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NATURE

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EDUCATION FOR INTERNATIONAL RECONSTRUCTION

THE present phase of the War seems particularly appropriate for further consideration of the possibilities arising out of the unrest which is growing in the countries of Europe at present under Nazi control. Propaganda is obviously of high importance in this connexion, and the announcement that the Government has appointed a directorate of political warfare to co-ordinate the whole of our foreign propaganda indicates awareness of the urgency of the situation ; the board will include representatives of the Foreign Office, Ministries of Economic Warfare and Information, and the British Council, and the B.B.C. and other bodies will co-operate. Three recent publications referred to below* make valuable contributions to the discussion of the subject.

Prof. Keeton attributes the failure of the attempt at world organization through the League of Nations to the absence of an international public opinion, and points out that to establish the machinery for international organization without such a public opinion would be to court failure a second time. International public opinion, however, does not grow of its own volition. It is primarily an educational process, and it is as a contribution to the formation of such an opinion that Prof. Keeton urges the formation of an international university.

The creation of an international solidarity sufficiently powerful to make international institutions an effective reality involves the use or development of an adequate technique, the abandonment of the indifference to the needs of human association which has been so common in democratic communities in recent years, and the establishment of some forum for the discussion and exposition of the methods to be used in establishing an international order. Developments such as the 'Round Table' discussions of the University of Chicago need to be taken up in Great Britain and widely extended, and an international university would have as one of its main tasks the organization of research into all those problems which arise in the achievement of a world order, and the publication of the results of such investigations.

An even greater task than research would be the teaching, both of the adult communities and of the youth, of those nations which supported the project. This is a task calling for much imagination and creative thinking as well as for careful organization, if we are to avoid the mistakes that have

* The Case for an International University. By Prof. G. W. Keeton. Pp. 40. (London : C. A. Watts and Co., Ltd., 1941.) 6*d*. net.
Offensive against Germany. By Sebastian Swaffner. (Searchlight Books, No. 2.) Pp. 128. (London : Secker and Warburg, 1941.) 2*s*. net.
P E P Broadsheet: The Future of Germany. (London : P E P, 1941.)

devitalized the adult education movement in Great Britain, and to foster the development, not of a hybrid internationalism, but of an ordered nationalism, seeking to establish the place of individual national cultures within the general pattern. Some of the work which has already been carried out in this field by the Committee of Intellectual Co-operation of the League of Nations has pointed the way, and the beginnings of an interchange of students and teachers already existed before the War.

What is now required is that these possibilities should be explored, not in an academic spirit, but with vigour and vision in full realization of the contribution they offer to the very founding of a new order. For that reason this task cannot be dismissed entirely until hostilities cease. The opportunities that lie to our hand must be seized and used as part of a great moral and spiritual offensive.

Although in his earlier book Sebastian Swaffner directed attention to the offensive value of an international academy, which could so easily be established in Great Britain now that there are so many *émigré* scholars in our midst, apart from a reference in Mr. Eden's speech of July 6 there have been few indications that the significance of the existence in London of a miniature Europe is realized. It would indeed be short-sighted policy if, in the recruitment of their services in our war effort, we overlooked these larger possibilities and failed to utilize their learning and skill in a direction which would demonstrate at once the shallowness of the Nazi pretence of a united Germany or Europe, and make so important a contribution to the preparation of a new European order.

In his "Offensive Against Germany", Swaffner says little about his earlier proposal for such an international academy or university. He is concerned primarily with what he terms the moral-psychological strategy of the War, of which so far we have allowed the Nazis the monopoly. Our attention to morale has been largely the defensive one of maintaining that of our own people, rather than the offensive one of breaking down the morale of our enemy. It is Swaffner's analysis of the weaknesses and vulnerability of German morale, of the methods and prospects of attack rather than his own plan of attack, that give value to his book. It is directly complementary to the P E P broadsheet, for the strategy of political warfare as well as the tactics used to attack the enemy's morale must be largely influenced by our view of what solutions of the problem of Germany are possible.

The P E P broadsheet starts with an analysis of the salient features in the current German situation, pointing out that the concentrated drive of the earlier phase of Nazism is becoming dissipated as an inevitable result of the extension of the Nazi campaign from a limited field where the Germans are in a majority to the wider European field in which they are outnumbered by at least four to one. Simultaneously, the clear-cut ideology and sense of mission developed in a closed artificial atmosphere is becoming confused or even inhibited, while the aggressive spirit of indicting an indefensible old order is giving place to a defensive attitude towards an even less defensible New Order. Strategically, these developments have led to immensely extended and increasingly costly and vulnerable lines of communication. Politically, they involve the inclusion within the German system of a majority of inhabitants non-German in sympathy and increasingly anti-Nazi in attitude. The need for absorbing and restarting a vast range of industries built up in competition with German industry throws a strain on the economic system comparable with that which in the administrative sphere has involved a sacrifice of much of the homogeneity and efficiency achieved by the Nazi system.

No violent revolutionary movement within Germany is to be looked for before or even after a military defeat, but the chances are strongly against successful Nazification of the territories occupied by Germany during the last eighteen months. The chances, on the contrary, are strongly in favour of growing spontaneous resistance movements in neighbouring occupied or threatened territories contributing to German defeats through sabotage, passive resistance and ideological means. The broadsheet concludes that development of these movements, rather than any development within Germany, is likely to shape the future social pattern of a defeated Germany, which must draw heavily from outside to replace the shattered influences now temporarily superseded by Nazism.

Visualizing the immediate post-war period, the P E P broadsheet suggests that there should be four stages in Germany as a whole or in any part of it. First the termination of Nazi power either by driving out the armed forces and Gestapo or by their surrender and demobilization. Then come the establishment of emergency military administration by occupying forces, and the prompt creation of as strong a bulwark against disorders and the lawless seizures of territory as conditions may require. The transfer of all civil affairs to a Reconstruction Commission, including American and of other independent members, as well as political, economic and medical branches, follows, and finally the gradual development of appropriate German self-governing bodies and the gradual transfer of power to them.

Disintegration of a defeated Germany is likely to be much more complete in the present war than in 1918, owing to the destruction of alternative nuclei and to other factors, but there is no reason why we should not let this disintegration run its course. The bulwark for the protection of Europe as a whole should be formed at first exclusively of non-German forces, and the military occupation of Germany is essential as the first stage in a carefully planned and directed re-creation of German institutions as an essential part of European reconstruction. Successful post-war treatment of Germany depends on the reconciliation of two apparently contradictory propositions: the German people can never again be trusted not to abuse their strength by trying to trample on weaker neighbours, and any settlement which discriminates against and refuses to trust the German people contains the seeds of another German war.

The P E P broadsheet concludes accordingly that Europe must be organized so as to divorce national structures from military and industrial power. This organization must be backed by world control of raw materials and communications, with the object not only of facilitating economic expansion, but also of thwarting policies of autarchy and militarism by automatic sanctions. The post-war settlement of Europe should be along the lines of the British Commonwealth rather than a written constitution, and within this framework the extent of a future German State should be decided by the unfettered choice of the peoples to be included in it. Establishment of social and economic opportunity and security is the only practical basis of enduring peace, and the winning of the peace depends on Britain holding the initiative and using it in the long-term interests of the European majority, and in the convergent interests of the United States and the Dominions, whose co-operation would be needed at every point. Behind this policy there must be visible British sea- and air-power, backed by war industries, maintaining stores instantly available to threatened countries on lease-lend principles, and by availability of strategic bases.

It is against this background that the value of the meeting between President Roosevelt and Mr. Churchill and the Charter of the Atlantic which issued from it must be assessed. The manner in which the eight points of the Charter meet the conclusions drawn from the P E P analysis of the German problem justifies the view that the Charter is a political weapon of the first order. The whole circumstances in which the meeting was held dealt such blows to German claims and propaganda that it can well be hailed as the launching of the moral and political offensive for which an important section of opinion in Great Britain has been pressing. If these hopes and expectations are justified, and the Government seizes the opportunities now opening in this field, and by the effort and thought which it devotes, not sporadically but continuously and systematically, to political warfare, we may well find in this meeting and Charter the token that the path to the New Order for which we strive may be shorter and less tortuous than anything which the military, naval or air situation would warrant our believing.

MAN AS A SOCIAL ORGANISM

Human Nature and the Social Order
By E. L. Thorndike. Pp. xx+1020. (New York: The Macmillan Company, 1940.) 18*s*. net.

"WHAT can men do, what do they do, and what do they want to do ?"—these are the questions that Prof. Thorndike seeks to answer in a very comprehensive and elaborate treatise. His undertaking is inspired by the belief that man has the possibility of almost complete control of his fate if only he will be guided by science, and that his failures are attributable to ignorance or folly. The main approach is through biological psychology, but all the social sciences are appealed to and utilized in an effort to deal with the human problem as a whole. The relative immaturity of the sciences dealing with man is continually stressed, but it is claimed that they provide a body of facts and principles which are "far above zero knowledge", and that even now they are capable of affording valuable guidance in the shaping of public policy.

The picture that Prof. Thorndike draws of human nature and its possibilities is based on a view of mind reached by him in his well-known and extensive studies of animal and human behaviour. Man is depicted as a bundle of inborn capacities and wants which are gradually organized by the action of the environment. The underlying conception is on the whole mechanistic. Man is a network of connexions between stimuli and responses operating in the service of a group of wants. A structure is built up as the result of the strengthening of connexions through repetition and the experience of satisfaction and annoyance. It is assumed that for every variation in response there is traceable a variation in the pre-formed structure. The fact that purposes operate is not denied, but this is not held to be incompatible with the postulates of mechanistic science. Purposive action, Thorndike thinks, is action determined by the consequences of the act. But such determination by consequences is made possible by the fact that whenever a goal is reached after striving there is an experience of satisfaction, and this sets up a 'confirming reaction' which has the property of strengthening any modifiable connexion on which it acts.

The account which is given of human capacities makes use of the vast amount of work which has been done on individual differences. In dealing with abilities stress is laid on their specific character. Factorial analysis is not, in Thorndike's view, likely to reveal the ultimate mental elements, but only statistical composites of them. It would seem that the mind must be conceived as an undifferentiated aggregate of innumerable elements, a mass of imperfectly correlated powers. A like insistence on variety, complexity and specificity is to be noted in the account given of human wants. Thorndike will have nothing to do with those who have tried to reduce the wants of mankind to some small number of primary desires, such as for love, security and power.

The wants of man are innumerable, and to discover how far they are rooted in inborn need, and how far they are artificially generated is a matter of the greatest difficulty. Yet he does give a list of primary desires and aversions, and quotes estimates made by juries of psychologists and others of the time and money spent by adults in the United States in satisfying these desires. Thus judged, it appears that about a fourth of the waking hours are devoted to the needs of subsistence and perpetuation, about a third to entertainment, about a tenth to companionship and affection, and an equal amount for the approval of self and others. Only four per cent of the working hours are given to intellectual wants, and about eight per cent to the welfare of others. Security claims only about seven per cent. As judged by the amount of money spent, it would appear that less than a third of the expenditure is allotted to keeping the population alive and able to reproduce itself; the pleasures of the senses take a tenth, the pleasures of the intellect less than half that. The selfish satisfactions take more than a fifth, and more than a third if the satisfactions of love and benevolence are included. The desire for security takes a tenth.

The value of these estimates which are here quoted as an example of the numerous investigations cited in the work will be doubted by many. Apart from the difficulty of classifying the concrete activities of daily life under broad headings like security, benevolence, and the like, the estimate seems to ignore the distinction between things that need to be bought for money and things that money cannot buy. Nevertheless, the case that Prof. Thorndike makes for the assumption that behaviour runs parallel with, and reveals the strength of, desires and aversions is impressive, and his hope that ultimately reliable scales of measurement will be discovered and effectively utilized in the social sciences may be well warranted.

Prof. Thorndike recognizes that in dealing with social policy we need to know not only what men's capacities are and what they actually want, but also what they ought to want and to avoid. The search for a standard of values is, indeed, regarded by him as "the most important job for thinking men" at the present time. He has, however, little faith in philosophical ethics, and makes a powerful plea for a natural science of values. By this he understands a study of the bearing of acts and conditions on the satisfaction of wants, present and future. Its task would be to give an exact enumeration of wants, of the varying weights to be attached to their satisfaction, and an estimate of the probable consequences of acts in the way of satisfaction or annoyance. He realizes, of course, that we cannot simply identify goodness with the satisfaction of wants, since we often disapprove of what we want. Nevertheless, he thinks that all moral and prudential judgments are ultimately "justified by wants". Presumably we should have to distinguish between wise and unwise wants, but it is difficult to gather what constitutes wisdom and the lack of it in this context. If maximum or harmonious satisfaction is the criterion, we must ask whether this is justified on the ground that people actually want such satisfaction or on the ground that they *ought to* want it, and if, with Prof. Thorndike, we lay stress on justice and impartiality in the allocation of satisfactions, is our ground for doing so to be found that men in fact want justice or impartiality or that they ought to want it.

The problem of the relation between what is desired and what ought to be desired is not seriously faced. I suggest that though a natural science of values is both possible and important, such a science will not of itself solve the problems with which philosophical ethics is concerned, and that judgments of value differ from judgments of fact more radically than Prof. Thorndike would allow. It remains that his careful enumeration of the elements of human welfare would probably find a large measure of agreement in democratic societies, and that an examination of social and political institutions in the light of criteria deducible from them would afford valuable guidance in the task of reconstruction. Of special interest is the account given of the methods that can be used for comparing the welfare of different communities by means of a weighted average score of their status in matters of health, education, recreation and social well-being.

To the application of his fundamental principles Prof. Thorndike devotes the major part of his treatise. He deals in turn with the problems of the family and eugenics, property and economic organization, law and government. In general his recommendations are in harmony with what might perhaps be called liberal individualism, though he is not so anxious to restrict the sphere of governmental activity as some individualists, and throughout he lays less stress on the particular conclusions he reaches than on the importance of scientific guidance and research in all matters of social policy. Somewhat strange is his treatment of the principle of equality. This he interprets literally, forgetting that most defenders of the principle do not mean by it the view that all should be treated alike, but rather that all differences in treatment require justification in terms of differential merit or need. In this sense of proportionate equality, justice cannot be contrasted with equality, but is, as Aristotle showed, based on it. Indeed, the principle of proportionate equality is implicit in Prof. Thorndike's own discussions.

These matters cannot here be further pursued. Something must be said, however, on the adequacy of the general theory of human nature and society which is here adopted as the basis of inquiry. We must ask, to begin with, whether a theory of society can be built up on the basis of a psychology of individual differences. Prof. Thorndike seems to think that the differences between communities resolve themselves ultimately into differences in endowment of the individuals composing them or in the range of distribution. But social structure can scarcely be interpreted in these terms. The social classes within a community, for example, are not in the main determined by differences in individual endowment, and changes from one type of social stratification to another have nothing to do with changes in genetic endowment. Similarly, on the basis of very similar genetic endowment very different social institutions can be built up. A science of society must therefore be largely a study of social forces, that is, of the forces which arise out of the relations between human beings. No amount of knowledge of individual differences will help us to determine the changes that are likely to be produced in a society by a change in the structure of the family or the penal law. Psychology cannot do the work of sociology. The direct study of social change is especially important if a basis is ever to be found for the calculation of the consequences of acts which Prof. Thorndike insists is so important in dealing with values. His approach here seems to me too individualistic, just as his conception of the human mind is too atomistic. Similarly, in his discussion of valuation, he never raises the question which now, above all, confronts all societies, of the relation between the good of individuals and the good of society. No doubt the elements of human welfare which he enumerates inhere in individuals, but may there not also be value in the forms of social life, for example, in certain types of family life or types of community ?

Finally, Prof. Thorndike's account of the nature and role of purpose in human life raises doubts. If purposive behaviour is but a back-stroke of past experience, a reaction confirmed by past experiences of satisfaction and annoyance, we should expect past experience to be far more effective in the shaping of human purposes than in fact it appears to be. Neither the folly nor the grandeur of human endeavour is in keeping with such dominance of the past. Both imply a power of reference to the future which goes beyond the past, and is in a real sense directive and forward moving, whether for good or ill. MORRIS GINSBERG.

THE HOME IN RECONSTRUCTED ENGLAND

Town and Country Planning

A Study of Physical Environment ; the Prelude to Post-War Reconstruction. By Gilbert McAllister and Elizabeth Glen McAllister. Pp. xxxii + 176 + 12 plates. (London : Faber and Faber, Ltd., 1941.) 12*s*. 6*d*. net.

THERE has been a great deal of talk of reconstruction since the German bombers have done so much damage to British towns : the five years plan for slum clearance which had been embarked upon before the War, the tentative efforts at central re-planning (of which the Bressey Report for London was an example), the recommendations of the Royal Commission on the Location of Industry—these and other similar projects were given a sudden possibility of rapid realization, through the barbarous results of destruction. Instead of the cautious, considerate, hesitating way in which we have so far attempted the reform of our environment, giving way to private interest, fearing to incur expense, lacking in faith and vision, something now will have to be done, and done rapidly, the moment the War ceases and national effort turns to the needs of peace. New houses, new roads, new factories must be constructed—the dilatory method of a five-year plan which takes twenty-five to accomplish, will no longer serve: either these buildings and means of communication will be huddled up or laid down on their old sites, perpetuating the old conditions (with slight tactical improvements) and leading to the old problems of wasteful existence, or the opportunity will be seized and some good at least be created to make up for the monstrous loss through the War.

It is to prepare the way for a full use of this opportunity that Mr. and Mrs. McAllister have written their prelude to post-war reconstruction: they do not, as yet, attempt to plan, but provide us with the background upon which planning should be based; in this same series and also under the ægis of the Town and Country Planning Association, a future volume by Mr. F. J. Osborn will forecast the lines upon which planning, to fulfil its function of providing an environment, healthy, convenient and beautiful, should proceed. The McAllisters' task is the very necessary and preliminary one of setting forth the magnitude of the work against a historic background, showing how the standards which we must aim at are part of a process of evolution which is continually advancing.

I have mentioned three of the main objectives of planning—housing, industrial location and transport; to these should be added agriculture (which requires special treatment as compared with most other forms of industry) and recreational open spaces (both inside the town and outside). This book is more particularly concerned with the housing aspect: as the authors say—". . . informed opinion, the technical town-planners . . . and perhaps most of all those who approach town-planning not as experts but as sociologists, interested in humanity and anxious for that progress which good environment can achieve, must begin . . . by a consideration of *the needs of the family*". They have accordingly dwelt upon the standards of design, space and density required for the good family life. They recapitulate, familiar though the figures may be, the bad effects upon health of unsatisfactory home conditions and especially they insist upon the advantage of the house in its garden as compared with the dwelling in its tenement block. But they point out clearly the dilemma which the continued growth of the great towns forces upon the home-seeker: "either suburbia and a garden and a tedious daily journey or flat life and no garden and an environment unsuited to family life". On the other hand they show how necessary it is to integrate the different aspects of community life. Readers of NATURE are familiar with the biological triad, environment, function and organism, translated by Patrick Geddes into place, folk, work. The authors show that a dormitory housing estate "divorced from industry" is insufficient; that a trading estate is an "atrophied, unbalanced development" without provision for residence. They then build up this admirable picture of all-round development: "Put a Trading Estate and a good housing estate together and you have roughly two-thirds of a town. Add to them facilities for shopping, for social life, for education, for entertainment, and you have four-fifths of a town. Limit the size of the town by encircling it with a belt of country, devoted exclusively to agriculture and to recreation and prohibit all building development within the belt, and you have a town that satisfies human needs. . . ."

This could scarcely have been better put and we can therefore forgive them if 142 pages out of 168 are given to housing, as this is the authors' special subject, and they have made it abundantly clear that they realize, and make the reader realize, the position of housing in the urban complex. The last two chapters, indeed, are a useful summary of planning powers and needs, both local, regional and national. They give a brief description of the position of statutory town-planning at the outbreak of the War and direct attention to its predominantly permissive character as compared with the positive constructive planning now required, not only to make good the destruction from bombing but also to provide for a proper location of houses and industry when the general dislocation which obtains to-day is to be reintegrated.

The main body of the book covers the many aspects of housing, including two useful chapters on building costs and organization of the building industry. It will be remembered that high building costs broke the Addison Housing Scheme after the War of 1914–18, and it is to be hoped that drastic steps will be taken to prevent a recurrence; after this War the rush for building will be much more intense, so that the capacity of the industry to cope with it is of vital importance. Costs and capacity to build are closely interrelated.

From the above brief summary of this closely packed volume of information, it may be judged how useful it should prove both to the general public which should be fully informed, as well as to official bodies, both local and governmental, which, of course, have the information, but sometimes can learn from an unofficial presentation of the facts.

PATRICK ABERCROMBIE.

COMPUTATIONS IN NAVIGATION

Marine Navigation
By Lt.-Comdr. P. V. H. Weems. Pp. x+443. (London: Chapman and Hall, Ltd., 1941.) 30*s*. net.

WHILE we may applaud Lieutenant-Commander Weems's efforts to simplify, to shorten and even to obviate the computations incidental to navigation, we cannot but regret his verbosity and his lack of lucidity. It is difficult to see for whom his book has been written. It would confuse and might well mislead a beginner. It will prove tiresome to an old hand trying to bring himself up to date, who will have to refer to the index and turn up several pages before he can arrive at a complete account of the new method and an example worked by it. A case in point is that of star altitude curves. A sample page showing some of the curves is given on p. 334, directions for use and some sort of explanation on pp. 353–57 and a worked example on p. 367.

Many of the diagrams are clear and self-explanatory; others are cluttered up with lettering. Many of the illustrations are too dark, or on too small a scale: others are redundant.

There is, however, much that is of interest. In Chapter 3 we are introduced to a set of five blank charts, WSN charts, devised by three cartographers at the author's request. We gather that they are adaptations of Lambert's conformal projection and that they preserve angles and represent great circles by straight lines with sufficient accuracy for the purposes of navigation. The distance and the initial and final courses on each of four great circle tracks have been taken from these charts and compared with those found by full-dress solutions of the spherical triangles. The differences are all insignificant. We may take it, then, that these WSN charts are as quick and handy for great circles as those of Mercator for rhumb lines. We may also accept the author's method of determining the directions of rhumb line chords of a great circle. But WSN charts are blank and "A sensible navigator would never compute and sail a course without referring it to a regional chart" (p. 110), that is, in effect, to a Mercator's chart.

In Chapter 10, on radio navigation, we hoped to find the latest methods of laying down a position line obtained from a wireless bearing. The position line is not mentioned: we are told to convert the great circle bearing to the mercatorial bearing and to plot the rhumb line. Curves of equal (constant) bearing are only mentioned in the title of a picture of a chart of the North Atlantic on which two families of them have been drawn. But one cannot talk away the fact that when the difference between the great circle and mercatorial bearings is significant, so also is the angle between the curve of constant bearing and either of the other two curves.

The chapters on celestial navigation are more satisfying. The rudiments of nautical astronomy are clearly and simply explained in a way that should help a beginner. Those that deal with the latest forms of almanacs are of interest. Lieutenant-Commander Weems has personally instigated and contributed to innovations that have reduced both the time and labour of working a sight.

Of the computations that a navigator cannot avoid when translating observed time and altitude into a position line the longest is the solution of the spherical triangle determined by a local hour angle (L.H.A.) and the declination of the body observed and an assumed latitude. With an almanac of the older pattern the computation of L.H.A. involved the determination and the application of the error of the watch on G.M.T.; the extraction of two elements (one only for the sun) from the almanac, entailing interpolation; the application of these and an assumed longitude to the observed time. The use of second setting watches and frequent time signals obviates the first step. An account of these watches and also of sidereal watches is given in Chapter 17. The U.S. Nautical Almanac and the British Air Almanac now tabulate the Greenwich hour angle and provide appropriate tables to reduce it to L.H.A. by interpolation, thereby shortening the remaining steps.

For the solution of the triangle, more than one set of tables has for long provided the answer by inspection and interpolation. All of them are voluminous, and but few navigators appear to use them. The tables of the Brazilian Aquino, for solution by division into two right-angled triangles, are handy and quick. They deserve more attention than they have received. At this stage we would join our author (p. 335) in impressing on navigators that much interpolation is saved without significant loss of accuracy by suitable selection of the assumed latitude and longitude. The tables published by Lieut.-Commander Weems are for the same solution as those of Aquino and appear in his "Line of Position Book", sample pages of which are included on pp. 342, 343. They are quick, easy to use and, so far as we can tell, sufficiently accurate. On pp. 362–65 a sight is worked by them and also by other similar tables for purposes of comparison. To judge by the number of figures used, Lieut.-Commander Weems's "Tables" and Hughes's "Sea and Air Navigation Tables", which appear to be identical, win in a dead heat.

The star altitude curves, referred to in the first paragraph of this note, are curves of equal altitude of certain selected stars, numbered to allow for refraction and plotted on a Mercator's chart. Their object is to provide a very quick means of obtaining a complete fix. The directions for use are explicit enough and that use is not limited to the selected stars. The explanation of their why and wherefore would puzzle a beginner. We have not tried them out.

G. V. RAYMENT.

PSYCHOLOGY FOR STUDENTS

A Biological Introduction to Psychology
An Introduction to Psychology for Students and Practitioners of Medicine. By Prof. R. J. S. McDowall. Pp. xiv+210. (London: John Murray, 1941.) 6*s*. net.

THERE are innumerable introductions to psychology, but few claim the distinction of being "biological" introductions. One therefore turned to this book, which was written by the professor of physiology at King's College, in the expectation that it would be something unusual. It might have been expected, for example, that it would have been written on evolutionary lines or along the developmental levels of the nervous system, since biology is mainly a study of increasing complexity in animal life. It might have progressed from the simple reflex to the greater complication of chained reflexes and thence to the instinct, the control of instinctual urges and the emergence of consciousness, the properties of memory, forgetting, and finally with the abnormalities associated with deranged function, so as to make a coherent whole.

Unfortunately, Prof. McDowall has not chosen a biological plan but has made an effort to make his book all-inclusive and so introduced unnecessary complication. He commences with a short section on adaptation. He then considers conscious activity, but follows this with processes of the nervous system. He proceeds to life's motives and the instincts. This section on the instincts includes the security instinct, the sex instinct, the power urge, and the spiritual urge. (It will be seen from this that Prof. McDowall does not adhere to the usual conception of the instincts, but adopts Adlerian theories and, in the spiritual urge, views which would be unacceptable to a large number of psychologists.) The last section of the book includes personality, reasoning, suggestion and hypnosis, dreams, the effects of mental states on bodily reactions, and the evolution of the individual.

There are a certain number of mistakes which are regrettable. For example, on p. 48, the author says "These phobias, or 'fixations' as they are sometimes called," and again on p. 49 he states "Many (i.e. phobias) are so deep, so fixed and so difficult to eradicate that in psychological parlance they are known as 'fixations.'" Such statements seem to show that Prof. McDowall does not appreciate that a fixation is a special term concerning emotional development in relation to the causation of neurosis or psychosis.

It would be unfair to condemn this book for such mistakes. It is a reasonably good introduction for the student as long as he is prepared to find it merely an introduction to psychology without having any special merit by being "biological". Moreover, it will please many by being essentially of the common-sense type, avoiding undue adherence to any particular school of psychological thought and making any assertions which need other than a superficial knowledge of psychology to appreciate. The style of the book is pleasant and friendly, and obviously inclined to lead the student gradually on from section to section.

There is a short appendix, which contains a number of case notes taken from Ross's "The Common Neuroses", Henderson and Gillespie's "Text-book of Psychiatry" and Howe's "Motives and Mechanisms of the Mind", etc. It is a merit of the book that it is not padded out with case notes, and those who write psychological books are well advised to follow Prof. McDowall's plan of placing case notes in a separate section so that they can be read apart from the text. The index is good and quite sufficient for a book of this kind. It would have been a good plan if a wide bibliography had been added, however, since an introduction of this kind should lead the student on to wider and more comprehensive reading. This would allow him to fill in the superficialities inevitable in an introduction and to correct the mistakes which have slipped into the text.

THE RISE OF SCIENCE IN RUSSIA

By ENG.-CAPTAIN EDGAR C. SMITH, O.B.E., R.N.

IN 1698, on February 6 and again on March 8, Peter the Great visited Greenwich Observatory, and as Flamsteed recorded, made observations of Venus. In Holland he had studied astronomy and other sciences, he had inspected Leeuwenhoek's microscopes and Ruysch's anatomical collections, and thus while pursuing his main object of learning shipbuilding and recruiting instructors and artisans, both in Holland and England he made himself acquainted with some of the science of the day. He was then about twenty-six years of age. Twenty years later he again visited Holland, but this time went on to Paris where he inspected the Arsenal, tapestry and printing works and natural history collections, went to the Sorbonne and Observatory and attended a meeting of the Royal Academy of Sciences, where he talked of maps. The newly founded city of St. Petersburg had already become his seat of government, in preference to Moscow, and one of his cherished ambitions was to establish in it an academy after the fashion of the Paris and Berlin Academies of Sciences and the Royal Society of London.

This scheme, however, Peter did not live to carry through, and it fell to his widow and successor, Catherine I, to inaugurate the Imperial Academy of Sciences, which for two hundred years was the scientific centre of the Russian Empire. The Academy was established in 1725, and it was at the last ordinary meeting of the Royal Society presided over by Newton that a letter from the Academy was read giving an account of its inauguration. Though the City and the Academy have changed their names (and the latter its location) they both are monuments to Peter the Great, who was the first to open the hitherto closed portals of his Empire to scientific thought and knowledge.

It is perhaps unnecessary to dwell on the backward state of Russia in the seventeenth century. Though the Empire stretched from the Baltic to the Pacific, from the Arctic to the Caspian, there were few schools and no universities. Russia can lay no claim to a Copernicus, Kepler or Galileo ; and the older histories of science can be searched in vain for the names of Russian contributors to natural knowledge. When the Academy of Sciences was in the making it was therefore necessary to draw its members from other lands, and so from France came its first astronomers, from Switzerland its first mathematicians and from Germany its first naturalists, and right throughout the eighteenth century, not only men of science, but also others learned in history, languages or architecture or skilled in painting, mechanics or engineering, were recruited from western countries by succeeding sovereigns. All these men were made members of the Academy of Sciences, provided with comfortable homes and adequate pensions, and St. Petersburg was the main centre of their activities.

Among the earliest to arrive in St. Petersburg were the French astronomer Joseph Delisle (1688–1768) and his brother Louis Delisle de la Croyère, and the Swiss mathematicians, Nicolas Bernoulli (1695–1726), his famous brother Daniel Bernoulli (1700–82) and James Hermann (1678–1733). Then in 1727 came Leonard Euler. He was then only twenty years of age, but he was destined to shed more lustre on mathematical science in Russia than any other individual. It is said that about half the memoirs in the *Transactions* of the Academy came from his pen. Joseph Delisle remained in Russia for twenty-one years establishing an observatory and lecturing to many students. His brother Louis Delisle de la Croyère served the State in various ways and perished with Behring on Behring Island in 1741. Nicolas Bernoulli died in St. Petersburg about a year after his arrival there, Daniel returned to Basle in 1733 while Hermann's stay was of the shortest. Three other men of science who were attracted to St. Petersburg in these early days were T. S. Bayer (1694–1738), who was given a chair of Greek and Roman antiquities, J. G. Gmelin (1709–55),professor of chemistry and natural history, and G. F. Muller (1705–83), who taught Latin, geography and history. The services of Muller led to his being called the "great father of Russian history".

One of the urgent needs of the Russian Government was a better knowledge of the many lands and races under its jurisdiction. Peter the Great had felt this need and for a number of years employed the German physician and naturalist Daniel Messerschmidt (1685–1735) to travel in Europe and Asia. On his journeys in Siberia Messerschmidt had the companionship of one of the many Swedish prisoners of war Peter had sent there. In the reign of the Empress Anne quite a large expedition was sent to explore Siberia from the Urals to the Pacific. Behring, the Danish navigator, Delisle de la Croyère, Gmelin and Muller were among the leaders of this expedition which left St. Petersburg in 1733 and did not return until 1743. Others who afterwards took part in the expedition were the Russian botanist S. Krascheninnikof (1712–54), the German medical man and naturalist G. W. Steller (1709–45) and the German savant J. E. Fischer (1697–1771), who became professor of antiquities at St. Petersburg.

For ten years Gmelin, Muller and their fellows explored the plains and mountains of Siberia from Tobolsk to Okhotsk, sailed on the great rivers Ob, Yenisei and Lena, searched for the remains of the great animals from which fossil ivory had long been obtained, and gathered together a great mass of information on this vast and sparsely populated land. Behring and many of his companions died in 1741 in the Far East, and Steller after being wrecked and suffering years of hardship regained touch with the home authorities only to disappear for ever. Great results were achieved by the expedition and it paved the way for that of Pallas referred to in NATURE of September 20, p. 334.

In the years which separated these two expeditions considerable strides were made in the furtherance of science in the capital. The reign of Catherine had been followed by those of Anne and Elizabeth, and in 1762 the great Catherine II ascended the throne. The University of St. Petersburg was founded in 1747 ; that of Moscow in 1755. Perhaps the most notable figure in St. Petersburg at this time was Michael Lomonosof (1711–65), father of modern Russian literature. Educated partly at the Academy, he had studied chemistry, mineralogy and metallurgy in Germany. In 1745, G. W. Richmann was made professor of experimental philosophy ; in 1747, Muller was made historiographer to the Russian Empire, and in 1751, A. N. Grischow (1726–60) became professor of astronomy and secretary to the Academy. In 1753, the year Franklin received the Copley Medal of the Royal Society, Richmann was killed by lightning when repeating some of Franklin's experiments. In 1757 the scientific coterie was joined by Æpinus, who two years later at St. Petersburg published his "Tentamen Theoriæ Electricitatis et Magnetismi", one of the great works on electricity in the eighteenth century. In 1760 Rumoffski published his "Course of Mathematics", said to be the first printed in the Russian language. Rumoffski had studied under Euler in Berlin and he was well known as a mathematician, astronomer, geographer, traveller and teacher. When more than seventy years of age he was curator of the University of Kazan.

With the accession of Catherine II in 1762 a new era in Russian education, science and literature began. Of German parentage, even her marriage to a boorish prince and her long acquaintance with the intrigues and boredom of the Russian Court could not destroy her love of books. She was fond, too, of patronizing learned men. She was able, in 1766, to prevail upon Euler to return to St. Petersburg from Berlin ; she entertained Diderot like a prince ; she asked D'Alembert to become the royal tutor and she sent her portrait to the Irish chemist and mineralogist Kirwan. Soon after Euler returned to St. Petersburg, he was joined by the Swedish astronomer, Lexell, and by Nicolas Fuss (1755–1825). These proved great friends to Euler in his blindness. In 1776 the Academy of Sciences celebrated its jubilee and in Weld's "History" will be found the letter of Euler's son, J. A. Euler, announcing that the Academy had elected the president of the Royal Society, Sir John Pringle, a foreign associate. Euler's death in 1783 left a blank in the Russian mathematical world never filled. He had thirteen children and of these Jean Albert (1734–1800), was the professor of natural philosophy, Charles (d. 1790), was a doctor at the Russian court and Christopher (d. 1814) rose to be a major-general in the Russian Army. His son-in-law Nicolas Fuss, in 1800, became secretary of the Academy of Sciences, in which post he was succeeded by his son Paul Henry. Another son, George Albert Fuss, was one of the first assistants at Pulkowa Observatory.

Towards the end of the reign of Catherine (who died in 1796), and during the reigns of Paul and Alexander I, scientific work seems to have languished somewhat. No doubt this was partly due to the disturbed state of Europe during the French Revolution and the Napoleonic regime. After this period of comparative stagnation science took on fresh activities during the whole thirty years reign of Nicolas I, who ascended the throne in 1825. Though a monarch who declared that "Despotism is the essence of my government, and it suits the genius of the land", yet he was not averse to giving his blessing to scientific projects and showering gifts on men of science. On one occasion he sent a diamond ring to James Nasmyth, the engineer ; on another he presented a fine china vase to Snow Harris, the electrician, and when Airy, the Astronomer Royal, was refused permission by the British Foreign Office to accept a Russian knighthood, Nicolas had a gold medal especially struck for him.

Soon after Nicolas came to the throne the Academy of Sciences put forward a plan for a new central observatory. Nicolas, through his minister, replied in 1830 "that the honour of the country appeared to him to demand the establishment, near the capital, of a new astronomical observatory, conformable to the actual state of Science, and capable of contributing to its ulterior advancement". In 1835 the foundation stone of the great Pulkowa Observatory was laid and in 1839 the institution was completed at a cost of about £100,000. It stands about ten miles south-east of Leningrad and unfortunately is now in the defensive zone of that city. Directed from 1839 until 1890, with but a brief break, by the Struves, father and son, it became a Mecca for astronomers, and Gould, the American astronomer, once called it "the astronomical capital of the world". The Struves had many able assistants and they were visited by eminent astronomers from all over the world. Russia was also greatly indebted to the Struves for their geodetical work which included the measurement of an arc of the meridian from the north of Scandinavia to the River Danube. When Otto Struve retired he was succeeded by Theodor Bredikhine (1831–1904) who previously had been professor of astronomy at Moscow, and he in turn was succeeded by Johan Backlund (1846–1916), who though Swedish by birth became a naturalized Russian.

The Government of Nicolas also did much to further magnetic and tidal observations and geographical and geological excursions. In 1828, Hansteen, the Norwegian physicist, accompanied by the German physicist, G. A. Erman, travelled to Siberia making magnetic observations, and their journey was followed by that of the great Humboldt who was accompanied by Ehrenberg and Gustav Rose, the chemist and mineralogist. It was Humboldt who put forward the plan for a world magnetic survey in which Great Britain and Russia took the leading part. Another expedition of note was that made in 1841–45 by Murchison, the French geologist de Verneuil and the Russian mineralogist N. I. Koksharov (1818–93), who, in 1865, became director of the Imperial Mineralogical Society of St. Petersburg. Two other eminent Russian geologists of this time were Gregor von Helmersen (1803–85), who, in 1841, published a geological map of Russia, and K. E. von Eichwald (1795–1876), professor of palæontology at St. Petersburg. The greatest naturalist of the reign of Nicolas in Russia, however, was the German, Karl E. von Baer (1792–1876), to whom the Royal Society in 1867 awarded the Copley Medal; this being the first time the medal had gone to Russia. Since von Baer's time it has been awarded to Metchnikoff, Mendeléeff and Pavlov.

It may be presumed that during the eighteenth century German and Swedish works on chemistry, mining and metallurgy found their way into the mining districts of European Russia and Siberia, but chemistry does not appear to have occupied an important place in the schools and universities. A Russian chemist whose name is mentioned in histories of chemistry is Klaus, the discoverer of ruthenium. Klaus was a professor at the University of Kazan founded in 1804. Among his students and contemporaries were Nicholas Zinin (1812–80) and Alexander Butlerow (1828–86). Both these men occupied chairs first at Kazan and then St. Petersburg. Another student and professor at Kazan was Wladimir Markownikoff (1838–1904), who in 1873 was given the chair of chemistry in the University of Moscow. Other leaders in Russian chemistry at this time were Friedrich Beilstein (1838–1906), Nicolas Menschutkin (1842–1907) and the great Mendeléeff, who was born at Tobolsk in 1834, being the youngest of the fourteen children of the director of the Tobolsk College. Mendeléeff's grandfather had produced the first Siberian newspaper.

Appreciations of these distinguished chemists are to be found either in the columns of NATURE or the *Journal of the Chemical Society*. Several of them made important investigations concerning the petroleum of the Caucasus, but it is worth recalling that it was the Swedish engineer Ludwig Nobel (1831–88), elder brother of Alfred Nobel, who revolutionized the Baku oil industry and introduced pipe lines, tank cars and tank steamers, making a fortune where others had failed.

The most famous scientific man connected with the University of Kazan was Nicolai Lobatschewski (1793–1856). "What Vesalius was to Galen, what Copernicus was to Ptolemy, that was Lobatschewski to Euclid", wrote Clifford. Kazan owed much to his organizing powers, and forty years after his death his bust was placed in the University and a prize founded in his honour. In human interest even Lobatschewski is surpassed by the remarkable woman mathematician, Sophie Kowalevski (1850–91). Her romantic marriage to Woldemar Kowalevski (1843–83), professor of palæontology at Moscow; his tragic death and her subsequent rise to fame make a story as interesting as one of her own novels. Her reputation was such that in 1886, when she was holding the chair of higher mathematics at Stockholm, the Paris Academy of Sciences broke through all the traditions of two centuries by admitting her to one of its meetings. As she entered, the whole of the members rose to salute her and the president declared that her presence should be a cause of pleasure not only to the mathematicians present but also to the whole company.

If space permitted, something might be said about the rise of engineering in Russia. One of Smeaton's last atmospheric engines was fitted up at Kronstadt, and both Smeaton and Watt were invited to Russia in the days of Catherine II. The first engineering shops in St. Petersburg were set up by British engineers, among whom were the Bairds, Handyside and the younger Matthew Murray. The early history of the engineering and other industries in Russia, however, is receiving the attention of Prof. P. P. Zabarinskij and other members of the Institute for the History of Science and Technics of the Academy of Sciences of the U.S.S.R., and already many interesting documents and facts have been brought to light and published.

PRESENT-DAY SCIENCE AND TECHNOLOGY IN THE U.S.S.R.

By PROF. J. D. BERNAL, F.R.S.

SCIENCE is a collective human enterprise. It belongs to no country or race. Yet at different periods it has owed its chief advance to the activities of men first in one part of the world and then in another. Modern science originated in Italy in the sixteenth century, spread to the Low Countries, and thence to England and France. It was in England that it first achieved effective organization in the Royal Society. The nineteenth century saw it established in every industrial country of the world, notably in Germany and the United States. In each of these countries a characteristic contribution was made both to the extent of new knowledge and to the new means of gaining it. In this century, the contribution that the new Union of Socialist Soviet Republics has made to science is as significant as any of the major contributions of other origins in the past.

Science, of course, was not a new thing in Russia. It can date its introduction as a living force to the many-sided genius of Lomonosof in the eighteenth century; and Russians can well be proud of the achievements of such men as Mendeléeff and Pavlov. But all these were relatively isolated workers. In no sense could the state of science in Russia before the Revolution be compared with that of Germany or Great Britain. The great change which the revolution brought about was to make conscious for the first time the necessary connexion between the ordered development of science and the life and work of the whole community. In this, of course, the new Government was inspired by the ideas of Marx and Engels, who had taken a lifelong interest in the progress and importance of science. Lenin had a wider and deeper knowledge of science than any statesman of his day, and even in the most difficult period of famine and civil war he laid the foundations of an entirely new development of science.

The conscious utilization of science, though to a certain extent implicit in State scientific institutions such as the Kaiser Wilhelm Gesellschaft in Germany and the Department of Scientific and Industrial Research in Great Britain, was foreign to the Western democracies; and this has made it difficult for many scientific workers to understand and appreciate the achievements of Soviet science. The task that was undertaken was not to push forward the bounds of knowledge by the work of a few isolated specialists, but to make scientific the whole productive and cultural activity of 160 million people, only a tiny minority of whom had any previous acquaintance with science or technology. The first twenty years of the Republic's life was occupied in a double task: the building up of scientific education, and the application of science to industrial, agricultural and medical needs. It was first necessary to create a body of competent scientific workers, starting from the handful that had sufficed for the needs of the Tzarist State. In 1919 there were only forty trained physicists in the whole of the Union. New schools, new universities, new scientific research institutes had to be founded and manned, and the necessary scientific instruments manufactured for them. Meanwhile, immediate problems of electrification, communications and agriculture had to be solved. This gigantic task could only have been achieved because it had behind it the enthusiastic interest and support of the whole people. It is characteristic of times of rapid progress and reconstruction that interest in knowledge should reach new heights. It was so at the dawn of the Greek City State, in the Italian Renaissance, in Civil War England; and it was certainly so not only for the Russians, but also for the submerged subject races of the old Empire—Mongols, Kazaks, Turkmen, Tartars, Georgians and Armenians.

In the creation of a new world it would be idle to look for the quietly pursued excellence and sound and acute scholarship that characterize an old-established and stable society. Science in the Soviet Union is not like science in Denmark or Switzerland. Nevertheless, the contribution to the advancement of knowledge made by the Soviet Union has been marked and important. In certain fields, especially in technology, Soviet discoveries and applications have already made a deep impression abroad. In physics, for example, the work of the Leningrad School on the mechanics of crystal deformation was the starting-point of much of the recent great advance in the understanding of the strength of materials and of ways of improving them.

The Soviet Union has also led in the application of low-temperature techniques to industrial uses, particularly for oxygen, hydrogen and methane, where Prof. P. Kapitza's new processes are being energetically developed. Proposals for radical innovations, such as underground gasification of coal, eliminating at one stroke the whole of the laborious task of the miner, are characteristic of the Soviet approach. The widespread and strictly scientific survey of mineral resources has already led to discoveries of new mineral deposits exceeding all expectations.

In agriculture, the advantages of a common scientific basis and the removal of obstruction from tradition or vested interest have led to remarkable developments, notably in vernalization, the production of new hybrids such as perennial wheat, and the improvement of stock through artificial insemination. The development of public health services on a universal and rational basis has probably contributed more than anything else to immediate human welfare, and the new and universal use of stored blood for transfusion is largely due to Soviet initiative.

It is not in these achievements, however, that the ultimate value of the developments that have taken place in the Soviet Union is to be found. They are, so to speak, only an indication of what is to come when the principles of the organized development and utilization of science can be fully carried out, not only in the Soviet Union but also in the world at large. Nothing has aroused such interest, and at the same time such opposition, in scientific circles as the idea first adopted in the Soviet Union of the planning of science. The opposition is now largely silenced, because the conditions of war have made most scientific workers realize in their actual practice that planning is not only necessary, but is also quite compatible with individual initiative and enterprise. Curiously enough, the very consideration of a science planned in relation to social needs brings to light new problems, which in themselves act as a stimulus to radically new discoveries, by breaking up traditional associations of ideas which are the most effective bar to progress.

The actual system of planning which has been evolved in the U.S.S.R. in the past twenty years is much more comprehensive and more closely integrated with the life of the country than anything in Great Britain even in war-time. The general direction of research is in the hands of the Academy of Sciences, which has grown from being an honorific society into a body controlling directly the research of some thousands of workers mainly on fundamental problems. The Academy is closely linked with the universities, which have grown enormously in number and size while steadily improving the standard of their scientific teaching. All university students are selected for ability and are supported by the State, as are the new science bursaries in Great Britain. In return, they must accept four or five years of work allotted to them after graduation. This system ensures an ample supply of the best brains for scientific and technical work. Already in 1934 the proportion of young men and women going to the university was five per cent, as against two per cent in Great Britain. Allowing for the greater population and for the fact that a far larger proportion take science, the annual output of scientific workers must be about twenty times what it is in Britain.

The greater part of the short-term research is carried out in the institutes of the commissariats of industry, agriculture and health. Research and development are closely linked, and the scientific workers are close to the problems arising in the workshop and the field. The actual plan of research is not imposed from above, but evolved after much discussion by the scientific workers themselves. It does not, however, stand by itself but is closely linked to the State Planning Commission, and thus forms part of the general production and cultural plan of the Union. The major short- and long-term problems are set by the needs of the country as a whole. How they are to be solved most quickly and effectively is left for the scientific workers themselves to determine. That is the essential safeguard for seeing that fundamental work is not neglected. The result of this integrated effort goes much beyond its immediate practical application ; it is producing a society that is scientific through and through.

The difficulties which, particularly in the years preceding the War, surrounded the work of Soviet men of science have often led to doubts in the rest of the scientific world as to the ultimate efficacy of the system adopted. The bitter test of war is showing that in this field also the Soviets were building better than we knew. It is to be hoped that, fighting together in a common cause, scientific workers in Great Britain will come to understand, far better than from any description, the new spirit and method which characterize science in the U.S.S.R., and that, in turn, we may be able to provide some of the advantages of a long tradition of discovery and criticism. The new world for which we are all fighting and working will need every contribution that science can bring.

BIOLOGICAL SCIENCE IN THE U.S.S.R.

By Dr. Joseph Needham, F.R.S.

THIS contribution is intended to be complementary to Prof. J. D. Bernal's account of science and technology in the U.S.S.R. It is obviously impossible for one scientific worker to do justice to all the many sides of work in such a vast field as biology in the Russian world, but in this respect I am so far happy that in some of the departments with which I am familiar, such as experimental morphology, the Russians have won a position of generally acknowledged leadership.

It is certainly true that since the Revolution of 1917 science has enjoyed greater State support, both moral and financial, than in any other country. But it seems on the whole that, owing to the policy of concentration on heavy industry and all those branches of science which connect with it, biological science rather lagged behind physics and chemistry. I visited Russia in 1935 in connexion with that very successful organization, the International Physiological Congress, and although my impression in viewing Russian laboratories at that time was that the general standard of work was not up to the best standards in Western countries or in the United States, I formed the belief that its upgrade was faster, and that parity would before long be reached or passed.

In biochemistry this has proved to be the case. Two instances of fundamental biochemical discoveries recently made in Russia may be given: first the identity of adenylpyrophosphatase with myosin itself by Engelhardt and Ljubimova. This connected for the first time the energy-providing phosphorylation cycles with the contractile machinery, since myosin is the contracting protein. Secondly, the elucidation of the phenomenon of trans-amination by Braunstein and Kritzman, revealed the transfer of nitrogen in the living cell parallel with that of phosphorus and hydrogen, about which so much is known. An interesting sidelight on the freedom of choice of work in Russia is that the biochemists at the Military Medical Academy at Leningrad specialized on problems of chemical embryology—an exceptionally unwarlike subject—in which valuable contributions were produced by Galwialo, Vladimirov and their colleagues. Similarly, the well-known vitalist and founder of the mitogenetic ray hypothesis, Gurwitsch, has always retained his chair in Moscow, in spite of his differences from official views. Little is now heard of this subject in any country, but it is well to remember that the majority of the work which claimed to support the existence of the rays was done outside Russia, and that some of its first and most sharp critics were Russian, such as Moissejeva of Kiev.

In experimental morphology and embryology there were formerly two main schools, one American, dealing with the development of invertebrates, the other German, dealing with that of vertebrates. Since 1933, the workers in this field, which in view of its German origin bears the name *Entwicklungsmechanik*, have almost all gone into exile, and the mantle fell upon the newer Russian school. Among its leaders were Koltzov (who so long ago as 1912, with but the Fischer polypeptide chain theory to go upon, suggested that the chromosome might be considered a giant protein molecule with the genes as side chains), Schmalhausen (author and encourager of important work on growth-rates), Balinsky, Filatov, Dragomirov, and others. Balinsky and Filatov have specialized on the induction of the nose and ear; they discovered the extraordinary powers which nasal placode and ear-vesicle have in inducing limb-buds on the flank of the amphibian neurula. Umanski discovered the induction power of cancer tissue, and explored the integrity required in tissue responding to neural induction. Wolffian regeneration of the lens of the eye has been intensively studied by Popov, Manuilova and their colleagues. In this literature it is interesting to note the appearance of names such as Sikharulidze and Murtasi from those Near and Central Asiatic races which hitherto have never had an opportunity of contributing to the advance of science.

One characteristic line of attack developed by the Russian experimental morphologists is the fusion together of several pieces of the same material, a technique possibly suggested by, and certainly in line with, the dialectical materialist idea of the transformation of quantity into quality. Thus Lopaschov, in important work, surveyed the results obtained in differentiation when from one to ten organization centres are isolated and grown together. Similarly, Polezaiev went far to settle the disputed question of whether limb-bud blastemas are undetermined or not by transplanting several of them at once, not only one (which is often resorbed), on to the new site. In this way it was found that development is always selfwise (*herkunftsgemäss*). The problem of the loss of regeneration competence has been much studied by this worker, with Schaxel, Liosner, Voronzova, and others, while the biochemical aspects of the

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regeneration process, never before explored, have been investigated by the school of Okunev, Blacher, Orechovitch, Kozmina, Vladimirova and many more. The association of the action of various proteolytic enzymes with the differentiation processes proceeding in parallel has thus been studied. Another case of comparisons between chemical and histological data would be the study of insect metamorphosis, which has been successfully pursued by Demjanovsky, Zolotarev and others; or the respiratory studies in fish development by the school of Trifonova.

It seems specially worthy of remark that the far-reaching support of experimental morphology in the Soviet Union has occurred in a country where, according to a common opinion, only research of immediate practical applications would be expected to find support. The fact is that no one can tell what practical applications a science may have. The Russians have, as it happens, benefited greatly by their backing of this pure science, since increasing knowledge of eye-transplantations has permitted of the grafting of parts of the eyes of dead persons into living blind patients, leading to the restoration of their sight. This operation is associated with the name of Filatov.

On the borderline between physiological morphology and genetics a great deal of work has been done. There is space only to mention the work of the Iljins on coat colour, of Rappoport on the production of phenocopies by treatment of flies with salts of metals, and of Vassin, who recognized in a naturally occurring semi-lethal genetic abnormality the persistence of the embryonic gill-slits, in sheep.

In pure genetics also there has been a vast effort. Vavilov, one of Russia's greatest men of science, travelled over the whole world and made collections of plant material which have no equal. A great deal of work is still being produced by his school, which came into conflict, in a celebrated controversy, with that of Lysenko (who has been called the Burbank of the Soviet Union). Lysenko was originally a plant physiologist who discovered a method, known as vernalization, of producing a spring-sown cereal from a winter-sown one—owing to the Russian winter climate a most desirable thing. It is not yet certain whether this achievement will have world-wide application. Later, Lysenko and his school became extremely critical of the generally accepted principles of classical Mendelism, and they are now repeating many of the fundamental experiments on which Mendelian theory has been based. Only time will show whether their experiments on the inheritance of acquired characters will have the same results as all previous such experiments, or whether perhaps in the process some valuable information, hitherto overlooked, will accrue. Some geneticists believe that some of Lysenko's results may be explained by virus infections. In any event, this controversy is an outstanding instance of the benefit which would be derived could the scientific workers of the Soviet Union in the future come into much closer contact with those of other countries.

Where genetics touches animal husbandry enormous progress has been made in Russia. The Soviet improvers of stock have not been hampered by the difficulty which exists in other countries, namely, that the pedigree breeds are in private ownership while the mass of cattle are unimproved. Artificial insemination, introduced by Ivanov and others, is practised on a large scale, permitting the wide dissemination of useful qualities.

In the foregoing survey, little has been said about the Russian zoological and botanical systematists, but I understand from competent colleagues that they have been worthily keeping up the great traditions of the last century on the foundations laid by Pallas and von Baer. A word should be added, however, about the marine biological stations, of which there are several; at least one near Murmansk, another on the Crimean coast, and a third near Vladivostock. The first-named of these produced valuable work on comparative biochemistry by Kreps and Verjbinskaia, and on comparative physiology by Koschtojanz; the third aided Okunev's work on regeneration. There are, moreover, certain special stations of interest, such as that at Sukhum-Kale on the Caucasian coast, devoted to the experimental neurology of apes, perhaps the only one existing anywhere apart from the Physiology School at Yale University.

In conclusion, a word on the facilities available to Russian biologists. My impressions are that work in a Russian laboratory resembles closely enough work here in Great Britain or in the United States, with the exception that there are considerably more technicians available for the use of the research workers, enabling them to concentrate on what is their proper business, the planning, carrying out, and interpretation of experiments. The subject of pay and opportunities cannot be dealt with here, but reference may be made to a contribution by Dr. M. Ruhemann on this subject in NATURE[1].

There can be no doubt that the U.S.S.R. has a vast contribution to make to world science, a contribution with a special quality that cannot be spared. We must hope that, after this War, contact between the scientific workers of the democracies and those of the Soviet Union will be far more intimate than what has been possible in the past.

[1] NATURE, 141, 792 (1938).

PROPAGATION OF RADIO WAVES ROUND THE EARTH

By T. L. Eckersley, F.R.S.
Marconi's Wireless Telegraph Co.

CONSIDERING the use to which the transmission of radio waves is put, it is remarkable how few have studied the problem. Engineers are interested in the terminal apparatus—the great transmitting and receiving stations; and physicists seem to be more interested in sending radio waves to themselves in the investigation of the ionosphere than in studying the transmission to others across wide open spaces. Both activities are essential to the creation of communication links, but a study of the application of the results obtained by physicists and engineers is also essential.

The mechanism of radio transmission is the same as that of light. Both comprise wave motions in the ether, but the wave-lengths used in radio, although covering a wide range, are very different from those of light.

Radio waves vary from a few centimetres to 20–30 kilometres, that is, sixteen or more octaves. Light waves are of the order of 10^{-7} cm., and there is only about one octave of visible light. The enormous range of radio waves makes the study of propagation difficult, but at the same time most interesting. Different wave-lengths have been treated piecemeal by different methods, but there should be, and is, one general method by which all problems can be treated.

The earth is practically a sphere, and for theoretical purposes it can be treated as a homogeneous sphere of uniform electrical conductivity. Irregularities do not matter much to the first approximation.

The propagation of radio waves round such a sphere can be treated mathematically. This was originally done by the great mathematicians such as Poincaré, and others. The mathematics are difficult. They were put on a firm and unimpeachable basis by G. N. Watson at the instigation of Van der Pol. Watson's investigation showed that for long waves the earth behaved as if it were a perfect conductor, and the results are only applicable, without further development, to perfect conductors. The whole theory has now been developed in two independent ways which agree and are applicable whatever the conductivity or inductivity may be.

The results of this mathematical investigation are now clear and definite enough. Waves of which the length is small compared with the radius of the earth are, as in light, practically confined to the region above the plane which is tangent to the earth at the transmitter.

The waves from the transmitter travel out in straight lines, and most, practically all, of the earth is in shadow. Nevertheless, some radio energy can penetrate by diffraction into the shadow region, and the longer the wave-length the more easily it does so.

However this may be, diffraction alone, or bending round the earth, is entirely inadequate to produce a signal at, say, the antipodes on any wave used in radio.

Diffraction is most effective when the wave-length is large, but even the longest waves that can be conveniently used in radio communication are so weak at the antipodes that they need increasing by a factor of the order of 10^{11} in order to overcome outside noise, even when the highest powers are used.

It is clear that in the normal radio range it is quite impossible to produce workable signals at the antipodes, or even at distances greater than about 3,000–4,000 kilometres, without the help of some agency which bends the rays round the world. This agency we now know is the ionosphere, which has been largely investigated by physicists in the last ten years. All the long-distance short-wave broadcasts, all the long-distance high-speed beam services, and all the linking up of 99 per cent of the world's telephones would not exist but for the ionosphere. The study of radio transmission round the earth therefore devolves itself into the study of the ionosphere and its effect on long-distance communication.

There are two aspects:

(1) The investigation of the constitution of the ionosphere.

(2) The exploitation of this knowledge in radio communication.

The Ionosphere

This is a region from 60 to 300 kilometres above the earth, in which a small proportion of the molecules are ionized, so that there is an appreciable atmosphere of electrons capable of reflecting and modifying wireless transmissions.

It is only recently that a detailed and fairly accurate knowledge of it has been obtained, by Appleton in Great Britain and by experiments initiated by Breit and Tuve in the United States.

The method by which the ionosphere, which at 100 or more kilometres is entirely out of direct reach, can be investigated, is very simple in essence. Radio impulses a fraction of a millisecond in length are sent up to the ionosphere, where they are reflected down to earth again. From the delay of the reflected echoes, their intensity and polarization, etc., a great many characteristics of the ionosphere can be deduced.

Measurements have been made at a large number of places on the surface of the earth, but the results are by no means sufficient. From these we know that there exists in all places examined a region between 60 and 300 km. above the earth in which there is an appreciable number of free electrons, reaching a concentration as great at 10^7–10^6 per c.c. This maximum density is an important characteristic of the layer. It is easily found with the impulse technique already described.

If the radio frequency of the exploring impulses is increased, their delay (that is, the time it takes for the impulses to travel up to the ionosphere and back) rapidly increases, and beyond a certain frequency the rays penetrate the upper layer and echoes cease. This critical frequency gives the maximum electronic concentration in the various layers of which the ionosphere is composed. Near the critical frequency, the curve which is known as the $P'f$ curve, relating delay time and radio frequency is split into two nearly circularly polarized branches, this being effected by the earth's magnetic field.

This critical frequency varies with the height of the layer concerned, the time of the day, season, epoch of the sunspot cycle, etc. It is possible, therefore, even with the limited observations at our disposal, to chart the world.

It is found, in effect, that wherever observations are taken, the curves relating delay and frequency are of the same general type, indicating the existence of three main layers, the E, F_1 and F_2 layers, approximately at heights of 100 km., 200 km. and 250–300 km.

A great deal has been found out about the ionosphere. Thus the E and F_1 layers behave normally and vary diurnally, seasonally and with the epoch in the sunspot cycle, as if ionized by the sun's ultra-violet radiation. The F_2 layer behaves in an anomalous manner. For example, contrary to expectation, the electron concentration in England is less in summer than in winter. Again, the concentration is different in the northern and southern hemispheres. There appears to be some annual ionizing agency independent of the sun.

By determining the polarization of the two branches of the $P'f$ curves near penetration in the northern and southern hemispheres, it has been found that the electron atmosphere is the major factor in guiding wireless waves. A positive ion atmosphere may exist in the lower E layer, but on account of the mass of the positive ions compared with the electrons, these have to be enormously in excess (10,000 to 1 or so) in order to affect the wireless waves. All we can say is that, experimentally, this excess does not exist.

One of the major factors in radio transmission is the attenuation of the waves. This is primarily caused by the collision of the electrons with the rest of the molecules. The electrons receive energy from the waves which is wasted as heat in collisions with the molecules.

By making experiments on the loss in reflexion as the impulses are delayed, it is possible to determine the collision frequencies at various heights, this quantity being of the order of 10^6 in the E layer and about 5×10^3 in the F layer.

The ionosphere is disturbed by the mechanism which produces magnetic storms, and also by bright hydrogen eruptions from the sun. This pathology of the ionosphere is of great consequence to communication engineers, and much has been learned about it.

Propagation: General

With the help of this knowledge of the ionosphere, it is possible to get a very fair idea of the propagation of radio waves round the world, and to deduce, for example, which waves are least attenuated and can travel the greatest distances.

Short waves, 10–100 metres, which have been extensively used in world-wide communications, are easiest to understand because ray methods can be used; and, just as in optics, it is possible to trace the rays modified by refraction in the ionosphere. The analysis of these short waves is, in fact, a branch of optics; but when the wavelength becomes comparable with the radius of curvature of the rays, wave methods, and not optics, must be used. Attenuation also largely modifies optical methods, and for exactness and proper understanding, optical methods should be discarded and wave methods used everywhere. Nevertheless, it is sufficient to use optical methods on short-wave ranges.

The correct mathematical method, which should be applicable to the whole of the radio range, is to determine the solution of the equations of propagation in the ionosphere, in the region between the earth and the ionosphere, and in the earth itself, and to satisfy the boundary conditions at the surface of the earth and ionosphere respectively. The difficulty is in obtaining solutions of propagation in the ionosphere, which depend on fourth order differential equations when account is taken of the earth's field.

An approximate development of this is a phase integral method similar to that used in quantum mechanics, which, if the change of phase and amplitude on reflexion at the ionosphere are known, is exactly equivalent to the above boundary problems. This phase integral often yields solutions in which methods are much simpler than in the boundary problems, and has been made to give a solution of the diffraction problem in which general relations of great interest are found. These methods—of universal significance—degenerate into optical ray methods for short waves (10–100 metres).

SHORT-WAVE TRANSMISSIONS

The application of our knowledge of the ionosphere is enormously helped by a proposition which translates the vertical $P'f$ results into relations for oblique transmission. Thus, if the critical frequency for vertical transmission is known, the critical frequency and consequently skip distance at oblique incidence are also known. This has been checked by an elaborate experiment between Chelmsford and Bodmin. With a sufficiently short wave, even the tangent ray escapes, so that even though it requires a much smaller electron concentration to bend the rays through a small angle, as in long-distance communication, there is ultimately a maximum usable frequency which is about four times the vertical critical frequency. Ground waves can, of course, be used at much higher frequencies. The above theorem is only exactly true if the earth's curvature and steady magnetic field are neglected.

The maximum usable frequency can be shown on a chart in which contours of the quantity are given. To the first approximation, the state of the ionosphere, and hence the contours of this chart, depend only on the sun's position. The chart can be drawn on transparent paper and slid over a map to give the maximum usable frequency for long-distance communication on any route. Complications in transmission may be produced by irregularities in the E layer, which are known to exist, but the cause of which is as yet unknown.

Short-wave transmission is very largely explainable on these optical lines. Each ray usually passes through the E layer up to the F layer, where it is reflected. In the passage through the E layer, it is attenuated by an amount proportional to the square of the wave-length. The shortest waves travel farthest provided they are not too short to be reflected.

LONGER WAVES

Experiment shows that above about 1,000 metres any increase in the wave-length increases the range, and extreme world-wide ranges can be obtained if waves of the order of 20–30 km. are used. These were originally employed in radio, until it was found that outside noise was so great on these frequencies, and the expense of the gear so high, that the use of such waves became uneconomic.

The behaviour of these waves can easily be explained, but not by ray methods. The boundary value or phase integral wave method must be used.

On these frequencies, 300 kc./sec. and less, there are no rays in the ionosphere, and we know that all the radio energy is confined to the E layer. The propagation in the E layer is not that of the propagation in a free electron atmosphere. Electron collisions with molecules are predominant, and the electrons do not move freely. The ionosphere behaves like a metallic conductor, and the parameter which controls the type of transmission is the ratio of the collision frequency ν_c to π times the actual frequency ν. When this quantity α is large, the ionosphere behaves like a conductor ; when it is small, like an Eccles–Larmor refractive medium. In this, the rays reach a level where the concentration is proportional to the square of the frequency.

In a conductor, on the other hand, there are no rays at all, and the energy only reaches a level which varies inversely as the square root of the frequency.

The transmission may be considered to be guided between two shells, the E region of the ionosphere on the outside and the earth on the inside. The attenuation depends on the resistivity of the shells. This, on account of skin effect, or the diminishing penetration into the layer on these frequencies, increases with increasing frequency ; that is, attenuation is proportional to $\sqrt{\nu}$, according to the 'Austin Cohen' law.

We therefore obtain the general fact that only extreme wave lengths, the longest and shortest, are useful for long-distance transmission, and this is the characteristic to which the correct treatment by boundary conditions or phase integrals leads. There is a maximum attenuation in day-time on the broadcast band (500–1,500 kc./sec.) and at such times the propagation is mostly, if not entirely, carried out by the ground ray, and is independent of the ionosphere. At night-time the layer changes ; α decreases, and there are reflections from the ionosphere and consequent distortions.

The character of transmission depends on the collision frequency in the E layer, and day-time attenuations are a maximum and ranges a minimum on the broadcast band.

Only a general account of radio propagation has been given. Much remains to be done in explaining the vagaries of the ionosphere, but the general characteristics of long-distance radio communication are now well known.

OBITUARIES

Mr. C. M. Hutchinson, C.I.E.

MR. CLAUD MACKENZIE HUTCHINSON, who died on August 2, at the age of seventy-two, was a pioneer in the field of agricultural bacteriology in India and also contributed notably to a wide variety of problems of tropical soil, fermentation and medical science. He was educated at Glenalmond and St. John's, Cambridge, where he got his 'blue' for golf in 1889–90 and graduated in 1891.

After some years as professor of chemistry at the Colonial College, Hollesley, he joined the scientific staff of the Indian Tea Association in Assam in 1904 and succeeded Dr. Harold H. Mann as scientific officer to the Association in 1907. In 1909 he was appointed Imperial agricultural bacteriologist at Pusa. He retired from the Indian Agricultural Service in 1926 and soon afterwards became chief scientific adviser to Messrs. Imperial Chemical Industries (India), a post he held until he returned to Great Britain in 1931.

Hutchinson's best scientific work was done at Pusa and received official recognition by the C.I.E. conferred on him in 1920. While in Assam he became interested in the cycle of nitrogen in tropical soils and this subject occupied much of his time and thought at Pusa. His publications on the influence of bacteria on soil fertility (1911), on nitrogen fixation in Indian soils (1919), on nitrogenous fertilizers in India (1919), on fermented green manures (1923) and on the conservation of humus in Indian soils (1927) were offshoots from this work but the main part was never published, for a serious illness struck him down a few days after he started to assemble the results on his return from the East. But the work itself had a widely stimulating effect in India: to cite one instance only, it was Hutchinson's studies on the fermenting of green plant residues that led to R. D. Anstead's activated composts, afterwards developed in conjunction with Gilbert Fowler and now attracting so much attention in Great Britain in connexion with the disposal of town waste.

An outstanding work on the bacterial wilt of tobacco, a fascinating study of the rice beer ferment 'bakr', work on the pebrine disease of silkworms, on the bacteriology of indigo manufacture and on indigenous sources of phosphoric acid, the development with W. Hodgkinson of the electrolytic chlorine (E.C.) process of sterilizing water, studies on the micro-anatomy of Cimex for the research workers on kala azar, and on antiseptic measures for use in sugar factories, were some of the other scientific contributions from an astonishingly fertile mind.

This versatility was the keynote of Hutchinson's character. He was an exceptionally gifted photographer and in addition to making the photographic section at Pusa one of the best of its kind, published notes on photographic illustrations and on photomicrography, and prepared a number of cinema films for agricultural propaganda. His advice on the laying down and maintenance of turf for golf courses was much sought. Landscape painting and bridge, at which he was highly proficient, were a solace when illness prevented outdoor activities, as was increasingly the case in recent years. He was an interesting and refreshingly acid conversationalist and debater.

Many friends will mourn a picturesque and stimulating personality. His marriage in 1914 to Alice Muriel, daughter of J. Walter Leather, Imperial agricultural chemist at Pusa, who survives him, was an exceptionally happy one; her untiring care did much to make possible the considerable scientific output he accomplished in spite of persistent illness.

E. J. BUTLER.

Dr. H. R. Spencer

DR. HERBERT RITCHIE SPENCER, the well-known London consultant in obstetrics and gynæcology, who died on August 28, was born at Atherstone in Warwickshire on January 16, 1860. Contrary to what has sometimes been stated, he was no relation of his namesake the famous philosopher. He received his scientific and medical education at University College, London.

Besides numerous contributions to periodical literature on the clinical aspects of his speciality he took a keen interest in its historical side and medical history generally. He played an active part in the Third International Congress of the History of Medicine held in London in 1922, and delivered the Harveian Oration before the Royal College of Physicians on "William Harvey: Obs etric Physician and Gynæcologist" in 1921, the Fitzpatrick Lecture before the same body on "The History of British Midwifery (1650–1800)" in 1927, and the Lloyd Roberts Lecture on "The Renaissance of Midwifery" before the Medical Society of London in 1924. He also read a paper at University College Hospital on "Medicine in the Days of Shakespeare" in 1929. He possessed a remarkable collection of old books connected with his subject, besides being a constant reader in the library of the Royal Society of Medicine and a valuable member of the Library Committees of this Society and of the Royal College of Physicians for many years. He was an accomplished scholar and delighted in translating Horace and Goethe.

Spencer received many distinctions at home and abroad. He was honorary LL.D. of the University of Aberdeen, and in 1923 was president of the Medical Society of London.

J. D. ROLLESTON.

WE regret to announce the following deaths:

Mr. W. H. Caldwell, formerly University lecturer in biology in the University of Cambridge, known for his work on the embryology of the Monotremata and Marsupialia, on August 28, aged eighty-two.

Mr. H. Grindell-Matthews, known for his inventions in the field of radio-telephony, on September 11, aged sixty-one.

Dr. Robert Thomas Hill, geologist of the United States Geological Survey during 1889–1904, aged eighty-three.

NEWS AND VIEWS

Sunspot and Magnetic Storm of September 18–20

THE largest group of sunspots since January 1940 crossed the sun's disk between September 10 and 23. The group was a complex stream of spots some 150,000 miles in length, and its maximum area exceeded 2,000 millionths of the sun's hemisphere, or about 2,300 millions of square miles. At central meridian passage on September 16·8, the centre of the group passed within 4° of the centre of the sun's disk. Thus the earth was in a favourable position to be affected by a corpuscular stream that might be shot out from this disturbed region within a day or two of September 16·8. Statistical data of sunspots and magnetic storms show that out of every ten spot-groups of great size (1,500 millionths of the sun's hemisphere or greater), seven groups are associated near the time of their central meridan passage with a magnetic storm, the mean position of the group at the time of the commencement of the storm being about one day past the central meridian (see the *Observatory*, 62, 319; 1939). A valuable criterion of especially active spot groups is the occurrence of brilliant chromospheric eruptions, or 'solar flares' (*loc. cit.*, p. 321), which may be observed in monochromatic light at certain wavelengths only—the solar spectrum lines generally used being C for visual observations and H and K for photographic records.

In the present case, a brilliant eruption was observed at Greenwich on September 17 at 8½h. U.T., this being associated with an ionospheric irruption (fade-out). About 20 hours later, a magnetic disturbance began; this developed into a great storm which proclaimed itself by disturbance on radio circuits and by displays of the aurora borealis. As recorded at Abinger, a first climax of disturbance was shown by the magnetic traces between 7h. 2m. and 7h. 6m. on September 18, but the maximum of the storm as a whole was reached at about 0h. on September 19. The total ranges recorded throughout were: 120′ in declination, 1,250 γ in horizontal force and more than 1,100 γ in vertical force. This storm is one of the most intense of the present solar cycle, other notable storms being those of January 25–26, 1938, April 16, 1938, March 24–25, 1940, and March 1, 1941. The maximum of sunspot frequency occurred in 1937–38.

Hermann Nothnagel (1841–1905)

PROF. HERMANN NOTHNAGEL, one of the most eminent research workers and clinicians in the second half of the nineteenth century, was born at Alt-Lietzgöriche in Brandenburg on September 28, 1941, the son of a medical man. After holding the chair of pharmacology at Freiburg in 1872 and that of special pathology and therapeutics at Jena in 1874, he was appointed professor of medicine at Vienna in 1883, and held this post until his death. Besides numerous valuable publications on neurology and pharmacology, many of which were translated into English, French, Italian, Portuguese and Polish, he edited a system of special pathology and treatment in twenty-four volumes (1894–1905), to which he contributed a classical monograph on diseases of the intestine and periton um. In conjunction with von Leyden he founded the *Zeitschrift für Klinische Medizin* in 1880, and was the founder and first president of the Vienna Society for Internal Medicine. He died on July 7, 1905.

Grass as Human Food

IN NATURE of July 19, p. 90, this problem was discussed briefly with special reference to an interesting pamphlet "Eating for Victory" by Mr. J. R. B. Branson, and it was pointed out that the main objection to the inclusion of grass in the human diet lies in its high content of cellulose. Mr. Branson has suggested to us that the danger from this source has been unduly emphasized. He recalls that in a paper read before the British Association in 1937, Dr. R. E. Slade stated that the dry matter in the leaf of the grass plant consists largely of soluble carbohydrates and proteins, together with minerals and vitamins, and that it is not until the plant begins to ripen that the carbohydrates change to cellulose and the protein moves from the leaf into the flower and seed. Moreover, according to data provided by Dr. H. E. Woodman, the dry matter of newly grown grass-leaf such as one gets in lawn-mowings, contains as much as 26·5 per cent of protein, 44·5 per cent of carbohydrate and 5·5 per cent of oil, making a total of 76·5 per cent of digestible matter.

The presence of valuable nutrients in young grass will not be denied, but the cellulose content of the remaining 23·5 per cent makes it questionable how much young grass, if indeed any, can be safely eaten over prolonged periods by the average human subject. The physical state of the cellulose, which is in long fibres liable to become bound into large obstructive masses, must be borne in mind. It would seem dangerous, therefore, to advocate the use of grass as an ordinary article of diet without the evidence of extensive scientific experiments as to the amount which can be safely ingested without overloading the excretory powers of the intestines.

Sound Integrating Machine

EXPLORING the sound field around a small source such as a bell or loud-speaker is usually a laborious and time-consuming task because it involves making many measurements in all directions around the radiating source. In the *Bell Laboratories Record* of July it is shown how this effort can be avoided by doing the work automatically with a sound-integrating machine. The apparatus to be tested is rotated on a turn-table while a small condenser microphone, which is mounted on the end of an arm, is swept backwards and forwards over it. This arm is oscillated in a vertical plane through an angle of 180° by a cam which moves it progressively more slowly as it approaches the ends of its excursion, so that equal radiating areas are traversed in equal times. The output of the microphone is amplified and applied to an analyser to determine the sound intensity in different frequency bands. A meter reading gives the average intensity of the sound in a selected band : and multiplication by a factor, involving the area of a hemisphere the radius of which is the length of microphone arm, gives the total power radiated in that particular band. This integrator measures sound outputs in about one fiftieth of the time previously required to make separate observations at many points about the source. It has been used extensively in developing telephone set housings.

Electrical Demonstration Equipment

IN the *Bell Laboratories Record* of July a description is given by C. D. Hanscom of a variety of equipment which has recently been assembled by the Bell System for use in public lectures. One of the most unusual demonstrations is a Rochelle salt crystal which flashes a neon lamp when hit with a gavel. This illustrates how a change in mechanical dimensions caused by the blow generates momentary voltages of considerable magnitude by the piezo-electric effect. A bar of steel (a permanent magnet) floating in mid-air demonstrates the power of modern magnets. A permanent magnet concealed in the base of the apparatus repels the bar, holding it up against the force of gravity ; a full packet of cigarettes can be supported in addition to the bar. There are also in the collection permalloy rods which are so permeable that they are magnetized by the earth's field, when held pointing north at or near the angle of declination. This is demonstrated by their ability to attract and hold short pieces of permalloy tape.

Decreased size of loading coils, made possible by research on magnetic alloys, is illustrated by a display board on which are mounted a coil with an iron-dust core, a much smaller coil of equal efficiency with a permalloy core, and a still smaller one with the same electrical characteristic, the core of which is molybdenum permalloy. Samples of the 2121-pair cable for exchange areas are included ; also a piece of the Minneapolis-Stevens Point coaxial cable which transmits frequencies of several million vibrations per second. A replica of Bell's original telephone is usually included with the exhibits.

Photography in Stellar Astronomy

A RADIO talk by the late Dr. Annie J. Cannon, entitled "The Story of Starlight", delivered on January 18 last, from Harvard Observatory, appears in the *Telescope* of May–June. A short description is given of the developments in spectroscopy since 1666 when Newton bought a crude prism at a country fair, "to try therewith the phenomena of colour". It is remarkable that two hundred years elapsed before Newton's work was carried to fruition, but when the potentialities in the study of spectra were realized, there was joy in being an astronomer. As Sir William Huggins remarked, "Those were the days when there was something worth while to do in astronomy". Dr. Cannon gives a brief account of photographic developments with special reference to the work of Harvard, where there are half a million negatives, which may be likened to a library of first and only editions, the whole forming the sole record of events observed in the stellar universe during the last half-century. The brief survey includes the important discovery of Miss Leavitt on the relation between the period of pulsation of a Cepheid variable star and its candle-power—a discovery which provides the data for determining the distances of these stars. This radio talk will be read with interest by the amateur astronomer.

Nature Study for Evacuees

THE Universities' Federation for Animal Welfare (U.F.A.W.) has issued two further useful and informative lectures for delivery to evacuee children, namely "British Snakes and Lizards", by Dr. R. C. Blackie, curator of Exeter Museum, and "Frogs and Toads", by E. M. Stevenson, lecturer in biology, University College, Exeter. The lectures are printed as brochures and accompanied by photographic plates for illustration and will help to solve a very pressing problem with many town teachers inexperienced of the countryside where they are now evacuated with their inquiring pupils. In a similar way, the various branches of the Workers' Educational Association have included nature study, biology, botany and kindred subjects in their programme of lecture courses for the coming winter. The West Lancashire and Cheshire Branch of the W.E.A., for example, is arranging nature study courses this winter at the University of Liverpool, Neston Library, Runcorn Technical Institute, Southport Technical Institute and probably Maghull Library, with a special appeal to teachers, and biology classes at the University and some of the branch towns. Attention has been given to nature study at the large Colomendey school camp, North Wales, but in most parts of the country considerable help in this subject is still required by town teachers in care of evacuees but handicapped by the limitations of their own experience of field natural history, which differs so radically from laboratory biology. A "Junior Naturalists' Society" has been formed by F. Stodart at Longfield, Kent, and much help is being given by local branches of the British Empire Naturalists' Association.

Bug Infestation

IN his latest annual report Sir Alexander Macgregor, medical officer of health for Glasgow, states that the total number of houses in that city in which bed bugs were found in 1939 was 309, or 2·1 per cent, as compared with 3·1 per cent in 1938. In 79 houses, or 0·5 per cent only, a "trace" of bed bugs was found, as compared with 0·9 per cent in 1938. In this group only old hatched eggs were found, but no living bugs or eggs were detected in beds or furniture, pictures or household belongings. In 62 houses, or 0·4 per cent compared with 0·5 per cent in 1938, a medium degree of infestation was found, that is, living bugs or eggs were present, but not in the structure of the house itself. In 168 houses, or 1·2 per cent, a serious degree of infestation was found, living bugs or eggs being present not only in the beds or on furniture but also in the structure of the rooms such as picture rail, skirting and door facings. In the great majority of houses infestation was detected at a fairly early stage by the nurse inspectors. The progress made in the prevention of any infestation during the last six years is shown by a fall from 10·7 per cent in 1934 to 2·1 per cent in 1939 and by a fall of serious infestation from 7·1 to 1·2 per cent during the same period.

Public Health in Mexico

ACCORDING to the *British Medical Journal* of August 9, the National University of Mexico, four years ago, founded its social service system under which every medical graduate is required to practise for five months as a health officer in some part of the country where there is no such representative. He sends in a weekly report of contagious diseases cases seen, and a monthly report which includes information on sanitary questions such as water supply and drainage. Since 1935 more than a hundred graduates have taken part in this social service programme.

Recent Earthquakes

THE provisional epicentres of two earthquakes have recently been found by the United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association. The first, on June 18, 1941, had its epicentre near lat. 51·5° N., long. 32° W., which is in the North Atlantic Ocean on the ridge which stretches from Greenland to the Azores. Occasional earthquakes are known to occur from time to time on this ridge, showing that it is still one of the unstable regions of the earth. The second shock, on June 26, had its epicentre near lat. 13° N., long. 93° E., which is near the Andaman Islands in the Bay of Bengal.

Sixteen large distant earthquakes were registered on the seismograms at Kew Observatory during August 1941. The greatest was on August 2, when a ground amplitude of 91 μ was attained at Kew, and a full suite of pulses was obtained on August 4, 6, 9, 15 (see NATURE, Sept. 13), 19, and 30. The shock on August 6 at an estimated epicentral distance of 8,800 km. had a probable depth of focus of 200 km. On August 9 there were six shocks, five being from an estimated epicentral distance of 2,030 km.

The Night Sky in October

THE moon is full on Oct. 5d. 8h. 32m. and new on Oct. 27d. 20h. 9m. There will be an occultation of the first magnitude star α Tauri on October 10, the disappearance as seen from Greenwich taking place at 3h. 16·1m. and the reappearance at 4h. 30·1m., the position angles being 290° and 252° respectively. Lunar conjunctions with the planets will be as follows: Mars on Oct. 5d. 23h., Mars 1° S.; Saturn on Oct. 9d. 4h., Saturn 2° N.; Jupiter on Oct. 11d. 4h., Jupiter 5° N.; Venus on Oct. 23d. 17h., Venus 8° S. Mercury is an evening star until Oct. 26 and then becomes a morning star. Venus is an evening star and sets at 18h. 38m. at the beginning and at 18h. 19m. at the end of the month. Mars is a morning star until Oct. 10 when it is in opposition to the sun, and then it is an evening star. At the beginning and end of the month the planet souths at 0h. 41m. and 22h. 6m. respectively. Jupiter is a morning star and crosses the meridian at 4h. 44m. on Oct. 1 and at 2h. 44m. on Oct. 31. Saturn is a morning star, the meridian passages being at 3h. 8m. and 1h. 7.m at the beginning and end of the month respectively. The Orionid meteor shower will commence about Oct. 18 and will continue for a few nights; the radiant point is close to ν Orionis. Comet van Gent (1941d) will be visible with the aid of a small telescope during the month. It will be easily identified, a 3-inch refractor showing it quite distinctly, as its magnitude is about 8·5. The comet is moving northward in declination in the constellation Ursa Major, and on Oct. 19 will be close to ψ Ursæ Majoris. Its distances from the earth and sun in the middle of the month will be nearly the same—about 108 million miles. Although it is receding from the Sun it is still approaching the Earth, for which reason its magnitude will not vary very much during the month, that due to the increase in distance from the Sun being nearly balanced by the change due to the decrease in distance from the Earth. An ephemeris for every four nights is given for the comet. A short ephemeris was given in NATURE of Aug. 2, p. 139.

EPHEMERIS FOR COMET VAN GENT (1941*d*).

1941 U.T.	α	δ	ϱ	r	Mag.
Oct. 1	11h. 25·3m.	+45° 01′			
5	16·0	45 24	1·270	1·050	8·5
9	06·3	45 45			
13	10 55·6	46 06	1·187	1·130	
17	43·9	46 27			
21	30·0	46 48	1·090	1·220	8·3
25	14·3	47 07			
29	9 56·2	47 26	0·993	1·316	

Announcements

Dr. W. H. Mills, F.R.S., emeritus reader in stereochemistry in the University of Cambridge, has been elected president of the Chemical Society until the next annual general meeting.

A meeting to celebrate the tercentenary of the arrival of Comenius in London will be held at the Caxton Hall, London, on September 29. The Archbishop of York will preside, and the principal speakers will be the Prime Minister of the Netherlands and the Foreign Minister of Czechoslovakia. A further meeting will be held at Cambridge on October 24 (see NATURE, Aug. 23, p. 222).

ERRATUM. In the letter entitled "Specific Heat of Supra-Conductive Tantalum" by Dr. K. Mendelssohn in NATURE of September 13, p. 316, the graph as printed is inverted. It should be read as if turned through 180°, without shifting the numerals of the ordinates.

LETTERS TO THE EDITORS

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

Radiations from Bromine (82)

An account has recently appeared of some work by J. R. Downing and A. Roberts[1] on the radiations from radioactive bromine, ^{82}Br, of period 34 hours. As their results differ in some important particulars from those I have obtained in a similar series of experiments it seems desirable to mention my results briefly. It was intended to carry out the investigations in some detail, but the work had to be abandoned in the spring of 1940 for more urgent duties, and it seems unlikely that I shall be able to resume it for some time.

The radioactive bromine was prepared by irradiating a thin selenium layer evaporated on gold foil with a beam of 4 Mev. protons from the cyclotron. After the decay of the short-period elements the radiations emitted from ^{82}Br were investigated by means of Geiger-Müller counters in the following methods: absorption of β-rays, absorption of γ-rays, absorption of Compton-electrons produced by γ-rays, β-γ and γ-γ coincidences. The results obtained were as follows.

Absorption of β-rays. At first sight the absorption curve seemed to have a shape similar to the absorption curve of the β-rays from radium E, thus indicating a simple spectrum with a maximum range of about 150 mgm./cm^2. However, a closer analysis revealed a departure from the standard radium E curve near the end of the range of the β-rays. The experimental errors in this region are inevitably large owing to the presence of a strong γ-radiation, nevertheless the results obtained are sufficient to establish the presence of a 'tail', which indicates the existence of a weak group of β-rays of longer range. It seems rather unlikely that this group is due to a contamination, as it decayed with the same period as the main group. Analysis of the logarithmic absorption curve made on the lines of Feather's method[2] shows that the best agreement with the experimental results is attained on the assumption that the β-radiation from ^{82}Br consists of the following two groups:

97 per cent of the disintegrations have an upper energy limit of 460 ± 10 kev.;

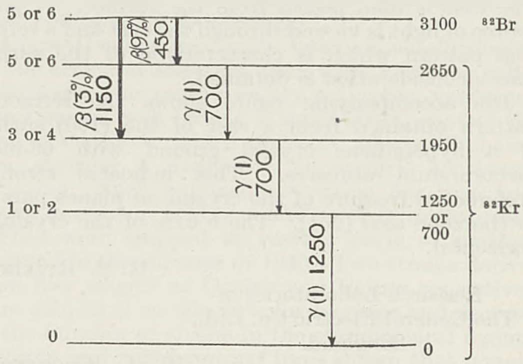
3 per cent of the disintegrations have an upper energy limit of $1{,}200 \pm 50$ kev.

Absorption of γ-rays. The absorption of the γ-rays was investigated in lead and aluminium. Here again the absorption curve seemed initially to be a purely exponential one, but on using better geometrical conditions the presence of at least two components was revealed. The best fit with the experimental absorption curve is attained by assuming the existence of two γ-quanta of about 700 and 1,300 kev., the intensity of the former being twice that of the latter.

Absorption of Compton-electrons. The energies of the γ-rays were also investigated by measuring the absorption of the Compton-electrons passing through two counters in a coincidence circuit. The absorption curve showed directly the existence of a γ-ray line of the energy $1{,}250 \pm 50$ kev., and the shape of the curve made it clear that yet another component must be present. By comparing that curve with those obtained with sources of thorium (B+C) and radium (B+C) in identical conditions it was found that the energy of the second component is 700 ± 50 kev. After correcting for the efficiency of the counters for γ-rays of different energies, the intensity of the softer γ-quantum was found to be twice that of the harder.

Coincidence measurements. All coincidence measurements were made with counters in a standard position, the efficiencies of which for β- and γ-rays had been previously determined. The ratio of β-γ coincidences to the number of β-rays was found to vary only very slightly with the thickness of absorbers for the β-rays. This result is not in contradiction with the assumed presence of two β-ray groups, since owing to the low intensity of the group of longer range the expected decrease of the coincidence ratio within the whole investigated region (up to 100 mgm./cm^2) is only about 15 per cent, and on the other hand the accuracy of the β-γ coincidence measurements is poor at the end of that region, mainly owing to the large γ-γ coincidence rate. Actually the results indicate a tendency towards a decrease of the relative β-γ coincidence rate, as would be expected from the presence of two β-ray groups; at the same time the results show that even the harder β-ray group is also correlated with a γ-ray emission.

The rate of β-γ coincidences per 1,000 β-rays—with no absorber—is $4 \cdot 88 \pm 0 \cdot 07$. The rate of γ-γ coincidences per 1,000 γ-rays was found to be $3 \cdot 14 \pm 0 \cdot 07$. From these figures we deduce that the γ-rays following the emission of the main group of β-rays form a cascade of 3 quanta per disintegration. The assumption of two 700 kev. quanta and one 1,250 kev. gives also an agreement between the observed rate of β-γ and γ-γ coincidences and the value calculated from the efficiency of the counters for γ-rays of these energies.



All the above results may be expressed in the nuclear level scheme of ^{82}Kr shown in the accompanying illustration, together with the transitions from ^{82}Br. The figures on the right side give the energies of the states in kev., and on the left side their presumed spins. As seen, the total disintegration energy of ^{82}Br is 3·1 Mev. The assignation of the spin values was based on the absence of direct γ-transitions from the upper levels to the ground-state, and on the small abundance of the more energetic β-ray group. A more definite determination of the spins could not be made without establishing the nature of the γ-transitions.

J. ROTBLAT.

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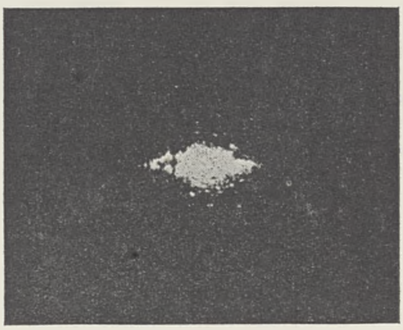
Aug. 20.

[1] Downing, J. R., and Roberts, A., *Phys. Rev.*, **59**, 940 (1941).
[2] Feather, N., *Proc. Camb. Phil. Soc.*, **34**, 599 (1938).

Refraction Patterns of the Surfaces of Opaque and Translucent Solids

IN a previous note, one of us (Rivlin[1]) has described a method for studying the distribution of facets of various orientations on the rough surfaces (ground, scratched or etched) of transparent solids.

We have since developed a similar method for studying such surfaces of opaque or translucent solids. This consists in making a cast of the rough surface using some transparent substance and in obtaining the refraction pattern in a manner similar to that previously described.



We have found 'Diakon' a suitable substance for the cast. A solution of 'Diakon' in ethyl acetate is painted on to the rough surface and is allowed to harden. The painting process is repeated until a suitable thickness of 'Diakon', say ½ mm., is obtained. The cast is then peeled from the surface. A point source of light is viewed through the cast and a refraction pattern which is characteristic of the surface under consideration is obtained.

The accompanying figure shows the refraction pattern obtained from a cast of the (100) surface of a hypersthene crystal ground with 60-mesh carborundum abrasive. This indicates strongly preferential fracture of the crystal on planes parallel to the zone axis [001]. The *b* axis of the crystal is horizontal.

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England.

W. A. WOOSTER.

Department of Mineralogy and Petrology,
University of Cambridge.
August 26.

[1] Rivlin, R. S., NATURE, **146**, 806 (1940).

Observational Clue to the Size of Meteors

CONSIDERABLE difference of opinion prevails concerning the size and mass of meteors. While one school of investigators, attacking the problem from theoretical considerations based on certain relations between amount of light emitted by an incandescent body and its extent of surface and mass, is prepared to give the nucleus of average naked-eye meteors a volume scarcely greater than a few cubic millimetres, another school, consisting mainly of experienced observers, but by no means indifferent to theoretical calculations, argues in favour of much larger dimensions for them—at least several cubic inches. As there is no possibility of observing meteors at close quarters, much less handling them, while on their aerial path, the question has remained undecided.

An observational clue, however, is available. Even in strong moonlight, one can often see distinctly meteors of the 2nd and 3rd magnitude. Owing to the illumination of their background, moonlight meteors not only appear to be much nearer objects, marking their trails, not *on* the dark background of the sky, as they usually do in moonless nights, but *in front of* the illuminated background. Occasionally, they send forth a momentary flash (which greatly adds to their brightness), due undoubtedly to the reflexion of moonlight from their surface. For such a thing to happen, not only should the reflecting surface of the meteor be suitably disposed towards the moon, but also it should have an appreciable area also.

Having observed the phenomenon a number of times quite distinctly, I believe that it furnishes observational evidence in favour of the relative large size of meteors.

MOHD. A. R. KHAN.

Begumpet,
Deccan.

Ionization Potentials of Polyatomic Molecules

THE recent development of our knowledge of the electronic structures of molecules makes it possible to specify with reasonable certainty the particular electron with which a definite molecular ionization potential is to be associated. In an organic molecule the variation of an ionization potential with, for example, alkyl or halogen substitution reflects the change in negative charge density in that part of the molecule in which the electron is located. The existence of resonance in a molecule also considerably affects the ionization potentials of the resonating electrons. It is clear, too, that ionization potentials are intimately bound up with chemical activity, dipole moments, refractivities, combination radii, electronegativities, etc.

In a programme concerned with the determination of molecular ionization potentials we have used absorption spectra in the vacuum ultra-violet whenever the absorption bands obtained were sufficiently discrete for the photo-ionization limit to be observed. When this was not the case electron impact methods were employed, the values being substantiated by whatever limited spectroscopic evidence was available. The spectroscopic values are accurate to at least 0·01 v., while the electron impact ones have the lower accuracy of about 0·1 v. Higher ionization potentials than the minimum have in general been obtained only by the electron impact method and are of a somewhat lower accuracy. Some of the values so far derived for the *first* ionization potentials

of certain classes of molecules are collected below:
H_2O, 12·56; CH_3OH, 10·8; C_2H_5OH, 10·7; C_3H_7OH, 10·7; $(CH_3)_2O$, 10·5; $(C_2H_5)O$, 10·2; H_2S, 10·42; C_2H_5SH, 9·7; $(CH_3)_2S$, 9·4; $(C_2H_5)_2S$, 9·3; $n(C_3H_7)_2S$, 9·2;
NH_3, 10·8; CH_3NH_2, 9·8; $(CH_3)_2NH$, 9·6; $(CH_3)_3N$, 9·4;
H_2CO, 10·83; CH_3CHO, 10·181; $(CH_3)_2CO$, 10·1; CH_2CHCHO, 10·06;
$CH_3CHCHCHO$, 10·19;
CH_3CCH, 11·25; $HCCCCH$, 10·74;
H_2CCHCl, 9·95; $ClHCCHCl$, 9·61 (*cis*), 9·91 (*trans*);
C_6H_6, 9·19; $C_{12}H_{10}$, 8·3; $C_6H_5CH_3$, 8·77; $C_6H_4(CH_3)_2$ (*o*, *m* and *p*), $\sim$ 8·3 electron volts.

Values given to 0·01 v. are spectroscopic, the others are electron impact values. For H_2O, H_2S, H_2CO and their alkyl derivatives the electron removed is a non-bonding $p\pi$ oxygen (or sulphur) electron. For NH_3 and the amines the minimum ionization potential corresponds to a $2p_z$(n) electron, which is non-bonding with orbital perpendicular, to HHH plane[1]. In methyl acetylene, diacetylene, the halogenated ethylenes and the aromatic molecules, π electrons of the double and triple bonds are involved, these being modified by resonance in molecules where conjugation occurs.

For acetaldehyde, acrolein and crotonaldehyde, very extensive Rydberg series were found in the vacuum ultra-violet, enabling the ionization potentials of these molecules to be obtained with unprecedented accuracy. One of the Rydberg series found for acetaldehyde contained sixteen members and gave a limit corresponding to $10·1811 \pm 0·0007$ v. This is the most accurate ionization potential so far determined for a polyatomic molecule. A fifteen membered series was obtained for crotonaldehyde giving an ionization potential of $10·187 \pm 0·001$ v. and a series of ten members in acrolein converging to a limit of $10·057 \pm 0·006$ v.

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[1] R. S. Mulliken, *J. Chem. Phys.*, 3, 506–14 (1935).

Carotenoids of Grass Silage

When using Moon's[1] method for the estimation of 'crude carotene' in routine silage samples, we have applied Moore's[2] chromatographic technique for removing other chromogens from the carotene solution, as obtained by Moon's method, in order to obtain a value for 'pure carotene'. In the case of silages the 'pure carotene' values may be considerably less than the 'crude carotene' values.

Latterly we have sought to replace the customary phase separation of 'crude carotene' and xanthophylls by using the same chromatographic technique for the removal of xanthophylls as well as of non-carotene chromogens from the petrol ether solution.

Values for 'pure carotene' obtained by (*a*) passing the petrol ether solution of 'crude carotene' after phase separation of xanthophylls through a column of dicalcic phosphate (prepared as recommended by Moore[2]) and by (*b*) passing the original petrol ether solution of total carotenoids through a similar column were in close agreement. For routine carotene estimations on silage, procedure (*b*) has the advantage of avoiding the phase separation.

The chromatograms of a series of samples of laboratory grassland silage examined in this way displayed an interesting feature. From the fourth day after ensiling, a well-defined blue-green band about 1 mm. wide appeared some 5 mm. *below* the strongly adsorbed 'xanthophyll' band at the top of the column. While attempting to repeat this observation on later samples, this band was not always obtained at once, but a light yellow band of the same thickness appeared in the same position on the column. On sucking off the petrol ether from the column this yellow band changed in the course of 3–5 hours to the same blue-green as originally observed.

This ready isolation of a blue-green chromogen from the petrol ether solution of the carotenoids of grassland silage may have a bearing on the production of 'grass yolks' in eggs from hens fed on silage[3].

A seasonal incidence of olive-tinted yolks has also been observed in egg-packing stations in Northern Ireland. In one case it was found that the birds were ranging on young pasture rich in suckling clover; the incidence of the olive tint was cured by shutting the birds off from pasture for a time.

It seems possible that the cause of this seasonal incidence of olive-tinted yolks may lie in the special richness of early summer pasture in carotenoids, together with factors increasing the lability of the carotenoids and favouring the production of carotenoid derivatives of blue or blue-green colour. One such factor might be acidity, present alike in grass silage and in the fowl's crop.

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Aug. 20.

[1] Moon, F. E., *J. Agric. Sci.*, 29, 295 (1939).
[2] Moore, L. A., *Ind. Eng. Chem.*, Anal. Ed., 12, 726 (1940).
[3] Gish, C. L., Payne, L. F., and Peterson, W. J., *Poultry Sci.*, 19, 154 (1940).

Polygenic Variability in Wild *Drosophila melanogaster*

Several authors have reported the recovery of variant types by inbreeding *Drosophila melanogaster* caught in the wild. The mutations described have generally been of single major genes, recognized either by their obvious morphological or lethal effects; inverted sections of the chromosomes have also been found. The literature of the subject has been reviewed by Dobzhansky[1].

Adaptation and speciation, however, chiefly depend on the action of selection upon what has been called quantitative, or more recently polygenic, variation[2]. Many genes, each having a small effect, control this type of variation, which probably affects all characters showing a range of apparently continuous variation. Such polygenic variation has now been shown to exist in wild populations of *D. melanogaster*.

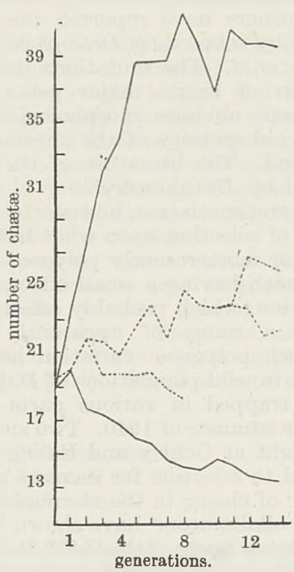
Flies were trapped in various parts of southern England in the summer of 1940. Two strains derived from flies caught at Ockley and Ealing respectively were subjected to selection for increase and decrease of the number of chætæ in the sternopleural regions. Dubinin and collaborators[3] have shown that populations from different parts of the U.S.S.R. have characteristic and different numbers of sternopleural chætæ, and my own experiments (unpublished) have shown the variation to be polygenic.

Before selection the two strains had a mean number of sternopleural chætæ within the range of variation found in laboratory stocks and flies collected from other localities. The Ockley strain had a mean of 19·05, a variance of 5·1552 and a range from 24 to 16 in a rather crowded culture; the Ealing strain a mean of 19·65, a variance of 2·3346 and a range from 25 to 15.

The results of selection are shown in the accompanying graph, in which the mean of the two sex-means is plotted against the filial generations. The Ockley strain (solid line) was selected in the first and following generations of the experiment. The line selected for increased number shows a remarkably rapid advance for five generations, during which the number of chætæ was doubled; from the fifth to the fourteenth generation no further advance occurred. The line selected for decreased number shows a slower but continuous advance after the first generation under the influence of selection, which appears to be still operative in the fourteenth generation.

The Ealing strain (broken line) was mated at random in the first two generations of the experiment, during which the number of chætæ increased slightly; selection in both directions was begun in the third generation. The high selection line shows an irregular advance which has not ended by the fourteenth generation. The low selection line returns to the parental level, where it remains stable for three generations. A decrease then begins which is ended by the death of this selection line. A second low selection line was started in the tenth generation by back selection from the high line; this led to a reduction of chæta number after the first generation of back selection. Thus after eight generations of selection sufficient variability was still present to permit not only of new increases, but also of decreases in chæta number when the direction of selection was reversed.

Both the wild strains selected possess a store of polygenic variability; in one, the Ockley strain, this was readily available to the action of selection, especially in the direction of increased number, giving an advance far greater and more rapid than has been obtained by selecting the progeny of crosses between laboratory stocks. In the Ealing strain the variability was more gradually released, so that selection was still operative after twelve generations. Such a liberation of stored variability is brought about by the recombination of internally balanced combinations of + and − polygenes[2].



——— Ockley strain
. . . . . Ealing strain
mean of ♂ and ♀ means.

The genes available for selection were not alike in the two strains; those in the Ockley strain increased the number of dorsocentral and scutellar bristles as well as the sternopleural chætæ on the number of which selection was carried out (the low selection line, however, showed the normal number of four dorsocentral and scutellar bristles). In the Ealing strain no change was observed in the number of dorsocentral or scutellar bristles.

Polygenic variability has previously been demonstrated only in laboratory stocks and domesticated plants and animals, although its existence in wild populations has been deduced from the behaviour of interspecific and inter-racial hybrids. It is now shown to exist within wild populations of *D. melanogaster*.

L. G. WIGAN.

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Merton Park,
London, S.W.19.
August 7.

[1] Dobzhansky, Th., *Biol. Rev.*, **14**, 339 (1939).
[2] Mather, K., *J. Genet.*, **41**, 59 (1941).
[3] Dubinin, N.P., and collaborators, *Biol. Zhurn.*, **3**, 166 (1934).

Importance of Adult Education

I READ many articles concerning after-the-War problems, but all are vague and not wholly convincing. At one time we had here in Colorado a Populist Party. It was a party of protests and for a time prospered, but it withered away because it had no adequate programme. Some wit wrote: "A Populist is a man who doesn't know what he wants, but wants it damned bad."

It seems to me that the first step towards a reasonable programme is to define our objectives. Let us begin with these: (1) every man his job; (2) an adequate standard of living.

We then proceed to ways and means. Universal employment implies universal capacity to render service, excluding only the unemployable, who have to be segregated in institutions, and many of these can undertake simple types of work. The ability to do useful work requires suitable and varied education. This education must have moral and cultural aspects, developing social conscience and breadth of view as well as technical skill. The work must be done for use, not primarily for profit, but there must be material rewards.

The standard of living depends especially on two things: (1) ability to produce; (2) ability to use.

The facilities for production have increased so greatly in recent years, that I have not met a man who does not believe that poverty could be abolished. Ability to use depends largely on education and social contacts. Thus the lovely English countryside is capable of affording enjoyment to thousands who at present regard it with indifference, and with no extra cost to any one, except perhaps facilities for getting about (when young, I used to go on foot, with a pack on my back). The libraries offer us untold wealth, if we care to use it. Thus the standard of living depends very largely on the standard of life.

At the same time we must recognize the fact that in recent years not only has the production of wealth greatly increased, but also this wealth has reached the people, and represents a triumph of democratic economy. The New York *Sun* recently offered some statistics, of which I quote a part: In 1900 there were in the United States about 1,000,000 telephones; now there are 20,400,000. In 1900 there were 8,000 automobiles; in 1941 there are 25,000,000. In 1920 there were only 1,000 radio sets; in 1941 there are 43,000,000. In 1910 there were 16,372,000 savings accounts; in 1941 there are 46,000,000.

These gains are enormous, yet not without their disadvantages. In the United States nearly a hundred thousand persons die from accidents each year, a large proportion due to incompetent handling of automobiles. The radio brings us wisdom, but more trash. Thus we have to learn to enjoy and profit by our blessings, avoiding their misuse. Here we have a clearly defined programme, and we can carry it forward without waiting for the end of the War. Among reasonable people it should meet with no hostility, but it does imply willingness to co-operate, and a certain degree of courage and faith. I can believe that very many of those who are now our enemies would be glad to join with us in the endeavour, once they are convinced that we are sincere and unafraid.

T. D. A. COCKERELL.

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A Scientific Press Bureau

THE second editorial article in NATURE of August 30, "Physics and the Future", remarks how remote is science to the majority of citizens. As never before, pure and applied science to-day plays an essential part in affairs, and it has recently been said that scientific development can make good in a very short time the material wastage and set-backs of this War. But it is only occasionally, as when 'Radiolocation' was announced, that the average citizen realizes that science is not entirely a means of producing more and more terrible weapons of destruction. The scientific attitude applied to our post-war problems, we believe, can rid civilization of recurrent wars and economic chaos. If we admit the ideal of democracy, the power of science to accomplish these ends must depend upon the public acceptance of science as a desirable thing.

Now how does the average citizen learn of the work of science? We find in the *Manchester Guardian* and *The Times* excellent accounts of new developments, but the mass-circulation newspapers almost without exception ignore scientific news but for occasional garbled items of a sensational nature, or comic strips of the "Buck Ryan and his Space Ship" type.

In the United States, newspaper readers are better served. Natural science editors contribute special and weekly articles in most of the large papers, and Science Service, directed by Watson Davis, publishes the weekly "Science News-Letter" which is frequently quoted by the Press.

While planning for the future, the representatives of science in Great Britain must admit the question of public relations in the post-war period, otherwise science may not attain the recognition necessary for it to contribute fully towards a better world. Instead, antagonism might grow up among those who know only of the inventions that have been misapplied in war and in commercial exploitation.

What is required now is a 'set of blue-prints' for a future Scientific Press Bureau, supported by the scientific societies and engineering institutions and staffed by experienced journalists. Bold in conception and vigorous in its policy, it must bring to the man in the street, through his newspaper, accurate and balanced knowledge of the work, aims and achievements of science and the technical arts.

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Herts. Aug. 31.

Plankton as a Source of Food

IN reply to the latest communication under this heading[1], I would like briefly to recall (*a*) the common agricultural practice of green manuring[2] in which often the only obvious addition to the land is of 'carbon'[3] though the benefit to future crops is undeniable[4], (*b*) the importance of freshwater algæ as soil surface-binders[5] even if the addition of potential humus is small, (*c*) the facts that many algæ are notoriously rich in vitamins[6] and are now known to contain growth-substances[7] in such amounts as might conceivably be absorbed from the soil by seeds[8] and roots[9] and have a formative and growth-promoting action upon various organs of vegetable plants[10], (*d*) that the exact manurial and other treatment can further condition the vitamin content and growth and robustness of a crop for reasons not yet understood[4], (*e*) the ubiquity and usual wastage of the human system as a source of combined nitrogen and phosphorus as well as of auxins[10], and (*f*) that Cyanophyceæ capable of fixing nitrogen can be grown in mineral solutions as well as on or near the surface of soil[11], while the presence of other algæ increases nitrogen-fixation by bacteria[5]; on the other hand it is often wasteful and may be harmful to add nitrates and ammonium salts to soils that have to be watered[12].

In my previous communication[13] I did not, nor do I now, contend that any (or even several together, so far as they are applicable) of these or related matters that may be concerned with plant nutrition via watering will actually benefit the growth and production of vegetable crops to an appreciable degree; my object was merely to suggest a mode of practical application after pointing out such a possibility, which, I maintain, should be fully investigated by means of controlled field experiments in proper bulk.

NICHOLAS POLUNIN.

Department of Botany,
University of Oxford.
Sept. 13.

[1] NATURE, 148, 314 (September 13, 1941).

[2] Imperial Bureau of Soil Science, Technical Communication No. 22.

[3] Russell, "Soil Conditions and Plant Growth", 7th ed., London (1937).

[4] Jenkins, "Organic Manures", Imperial Bureau of Soil Science, Technical Communication No. 33 (1935).

[5] Fritsch, "The Rôle of the Terrestrial Alga in Nature", Essays in Geobotany . . ., 195, California (1936).

[6] Tilden, "The Algæ and their Life Relations", London (1935).

[7] van Overbeek, *Bot. Gaz.*, 101, 940 (1940).

[8] Croxall and Ogilvie, *J. Pomol. and Hort. Sci.*, 17, 362 (1940).

[9] Hitchcock and Zimmerman, *Contrib. Boyce Thompson Inst.*, 7, 447 (1935); Pfahler, *Jahrb. wiss. Bot.*, 86, 675 (1938).

[10] Went and Thimann, "Phytohormones", New York (1937); Meyer and Anderson, "Plant Physiology", London (1940).

[11] NATURE, 142, 878 (1938).

[12] Barker, "The Use of Fertilizers", London (1935).

[13] NATURE, 148, 143 (1941).

DRY FUEL FORESTS OF THE MADRAS PROVINCE

A SMALL illustrated monograph written by Mr. A. L. Griffith, I.F.S.* provincial sylviculturist, Madras, merits the close attention of the administrative and forest officers in West and East Africa.

A century ago in the 1830's and 1840's Madras was passing through some regrettable and painful forestry experiences. The administration for four decades had had no belief in the necessity of a forest policy or in forest protection ; and the people naturally wanted neither. Whilst, therefore, during the first half of the nineteenth century the finest teak forests or the most accessible at that time were despoiled, the larger areas of forest situated in the central and eastern regions—what are termed here the dry fuel forests (savannah or bush in Africa)—were regarded as of no value and the population allowed to cut, burn and overgraze them, as in the past. Even when the Government realized that some form of protection should be given these areas, they were not regarded as 'forests' or placed under the then existing Forest Department. The idea grew and persisted that the work of the forest officer should be confined to the management of marketable timber forests only—an idea which has resulted in irretrievable harm to much forest and has caused the disappearance of large areas both of 'timber forest' and 'dry fuel' or 'bush' forests. Mr. Griffith writes : "The dry fuel forests of the unreserved, waste lands and panchayat forest" (in which the administration at one period placed such a childish faith) "have either completely disappeared or are very rapidly disappearing due to the ravages of man and his animals, chiefly goats." Some of Mr. Griffith's predecessors were writing nearly identical words almost exactly a century ago ; the country, be it remembered, being at that period much less developed and the population and their animals very much less numerous.

At the present day we are told that the dry fuel forests of Madras are one of the most important types occurring in the Province, and in reserved forest alone they consist of roughly 900,000 acres with an annual cut of approximately 30,000 acres which produces an annual revenue of Rs.400,000. This type, says the author, occurs in twenty-two out of twenty-eight districts, and the general climate has an average rainfall of from 10 to 35 in., most of this precipitation coming from the north-east monsoon in October and November. Apart from this rainy period the rest of the year is generally very dry and very hot. These forests are essentially 'local' forests, and supply the needs of the local villages with fuel, agricultural implements, small building timber, grazing, etc.

What is the difference between this 'type' and that of the large areas of so-called savannah or bush in Africa, upon which the people equally depend in one way or another for the chief ingredients of existence ? Yet in Africa, by many of the administration at least —and probably not a few forest officers (all brought up in the belief)—savannah or bush was until quite recently not regarded as forest or as meriting or requiring any attention. That the recognition of the value of the type took upwards of a century in Madras is surely no reason for wasting so long a period and making the same mistakes in Africa. The following brief extract from the monograph, which must be read to be fully appreciated, may be considered :— "These areas which are in the reserved forests are worked in general on a thirty-year rotation, now in many cases being raised to forty years, by the system of simple coppice. At each coppicing the mortality of stools is 5–10 per cent and this is not being replaced by natural regeneration.

"*Hence the improvement and maintenance of these forests by artificial regeneration is an absolute necessity*" (italics are the author's).

During the past ten years it has been shown that this artificial regeneration can be done with a certainty of success and at a reasonable cost even under the poorest conditions by the 'rab' method, and at practically no cost at all by the '*rab-kumri*' method, that is in conjunction with field crops (shifting cultivation).

* "Note on the Artificial Regeneration of the Dry Fuel Forests of the Madras Province" (*Ind. For. Rec.*, Silvic. (New Series), 3, No. 8. New Delhi, Govt. of India Press: 1940).

STEAM HEATING OF BUILDINGS

SO long ago as 1653, Sir Hugh Plat, of London, heated glasshouses with steam from a cast-iron pot placed outside. This is described in his book on horticulture, "The Garden of Eden". James Watt is believed to have used in 1784 the first elementary steam radiator. It was fitted in his study and consisted of an iron box with connecting pipes through which steam was passed from boilers. In 1825, Matthew Murray, of Leeds, the well-known competitor of James Watt, heated his house, which was locally known as "Steam Hall", by means of exhaust steam from the engine of his adjoining works. Meanwhile, in 1804, Oliver Evans in the United States had mentioned in one of his patents the use of exhaust steam from engines for heating.

An interesting article by David Brownlie, which deals specially with steam heating in the United States, begins in *Engineering* of September 5. He points out that from the technical and scientific point of view, one of the most serious defects of modern civilization lies in the fact that the condensing steam engine and turbine still lose some 55 per cent of the total heat in the coal, or other fuel, in the condenser. Even more serious is the use of the non-condensing engine, of which a particularly bad example is the steam locomotive operating at a thermal efficiency of no more than 6–8 per cent. Now experience with thousands of plants, mostly relatively small, has shown that great economy in fuel can be obtained by employing back-pressure or pass-out engines and turbines and utilizing the exhaust steam for heating and process work. The actual thermal efficiency under average conditions is thus raised to 65—75 per cent by the reduction or elimination of the loss of latent heat.

The exhaust steam can be used directly in individual establishments or by what is popularly termed 'district heating' In general this means the supply of steam or hot water by means of long-distance pipe lines for the heating and general service of all types of buildings extending over a whole district or part of the area of a town.

The re-organization and improvement of the whole fuel system of Great Britain is long overdue, and one of the most important requirements is an extensive development of district heating. To indicate the possibilities in this direction the author first discusses the two chief countries in which district-heating is employed, namely the United States and the U.S.S.R. An important point, the significance of which has not yet been generally realized, is that most of the heating in the United States and all other countries except the U.S.S.R. is carried out on thermally inefficient lines by live steam, and not by the exhaust steam, so that the total power generated in the heating stations is very small. Russia is the only country that has developed district heating upon an extensive scale by using exhaust steam from public supply electric power stations.

In the United States there are at the present time about 175 district heating companies in operation, probably supplying more than 35,000 million pounds of steam per annum. This represents only a small proportion of the total heat used in the domestic field, which requires more than 100 million tons of coal (anthracite and bituminous) per annum in addition to large amounts of oil, natural gas, coke and other fuels. District heating was made a commercial success in 1877, at his house in Chestnut Avenue, Lockport, New York, by Birdsill Holly, who founded the first steam heating company, known as the Holly Steam Combination.

The largest district heating system in the United States at present is that of the New York Steam Corporation. In 1882 the first heating station was put into service at Cortlandt Street in the Broadway area, supplying steam at 80 lb. pressure through three miles of mains. The present total length is equivalent to about ninety miles of 12 in. pipe. It has five heating stations all operated on modern steam-driven power-station lines, the largest being the Kips Bay plant at 35th Street on the East River. The pulverized-fuel equipment for the five boilers at Kips Bay consists of seven mills in an adjoining building with a total duty of 160 tons of bituminous coal an hour. An important feature of the equipment is the softening plant dealing with New York town water.

The ninety miles of mains interconnecting the five stations are of lap-welded steel with welded flanges and corrugated copper expansion joints, and numerous draining stations, capable of operating, if necessary, at 250 lb. per sq. in. pressure. Most of the insulation is 85 per cent magnesia, in blocks 2 in. thick, with canvas and tarred felt outer covering. The mains are generally laid below the pavements in concrete and tile conduits with cast iron covers, the space between the mains and walls and floor of the conduit being filled with loose slag wool.

ANTARCTIC DISCOVERIES

By Prof. R. N. Rudmose Brown

SOME preliminary accounts of the important discoveries of the United States Antarctic Expedition, 1939–41, under Rear-Admiral R. E. Byrd, are published in the *Geographical Review* of July, in an article by Lieut.-Commander R. A. J. English, U.S.N. The vessels of the expedition, *North Star* and *Bear*, reached the Bay of Whales on the Ross Ice Barrier on January 11, 1940. A base to accommodate thirty-seven men was set up on the barrier within a few miles of Admiral Byrd's old base of Little America. The *North Star* then left to establish the east base for sixteen men in Marguerite Bay on the west coast of southern Graham Land. There she was joined by the *Bear* and when the unloading was completed the two vessels left for the United States not to return until the early months of 1941, when both bases were evacuated and the whole expedition left for home.

The year in the Antarctic was well used in sledge journeys and in flights. Between Charcot Island on the east and the Ruppert Coast of Marie Byrd Land there was a gap in the known coast-line of Antarctica extending over some seventy degrees of longitude. To the south of the unknown coast-line Ellsworth had established continuity of ice-covered land with many peaks in his trans-antarctic flight of 1935. Light was thrown on this problem by flights from the *Bear* on her journey from the Bay of Whales to Graham Land, which was approximately along the parallel of 70° S. There were several short but important flights. A flight along the Ruppert Coast to about long. 135° W. revealed a coastal range about 4,000 ft. in height, snow-covered but with rock exposures near the coast. Far to the south the peaks of other ranges were seen. From lat. 70° 58′ S., long. 105° 33′ W. a flight southward again revealed such ranges lying parallel to the coast. Lastly, a flight from lat. 70° 4′ S., long. 95° 19′ W. confirmed the impression of the last flight of a mountainous peninsula immediately to the west, and the main coast-line was found to extend eastward in about lat.73° S. These flights have thus filled in the coast-line south of the Pacific except for a stretch of some three hundred miles between long. 115° and 122° W.

The general arrangement of the mountains in this section of Antarctica would appear to be a series of ranges more or less parallel with the coast. The Rockefeller Mountains seem to be the western end of a long range broken by many glaciers pouring northward from the high plateau of Marie Byrd Land. The highest peak discovered was Mount Hal Flood, over 10,000 ft. in altitude, in lat. 76° 4′ S., long. 135° 50′ W. Farther eastward there were sighted bare coastal mountains towards which the interior plateau fell. These coastal mountains extended at least as far as long. 133° W. They suggest a continuation of the Andean folds of Graham Land. Incidentally also later flights supplemented Rymill's charting of Alexander I Island by adding the southern coast-line. This was determined in flights from the east base. Another of these flights mapped the western end of King George the Sixth Sound, which was also examined by one of the numerous sledge expeditions from the same base.

Some new facts in regard to the Ross Barrier seem to have been discovered. A flight from the base to lat. 81° 8′ S., long. 176° 15′ W. showed wide fractures in three places, not yet specified, which suggests that the ice was aground. A large snow-covered island, about thirty miles long, was noted south-east of Roosevelt Island in approximately lat. 81° S., long. 158° W. This, of course, would mark a land area overlain by the shelf-ice of the Barrier.

A flight was made along the northern face of the Queen Maud Range from Mount Hope near the Beardmore Glacier to long. 147° W. In long. 175° W. a mighty glacier nearly as large as the Beardmore Glacier was noted.

Perhaps, however, the most important result of all was achieved from the east base in a flight southward and then south-eastward across the Eternity Range of southern Graham Land to the missing western coast of the Weddell Sea. This coast has proved unapproachable by sea. Larsen, Bruce, Filchner and Shackleton each were foiled by heavy packs in attempts to penetrate the western part of the Weddell Sea and between lat. 71° S. and the Weddell or Filchner Barrier in lat. 77° to 78° S. nothing was known. The Eternity Range was photographed and followed southward to lat. 74° 37′ S., long. 61° 15′ W. Beyond this as far as lat. 77° S. a south trending coastal range was visible with summits of apparently decreasing altitude. These discoveries suggest that the Weddell Sea may be wider at its southern end than had been believed. From both the west and east bases further work was done by plane and sledge, and extensive photographic surveys were made especially in Marie Byrd Land. Other aspects of the work of this highly successful expedition are not available. The article in the *Geographical Review* includes a preliminary small-scale map.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

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