall and almost constant mist. Here the trees are less lofty and the canopy less dense than in the mountain forest region, and epiphytes and ferns are even more abundant.

In the much smaller island of Principe, what little virgin forest remains seems to resemble that of the lower rain-forest of St. Thomas, with Rubiaceæ, Euphorbiaceæ, Orchidaceæ and Filicinæ particularly abundant.

The total number of indigenous species on the three islands is 682, of which 171 are endemic; this is a high degree of endemism having regard to the nearness of the continent. Only eleven of these endemic species occur on more than one island and this, together with the fact that each island has a comparatively large number of species found on the mainland but not on the other islands, affords strong evidence that the islands were never connected with each other, but that each received its independent quota from the rich mainland flora.

The information given under each species includes synonymy, distribution within the islands and beyond, and citation of all known specimens in herbaria. Most of the newly described species are figured.

FORTHCOMING EVENTS

Monday, June 11

GAS RESEARCH BOARD (at 1 Grosvenor Place, London, S.W.1), at 2 p.m. Annual General Meeting.

ROYAL COLLEGE OF SURGEONS (Lincoln's Inn Fields, London, W.C.2), at 4 p.m.—Prof. F. Davies: "The Early Development of the Human Embryo" (Arris and Gale Lecture).

WOMEN'S ENGINEERING SOCIETY, Manchester Branch (at the Engineers' Club, Albert Square, Manchester), at 6.30 p.m.—Miss V. Holmes: "Women and Workshop Skill".

ROYAL GEOGRAPHICAL SOCIETY (Kensington Gore, London, S.W.7), at 8 p.m.—Dr. J. V. Harrison: "Journeys in Luristan".

Tuesday, June 12

ROYAL SOCIETY OF ARTS (John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. F. M. R. Walshe, O.B.E.: "Infantile Paralysis" (postponed from May 9).

CHEMICAL ENGINEERING GROUP OF THE SOCIETY OF CHEMICAL INDUSTRY and the INSTITUTION OF CHEMICAL ENGINEERS (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Mr. L. W. Needham and Mr. S. Lynch: "The Use of Suspensions as Heavy Liquids" (postponed from May 8).

QUEKETT MICROSCOPICAL CLUB (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 7.30 p.m.—Mr. E. Mackie: "A Consideration of the Requirements for Cinemicrographic Apparatus".

Wednesday, June 13

INSTITUTE OF PETROLEUM (26 Portland Place, London, W.1), at 5.30 p.m.—Chairman of the Heavy Duty Engine Oils Panel of the Standardization Committee of the Institute: "Engine Testing of Heavy Duty Oils".

Thursday, June 14

ROYAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Dr. G. M. B. Dobson, F.R.S., in collaboration with Mr. A. W. Brewer and Mr. B. Cwilong: "The Meteorology of the Lower Stratosphere" (Bakerian Lecture).

Tuesday, June 12—Wednesday, June 13

INSTITUTION OF GAS ENGINEERS (1, Grosvenor Place, London, S.W.1). Annual General Meeting.

Friday, June 15—Saturday, June 16

INSTITUTE OF BRITISH FOUNDRYMEN (at the Waldorf Hotel, Aldwych, London, W.C.2).—Annual meeting. Members of the Iron and Steel Institute are also invited to attend.

APPOINTMENTS VACANT

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

LECTURER IN MATHEMATICS at Battersea Polytechnic, London, S.W.11—The Clerk to the Governing Body (June 11).

SENIOR EXECUTIVE OFFICER responsible primarily for Research and Public Relations, Institute of the Motor Trade—General Secretary, marking envelope "Executive Officer" (June 16).

A LECTURER IN MECHANICAL ENGINEERING, and a LECTURER IN ELECTRICAL ENGINEERING, at West Ham Municipal College—The Education Officer, Education Offices, 95 The Grove, Stratford, London, E.15 (June 16).

LECTURER IN CHEMISTRY at the Royal Technical College, Salford—The Principal (June 18).

LECTURER IN PHYSICAL AND INORGANIC CHEMISTRY, Royal Holloway College, Englefield Green, Surrey—The Principal (June 18).

TWO TECHNICAL OFFICERS FOR THE MINISTRY OF FOOD, to supervise factory production of dehydrated food—Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia House, Kingsway, London, W.C.2, quoting F.3854.A (June 20).

TWO CHEMISTS (Technical Officers) in the Infestation Division of the Ministry of Food—Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia House, Kingsway, London, W.C.2, quoting F.3374.A (June 20).

INSTRUCTOR AND LECTURER ON INDUSTRIAL CHEMISTRY at the National Fire Service College, near Brighton—Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia House, Kingsway, London, W.C.2, quoting F.4165.A (June 20).

LECTURER IN CHARGE OF THE DEPARTMENT OF ZOOLOGY, University College, Leicester—The Registrar (June 20).

ASSISTANT LECTURER IN PHYSICAL AND INORGANIC CHEMISTRY at Queen Mary College, University of London—Acting Registrar of the College, c/o King's College, Cambridge (June 20).

LECTURER IN AGRICULTURE AND FARM MANAGER at Harper Adams Agricultural College, Newport, Shropshire—The Principal (June 20).

LECTURER IN BIOCHEMISTRY for the Yaba School of Medicine, Nigeria—Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia Street, London, W.C.2, quoting F.4082.A (June 21).

LECTURER IN CIVIL ENGINEERING in the University of Birmingham—The Secretary (June 23).

PRINCIPAL OF NEWTON HEATH TECHNICAL SCHOOL—The Director of Education, Education Offices, Deansgate, Manchester, 3 (June 23).

LECTURER IN BUILDING SCIENCE at the Huddersfield Technical College—The Director of Education (June 25).

PROFESSOR OF PHYSIOLOGY at King's College of Household and Social Science—The Academic Registrar, University of London, Richmond College, Richmond, Surrey (June 26).

CO-ORDINATOR OF RESEARCH AND PRINCIPAL OF THE PUNJAB AGRICULTURAL COLLEGE, LYALLPUR—Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia Street, London, W.C.2, quoting F.4220.A (June 26).

READERSHIP OF ENTOMOLOGY in the University of Durham, tenable at King's College, Newcastle-upon-Tyne—The Registrar of King's College (June 30).

INSTRUCTOR-ORGANIZER FOR MINING EDUCATION under the Shropshire Education Committee—The Secretary for Education, County Buildings, Shrewsbury (June 30).

LECTURER-IN-CHARGE (female) OF THE HOME SCIENCE DEPARTMENT, Technical Education Branch, Education Department, Sydney—Acting Official Secretary, New South Wales Government Offices, 125 Strand, London, W.C.2 (June 30).

UNIVERSITY DEMONSTRATOR IN ENGINEERING, University of Cambridge—The Secretary of the Appointments Committee, Engineering Laboratory, Cambridge (July 2).

ASSISTANT EDUCATION OFFICER FOR TECHNICAL EDUCATION to the Hertfordshire County Council—The County Education Officer, County Hall, Hertford (July 3).

TWO LECTURERS IN THE DEPARTMENT OF PHYSIOLOGY, one with special knowledge of Experimental and Human Physiology, and the other with experience in Biochemistry, University of Aberdeen—The Secretary (July 7).

ASSISTANT with special knowledge of PHYSICAL or INORGANIC CHEMISTRY in the Department of Chemistry, University of Aberdeen—The Secretary.

LECTURER IN HYGIENE at Derby Training College for Women Teachers, 93 Uttoxeter New Road, Derby—The Principal.

LECTURER IN MECHANICAL ENGINEERING, and a LECTURER IN MATHEMATICS OR SCIENCE, at Erith Technical College, Belvedere, Kent—The Principal.

A SENIOR OFFICIAL OF THE INSTITUTION OF STRUCTURAL ENGINEERS—The Secretary, 11 Upper Belgrave Street, London, S.W.1, marking the envelope "Science".