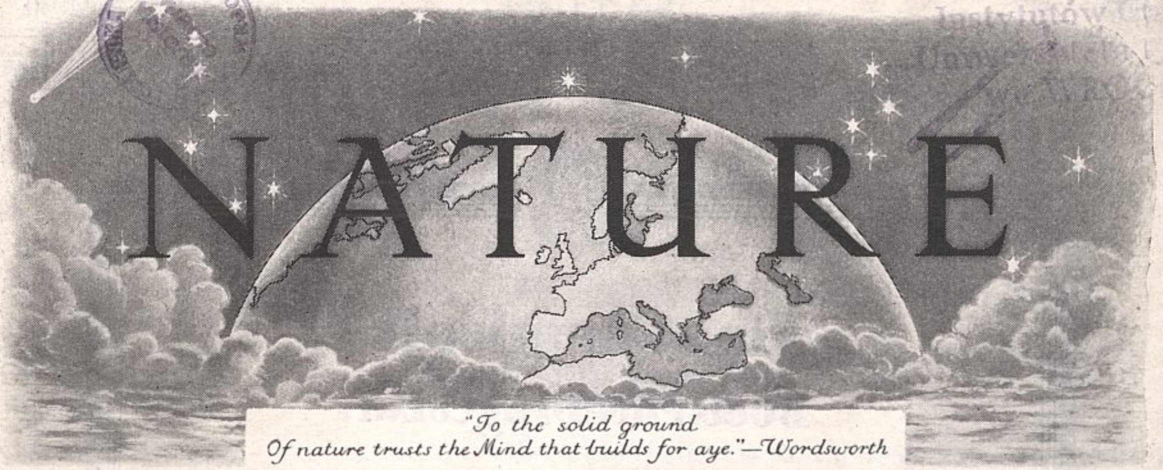

NATURE

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

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SCIENTIFIC PLANNING OF LOCAL GOVERNMENT

IT is becoming a commonplace to say that war is no longer an affair of armed forces alone. Curtailed lighting, restrictions on travel whether by road or by rail, national registration, the rationing of food and of petrol, the exigencies of civil defence, and many other measures have brought home to all that national needs and effort must, on occasion, override all personal and individual considerations. Nothing can be allowed to stand in the way of our immediate purpose, which is to win the war, with the view of establishing an order based on the peaceful settlement of international disputes.

It would be disastrous, however, if the restraints necessarily imposed on individuals in a time of war engendered merely a sense of frustration. Behind even the prosecution of the war lies the purpose of safeguarding our national life and existence, for it is the preservation of our mode of life, with its traditions and heritage of justice and freedom, that has called forth this effort. Nevertheless, the very disturbances and shocks administered to the structure of our national life may loosen obstacles that have hindered its development in the past. Amid all the tragedy and wreckage of war, any opportunity which it may afford to redeem the mistakes of the past should not be forgotten.

There are few fields of planning in which to some extent fresh opportunities are not opening up and possibilities of further progress and development appearing. The organization of national defence has given a fresh impulse to many forces making for regionalism, the co-ordination of local authorities or of public services, the control of the location of industry and like matters. Under the exigencies of war, fresh experience is being gained which should ultimately be of value in the reintegration and development of national life, both under local authority and central government. Particularly is it true that the organization of civil defence, whether in the actual precautionary services against air attack or in the dispersal of population in evacuation schemes, has exposed defects in our administrative system which should be rectified at the first opportunity.

Notable among such weaknesses are the difficulties which local administrative units, often with archaic and thoroughly unscientific boundaries, can put in the way of a uniform and adequate plan of defence ; and the failure of such bodies to appreciate the differences between urban and rural conditions and to apply measures appropriate and adequate in each sphere. It is not easy to assess the wastage which has been caused by such weaknesses ; but an attempt should be made not merely to eliminate such waste but also to deal with its underlying causes.

An outstanding contribution in this field is Dr. W. A. Robson's study "The Government and Misgovernment of London", which appeared a short time before the War broke out. The attention of scientific workers has already been directed to this book in these columns (NATURE, **144**, 846 ; 1939), but much of the third part of Dr. Robson's book is of general validity and far from being confined to the particular question of London. The issues of regionalism, the principles of democracy involved, no less than those of planning, affect more or less acutely, problems of national and local administration throughout Great Britain, and the stimulating discussion of these matters deserves the careful attention of all those who are determined to seize any fresh opportunities which the testing time of war may present.

Regional reorganization, whether in London or elsewhere, is not necessarily a political question in the party system at all. There is little reason to believe that any political party would gain or lose much by the introduction of reform and, in the main, all are in favour of administrative efficiency as they understand it.

If, however, on political grounds reconstruction is not likely to meet real difficulties, strong opposition may be encountered from the numerous local authorities whose prestige or even existence might be affected. Dr. Robson directs attention to the importance of this appearance of vested interests in local government and to the need for investigation by competent sociologists. There is an obvious need for impartial scientific investigation. The picture of muddle and frustration which Dr. Robson draws is far from being a matter of local concern. The organization of London's government is a national question calling for national leadership and direction. Solution of the problem on such scientific lines as suggested by Dr. Robson would, moreover, have effects reaching far outside the boundaries of even Greater London. Not merely would a great impetus be given to regionalism, but also experience would be forthcoming which would contribute immensely to the wise planning of national resources and the effective handling of the intricate issues involved in the national planning of transport, the utilization of land and the preservation of amenities.

What is clear is that the whole question still offers a wide field for investigation or research. Municipal research is in fact largely unknown in Great Britain, and most municipalities are content to carry out their own investigations independently of the experience or practice of others. There is no information service available for municipalities to promote co-operation in the study of problems of municipal administration, and there are few signs of any desire for such co-operation. The recommendation in the report on the location of industry issued by Political and Economic Planning (P E P) for the establishment of a central information service on industrial siting (see NATURE, **143**, 770 ; 1939) is essentially a step in this direction, but much more definite study and investigation are required. Regional problems require separate study, and above all study inspired by the belief that regions are not congeries of local units. The need for comprehensive improvement must be admitted, and the investigations prompted by a broader view and higher statesmanship. Only in such a spirit can we hope for effective experimentation with plans for federal or dual metropolitan government, and acquire the basic experience or use it wisely.

When all allowance has been made, however, for the need for fuller investigation on particular issues, it cannot be denied that there is already available an immense amount of knowledge which, if pooled and really utilized, would permit a much more effective co-ordination of national and local resources. The urgent necessity for economy in both local and national administration is a further reason for action. Unless some real attempt is made in London and elsewhere to find a regional solution on scientific lines for these interlocked problems of the chains of towns for which Patrick Geddes introduced the term 'conurbation', so far from the resources of the nation being husbanded and expended to the best advantage, we are likely to see yet further waste and frustration, through short-sighted economy starving essential services and neglecting bold and far-reaching measures which would eliminate the meaningless rivalries, overlapping and duplication so often encountered at present.

To secure action it is not enough to have an adequate plan and programme. Equally essential is a public opinion among the electorate alive to the possibilities and determined on reform. Unfortunately, as Prof. H. A. Mess pointed out a year ago in an able article in the *Political Quarterly* (**9**, 389 ; 1938), there are factors tending to weaken civic consciousness, and new cohesive devices and new forms of government may be required to develop civic consciousness in, for example, Greater London. At the best, in a new town there is a considerable time-lag before consciousness and sentiment adapt themselves to the new situation, and still longer before there is a change in local government.

This matter of local sentiment and public opinion is not entirely a matter of education. The term 'local sentiment' is ill-defined and often absurd. It would be hard to answer such questions as in whose minds it is found, how widely it is diffused, how strong it is and in what kind of attitudes and actions it results. The analysis by sociologists of such questions as these and others involved in the rise and decay of towns should be as valuable to those faced with the practical problems of administration as to those concerned with the education of the electorate in citizenship.

From whichever side we approach such problems, whether from that of education, the investigations which lead up to the planning, or the technical aspects and administrative detail of the planning itself, the responsibilities and opportunities of scientific workers are unmistakable. If we are to build, with resources impaired if not crippled by the sacrifices and vicissitudes of wartime, a social order in which the advantages which modern science has put at our disposal are more freely and fully utilized, and the present obstacles to that utilization or the forces dissipating our resources have been eliminated, scientific workers must play a major part. No defeatist spirit can be tolerated. Only as men and women, whether scientific workers or not, address themselves hopefully and adventurously to this creative task, ready to seize whatever opportunities may come and resolved that no inherited prejudices or vested interests of administration or property shall be allowed to injure the common welfare, can we hope to build cities and communities which will enjoy the true abundance which might be ours. We must be planning for that future even in the stress of war, if we are to be ready when the opportunity comes to transmute our dreams and visions into the cities, workshops and homes of a new era of civilization.

FUTURE OF ZOOLOGY IN INDIA

A LONG series of volumes, bearing the title of "The Fauna of British India", has been published under the authority of the Secretary of State for India, with the object of ensuring that the rich fauna of that great continental area is made properly known and, at the same time, of providing authoritative means for its identification. While its inception is more than fifty years old, the wisdom in launching this project has become increasingly justified in recent years. The first volume, which dealt with part of the Mammalia, appeared in 1888. The latest volume, also dealing with Mammalia, was issued in 1939 and is reviewed on the next page. Throughout this period, one or more volumes have been issued almost every year. During the War of 1914–1918, five volumes were published.

The "Fauna of India" has become increasingly used in Indian universities, colleges and museums. Furthermore, certain of the volumes rank as essential tools in the work of the scientific staffs of those Government departments concerned with agriculture, fisheries, forestry and tropical medicine; and indeed, certain forthcoming volumes promise to be of special importance in this respect. The "Fauna" series aims at providing accurate descriptions of all species of Indian animals and, thereby, forms the basis upon which further study depends. The importance of accurate identification scarcely needs stressing, whether it be, for example, of a mosquito concerned with disease transmission, an insect devouring a crop or an animal of solely scientific interest.

This primary object of the "Fauna" is being gradually achieved, but there is still a long and uphill road to traverse. For one thing, some of the earlier volumes are now out of date and need revision in the light of increased knowledge. Many divisions of the animal kingdom have not yet been dealt with, and there is the added difficulty of finding competent specialists willing to undertake the monographing of certain important groups. The Termites are a case in point, as they rank among the most destructive of Indian insects; little progress is being made in their study, mainly owing to difficulties attending their identification.

We learn with regret that the Secretary of State for India has decided to cease publication of the "Fauna of British India" for the duration of the War. While recognizing the present necessity for economy, it needs emphasizing that much of zoological progress in India may become involved in this decision. It behoves those who have such progress at heart to combine their efforts and do all that is possible to discourage any policy directed towards further economy, possibly resulting in the cessation of the publication of the "Fauna of India" altogether. Such an outcome would, in the long run, heavily counterbalance any monetary savings achieved.

The projected dominion status for India is linked with the growing part being played by Indians in the scientific development of their country. In this latter connexion they need every help that we can provide. From the zoological point of view, the least we can do is to ensure the continuance of this long-established publication.

THE MAMMALS OF INDIA

The Fauna of British India, including Ceylon and Burma
Edited by Lt.-Col. R. B. S. Sewell. (Published under the Patronage of the Secretary of State for India.) Mammalia. Vol. I: Primates and Carnivora (in part), Families, Felidae and Viverridae. By R. I. Pocock. Pp. xxxiii+464+31 plates. (London: Taylor and Francis, Ltd., 1939.) 30*s*.

BLANDFORD'S "Mammals of British India", published in 1888 and 1891, has until now been the standard work on the subject, and useful as that has been, it had for some years been regarded by zoologists as out of date, since a vast amount of additional knowledge on the subject has been gained in the last half century. A new edition that would embody the latest views on classification and the experience of sportsmen and travellers was greatly needed, and in 1923 Mr. Pocock, an eminent authority on the mammals of the world, undertook the task, little realizing the length of time that would be required owing to the vast amount of material to be handled and examined and the extent to which names of species and races required revision.

Formerly species were recognized mostly by their external appearance and local races regarded merely as varieties, whereas now careful measurements of the skulls and, where possible, other parts as well, has to be carried out. Well-defined local races are distinguished by the trinomial method of nomenclature.

That the work has been done with the utmost pains and thoroughness is clear from a perusal of the present volume, which deals with the orders Primates and Carnivora (in part). Of the former, British India possesses two species of gibbon, *Hylobates hoolock* and *H. lar*, these being the only representatives of the man-like apes, though the more ordinary types of monkeys are well represented by the macaques and langurs or leaf monkeys and the lemurs by the lorises.

Of the monkeys proper the author recognizes three distinct races of the rhesus in British India, the typical race occurring throughout nearly the whole of northern India and to a great extent Burma as well. This, the best known of all the monkeys as it is largely imported alive into European countries, although not regarded by the Hindus as sacred, is nevertheless left unmolested and so has become a very familiar object in native villages.

The lion-tailed macaque, also known as the wanderoo monkey, is certainly the most striking in appearance on account of the large growth of grey hair surrounding the face and the glossy black hair of the remainder of the body, but it is rare and keeps strictly to the thick forests of the Western Ghats.

Of the small lemurs, or lemuroids, the slow and slender lorises are well known, but research has shown that of the former there are no fewer than four and of the latter six distinct races. All are strictly nocturnal, sleeping bunched up in the fork of a tree by day, when they have much the appearance of the little spotted owl (*Athene brama*) and "the same habit of swaying the head and, when fighting, utter a similar screech". At the approach of darkness they creep forth and capture their prey "after a stealthy approach, with a lightning grab of both hands, and hold it in a tenacious grip while devouring it."

The greater part of this volume deals with the Carnivora, in which the author admits that classification is difficult. Of the Felidæ the zoologists of old grouped all in the genus *Felis*, with the one exception of the cheetah or hunting leopard which was distinguished by its so-called non-retractile claws; but Mr. Pocock finds that this animal is actually more nearly allied to the ordinary cats than the latter are to the lions, tigers and their near relations. He places the great cats (lions, tigers, etc.) in a separate subfamily, Pantherinæ, the more ordinary cats in that of Felinæ, including a number of genera, while the hunting leopard alone occupies the subfamily Acinonychinæ.

The lion was formerly abundant in northern India; but is now nearly extinct there, the few that remain being restricted to the Gir Forest in Kathiawar, where they are protected. The author believes that it made its way into India through Persia and Baluchistan in comparatively recent times and was not there long enough to penetrate far southwards. Its near extermination has been brought about by human persecution and not, as has often been suggested, by competition with the tiger.

This volume will surely rank as a very worthy member of a fine series.

D. SETH-SMITH.

GREY OWL: NATURALIST

Half-Breed
The Story of Grey Owl (Wa-Sha-Quon-Asin). By Lovat Dickson. Pp. xii + 346 + 12 plates. (London: Peter Davies, Ltd., 1939.) 10*s*. 6*d*. net.

"Grey Owl went to his last resting place as he would have wished. . . . As the sun set on Lake Ajawaan, the burial party turned back to town, one hundred miles distant, leaving Grey Owl among the birches and pines he so much loved, at peace in a remote and lovely grave."

THAT was in 1938, and thus was marked the end, at the early age of fifty years, of one of the most intriguing personalities that graced modern times. But it also marked the beginning of a rumpus which raged for some considerable time after his death. Grey Owl or Wa-Sha-Quon-Asin, a self-styled North American Indian, was shown to have lived his younger days in Hastings and attended the Grammar School there. His name was Archie Belaney, and his aunts still live in that town. Had he hoaxed the world, or was there a conundrum demanding thorough investigation? Mr. Lovat Dickson, Grey Owl's friend and confidant, spared no pains in his endeavour to establish the truth. But it seems that the whole truth may never be told. That he was not a full-blooded Indian of the Ojibway tribe is now certain; but that he was a pure 'white' is uncertain. It depends upon the origin of his mother, which so far has not been thoroughly traced. But after carefully examining the details meticulously recorded by his biographer, it seems impossible not to believe that he was a half-breed. For if he was not, then much of his behaviour, and indeed his very physical appearance, are incomprehensible.

Interest in that aspect of Grey Owl has naturally died down somewhat, but Mr. Lovat Dickson's book will arouse afresh and with even greater vigour interest in Grey Owl as a human personality and especially as a naturalist. During the present time of increasing interest in the teaching of biology and natural history, the book will prove of inestimable value for the inspiration that Grey Owl has given; for he was no mere sentimentalist where animal life was concerned. True, he loved animals, and in loving them learned *how* to study them, for, as one great zoologist once quoted in parody:

"He studieth best who loveth best,
All things both great and small."

"Here [at Ajawaan] he will live out his days, knowing only these animals and birds that he loves and who love him, sharing in their joys and sorrows, their triumphs and disappointments; watching them mate and sharing their parental triumphs; guarding them as best he can from Death, the only intruder who can do them harm." This is surely field natural history at its best; doubtless an unattainable ideal for most of us who have to live and study in less rural or less congenial surroundings, but at the same time an inspiration to achieve the best methods possible. In schools and colleges, much can be done by keeping and studying animals in captivity. Grey Owl's methods can be adapted to such less ideal conditions, so that the aquatic animals in the aquarium, the frogs in the frog pond, and the rabbits in their run receive the consideration which is their due. Love of Nature will naturally follow (if it is not already there), and just as Grey Owl, through the influence of his wife Anahereo, became converted from a killer to a conservator of wild life, so will students of natural history and biology become imbued with the desire not only to learn but also to preserve. It will not be necessary then to teach students, for example, that when gathering material for study only the minimum should be taken, and when they intend to study twigs in winter or summer they should never take even one twig from a sapling, thus disfiguring the tree for life. A host of ideas for field work, too, can be culled from this study of Grey Owl's life.

Even as a boy, Archie Belaney valued animals as living creatures, not as dead trophies. At Hastings he was allowed to keep his "friends", including snakes, frogs, birds, silk-worms, and rabbits, in a room at the top of the house. One is struck by the similarity between this boy and the boy Raymond Ditmars who kept his menagerie at the top of a house in New York. The former finally became a conservator of wild life under the Government of Canada; the latter is a curator in the New York Zoological Park and is still one of America's leading naturalists.

Through his very obvious desire to give a faithful biography of this truly wonderful man, Mr. Lovat Dickson may not even realize himself how much Grey Owl's love of Nature as here recorded will prove a unique source of inspiration to many students of plant and animal life; and the tenacity and singleness of purpose of Grey Owl is an absorbing study in itself. In his younger days he showed not so much a stubborn impatience with stiff English life as a strict determination to achieve a purpose. He achieved more than his purpose. He learned that it was undignified as well as unwise to take more of the fruits of the earth than one needed. He also achieved a keen sense of values, for he himself wrote: "You still believe that man, as such, is pre-eminent, governs the Powers of Nature. So he does, to a large extent, in civilization, but not on the Frontier, until that Frontier has been removed." Later, of his adopted tribe, he said:

"Nature is to us a sanctuary. To the Indian all Nature is sacred. All things are in accord, all part of the one great plan, Creation. . . . Thus, the Indian attitude towards Nature. Thus his philosophy—that not only man but all living creatures of the forest have a right to live, to freedom, a right to be happy in their own way, a right to a place in the sun."

The book never lacks interest. For reasons already given it should be read by teachers of biology, natural history and psychology; all students of these subjects should read it, too, and we strongly recommend that it be given a place on the shelves of school libraries for the benefit of older pupils. Mr. Lovat Dickson's absorbing style transports the reader to the open tracks and great forests of Canada where the sough of the birches and pines can almost be heard, while it seems impossible never to have met Jelly Roll, McGinnis and McGinty and the other animal characters which antic and prattle their parts through the narrative.

This raises a point to which the reviewer would direct the attention of Mr. Lovat Dickson. The book as it stands will be read by, and surely satisfy, many who knew of, and appreciated, the work of Grey Owl; it should also command the attention of biologists and natural historians; but it is not suitable—indeed is not meant—for younger children. For example, Grey Owl's apparent views on marriage would not be compatible with those of the average 'civilized' white man. But Grey Owl obviously loved children as he did other animals. He came into contact with many thousands of young admirers throughout the world. He wrote for them, he lectured to them (only the fact that he refused not to mention the "controversial" subject of fox-hunting prevented him from broadcasting to them during one of his rare visits to Great Britain). A "Life of Grey Owl" suitable for younger children would be a source of inspiration to them—an example of nobility of character (too often left to more warlike heroes to set) and, more important, a leader in the most desirable way of studying life around them.

LANDMARKS IN NEUROLOGY

Selected Writings of Sir Charles Sherrington
A Testimonial presented by the Neurologists forming the Guarantors of the Journal *Brain*. Compiled and edited by D. Denny Brown. Pp. xiv + 532. (London: Hamish Hamilton Medical Books, 1939.) 25*s*. net.

NEUROLOGISTS will open this volume with the highest expectations and will not be disappointed. It is a testimonial to Sir Charles Sherrington made up of extracts from his writings and edited by a colleague who has been in close touch with all his later work. True, it would need an incredibly bad editor to spoil the effect of such remarkable material, but Dr. Denny Brown has been a very good editor indeed. By a careful choice of extracts and the use of occasional connecting passages he has made a series of chapters, each complete in itself and each dealing with a particular theme. Some of the chapters are mainly derived from early papers, for example, on the nerve roots, some from the work at Liverpool or at Oxford, but most of them contain extracts from several sources and show the development of the subject in Sherrington's hands as well as his final judgment on it. We see the detailed mapping of motor and sensory supply, followed by the classical analysis of reflex activity in the spinal animal. Several aspects of reflex co-ordination have chapters to themselves, and considerable space is naturally given to the discussion of reciprocal innervation. One chapter is derived from the paper with Grünbaum on the motor area of the brain, and the last two deal with more recent work on the intimate nature of excitation and inhibition and on the adjustment of muscular contraction. There has been no attempt to include many of the topics dealt with in the book which had such a decisive effect on the progress of neurology, the "Integrative Action of the Nervous System", for the present volume is designed as a companion and a supplement to it.

The editor has done his work so well that the reader very seldom realizes that he has done it at all; there are footnotes to show the composite sources but the chapters have all the freshness and distinction of the original papers, and there is no sense of discontinuity where one extract succeeds another. In his choice of material, too, Dr. Denny Brown deserves our thanks; though with him we may deplore various omissions, his selection covers all the major lines of Sherrington's researches, and is constantly reminding us of the wide range as well as the originality of his work.

Sherrington's primary business has been with the physiology of the nervous system, and this volume is primarily a record of his scientific achievements in that sphere. For many of its readers, however, it will be valued even more as the record of a personality, as a record of Sherrington's way of looking at things, of solving a problem and of writing of what he has done, as a study, in fact, of the behaviour of a remarkable individual, 'C. S. S.' All through the book there are examples of the acute observation which finds so much new meaning in a posture of a cat's hind limbs or a flick of its ear, and of the experimental skill with which a complex act is resolved into its simplest components. For it has been Sherrington's achievement to explain the integrative properties of the nervous system by the analysis of such finished products as standing or scratching. But these chapters reveal much more than the method of approach and the technical equipment of a celebrated neuro-physiologist; they show as well the characteristic outlook and characteristic style which lends a peculiar charm to Sherrington's prose and is essential to the complete picture. In the present volume there are abundant examples of the apt turn of phrase, the striking metaphors and sudden illuminating comparisons which enrich his sentences.

We could have wished for more: this, indeed, is our only disappointment, though Dr. Denny Brown is not to blame. We cannot, of course, have a single volume to illustrate the many qualities of one who inspires such high regard and warm affection in all his colleagues. We should have liked samples of his verse, of his reviews and historical or biographical writing to place beside the strictly scientific papers. In his preface, Dr. Denny Brown lists some of the extracts he would have liked to include. The list is tantalizing, though it does not diminish our gratitude to the editor for what he has done. The testimonial he has given us is worthy of the great man of science to whom it is addressed and will certainly induce the reader to sample 'C. S. S.' in his other moods.

E. D. A.

PROBABILITY AND ITS APPLICATIONS

Probability, Statistics and Truth

By Prof. Richard von Mises. Translated by J. Neyman, D. Sholl and E. Rabinowitsch. Pp. xvi +324. (London, Edinburgh and Glasgow: William Hodge and Co., Ltd., 1939.) 12*s*. 6*d*. net.

THIS book is scarcely the philosophical treatise which its title may suggest. It is the written-up version of six lectures on probability and applications, as conceived from von Mises' special pragmatic and empirical point of view. The lectures, to each of which a chapter is devoted, are couched in popular and non-mathematical style, but have none of the faults of this style. The English translation is excellent.

Dr. von Mises is well known as a strong protagonist of the relative frequency theory of probability. Probability to him is the limit of relative frequency in an indefinitely continued sequence of trials, but the sequence must be random. Imagine a coin spun repeatedly; write 1 for heads, 0 for tails. Then, according to von Mises, if in n spins m 1's appear, the probability p of heads for this coin is the limit of m/n as n tends to infinity; but he postulates not only the existence of this limit, but also the important additional property, that if any infinite subsequence be lifted out of the parent sequence on the basis of position only, irrespective of whether 1 or 0 appears in that position, then that subsequence shall have the same limit p as before.

Much of the earlier part of the book develops in simple language this theory of random sequences, and compares and contrasts it with the classical theory of probability. The later chapters pass, rather more summarily, to such topics as the so-called 'law of large numbers', kinetic theory of gases, the quantum theory, statistics and causality and the principle of uncertainty. This is all interesting, and done with an original turn, but the mind of the reader keeps reverting, with sympathetic scepticism, to the original attempt to define randomness. How can the postulate of place selection be expressed in mathematical form? We may lay down particular subsequences, for example, those enumerated by the squares of the natural numbers, or by the prime numbers, and so on. These are special place selections, and even for them it will surely be necessary to prove that parent sequences admitting such place selection actually exist. The author assures us that A. H. Copeland and A. Wald have found satisfactory answers to such questions as these.

All the same, to the present reviewer, a von Mises sequence is merely a *sample* sequence, extended to infinity, for the coin or other object, and is only one of an aggregate of sample sequences characteristic of the object. A sample of what ? There's the rub ; we are brought back to the *a priori*. And why bar the door so strenuously to sequences other than the postulated random ones ? Systematic sequences, for example, 010101 . . ., are imaginable, as well as sequences which, in respect of the same coin or object, may not have the same limit p. The desirable thing would be to deduce the sequences from *a priori* conditions, and to show that the exceptional ones, which we may, if we please, call non-random (though the concept of randomness becomes unnecessary), are of zero measure in the aggregate of possible sequences.

Such views, which are put forward here for what they are worth, are in no way intended to disparage the book, which is a most valuable addition, from any point of view, to the literature of statistics and probability. A. C. A.

DEVELOPMENT IN ETHIOPIA

Ethiopia
An Empire in the Making. By Ferdinando Quaranta. Pp. xx+120+23 plates. (London : P. S. King and Son, Ltd., 1939.) 7*s*. 6*d*. net.

WE have to go back to the days of Rome for the mode of development inaugurated by Italy in its new Empire of Ethiopia. It started with road-making, on which at one time 60,000 Italians were employed, and already more than 3,000 miles of macadamized highways have been built out of 7,000 miles planned. At the same time the Italian scientific societies were mobilized to collect and tabulate the facts relating to earth, air and water. Lake Tana is stated to be of little importance to the Nile floods. Alluvial gold was discovered and is now being worked, but there is no likelihood of rich reefs. Platinum seems possibly to be of more importance, and there was also discovered copper and iron ores, but no petroleum. The fauna and flora were surveyed in connexion with their adaptation to various altitudes and meteorological conditions.

Meantime, Castellani's wonderful health service of the war had been converted into a permanent organization for the country with a first-class research laboratory adapted to pathology and parasitology at Addis Ababa and hospitals in each of the four provinces which were created ; about eight hundred qualified medical officers are employed. Surveying the collected facts, Italy granted twelve billion lire (£133 million) to be spread over some years for special development. Agricultural veterinary and forestry services were established with experimental stations in each province, these governed and manned by university-trained officers. In the civil administration we deduce that the method employed is an army to keep the peace, with specially trained civilians whose duty is mainly the development of the country. There is little information on the administration, but the education and health of the natives seem to be an especial care. Meantime large areas of land in the high plateaux were found derelict, much of it the former property of Ras Makonnen, and steps were taken to colonize it. Upwards of a thousand Italian families have been here settled, growing grain, coffee, cotton and a host of minor products. For some years this immigration may be almost indefinitely increased by the introduction of regular cultivation in place of the alternate clearing and fallowing of the land employed by the natives. To this end a commission is at work investigating titles to land so far as they exist.

The technique of the Italians throughout would seem to be that of a large business firm rather than the haphazard method usually adopted in British colonies, where development is in the first instance confined to what already exists, usually by the increased employment of the old methods. Scientific men are only called upon when some pest appears or there is a shortage of food, the basal facts required for their employ being still unknown. We can recall no instance where the State has boldly capitalized development and colonization, the great settlement hoped for in East Africa at the beginning of the century having degenerated into the formation of large ranches worked by native labour, a condition paralleled all the way south to the Cape. Here in Ethiopia, if success be ultimately achieved, may be seen the commencement of a planned "Dominion" rather than a "Colony", the successful result of which would be of profound world importance. J. S. G.

GEOLOGICAL RESEARCH IN CHINA

The Geology of China
By Prof. J. S. Lee. Pp. xv + 528. (London: Thomas Murby and Co., 1939.) 30*s.* net.

THE remarkable growth of geological knowledge concerning China commenced with the foundation of the National Geological Survey, under the able directorship of the late V. K. Ting, in 1915. Its unbroken series of publications appeared in 1920 and those of the Geological Society of China in 1922. The first volume of A. W. Grabau's "Stratigraphy of China" was issued in 1924, the second in 1928, but invaluable as this exhaustive compendium was for a time, it soon became out of date as new results were accumulated, mainly by Chinese geologists whom Ting and his associates had trained. As the years passed, contributions rapidly increased, for provincial surveys, universities and foreign authors of many nationalities added their quota to the literature.

A new summary was overdue and it has been admirably accomplished by Prof. J. S. Lee, himself a pioneer of the new movement. The book is not, as its title might indicate, a text-book of regional geology of the stereotyped kind: it is rather a collection of essays, planned on a common 'structural' basis, in which all the essential facts are incorporated and their significance exposed.

In the successive chapters of Part 1 the following topics are discussed: the natural physiographical units of China and adjoining territories; the rocks of its ancient floor; its marine transgressions with the succession of their sediments, their characteristic fossils and the chronology of their movements; the geotectonic aspects of the Cathaysian geosynclines and geanticlines, as well as the history of the east-west fold zones which interrupt them at regular intervals. Descriptions of certain types of shear-forms and of their influence upon the existing framework of eastern Asia follow. Studies such as these, continental in their scope, lead naturally to wider inquiries still, and Chapter viii contains an analysis of the facial traits of the earth as a whole, to which is added an exposition of the author's views on the origin of tectonic movements and marine transgressions in general. These, advanced in logical sequence and entering into controversial geodynamical problems, evade abridged treatment and are best considered as a whole. Certain notable conclusions, however, are briefly stated as follows:

"All tendencies to shearing movement on the continents are to be reduced to two components: the one towards the equator and the other towards the west. The latter is more pronounced in, if not restricted to, the low latitudes" (p. 351).

This, as the author admits, "sounds strikingly Wegnerian". Again:

"As a whole, then, the surface strain of the earth can be explained by an adequate increase of rotational speed" (p. 358); and

"The data thus assembled, when correlated with the 'pulsations' of A. W. Grabau . . . seem to favour the conclusion that it is the continued contraction of the earth that has caused the increase of its rotational speed" (p. 364).

These forcible speculations add value to and widen the appeal of the work as a whole, which still remains the only available, concise review of geological research in China as it stands to-day. Prof. Lee has succeeded in the extremely difficult task of condensing into comparatively little space a great amount of widely scattered stratigraphical and structural information, without sacrificing a lucid continuity of style for the sake of brevity.

Part 2 contains two chapters only, one of which is devoted to the contentious problem of China's Pleistocene climate. The other is headed "Regional Stratigraphy", and in it the larger stratigraphical units of fifty-one separate areas, ranging from Jehol and the Inshan Range in the north to Kuangsi and Kuangtung in the south, from South Manchuria and Chekiang in the east to Kansu and Yunnan in the west, are tabulated in natural successions with short lithological details and lists of leading fossils. How far the omission of subdivisions, and in rare cases of even larger units, is justifiable on grounds of simplification is a matter of opinion, but such arbitrary classifications are rarely entirely satisfactory. This one would have been improved by explanations of the origin of the terms and by the insertion of co-ordinates of the localities mentioned. As extensive tracts in China still await survey, modifications of the lists may be anticipated in future editions.

Each chapter is followed by its own selected bibliography, which would have been more serviceable had numerical references been given in the text and index. Illustrations total ninety-three items, including maps, sections and half-tones.

Geologists concerned with the great problems of continental movement will peruse the book with advantage; for students of Asiatic geology, whether their work or only their inclination leads to the East, it is an indispensable guide.

J. COGGIN BROWN.

ELECTRONIC MUSIC

By Dr. L. E. C. Hughes,
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By electronic music is meant the electrical reproduction of musical tones through loudspeakers, the actuating currents either having a purely electrical origination, or, if arising from a musical source, depending essentially on electronic means for their control and amplification, thereby leaving the musical designer free to make experiments which are not limited by the necessity of making adequate acoustic power.

The most comprehensive developments have taken place in the United States of America, where Benjamin F. Miessner and Laurens Hammond lead the patent and commercial fields, and Lee de Forest demonstrated an electronic organ, one valve for each note, so far back as 1915. Germany, France, and Great Britain have also made important individual contributions, and the literature of the subject grows apace. This article is a brief review of the important electronic instruments available in Great Britain. The accompanying table gives the characteristics of a representative selection of such machines, without attempting to be exhaustive, because of the rapid developments in this field and the repeated introduction of new types. Those with novelty value do not compete among themselves, like the pianos. There is certain competition among the organs, since they have all been highly developed to meet a common need. Comparisons are difficult, since one cannot get them in pairs for a proper trial, but probably the time is coming when a scientific assessment of their qualities is due, which would settle many contentions among organists. Technically speaking, no one is quite certain what organists really want.

There are three major aspects of the problem, commercial, scientific and artistic. The commercial drive incites people to want something new or to do something already satisfactory in a cheaper or simpler way, for example, reducing the cost and bulk of pipe-organs, a lighter substitute for bells, or more noise from the feeble harpsichord. The

Representative Electronic Musical Instruments

<table>
<tr><th>Type</th><th>Name</th><th colspan="2">Basic principle</th><th>Note operation</th><th>Special effects</th><th>Tone Registration</th></tr>
<tr><td rowspan="5">Novel</td><td>Thérémin</td><td colspan="2">Beat oscillator</td><td>Hand-adjustment</td><td>Glissando, Tremolo, Stop-button</td><td>None</td></tr>
<tr><td rowspan="2">Martenot</td><td colspan="2" rowspan="2">Beat oscillator and filters</td><td>Hand in ring</td><td>Glissando, Tremolo</td><td rowspan="2">Stop keys</td></tr>
<tr><td>Keyboard</td><td>Tremolo</td></tr>
<tr><td>Trautonium</td><td colspan="2">Neon relaxer with formants</td><td>Wire over plate</td><td>Glissando, Tremolo</td><td>Continuous stop knobs</td></tr>
<tr><td>Novachord*</td><td colspan="2">Valve oscillators with multivibrator division and filters</td><td>Keyboard (72 notes)</td><td>Mixed Tremolo, variable attack and decay</td><td>Dial stops, foot sustain</td></tr>
<tr><td rowspan="3">Piano</td><td>Miessner or Vierling</td><td rowspan="3">Hammer on strings</td><td>E-s pick-up</td><td rowspan="3">Piano keyboard (88 notes)</td><td>Swell and filters</td><td>Stop keys</td></tr>
<tr><td>Neo-Bechstein*</td><td>E-m pick-up</td><td>Swell</td><td>None</td></tr>
<tr><td>Pianotron*</td><td>E-s pick-up</td><td>Volume control only</td><td>None</td></tr>
<tr><td rowspan="5">Organ</td><td>Orgatron*</td><td colspan="2">Air-blown reeds, E-s pick-up</td><td rowspan="5">Manuals, pedals, swells, tremolos</td><td>—</td><td rowspan="5">Stop keys, pistons, and couplers</td></tr>
<tr><td>Coupleux</td><td colspan="2">Valve oscillators and filters</td><td>—</td></tr>
<tr><td>Hammond*</td><td colspan="2">E-m generators, synthetic</td><td>Variable stops</td></tr>
<tr><td>Midgley*</td><td colspan="2">E-s generators, synthetic</td><td>Variable stops</td></tr>
<tr><td>Electrone*</td><td colspan="2">E-s generators, synthetic</td><td>Synthetic bells</td></tr>
</table>

Instruments marked * are easily available in Great Britain and have been examined by the author. All instruments, except the Pianotron, have foot-swells; the organs, except the Hammond, have grand-swells also. In the Hammond, one stop only on each of the manuals and pedals can be drawn at a time. Specifications of organs can be varied over a wide range, according to requirements; the Hammond and the Novachord alone are mass-produced, and therefore invariable.
(E-m = electro-magnetic, E-s = electro-static)

scientific urge is to do these things in a new way, producing perhaps novel effects which may or may not have an eventual commercial value. The artistic aim in supporting these endeavours is to obtain new methods of expression and to compose for them, since composition in orthodox modes seems to be declining. The usage of an instrument depends on whether it is commercially satisfactory at the price, and on the sales drive to satisfy a manufactured demand.

The instruments mentioned have had some circulation and demonstration. The Electrone has been well received in cinemas and by the British Broadcasting Corporation, while the Hammond* has become best known. In the few years that the latter has been available, about four hundred models have been sold in Great Britain as compared with some six thousand in the United States, the production being fifty to sixty a week. Of the other organs, the Orgatron was used at the last Eisteddfod, and the Midgley* has just been launched. The Pianotron has recently appeared, made both by Everett and Chappell, and meets the modern need of conservation of space combined with concert-grand tone and volume. The latest instrument, the Novachord (a Hammond product), is so entirely novel, except its ordinary keyboard, that it will keep musicians of all grades amused for a long time. It is the sort of machine from which any keyboard enthusiast can get something worth while; it does not demand the discipline of the piano or regular organ.

The Novachord

Of the instruments offering novelty value many have been described, using a great variety of physical effects for generating and synthesizing desired or new musical tones. Valve oscillators, either pre-set or beating, have frequently been employed; also blocked-out wave-forms, either sinusoidal, chopped, or obtained from recordings of high-grade musical instruments, on spinning disks, scanned by light falling into a photo-electric cell, have been used.

The Novachord uses valves entirely, and in a new way. It is the second musical machine put out commercially by Hammond, and we are told there are more to come. It cannot replace any existing instrument, although it can imitate passably many familiar timbres. It has a 6-octave keyboard, above which is a row of stop-lever controls; for the feet there is a swell pedal, a duplicated sustaining pedal, and a bass sustaining pedal. The omission of the pedal clavier is a good selling point for non-organists. The keyboard manuals are not strictly percussive, as in a piano, but by setting the controls for a long build-up time, a very effective percussive touch is obtained, permitting, for example, a legato violin solo with a light harp-like accompaniment, passing through each other, if desired, on the one keyboard. The pedal sustains the weaker notes, without altering their loudness level.

The tones are obtained from twelve oscillators, the frequencies of which correspond to the top chromatic octave, the highest fundamental frequency being $E = 2637{\cdot}0$ ($A = 440$). The remaining fundamentals are derived from these twelve frequencies by division, one half in each of the five stages, each in a multivibrator dividing circuit, rather like those in television scanning circuits. Each fundamental has a control valve in which the output wave-form is adjusted, together with its attack and decay. The 72 notes, therefore, require 144 valves; some channel-amplifiers and power-packs bring the normal total to 159, double-triodes and small pentodes forming the majority. It is claimed that all valves, except the output stages, are lightly loaded and that the valve hazard is greatly diminished. The scheme for frequency-division seems logical, since the top frequencies cannot require much harmonic development; also the tuning operation on the top notes makes for precision over the whole range. Tuning is effected by adjusting the oscillators until one of the divided frequencies beats a known frequency with a known harmonic of the rectified mains.

The basic qualities of the Novachord are in the great range between percussive and singing, and in the adjustable attack. The tone-controls and filters, all adjustable over a wide range, are to some extent what one might expect, leading from a full diapason, reminiscent of a cathedral when fully delayed, to a thin reedy wood-wind of considerable power. Brassy and delicate tones are available, and the string tones are better than have been previously heard on a non-string instrument. A guitar effect is easily obtained, but, what is more interesting, good imitations of clavichord and harpsichord can be found, with, of course, ample volume; such possibilities may help to revive the interest in the older keyboard music, especially in public, which must have waned to some extent because of the lack of acoustic power and the difficulty of the cramped keyboards in authentic models.

A new feature in electronic music is not so much that three degrees of tremolo are here available, but that there are also six different rates, distributed in the twelve oscillators. The result is a delicate shimmer rather than the usual throb or wobble, recalling *tutti* violins; perhaps this is an effect organists are seeking; they never seem

* Descriptions of the Hammond and the Midgley organs appear in a paper recently issued by the Institution of Electrical Engineers, to be printed later in the Institution's *Journal*, entitled "Electronic Musical Instruments and the Development of the Pipeless Organ", by G. T. Winch and A. M. Midgley.

certain whether they require amplitude or frequency modulation, or both.

In construction, the Novachord has novel features. The whole of the valve system, couplers, filters, etc., is built into an enormous chassis, which can be turned over for servicing ; electrical connexions to the keyboard are taken through long springs, so that the valve system need not be made dead during adjustments.

Finally, it may be remarked that there is no synthesis of notes on an equi-tempered scale involving borrowed quasi-harmonics, as in some electronic organs. This may please regular organists, because the non-coincident harmonics of the notes of a chord beat against each other in the customary way, and are not resolved into a perfect series of overtones, which is apparently one of the things conservative organists do not like, however pure it may be declared to be. We refrain from attempting to define what a pure tone, in the musician's sense, is supposed to be.

New Pianos

The difficulties of imitating a piano are great, the initial impulse and the dither being awkward from the electronic point of view. A negative time-constant of attack has been achieved in the Novachord and this may lead to a complete electronic piano. The electrical amplification of piano tones is of long standing, but the usage has been slight ; the recent arrival of the Pianotron may change this.

It is an easy matter to apply either electromagnetic or electrostatic pick-ups to the strings of the piano, and to control the output currents in volume and tone ; the mistake which seems to have been made is to try to get something new out of hitting a stretched string with a felt hammer. It is true that tone amplification permits less tension in lighter strings and the elimination of the sounding board, with consequent lighter frames and extremely long time of decay, due to reduced damping. In the Neo-Bechstein, the middle forty notes alone have double strings, the remainder are single. This results in a steel-string tone, substantially undamped when sustained, with great range of crescendo and diminuendo on the swell pedal. Supposing that one wants real steel-string tone, very great care is necessary to avoid considerable blur. This instrument uses electromagnetic pick-ups, one for each set of four strings, located near the ends of the strings remote from the hammer. In the Vierling Electrochord there are a number of pick-ups along the wire, so that some of the sustained overtones are not lost.

Whereas in the Neo-Bechstein the piano has been simplified, in the latest Pianotron, where only straight amplification with electrostatic pick-ups is attempted, it has been found that it is essential to take the greatest care in the construction of the complete small piano, otherwise defects in the tone production are magnified. The electrostatic pick-ups are merely adjusted screws, ranged on a shaped board, which can be fitted into any ordinary piano : screening to some extent is essential, but the scheme permits concert-grand volume in the smallest space at a very reasonable cost. Many novelties may come and go, but the attractions of the dynamics of the free felt hammer on trichords will remain for those who wish to attain to them.

Pipeless Organs

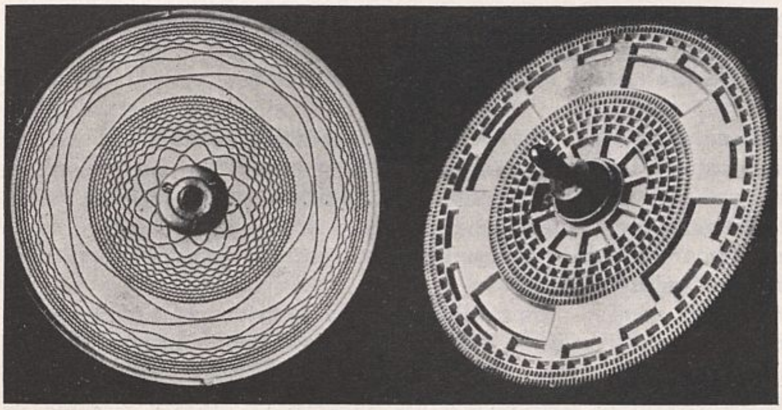
The dictionary definition of an organ must now be curtailed by the omission of any reference to pipes blown by air, for clearly an instrument which is played like an organ and sounds like an organ is certainly an organ, in spite of the purists. The wide variety of wave-forms obtainable from a valve oscillator has induced inventors to synthesize and control tones for organ purposes in diverse ways ; the more recent successful instruments, however, do not use valves at all, except for amplification.

The Orgatron is most near a regular organ ; indeed, it is a five-rank instrument, entirely pneumatically controlled, with air-blown free reeds, the motions of which are amplified through electrostatic screw pick-ups. The scheme is rather like that of the Pianotron, except that the polarizing voltages are not constant but are applied to the ranks as required by the stop keys. Fundamentally, when a key is depressed, high-pressure air is passed into the tube mechanism and eventually allows low-pressure air to pass through all reeds brought in by the pneumatic action of the stops. The stops also charge the pick-up screws to pre-set potentials through resistance-capacity retarders (to obviate key clicks). The fluctuating potentials on the screws, arising from the motion of the reed and consequent change in capacitance, are applied rank by rank, all the rank screws being in parallel, to the relative amplifier, after which they are mixed by anode-coupling.

Thus there is no synthesis of tones in the electronic sense. The five ranks of reeds, of which there are 289 in all, are voiced and tuned by the usual manipulation of the languids, and fundamentally give celeste, melodia, diapason, viole, and a pedal tone. From these a good selection of registrations is possible, augmented by a synthetic oboe and quintadena. Actual tubular chimes can be operated by second touch on the great, and an echo-radiating unit helps with reverberation in damped surroundings. Tremolo arises from a motor-driven paddle in front of the loud-speakers

In appearance, the Orgatron is similar to most other two-manual organ consoles.

The Hammond organ has previously been described in these pages (Nature, June 19, 1937, p. 1043), and was shown by Sir James Jeans recently at the Royal Institution. The original model has been brought into conformity with the requirements of the Royal College of Organists for non-secular purposes by curving and adding a few notes to the pedal clavier, by having independent swells for the two manuals, and replacing the manual stop keys by pistons. Readers will remember that tones are synthesized from 96 inductor generators on two shafts driven by a synchronous motor, a number of adjustable stops for experimentation being provided.



The Compton electro-static frequency generator.

Left, one of the stators, showing the electrified tracks between anti-phase sine-wave insulating ridges, the remaining spaces being earthed; right, the rotor, which scans all the tracks and couples the modulated potential to the grid of the amplifier via the ball-bearing contact at the end of the shaft.

Scientifically, the Electrone and the Midgley are very similar. Each uses electrostatic runners, the periodic change in capacitance modulating the potential steadily applied through a resistance. In the Electrone there are twelve generator units, corresponding to the lowest chromatic scale, driven by one continuous belt from a synchronous motor. In the generator unit the scanner is connected, together with the eleven others, to the grid of the first amplifying stage. The radial scanning blocks, one per wave-length, are embossed so as to oppose double sine-wave tracks with earthed separations.

It is evident that all the harmonics of a bass-note can be obtained from one unit, since there is no fundamental difficulty in cutting tracks of an increasing number of wave-lengths. The total number of tracks is, however, markedly reduced by borrowing. For example, on the natural scale the *G*-wheel has a speed 1·5 times that of the *C*-wheel, all the units being the same, except for speed. Therefore the 3rd harmonic of *C* coincides with the 2nd harmonic of *G*; so why not use the 2nd harmonic track on the *G*-wheel when the 3rd harmonic of the *C*-wheel is required, thus dispensing with the 3rd harmonic track on the *C*-wheel, and so on, yielding a great economy in tracks? The driving wheels, however, are so diametered that the fundamentals and the harmonic tracks are equi-tempered. This makes the *G*-wheel about 0·1 per cent slow on the *C*-wheel. The third (borrowed) harmonic of *C* is therefore a little out of tune, a fact which is easily noticed on a cathode-ray tube, but it is doubtful if any organist can have noticed it by ear. Again, when *C* and *G* are sounded together, either on the keys or as a synthetic stop, the third harmonic of *C* does exactly coincide with the second of *G*, since it is borrowed, the increased magnitude of the common frequency being provided for in the electrical circuits. This means that the beat which ought, on the equi-tempered scale, to be present between the third harmonic of *C* and the second harmonic of *G*, amounting to about 0·1 per cent of the nominal common frequency, is not there. This argument can be greatly extended, the absent beats between some harmonics being more pronounced than that above indicated. The Electrone compromises in that only the third harmonics are borrowed.

There is no doubt that the scheme works and the machine sounds very much like a regular organ, but is it this absence of beats among harmonics which prevents the more precious and conservative of organists from admitting that the Electrone is an adequate substitute, at a third the cost, for a regular pipe-organ? Can any ears be so sensitive in a live room?

The Midgley electronic organ functions in a very similar way, except that in the unit generator the dielectric alone rotates. The sine-wave areas on the stator electrodes oppose the blocks of the scanning dielectric as before. The notes are synthesized as required by the stops in the electrical circuits as before; registering a number of stops builds up the contributions, just as extra ranks of pipes are ordinarily brought into action. Corresponding in function to the draw-bars in the Hammond, sets of dials are provided for players to experiment with in using new stops or doubling existing stops.

It can be fairly claimed that these electronic organs function as intended, but whether one is superior to the others for a specified musical purpose is an open question and must await a proper series of trials, with adjudication by a representative body of musicians; meanwhile, those who have to pay for organs are deciding for themselves.

Accepting the musical adequacy of electronic organs, their use in churches has several artistic and technical advantages. The disposition of the sound radiators permits a fine unanimity of attack in congregational singing. Acoustical treatment to enable preachers to be heard need not spoil reverberation, which can be increased artificially to any degree desired. Finally, the great enemy of pipe-organs, cold weekdays and a warm Sunday, is rendered innocuous: electronic organs scarcely need tuning.

The craft of the organ tuner, with his mallet and cones, has started to pass; he is being replaced by an electrician, with no more equipment than is required for servicing a radio-set. There is one thing we can be certain of, no electronic organ ought to succeed unless it is finally voiced by a craftsman of tradition. If this is not insisted on, classical organ tone will not be known to the rising generation, brought up on secondhand and harsher music, and may be lost for ever.

APPLICATIONS OF PSYCHOLOGY IN WAR CONDITIONS

A SYMPOSIUM on some applications of psychology in war conditions was arranged by the Industrial Section of the British Psychological Society and held on January 25. The introductory paper was by Dr. May Smith, who gave an outline of the final report of the Health of Munition Workers Committee, published in 1918, and addressed to the Right Hon. Winston S. Churchill, M.P., then Minister of Munitions. The Committee included Sir George Newman, Sir Walter Fletcher, Sir Leonard Hill, representatives of the Home Office, members of Parliament, physiologists and pathologists. It had been appointed in September 1915 "to consider and advise on questions of industrial fatigue, hours of labour, and other matters affecting the personal health and efficiency of workers in munition factories and workshops".

At the beginning, the Committee was confronted with the width and complexity of its inquiry. The central and foremost problem was concerned with fatigue. Having realized that continuous human activity is associated with a gradually diminishing capacity, the Committee decided that the only direct test was that of output.

Views on the more theoretical aspects of fatigue were really immaterial, since it was known that the ordinary restrictions on hours of labour had been very widely relaxed, that Sunday labour previously forbidden for women and young persons and practically unknown for men, except for a few continuous processes, had become common. The employment of men for 70–90 hours a week was common, more than 90 hours was not infrequent, and there were even cases in excess of 100 hours. In short, there was a return to some of the worst conditions of the early nineteenth century.

The Committee used two methods of getting information: (1) it took evidence from people in direct contact with workers, (2) it initiated *ad hoc* investigations. The first method enabled it to get information at once, the other necessitated time.

On reading through the evidence, it is impossible not to be struck by the volume and pertinence of the findings. On the whole, the evidence showed that long hours imposed too severe a strain on the workers, with the result that the rate of production tended to decrease, sickness absence and broken time to increase. Evidence of the almost intolerable strain on the management was given. The full blast of the hours was not felt at first, because the increased pay resulted in better food.

Such evidence, while overwhelming in some cases, was, however, not quantitative, and witnesses differed widely as to what constituted reasonable limits; the Committee had to emphasize the almost complete absence of any scientific data.

The appointment of Dr. H. M. Vernon and others was intended to supply this deficiency. He showed by output figures that the 12-hour day was a costly and useless procedure, that the long hours simply defeated their own end. "The country cannot afford the extravagance of paying for work done during incapacity from fatigue just because so many hours have been spent upon it," reported the Committee.

Apart from hours, environmental conditions were realized as important, and ventilation emerged out of the hands of the engineers and passed to those of the physiologist, and under the ægis of Sir Leonard Hill there entered the katathermometer.

Lost time through sickness absence, lateness, broken periods, or just absence, soon became a formidable problem. The causes of lost time were classified into two main groups : (*a*) Causes mainly inherent ; for example, the employment of people of inferior physique, inadequate housing and transport facilities, wintry weather, darkened streets and inequalities of food supply, the domestic duties of married women, the war-preoccupation and exigencies of all workers, sickness and disease caused by conditions outside the factory. (*b*) Causes mainly controllable ; for example, fatigue, sickness and accidents of factory origin, insufficient wage incentive, faulty internal organization, indifference, slackness, laziness, discontent, prolonged hours, overtime, insufficient rest periods or holidays, and excessive consumption of alcoholic beverages.

The Committee came to the conclusion that the absence through sickness was considerably underestimated, and pointed out that if there is an undue proportion of sickness in any group of workers there is also likely to be lessened vigour and activity among those who are not away sick. It noted the absence of adequate records, partly due to difficulty in regard to medical certificates and partly because minor illnesses were not reported.

The section on incentives starts off, not with wages or bonuses, but with the statement that "the first incentive is the health and physical fitness of the worker", and although the Committee confined itself to the factory conditions contributing to that, yet the field covered is very wide. Only after this does the Committee discuss wages, which must be "well adjusted, equitable and clearly understood".

The Committee notes that "what is needed is not a cast-iron system of employment but a sympathetic or correct understanding of the physical and mental capacities of each worker and their most satisfactory and economical application".

The present War has introduced many of the conditions of the War of 1914–18, but already after four months there are signs of an interest not aroused until after thirteen months before ; happily we are better equipped now than in 1914.

Dr. Vernon took up the discussion, pointing out that excessive hours constitute a major problem when increased output is urgent. Many employers cannot grasp the fact that, after a certain number of hours of work, the worker is so fatigued that production falls. Some investigations undertaken during the War of 1914–18 showed that the actual gross output—not merely the average hourly output—is less on a 12-hour day than on a 10-hour. It is true that in the early stages of a war, patriotism plays a definite part in keeping up the output, and in the last War employers often defended the excessive hours on these grounds ; but Nature cannot be defied indefinitely and many men and women were in a chronic state of fatigue. For many processes in munition work, Dr. Vernon found that output is a very satisfactory measure of the effects of hours of work, since the same materials are being used and the same articles made, the only important variable being the number of hours worked. Sunday labour, except for emergencies, proved wholly unsatisfactory, in spite of the extra pay : it has been described as "8 days' pay for 7 days' work with 6 days' output".

The problems involved in night-shift work are not easy to solve, for, quite apart from the organization within the factory, there are complications connected with the domestic arrangements of the workers and transport.

With regard to the material environment, Dr. Bedford pointed out that there is now available considerably more scientific knowledge than in 1914. Numbers of researches have been made to find out the relationship of lighting, heating and ventilation conditions to efficiency, comfort, accidents, and health. The last twenty-five years have shown a pronounced tendency to have more light, not only for fine work but also in general : a good light is felt to be more cheerful. Working all day in artificial light gives people a feeling of being cheated ; if, however, owing to the nature of the work, this is inevitable, much can be done by the use of extended light services and by arranging artificial windows and similar devices.

Heating and ventilation cannot be kept separate. It used to be considered adequate if the air was pure and stimulating : now increased emphasis is laid on the need for an adequate degree of warmth as well. As with lighting, the standard of warmth has gone up ; many factories used to be below 50° F., whereas recently a research worker experienced difficulty in finding one below 55°. For the full assessment of thermal conditions a single yardstick, however, is impossible ; individual conditions have to be considered and weighed.

The recent 'black-out' regulations have added to the difficulties of factories relying on open windows, so that there are many complaints of stuffiness and overheating. Forms of light-traps, however can be devised, which allow of the entrance and exit of air while complying with the lighting regulations.

Dr. Millais Culpin said that since 1914 considerable progress has been made both in the diagnosis and treatment of psycho-neurotic illness. The last War took us unawares, with few doctors capable of treating such illness or even of recognizing its existence. Psychological casualties in the civilian population under direct war risk may be fewer than we might expect, for the civilian is allowed to show manifest fear or to run away. That some kinds of psychoneurotic people should retire to the West Country—as many did during 1914–18—is best for everybody. He regretted the use of a phrase now rather popular, namely, 'fright neurosis'. Fear is of biological significance, and to be afraid, even greatly afraid, is, in some conditions, a natural reaction. Pathological fear is in a very different category, the reaction being usually quite inadequate to the situation.

Nor is it right to class all psychoneurotics in one group; some of them can be diagnosed as likely to break down in peace or war, and some will not; others will withstand the most difficult conditions. Some who had managed to adjust themselves to the last War and to the years since have broken down now, suppressed memories of the last War being touched up. To confuse such cases with 'fright neurosis' is disastrous.

How civilians will behave in air raids is difficult to predict. It is possible that some with a high degree of claustrophobia will prefer to be bombed rather than have the feeling of being in an enclosed space; within a shelter some may faint, and others may adjust to the circumstances although feeling considerable discomfort. With regard to the question of what can be done with cases of uncontrolled behaviour or of those who faint in an air-raid shelter, Dr. Culpin said that the fainting neurotic might be left to himself, while harsh treatment might be needed for others. Two schools exist in the medical profession with regard to the treatment of the neurotic who has broken down: one is the school which would diagnose and treat by psychological means, and the other he called the 'kick in the pants' school. Fortunately for the world, the latter is found chiefly among the elderly, who are despised by the younger and more adequately trained doctors.

Mr. Alec Rodger, discussing the selection and grading of personnel, said that a great stimulus to this was provided by the Americans in the War of 1914–18. In order to sort out people fit for different kinds of training, nearly two million men were given intelligence tests. The experiment proved so successful that other countries, including Germany and the U.S.S.R., have adopted similar intelligence testing procedures. Mechanical aptitude tests have also been widely employed. Both intelligence and mechanical aptitude tests and other psychological techniques are used to a limited extent in our own fighting Services.

The value of tests in the grading of personnel needs special emphasis. Many are accustomed to think of them only as instruments in the selection of men and overlook the fact that they can be used effectively in the grading process, the aim of which is to arrange that individuals of similar abilities are instructed together. Mr. Rodger added that, since intelligence tests had been used by many school and other authorities over a period of years, much data of value to the Services could probably be made available immediately.

CENTRAL REGISTER OF SPECIALISTS

(SECTION FOR SCIENTIFIC RESEARCH)

IN the issue of NATURE of April 8, 1939, p. 575, there was an account of the establishment by the Royal Society and the Ministry of Labour jointly of the Central Register of Specialists (Section for Scientific Research), with the main aim of providing a list of scientific workers whose professional services might be useful in time of war. It will be remembered that each scientific worker was asked to fill in a card giving an account of his qualifications and some details of his career. From the point of view of the Royal Society the register also had a secondary purpose, for, if there were not to be a war, then it was felt that this was a good opportunity to obtain a census of the scientific knowledge of the country which would be of general value. With the outbreak of war the main purpose of the register was called into play, even before its compilation was complete, and it will be of interest to give a short account of some of its consequent workings. This article only deals with the register of men of science, and does not touch on the similar work of the Ministry of Labour in other branches of learning or technology.

In the spring of 1939, cards were sent out to men and women whose names had been furnished by certain learned societies. Up to the end of July a little short of eight thousand had been sent out and some five thousand replies received. Since July, several hundred more have been sent out to people who had been missed in the earlier lists, and the total number of cards returned is now more than six thousand. This list is largely composed of names from universities, from industries and from the research associations. Men already in the Government service have also been permitted to send in their cards, so that they are included in the census; though of course their services are already at the disposal of the Government, so that for them the more immediate function of the register does not arise. The committee of men of science which is helping to work the register is subdivided into panels composed of experts in each subject, and during the summer the panels met to sort out and classify their cards. There are, of course, great differences in the characters of the various subjects, and there was great uncertainty in the natures of the expected demands, and so no uniformity was attempted in the practice of the different panels. For example, the engineers and physicists subdivided their list into quite small groups, whereas in mathematics it was inappropriate to do this because, apart from the leading experts in each branch whose names would be well known, general mathematical skill is easily transferable from one subject to another.

On the outbreak of the War, the register immediately began to function. A certain number of leading men of science had already been earmarked for service directly, so that it was for junior posts that the register was specially useful. Recourse to the register is now the normal procedure for filling all scientific posts in the Government service when these are of the standard of the register. The way the register operates is usually somewhat as follows. The Government department requiring staff presents a written demand to the register for the staff that is needed in order to fill a certain number of posts, stating the nature of work, the qualifications required and the salary offered. A preliminary selection from the cards in the register is made by the staff of the Ministry of Labour with the advice and assistance of the expert panels, and often of technical representatives of the departments. The selection is then submitted to the appropriate panel so that the selections can be considered, and if necessary discussed with a technical representative of the ordering department. In this way the quality of the man needed can be more accurately assessed. When a final selection has been made, the men selected are circularized and are asked whether they are willing to be considered for the post offered provided that their employers are willing to release them. Thus the department concerned receives from the register what is practically a short list of suitable candidates who are known to be willing to take the post offered. The department then itself arranges for interviews and makes the appointments, and the Ministry of Labour takes no further part in the proceedings, except to record appointments.

It may be appropriate here to refer to a matter which has received some attention though it is not directly connected with the register. In many laboratories a number of men are doing co-operative research, and it was felt that the operation of the register, which deals with individuals, might seriously endanger such work by taking away some members, possibly even though they might be only minor members, of such teams. The question of safeguarding scientific teams was entrusted to the Department of Scientific and Industrial Research. The matter proved by no means easy, because a team is a very indefinite thing. For example, in one university a laboratory might with equal justice be regarded as either one or several teams, while in another, with quite as good a scientific record, the work of the members would be so independent that it would hamper their usefulness to call them a team at all. In the end it was settled that (with one or two special exceptions) there were to be no teams in universities, since if the operation of the register was in danger of spoiling important team work it would be easy for the university or the head of a department to make (as 'employer') representations to that effect. On the other hand, there was danger that the production of industry might be seriously hampered by draining away the members of its research teams, and so the research laboratories of a number of firms have been registered as teams. Their members cannot be called on through the machinery of the register without consultation with the Department of Scientific and Industrial Research.

The register has now been working for more than four months and it is possible to review some of its results. It appears that it has well justified the effort put into its preparation. For the most important appointments it was of course scarcely necessary, as the likely candidates for such appointments would be familiar to any adviser, but for other appointments it has been most useful, so that wherever a need has arisen in the Services, names could be put forward to meet it. In some of the subjects the demand has exceeded the supply, but there are a good many where the opposite is the case. As might be expected, the biological subjects are not in great demand for matters connected with the Services, and few new outlets for them are apparent in agriculture or industry; it looks unlikely that, for example, there will ever be calls for more than a limited number of zoologists or botanists as such. On the other hand, certain categories have become practically exhausted of scientific men. The question of training people for rare categories is being examined, and persons with 'secondary' qualifications in them are used when possible.

Consideration has been given to the point that it is now possible to say that a good many of those on the register who are reserved under the Schedule of Reserved Occupations will probably never be called on to use their professional knowledge for war purposes in a civil capacity, and the possibility has been examined of notifying them that they are released from their reservation. It was felt that it would be very invidious to take the initiative in this, but machinery has been set going to arrange for the possibility of release. It will be open to any scientific man reserved under the Schedule to apply for release, and his case will be considered by the appropriate panel. In arriving at its decision, the panel will give consideration to any representation by the applicant's employer (university, firm, etc.), and to the possibility that the applicant's professional services might be needed later, even though the demand is not yet apparent. In view of the differences of demand in the various scientific subjects, each panel is adopting its own policy, but broadly speaking the general policy will be that release will be granted to anyone who is unemployed or likely to become so, while for others the grant will only be made after much more careful consideration of each application.

OBITUARIES

Sir Francis Goodenough, C.B.E.

SIR FRANCIS GOODENOUGH died on January 11, after a long period of ill-health, at the age of sixty-seven. It is possible to surmise that had he come under the influence of a science master at an impressionable age, as has happened to many of us, he would have made a career in some branch of science which would have gained a great leader. As it was he performed what is perhaps the more difficult feat, namely, the introduction of some measure of planning and science into commerce.

He lived to see the subject of management adorned by the adjective 'scientific' and to participate in international congresses under the double heading. He was one of the first and greatest salesmen in the gas industry, where he emphasized the importance of supplying a service as well as a commodity. Equally valuable were his services in the cause of education applied to gas engineers and gas salesmen. Here he insisted that the scheme, elaborated in conjunction with the City and Guilds of London Institute, should be one of education as distinct from examination only. It is known that the early difficulties in connexion with this were almost overwhelming, and that but for his patience it would have been difficult to overcome them.

Sir Francis was a pioneer of co-operative advertising and a leader of many other co-operative movements both within and without the gas industry. A man of rare vision and large ideas, faculties usually involving impatience, he was characterized by an easy and genial manner and the quality of complete sincerity. In addition to his successful career with the Gas Light and Coke Company, which he saw rise from something very much smaller to its present outstanding position, he was always visualizing developments ahead of the time.

Sir Francis was one of those who will probably appear greater in retrospect than he does at the time of his activities, when personalities and policies hold the stage. Science and commerce lie perhaps on opposite sides of the river of daily endeavour, but many bridges are being built across the river, over which traffic struggles in either direction. One such bridge builder was Goodenough; the edifice he has erected, built on sound foundations, will stand the stresses of stream and wind and the increasing load of progress for many years to come. E. F. ARMSTRONG.

Miss E. K. Pearce

MISS ETHEL KATHERINE PEARCE, whose death occurred on January 8, at Morden, Dorset, at the age of eighty-three, was an entomologist who devoted her energy and enthusiasm almost entirely to Diptera. A daughter of a vicar of Morden, she had around her one of the finest entomological hunting grounds even in a county as favoured as Dorset. The first series of her work, "Typical Flies", a photographic atlas in which the author sought to popularize and extend the study of an order of insects much neglected in those days, was published in 1915. A preface giving practical guidance for collecting and preservation is followed by a sketch of Brauer's classification of the Diptera, and his sixty families are named, the Aphaniptera (fleas) being included. The forty-five pages of reproductions from photographs, considering the great difficulty of such work, are admirable, the flies figured being all recognizable and characteristic. In some cases preliminary stages are shown. The photographs of typical Dorset localities are a very pleasing and helpful feature. They not only give information as to the habitat of the fly, but also tempt the Nature lover to explore such delightful environment.

The flies taken as types of the various families were chosen with the help of the late Prof. Theobald, F. C. Adams, and other capable authorities, with great care. A second series appeared with 125 photographs in 1921, and a third series with 162 photographs in 1928. In all, fifty-five out of the sixty families of flies enumerated by Brauer are represented in the three series by a type fly. The brief biological notes given under the figures add much to the interest of the book. The author was helped, too, in her work by her brother, Mr. N. D. R. Pearce.

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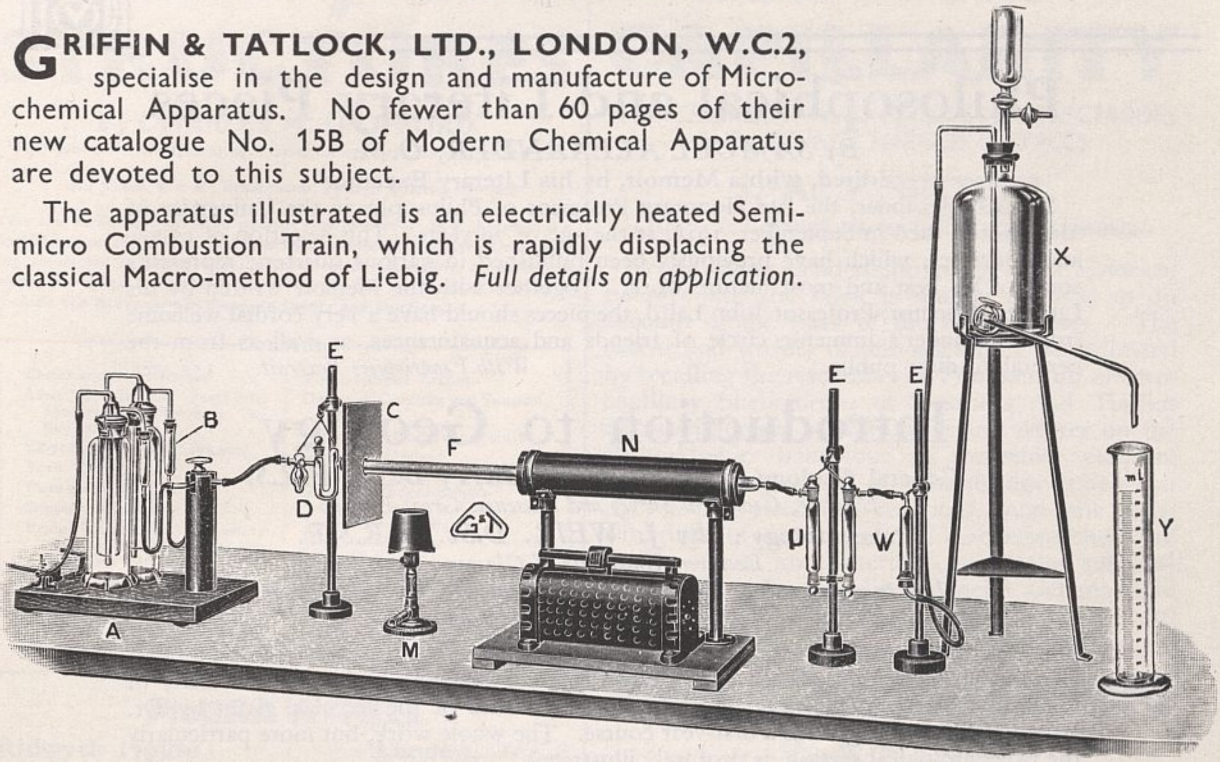

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Amiable and benevolent, and ever keen on doing useful work, Miss Pearce's death leaves the ranks of entomology the poorer. Her contribution cannot fail to aid beginners in classifying and identifying the flies they find. Non-specialists, also, who wish to place any fly they see in its systematic position, will likewise find Miss Pearce's guide a boon.

F. H. Haines.

We regret to announce the following deaths:

Prof. Aristide Busi, director of the Institute of Medical Radiology, Rome, aged sixty-five years.

Mr. W. M. Gardner, principal of Bradford Technical College during 1905–21, on December 22, aged seventy-eight years.

Mr. W. H. Lovegrove, formerly conservator of forests, Kashmir, on January 25, aged seventy-two years.

Prof. Ugo Mondello, the well-known seismologist, formerly director of the Ardenza Observatory, Italy, on December 3, aged sixty-one years.

Prof. S. Lees, Chance professor of mechanical engineering in the University of Birmingham, aged fifty-four years.

Mr. B. D. Porritt, director of research of the Research Association of Rubber Manufacturers, on January 28, aged fifty-six years.

Mr. F. T. Shutt, C.B.E., formerly Chief Dominion Chemist and assistant director of the Central Experimental Farm, aged eighty years.

Prof. C. A. Strong, formerly professor of psychology in Columbia University, aged seventy-six years.

NEWS AND VIEWS

Scientific Collaboration between Britain and France

A delegation from the Centre National de la Recherche Scientifique, led by its director, Prof. H. Longchambon, has been visiting Great Britain during the past week. The other members of the delegation were: Prof. M. Fréchet, professor of mathematics at the Sorbonne; Prof. G. Darmois, professor of mathematics at the Sorbonne; Prof. F. Joliot, professor of physics at the Sorbonne; Prof. P. Auger, professor of physical chemistry at the Sorbonne; Prof. C. Sadron, professor of building legislation at the Ecole Nationale Supérieure des Beaux-Arts, Strasbourg; Prof. G. Dupont, professor of theoretical chemistry at the Sorbonne; Prof. Denivelle, professor of chemistry at the Ecole Supérieure de Chimie at Mulhouse; Prof. A. Mayer, professor of medicine at the Collège de France; Prof. L. Blaringhem, professor of botany at the Sorbonne; Prof. P. Chouard, professor of agriculture at the Conservatoire National des Arts et Métiers; Prof. P. Langevin, professor of experimental physics at the Collège de France; Dr. P. Montel, professor of mathematics at the Sorbonne. This, it may be presumed, is one of the measures referred to by Lord Chatfield when he spoke recently in the House of Lords on the exchange of information and extension of the liaison between the scientific organizations of Great Britain and France (see Nature, Jan. 27, p. 142).

The programme arranged for the visitors included a reception at the Royal Society on January 29, when the guests were received by Sir Albert Seward and Prof. F. G. Donnan on behalf of the Royal Society. Dr. E. V. Appleton then addressed the meeting, and described the organization of the scientific effort for defence in Great Britain. The French delegation was introduced by Dr. Montel, after which Prof. Longchambon described the steps taken in France to mobilize scientific research for the country's war effort. Prof. Langevin also spoke. On January 30, the French delegation visited the National Physical Laboratory at Teddington, and on the following day travelled to Cambridge, where they saw the Cavendish Laboratory (Prof. W. L. Bragg) and the Colloid Science Laboratory (Prof. E. K. Rideal). A meeting of the Royal Society was arranged for February 1, at which Sir Arthur Eddington was reading a paper on "The Masses of the Proton, Neutron, and Mesotron", and L. Jánossy and B. Rossi a paper on "Photon Component of Cosmic Radiation". Prof. E. J. Williams was giving an account of his experiments on the transformation of mesotrons into electrons (see Nature, Jan. 20, p. 102), and Prof. P. Auger and Prof. P. M. S. Blackett were taking part in the discussion. On the same evening the French delegation were being entertained to dinner by British men of science.

Scientific Research for the Services

The Advisory Council of Scientific Research and Technical Development (see Nature, December 30, 1939, p. 1085) held its first meeting at the Ministry of Supply on January 25. Colonel J. J. Llewellin, in the absence of the Minister of Supply through illness, pointed out the Ministry has numerous establishments for research and development, etc., which, in some directions, work for all three Services: these establishments are supplemented by work in progress at various other research laboratories throughout the country. Lord Cadman, chairman of the Council, said that the research programme is most extensive, comprising more than a thousand items. The subjects being dealt with vary within very wide limits; it is therefore necessary to have an extensive and comprehensive scientific representation on the Council, which will function through a number of committees, on which other men of science will be invited to serve. So far, the committees formed deal with metallurgy, general physics, ballistics, structural engineering, communications, etc. The Directorate of Scientific Research of the Ministry of Supply already has a permanent staff of about nine hundred, but it is satisfactory to know that the Council also proposes to enlist the aid of independent outside men of science if, and when, required.

Institution of Electrical Engineers: Faraday Medal

DR. ALEXANDER RUSSELL has been awarded the eighteenth Faraday Medal by the Council of the Institution of Electrical Engineers. The medal is awarded for notable achievement in, or help to, electrical science or industry, and Dr. Russell is qualified in both respects. His works on alternating currents and the theory of cables have long been classical; not less well known are his researches on the sphere gap, and many other mathematical researches and papers communicated to the learned societies. He recently published the "Life of Lord Kelvin", whom he knew in the early days. Dr. Russell has been connected with Faraday House from its inception in 1889, and became principal in 1909. During fifty years he has helped in, or been responsible for, the training of thousands of electrical engineers, now to be found all over the world. The outstanding feature of this education has been the encouragement of men to bear their own responsibilities; many of his students, both in the early days and recently, have achieved important work even during their student days. He has been for many years a valued contributor to NATURE.

Dr. Russell is a past president of the Institution of Electrical Engineers, of the Physical Society of London, and of the Junior Institution of Engineers. He was elected fellow of the Royal Society in 1924 and made an honorary member of the Institution of Electrical Engineers in 1937. Later in the same year he retired from the more active work at Faraday House and became advisory principal. He thus holds available for the College his life's experience, and maintains contact with the hundreds of old students who can call in to see him, and with the thousands who can only write. We like to think that it is this aspect of his life's work, and the army of valuable men that has resulted from it, that the Council of the Institution of Electrical Engineers had in mind, not less than his mathematical researches, when the award of this year's Faraday Medal was made.

Captain C. W. Hume

CAPTAIN C. W. HUME resigned from the editorship of the *Proceedings of the Physical Society* on January 1, after having been responsible for that journal for a period of twenty years. A member of the reserve of Army officers, he rejoined his unit some time previously, and continued his editorial work until impending changes made it no longer possible. During his tenure of the office, he had seldom missed a Council meeting, and was usually present at science meetings, to obtain a record of the discussion on papers at first hand. He took great pains with the preparation of the *Proceedings* to ensure that papers should be free from ambiguity and obscurity, and printed in uniform style. His other interests were many. He founded the University of London Animal Welfare Society and the Universities Federation for Animal Welfare, and had also taken an active part at one time in the Association of Scientific Workers and the Parliamentary Science Committee, as it then was.

African Studies and the War

NOTWITHSTANDING the War, native administration in Africa must be carried on; and the problems incidental thereto are likely to become more, rather than less, insistent in the world turmoil which now prevails. For the moment, indeed, paradoxical as it may seem, circumstances probably are more favourable to African studies directed to possibilities of future development than if the end of hostilities were within measurable distance. Such, at least, would appear to be the judgment of H.M. Secretary of State for the Colonies, at whose request Lord Hailey will shortly pay a visit to a number of the British dependencies in West, East, and Central Africa to undertake an informal study of certain aspects of native administration. This investigation will carry further the work on such questions which Lord Hailey has already done during his earlier visits, when collecting material for his "African Survey". His inquiries on this occasion, which are expected to take about six months, will be directed in the main to the comparative study of forms of native administration, with special reference to their technical working and their future development. It will be of more than passing interest to see how in the judgment of so experienced an observer as Lord Hailey the diversity of conditions which will be brought under notice justify, or the reverse, the standardization of administrative methods in the interests of native advancement, and how far a more intensive study of native institutions in relation to administration than they have yet received, is demanded.

At the close of his tour, Lord Hailey will spend a short time in Southern Rhodesia, where facilities will be afforded for an unofficial study for comparative purposes of the principles and methods of native administration followed there. This study, it is anticipated, will be of great value when further consideration is given to the difficult questions of native policy in the Rhodesias and Nyasaland, to which attention is directed in the Report of the Rhodesia–Nyasaland Royal Commission (see NATURE, **143**, 829; 1939).

International Co-operation and African Studies

INTERNATIONAL co-operation, which in recent years has contributed so markedly to progress in African studies, is now necessarily much curtailed. Nevertheless, the International Institute of African Languages and Cultures, although its existence as an international institution seemed to be threatened, has decided that, so far as possible, its work must continue. In a communication over the signature of Lord Lugard, chairman of the Executive Council, which has been circulated to the members of the Institute, the reasons for the decision are given. Science, it is pointed out, is neutral, and further, the peoples of Africa, in war as much as in peace, need all that science can do to promote their welfare and advancement. "It seems to us important," says Lord Lugard, "that public interest in the welfare of the African peoples should not be 'blacked out' by a too exclusive concentration on events in Europe", adding "we are convinced that the Governments which have accepted responsibilities in Africa will not wish the war to put a stop to the various efforts at the social progress of its peoples, which they have initiated in years of peace." That this view is justified is borne out by the mission undertaken by Lord Hailey at the request of the Colonial Office, to which reference is made above. Further, if the War of 1914–18 may be regarded as a precedent, the problems of native Africa, when peace comes, will not be such as can be solved by improvisation, but only on a basis of the results of carefully digested scientific study over a considerable period.

African Native Institutions and Christianity

A STRIKING instance of the adaptation of African institutions and ways of thought to the promotion of Christianity after intensive study is contributed to the current issue of *Africa* (**13**, 1, January 1940) by Prof. N. de Cleene. Incidentally, it illustrates the flexibility, to which reference is often made, of Catholic Missions in dealing with native races. In response to a suggestion made by Prof. de Cleene that native art might be of service in the Christianization of Africa, the R. P. A. Walschap, a missionary in the Belgian Congo, made a scientific study of native music and the dance. Being struck by the predominating part played in native appreciation by the element of rhythm, not only did he introduce it into his church services, composing a mass and other music in native style, to be sung to the accompaniment of native instruments, but he also arranged a series of religious dances, in the native convention, for performance at the religious festivals of the Church. The result was a remarkable accession of interest and understanding.

The second example makes use of the graphic arts. The R. P. Vandenhoudt, from the time of his arrival on the Lower Congo some years ago, had made a study of the principles, methods and concepts of native graphic art. He was much struck with native ability in making crude but graphic representations of scenes and events in everyday life. He thereupon conceived the idea of representing scenes from the Holy Scriptures according to native concepts and in native technique. Among a number of scenes to which the method was applied, the most successful, and one which was immediately understood, was the sacrifice of Isaac by Abraham, in which the intended victim was represented according to a native custom, in which the head of a man condemned to be beheaded was fastened to the bent bough of a tree and shot into the air when the fatal blow was struck.

The British Museum (Natural History)

THE important entomological collections, manuscripts, etc., bequeathed by the late William Miller Christy have been received at the Museum. The total number of specimens is 21,312. The collection consists entirely of British Lepidoptera, and includes a large number of specimens which will be of great value as additions to the existing British collection. Mrs. Brownlow, who inherited them, has presented to the Museum a large number of important entomological books from the library of the late Mr. Christy. Further specimens of vanadinite (lead vanadate), including a doubly terminated crystal from Abenab, South West Africa, have been presented to the Department of Mineralogy by Mr. J. N. Justice, and the Department has also acquired two fine specimens of the rare potassium barium zeolite harmotone collected during the summer of 1939 at Ben Resipol, Argyll.

The Trustees of the British Museum decided at their meeting on January 26 that certain of the galleries in the Natural History Museum should be opened to the public on Saturday and Sunday afternoons, beginning on February 3. Much material has been evacuated for greater safety, and many exhibits have been protected in their places in the galleries. There remains, however, a very large proportion of the exhibits in certain galleries, and the Trustees are anxious that the public should have access to them so far as possible. In addition, it is hoped to organize a number of special exhibits of topical interest, about which a further announcement will be made at a later date. The hours of opening will for the present be from 1 p.m. to 4 p.m. (on Saturdays and Sundays only), but the closing hour will be extended as soon as the lengthening of the days and the introduction of summer time make this practicable. Children below the age of twelve will not be admitted unless they are in the charge of an adult, and visitors are requested to carry gas masks.

The Newcomen Society

AT a meeting of the Newcomen Society held at the Institute of Marine Engineers on January 17, Eng.-Capt. E. C. Smith read the second part of his paper on "The First Twenty Years of Screw Propulsion 1838–1858". Having in Part 1 dealt with the work of John Ericsson in the United States, Capt. Smith gave a review of the early progress of screw propulsion in both the Royal Navy and the British Mercantile Marine. The first screw vessel in the Royal Navy was the curious little *Bee* of 33 tons and 10 horse-power built in 1842 and fitted with a side-lever engine driving both paddle-wheels and a screw. The *Bee* for many years was attached to the Royal Naval College, Portsmouth, for the instruction of officers in steam. The first screw man-of-war in the Navy was the sloop *Rattler*, the trials with which in 1844–45 led to the screw being adopted for practically all naval vessels. By 1850 there were about forty screw ships in the Fleet, by 1858 and about 350. Generally speaking, in the larger wooden ships the screw was regarded as an auxiliary and was fitted so that it could be lifted out of the water.

The first mercantile screw vessel to make a sea voyage was the *Novelty* of 1841. The famous iron screw ship *Great Britain* was laid down in 1839 and completed in 1845. She was the first screw ship to cross the Atlantic, but a regular service to America by iron screw ships was not started until 1850, when the *City of Glasgow*, the first ship of the old Inman line, made her appearance. The year 1850 also saw the mails sent from Plymouth to the Cape for the first time by steam. Quite small iron vessels were used, and some of them were fitted with Joseph Maudslay's feathering screw. By January 1, 1857, the Board of Trade register included about five hundred screw-driven vessels, nearly all of them being constructed of iron. A second paper read at the meeting was by Mr. A. S. Davies, and consisted of some extracts from the ledgers of the Coalbrookdale Company relating to castings for Newcomen engines between 1717 and 1769.

X-Rays in Industry

METHODS of utilizing X-rays in industry were discussed in a lengthy paper by Mr. H. P. Rooksby, of the Research Laboratories of the General Electric Co., Ltd., in a paper read before the Royal Society of Arts on January 17. The methods of utilizing X-rays fall into two groups which depend (*a*) upon their power of penetration through various materials, and (*b*) upon their reflection by the regular arrangement of atoms in crystalline substances. The varying resistance of materials to penetration by X-rays enables a kind of density picture of a complex object to be obtained by irradiating the object with X-rays and examining the emergent beam by means of a photographic plate or fluorescent screen. This use is widely known.

Another use for X-rays concerns the continuous series of solid solutions formed by luminescent zinc/cadmium sulphides. Members of this series are used extensively in the manufacture of the screens of the cathode ray tubes, and for colour modification of certain mercury vapour discharge lamps. New fluorescent colours are often obtained by blending two zinc/cadmium sulphides of different compositions. A chemical analysis alone will not reveal when this has been done. The X-ray method enables the composition of both phases to be determined, as each phase will show up separately on the X-ray pattern. In some manufacturing processes, it is necessary to determine what effective heat treatment has been given to a sample of coke or 'amorphous' carbon. It is found that the ultimate particle size of amorphous carbon depends more upon the actual temperature of heat treatment than upon any other factor, so that the temperature to which a given sample has been treated can be ascertained with reasonable accuracy by comparison of its X-ray pattern with those of the standard period of cokes. In conclusion, the author emphasizes the fact that few recognize how wide is the scope of X-ray analysis. Certain physical properties such as the coefficient of expansion, which can be easily measured in the classical way, have also been measured by X-ray methods, and satisfactory agreement has been found. These new methods should not be regarded as merely repetitive, for new aspects of the physical property may be revealed by the new method of approach.

The Friendship of Boyle and Wren

IN a recent paper (*Bull. Hist. Med.*, 7, 970 ; 1939) Ruth Musser and John C. Krantz, jun., relate that Robert Boyle and Christopher Wren first became acquainted in London in 1648 when Boyle was aged twenty-one and Wren sixteen. In 1664, when both were at Oxford, Wren, who had been made Savilian professor of astronomy four years previously, conceived the idea of conveying medicines or poisons directly into contact with the blood of animals by inserting pipes directly into their blood vessels. The experiment was carried out on a dog in collaboration with Boyle at an Oxford meeting of the Royal Society at Wadham College, of which Wren was a member. The first experiment was made with a warm infusion of opium which was injected into one of the superficial veins of the dog's hind leg and produced profound stupor in the animal. Afterwards, experiments were made with an infusion of brown antimony oxide, which caused vomiting and was nearly fatal. Diuretics were injected at the suggestion of a famous physician who may have been Willis, and lastly transfusion of blood from one animal to another was carried out with considerable success. The experiments were brought to an end by the outbreak of plague in the summer of 1665, when Wren went to Paris, but the friendship of these two great men continued, owing to their activities connected with the Royal Society, until Boyle's death in 1691.

Meteorology in India

THE report on the administration of the Meteorological Department of the Government of India in 1938–39 covers a period during which an important stage in the re-organization of the department was completed. The scheme was planned to involve no increase in the budget grant and yet to give the following additional facilities : (1) an afternoon weather chart for the headquarters office at Poona ; (2) the re-establishment of the forecasting centre at Delhi ; (3) the establishment of a wireless station at Poona ; (4) re-organization of the superior staff ; (5) the transfer of the upper air office from Agra to Delhi ; (6) an increase of staff in the R.A.F. Meteorological Offices and the setting up of additional observatories in North-West India.

The aerological observatory at Agra dates from 1914. It was originally just a research station, and the position was chosen solely with the view of getting the maximum possible information about the upper atmosphere with the aid of sounding balloons. The growth of aviation has involved the observatory in an ever-increasing number of administrative and purely utilitarian activities, and for these Agra is a backwater. It is accordingly being transferred to a new 20-acre site that has been chosen at Delhi, where it can come into closer contact with aviation interests and where it will have access to the upper wind charts prepared in the normal routine of daily forecasting.

The Imperial Council of Agricultural Research continued to finance the Agricultural Meteorology Section, although proposals were under consideration for making the section a permanent part of the department. New developments in this section included the construction of a 35 ft. tower at the Central Agricultural Meteorological Observatory, for the study of exchanges of heat and moisture between the surface layers of the soil and the atmosphere. The Calcutta office issued storm warnings during sixteen periods of disturbed weather over the Bay of Bengal. The outstanding cyclone of the year in that region was that of October 5–12, 1938, which on approaching land caused much damage and some loss of life in the Ganjam district when sea waves inundated the coastal areas and swept away houses and cattle. The Poona office had a greater number of disturbed periods to deal with over the Arabian Sea, and one cyclone redeveloped into a very severe storm early in October after having weakened during its passage across the Peninsula from the Bay of Bengal.

The Bureau of Human Heredity

THE Bureau of Human Heredity is carrying on, though with reduced activity, during the War. Although some international connexions are cut off, a compensation is the possibility of obtaining a median sample of the population through the careful examination of entrants for the Services. This is not to be lost sight of, as collaboration with medical men in examining and collating genetical conditions would be of great importance in furnishing figures of medical, anthropological and genetical value. Although the Bureau has lost several workers, it has enlisted the support of Prof. F. A. E. Crew as honorary medical secretary. Correspondence with men of science in other countries continues, but in diminished volume, which may give time for other projects, including (1) surveys of the genetic background in tuberculosis, (2) the human analogue of the transmission of cancer in animals, (3) certain immunological problems. It is hoped also to compile a preliminary list of inherited disorders and defects based on recent research for the use of practitioners and teachers. The address of the Bureau is 115 Gower Street, London, W.C.1.

Cereals for Spring Sowing

THE National Institute of Agricultural Botany has just issued a war-time leaflet (Farmer's Leaflet, No. 2, "Varieties of Cereals for Spring Sowing"). Its appearance is opportune, for it both presents an epitome of spring oats and barley in the light of their general utility, as well as their possible substitution on land which was primarily intended for wheat, but which may yet be unsown owing to unfavourable weather. There are also some varieties of wheat normally used for autumn sowing which can be sown up to the end of February with reasonable chances of success. Quality in home-grown wheat at the moment is in abeyance ; but other things being equal, the same condition does not apply to oats. These are mainly intended for consumption on the farm, and the value of oat grain for all forms of stock feeding is determined by the amount of husk the grain contains. Thus, where the farmer is in a position to exercise a preference, it should be in favour of a variety with as thin a husk as possible.

In recent years nothing has happened to impair the reputations of Spratt-Archer and Plumage-Archer barleys amongst farmers and maltsters, and in general the recommendation of these varieties cannot be improved upon. There is, however, a case for the Danish varieties Kenia and Maja on rich soils, since both these barleys are early in ripening and both possess shorter and better standing straw than either of the two varieties mentioned above. On less rich soils, and where earliness in ripening is a requisite, the native varieties Standwell and Maltster may be utilized with advantage. Copies of the leaflet may be obtained from the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

Mr. A. H. Mackmurdo

THE communication entitled "The Social Organism", printed on p. 187 of this issue, has additional interest in the age and associations of the author. Mr. Mackmurdo, who is eighty-nine years of age, is believed to be the only man living who can claim to have been a friend both of Charles Darwin and of Herbert Spencer. For many years he worked with Spencer, and seventy years ago, at the age of nineteen years, he began his subscription to NATURE at the suggestion of Charles Darwin.

Announcements

CAPTAIN ROBERT KEMP has won the Buckston Browne prize for 1939 with an essay on the value of periodic medical examination in middle life.

DR. ETIENNE BURNET, director of the Pasteur Institute of Tunis, has been made a Commander of the Legion of Honour.

DR. C. G. DARWIN will deliver the thirty-first Kelvin Lecture of the Institution of Electrical Engineers on April 25, at 6 p.m. The title of Dr. Darwin's lecture will be "Thermodynamics and the Coldest Temperatures".

MESSRS. W. AND R. CHAMBERS, LTD., announce the early publication of "Chambers's Technical Dictionary". This single volume work contains terms drawn from many branches of scientific and industrial activity, and is under the editorship of C. F. Tweney and Dr. L. E. C. Hughes.

IN memory of the late Prof. V. R. Williams, the Russian authority on soils, the Timiryazev Agricultural Academy in Moscow has founded three annual prizes to be awarded for the best work on soil study and cultivation. The first prize is of 5,000 roubles, the second of 3,000 roubles and the third of 1,500 roubles. The Commissariat of Agriculture is preparing for publication a complete collection of Prof. V. R. Williams' work. New editions of the most important of them will be published this year.

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.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 191. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

3 : 4-Benzpyrene, Paramecium and the Production of Tumours

THE blastogenic hydrocarbons are photodynamic ; therefore, in order to observe their action on living cells, cultures must be kept in the dark, and examined in light not shorter than 410 $\mu\mu$. Under these conditions, using 3 : 4-benzpyrene and Paramecium, it has been shown that growth-rate is increased ; this effect thus reproduces in a test-tube the increased cell-growth observed when the hydrocarbon is applied to the tissues of vertebrates, for example, the hyperplasia of the epidermal cells, when the skin of mice is painted[1].

Continuing this line of research, I have tried to reproduce the conditions under which tumours arise. This has necessitated the cultivation of Paramecium for a long time in a medium containing 3 : 4-benzpyrene ; to keep the cultures going, they had to be sub-cultured two or three times a week.

Two sets of experimental cultures were maintained, containing one in a million benzpyrene, and one in five hundred thousand. In the latter, a few large organisms of abnormal shape were found on the sixty-second day. Similar abnormal organisms were also found in the one in a million cultures on the hundred and twenty-second day. This strain of Paramecium has been continuously under observation for more than two years and never have any abnormal forms been seen, either in control or experimental cultures.

Fig. 1.

OUTLINE DRAWINGS OF SPECIMENS FIXED IN 'SUSA' AND STAINED WITH CARMALUM.

The ruled areas are macro-nuclei ; Nos. 1, 4, 6, 8, 12 are normal Paramecia ; No. 10 is about to divide into two.

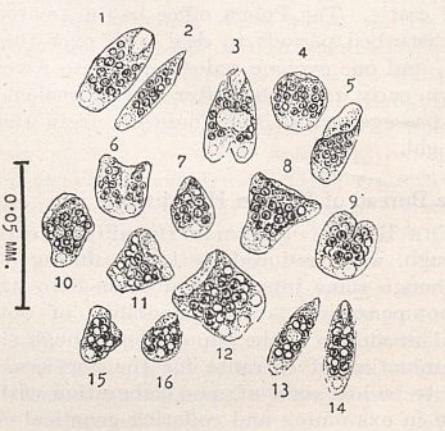

Fig. 2.

THE APPEARANCE OF LIVING INDIVIDUALS IN A STRONG SOLUTION OF GUM ACACIA.

The dotted circles are contractile vacuoles ; the other circles food vacuoles ; the macro-nucleus in 3, 10 and 13 is shown dotted with a full line margin ; Nos. 13 and 14 are normal individuals ; No. 2 is a side view of No. 1 ; No. 9 shows No. 8 contracted ; Nos. 8, 11 and 12 swim like Vorticella, the others swim in wide irregular spirals.

The experimental cultures never underwent conjugation. Furthermore, after the abnormal specimens were removed from the cultures, the cultures continued to present only normal forms. Later, single abnormal forms again occurred in the one in five hundred thousand culture on the eighty-third day, and in the one in a million on the one hundred and sixty-fifth day.

The abnormal specimens were picked out and placed in normal media as single-cell cultures : they grew into populations of abnormal Paramecia, some many times the normal size, some midgets, some 'Siamese twins', some triplets, some no more than knobbly monsters, some presenting little departure from the normal and some apparently quite normal.

Outline drawings of some of these fixed with 'Susa' and stained with carmalum are shown in Fig. 1 ; examined in gum, their appearance in life is well seen and illustrated in Fig. 2.

These abnormal forms have been sub-cultured in normal medium for several months by picking out single individuals. When sub-cultured by using a platinum loop, normal forms, which are often the progeny of the abnormal, quickly outgrow the abnormal, which thus become lost.

Breeding out various abnormal forms shows how this comes about : certain of the abnormal types, especially twins and triplets (Fig. 2, Nos. 3, 10 and 12), throw normal as well as abnormal individuals. Some of the abnormal forms, however (Fig. 2, Nos. 7, 11, 15 and 16), breed true and have been kept in pure culture for many generations by sub-culturing with a platinum loop. Thus, long exposure of Paramecium to benzpyrene results in the production of a set of polymorphic cells. Here we have a striking resemblance to the assemblages of cells of which tumours are composed; it is well known that the cells from a single tumour are widely polymorphic both in size and structure: for example, their content of chromosomes may be either normal, above the normal, or below; cells with many times the normal number are common.

The similarity between the formation of a tumour by benzpyrene and the changes observed in Paramecium thus embraces the following facts:

(1) They occur among cells long stimulated to a growth-rate above the normal.

(2) They occur only after long exposure to the hydrocarbon.

(3) Only a very few of the exposed cells present the change.

(4) Once the change has occurred, it is reproduced by cell division for many generations after the hydrocarbon has been removed.

(5) The population of cells which result show wide morphological variation.

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Jan. 1.

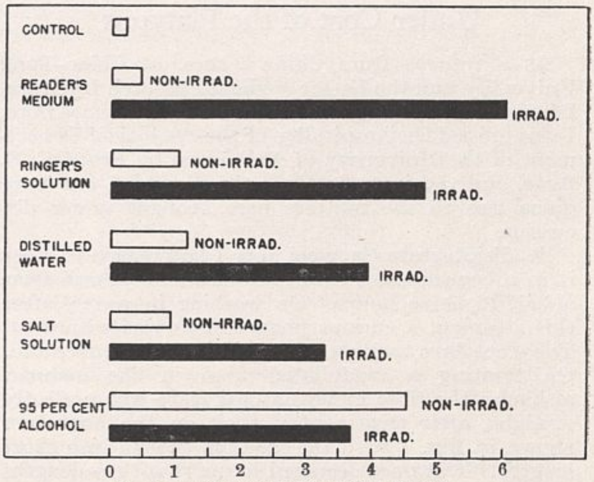
[1] NATURE, 144, 154 (1939).

Effect of the Suspending Medium on the Production of Growth Factors by Injured Cells

IN investigating the production of proliferation-promoting intercellular wound hormones by cells injured by various means[1], a study has been made of the effects of the suspending media on the production of the factors by cells injured with lethal ultra-violet radiation

Reasoning that if the proliferation promoters are physiological products of living cells, the ratio of the production of the factors by irradiated and non-irradiated cells should be greatest when they are suspended in a favourable medium, containing nutrient material, a comparison was made of the production of the factors in distilled water, isotonic sodium chloride, Reader's medium[2], 95 per cent ethyl alcohol, and Ringer's glucose phosphate solution. Yeast was suspended in these media at a concentration of 100 gm. per litre. All suspensions were irradiated simultaneously with lethal ultra-violet until there was practically complete killing in the salt solution. The suspensions were then filtered through Berkefeld *N* filters, and the filtrates taken to dryness and made up to five times their original concentrations. These solutions were assayed on yeast according to techniques previously described[3].

The results of typical assays are shown in the accompanying illustration. The greatest production of the factors by irradiated cells and the least by



Yeast growth after 24 hr.; mgm. per c.c.

non-irradiated cells occurred in the most favourable medium (Reader's). Next followed Ringer's glucose phosphate solution. In distilled water and salt solution, in which the cells had no nutrient supply, the ratio of irradiation products to controls, as well as the potency of irradiation products, were less, as would be expected if the factors were elaborated by living cells and not simply extracted from killed cells. There was somewhat greater release of proliferation-promoting factors by both non-irradiated and irradiated cells in distilled water as compared with salt solution, evidently due to the lowered osmotic pressure in the former favouring extraction. In alcohol, irradiation led to less, instead of greater, yields, the toxic effects of alcohol and irradiation together apparently killing the cells too quickly to permit as great elaboration of the factors as in alcohol alone. Were the factors dead-cell disintegration products, one would not expect any decreased yield in alcohol as a result of irradiation unless irradiation destroyed the active factor. That this could not have accounted for the lesser yields obtained was determined by separate experiments on the irradiation of active filtrates, the degree of inactivation being negligible under the conditions of the experiments.

The results indicate that disintegration of dead cells cannot account completely for the proliferation-promoting products obtained from injured cells, and support the hypothesis that injured cells release such factors into their suspending media as a physiological response to injury.

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Dec. 7.

[1] Fardon, Norris, Loofbourow and Ruddy, NATURE, 139, 589 (1937); Sperti, Loofbourow and Dwyer, NATURE, 140, 643 (1937); *Studies Inst. Divi Thomae*, 1, 163 (1937); Sperti, Loofbourow and Lane, *Science*, 86, 611 (1937); Loofbourow, Cueto and Lane, *Arch. exp. Zellforsch.*, 22, 607 (1939); Loofbourow and Dwyer, *Science*, 88, 191 (1938), NATURE, 143, 725 (1939), *Studies Inst. Divi Thomae*, 2, 155 (1939); Loofbourow and Morgan, *J. Bact.*, 38 (1939), in the press.

[2] Reader, *Biochem. J.*, 21, 901 (1927).

[3] Loofbourow, Dwyer and Morgan, *Studies Inst. Divi Thomae*, 2, 137 (1938).

Under Coat of the Platypus

As a refugee from China where, at Chiao-Tung University and the Lester Medical Research Institute, I had been studying the structure of the wool fibre, I was offered the hospitality of the Zoological Department of the University of Melbourne by Prof. W. E. Agar, and the investigations there carried out have given rise to the matters here brought under discussion

To disintegrate the wool fibre I had reason to steep it in a concentrated solution of caustic potash from a half to three hours. On washing in water, after this steeping, a curious phenomenon was witnessed. The wool fibre took on a beautiful regular curvature. On treating a medullated fibre in like manner, although the fibre in its natural state was perfectly straight, after treatment it took on the curvature shown in Fig. 1 with the medulla broken into short lengths. It at once occurred to me that these lengths each represented a day's growth. If this were so then there would be approximately 365 of these for a year's growth, and multiplying this number by the unit length should give the fibre length of one year's growth. This I found to be approximately correct.

One explanation of the effect here observable appears to be that the cortex of the fibre contracts while the medulla does not do so and consequently is constrained to take up the positions shown. A normal wool fibre without medulla shows a similar curvature when similarly treated, this probably being due to the different contractions of scale sheath and cortex. The periodicity of the break along the normal wool fibre is about equal to twelve diameters, that is, about one hundredth of an inch with a typical Merino wool fibre. The curvature of the wool fibre in the lock or staple is partly to be attributed to this periodicity and partly to the varying lengths of fibres composing each staple. Thus the shorter fibres decide the length of the staple and the longer fibres, of necessity, take on the curl or crimp to fit themselves to this length. On looking at the coat of the platypus in the University Museum, I was naturally struck with the 'ladder' structure shown in Fig. 2, and it was but a step further forward to ask: Is this ladder structure due to the daily periodicity—does each ladder represent a day's growth of the fibre ?

By the kind collaboration of Mr. Kendall of the Melbourne Zoological Gardens and Mr. David Fleay

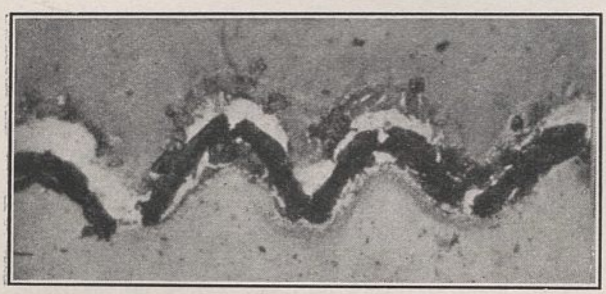

Fig. 1.

MEDULLATED FIBRE CURVED AFTER TREATMENT WITH CAUSTIC POTASH. (× c. 36).

Unit length approximately $\frac{3}{4}$ and $\frac{3}{4}$ of $\frac{1}{45} = \frac{1}{60}$ or 60 breaks per inch. And 365 days ÷ 60 = 6 inches, length of fibre for one year's growth.

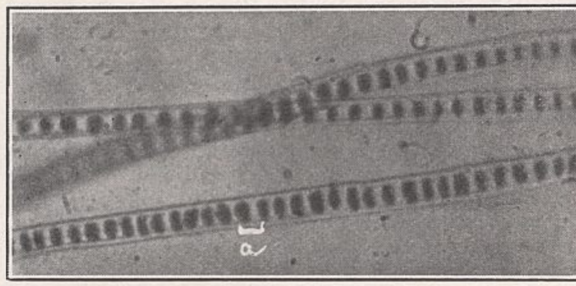

Fig. 2.

LADDER STRUCTURE OF UNDER COAT OF PLATYPUS. (× c. 330).

One ladder = $\frac{1}{8}$ in., and 440 × 8 = $\frac{1}{3520}$ length of each ladder. Fibre $\frac{1}{2}$ in. long, therefore $\frac{3520}{2}$ = 1760 ladders or days. And $\frac{1760}{365}$ = 4 years and 300 days. (Age of Animal).

of the MacKenzie Sanctuary, Healesville, near Melbourne, I was able to obtain fibres from two animals of known age, and on testing out the theory I was surprised and naturally delighted to find the wonderful coincidence as shown in the following table :

	A	*B*	*C*	*D*	*E*
Fibre length	$\frac{1}{2}$ in.	$\frac{1}{4}$ in.	$\frac{1}{4}$ in.	$\frac{1}{2}$ in.	$\frac{1}{3}$ in.
Length of ladder	$\frac{1}{3000}$	$\frac{1}{3000}$	$\frac{1}{3000}$	$\frac{1}{3000}$	$\frac{1}{3000}$
Ladders per fibre	1500	750	750	1500	1000
Age by ladders	$4\frac{1}{5}$	$2\frac{1}{18}$	$2\frac{1}{18}$	$4\frac{1}{5}$	3 (nearly)
Actual age	Well over $2\frac{1}{2}$	2+	2+	Not known	Not known

A is the Zoo platypus ; *B* "Jack" from the Sanctuary ; *C* "Gill" from the Sanctuary ; *D* from the University Museum ; and *E* a stuffed specimen from the Zoological Gardens.

This, however, seemed too good to be true, so I set to work to examine each coat thoroughly, and to my chagrin I found a fibre in the coat of Gill, one of the Sanctuary animals of known age, much too long to fit in with my theory. At the same time, however, I noticed the waved character of the fibres and, from my experience with wool staples and fibres which had shown a similar effect due to the variation in lengths of the fibres composing the staple, I at once thought of different rates of fibre growth which would account for this long fibre. But if my theory were correct there would only be the same number of ladders upon this longer fibre as upon the shorter fibres—in other words, the ladders would be longer. On measuring the ladders on this longer fibre I found that they were longer and that consequently on the longer fibre there would only be the same number of divisions as on the shorter, slower growth fibres. The following are the details :

For *C* ("Gill" from the Sanctuary) :

Longest fibre	$\frac{1}{3}$ in.	Average fibre		$\frac{1}{4}$ in.
Length of ladder	$\frac{1}{2590}$	,,	,,	$\frac{1}{3000}$
Ladders per fibre	863	,,	,,	750
Age by ladders	$2\frac{1}{3}$	,,	,,	$2\frac{1}{18}$
Actual age	2+	,,	,,	2+

As these ladders are approximately only about one three thousandth of an inch in length, it is wellnigh impossible to count the ladders for even a two years' growth. It would seem, however, that the theory here set forth, that each ladder represents a day's growth of the fibre, is likely to be correct.

There is, however, one other matter to be considered which might invalidate the whole argument: Is the coat of the platypus composed of life-length fibres or only of year's-growth fibres? Does the platypus retain its under coat for its life or does it 'moult' or cast its coat yearly? Curious to relate, certain animals, such as the musk ox, cast their under coat yearly, but the Merino sheep, which according to the late Prof. Cossar Ewart has thrown off the outer hair coat of the wild sheep and retained only the under coat, does not cast this under coat: Merino sheep have been sheared carrying a five-years' growth of wool.

I would therefore ask the help of other workers in the elucidation of the two problems basic to the theory here advanced:

(1) Do the animals carrying a 'laddered' under coat cast this coat yearly, or do they retain the under coat for life, the life-histories of the animals being shown on the fibres just as the age and history of a tree are revealed by the rings from bark to centre?

(2) Is the 'ladder' truly representative of a day's growth of the fibre in the case of animals other than the platypus which show this ladder structure of the fibre?

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The Social Organism

IN the last few years science has thrown her searchlight upon social physics, making amazing discoveries. She shows that there are laws underlying social physics as immutable as those she has discovered in material physics. This fact compels the assumption that the evolution of social bodies follows the pattern of all organisms in an increasing specialization of parts with a reciprocal unification of structure. This means also that a society in its evolution becomes a social organism. The facts disclosed by science lead to no other interpretation.

In our study of natural history which now includes the history of societies, we find that all beings—mechanical, vegetal and animal—may be classed in a serial order ranging from the most simple to the most complex, and from a motor-car to a social organism. In the inevitability of this order man will find he has a sure guide to control his interference with and to direct his assistance to Nature's process of social evolution. Hence the call everywhere heard for the help of science in the work of social organization.

So long as we ranged social phenomena as a class apart from physical phenomena, science could not pass the frontiers of the latter. She had to concentrate upon improvements in mechanics and chemistry.

One cannot organize a heap of sand. Before a body can be organized there must be some binding element tending to integrate its diverse parts into a whole. This necessity becomes more evident as organisms rise in the order of their complexity. In the long past this binding element was supplied by the general concept of a superhuman power. To-day this concept is no longer general. Societies have been trying to pull themselves together either by a common defence of material possessions or by a common defence of personal rights.

But science alone can supply the missing link between the individual and society. This link is in the new conception of the social body as an organism in process of development.

The supernatural concept of the past had reference only to the individual, and in its decay it has given rise to an unrestrained individualism which has engendered disorganization and disruption instead of organization and integration.

A modern society is composed of individuals who are forced to live in association and to maintain their life by co-operation. This is the new phase and one pointing directly to the organization of the maintaining activities in accord with the law of organic life.

In the absence of scientific direction, we have been intensifying the specialization of the individual without any compensating balance in the form of a common conception such as will induce the highly specialized individuals to direct their specialized competence in building up a welfare beyond that of the individual, but one within which the welfare of each would be embodied.

In this lack of any integrating influence in the presence of elements which are in themselves disintegrating, lies the cause of the restiveness and the antagonisms of the present day in almost every European nation.

The universal instinct of man is restless in its search for law and order, and if it find no real law and order outside his own consciousness, he will create a fictitious law and order—Bolshevism, Socialism, and what not.

Here social science, which is the capital science, together with all the sciences preliminary to this, from astronomy to physiology, may keep societies out of the bog into which they are drifting. Never before has science had such an opportunity of educating and directing the civilities which constitute the civilization of mankind. By insistence upon the recognition of each body-politic as a social organism true to type, and by the habit of a conception which will enlarge the aim of science, industry and arts, this enlargement of the social functions will cause a new social structure to arise for their ample accommodation; which sociological structure will follow the pattern of physiological structures.

By the process of evolution millions of unicellular organisms have been brought into organic integration to form a multicellular physiological structure—vegetal, animal or human. By the same process Nature is incorporating millions of individuals in a multipersonal organism. This is the positive fact upon which social science is built.

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Wickham Bishops,
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Jan. 5.

Energy Changes Accompanying Magnetization

IT is generally stated that the heat evolved in a hysteresis cycle is given by the expression $\int HdI$, where I is the intensity of magnetization of a ferromagnetic specimen in an effective field H, although it is very difficult to provide an adequate proof of this statement. In recent years several attempts have been made to investigate the heat liberated or absorbed when a ferromagnetic is taken through the several stages of a single hysteresis cycle step-by-step. Thus, Adelsberger[1] found that the total quantity of heat liberated by unit volume of a hard steel in a single complete cycle is equal to that calculated from $\int_{-H}^{+H} HdI$, and so provided a proof of what is known as Warburg's Law.

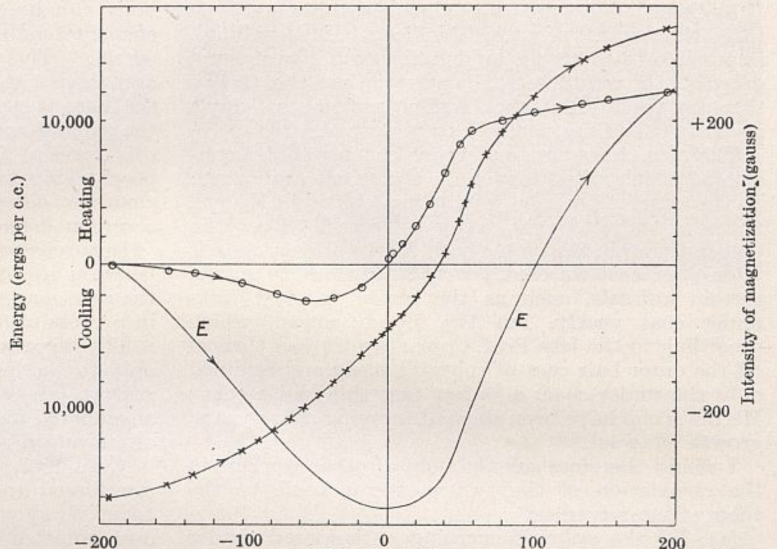

Fig. 2.

STRESS 8·67 kgm./mm.².

Now, while there is little doubt about the correctness of this law, there is much uncertainty about the heat changes accompanying the magnetic changes taking place when a cycle is described in a step-by-step process. This is because the temperature changes are exceedingly small; for example, in the very favourable case of a hard steel, the total rise in temperature when its magnetism is reversed in an ordinary laboratory experiment is only about 0·005° C. Consequently, all experiments which have hitherto been made have relied either upon the use of multiple thermojunctions electrically insulated from, but in thermal contact with, a ferromagnetic rod, or upon the use of multiple specimens, each of which acted as one metal of a thermocouple, or upon the use of a divided specimen to each portion of which a thermojunction was attached, the several thermocouples being connected in series to a sensitive galvanometer. References to these experiments will be found in a recent paper by Hardy and Quimby[2].

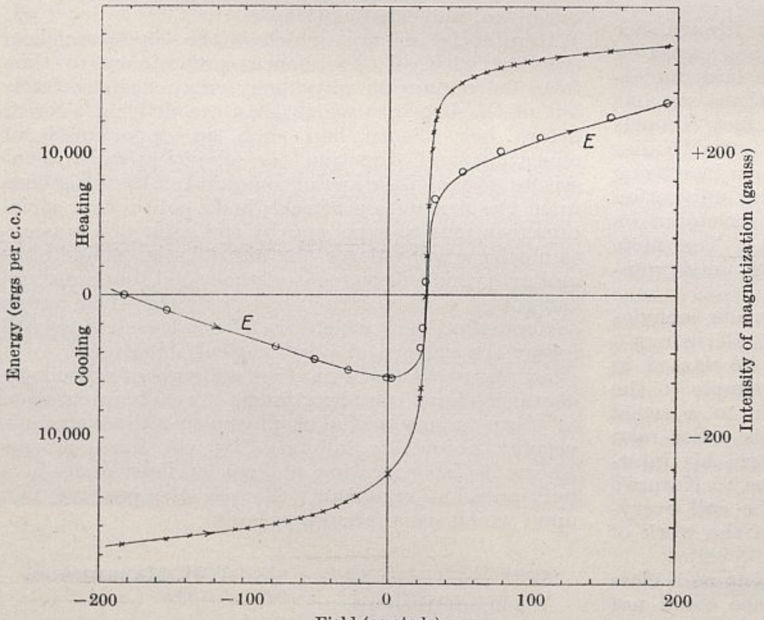

Fig. 1.

ZERO STRESS.

We have recently developed in this laboratory a new and sensitive method which permits the measurement of sudden changes in temperature when some twenty thermojunctions are connected directly to an undivided rod about 5 mm. in diameter and 40 cm. long. Incidentally, the method could readily be used to measure the rate of change of the modulus of rigidity of a metal with rise in temperature. The great advantage of our method is that it enables us to measure the thermal changes accompanying magnetization processes when the rod is subjected to a steady severe longitudinal stress. In this way we have been able to obtain measurements with a hard-drawn, unannealed nickel rod, 99·67 per cent pure, the main impurity being magnesium, kindly supplied by Dr. L. B. Pfeil, of the Mond Nickel Company Research and Development Department, when under tensions of 1·70, 3·72, 5·28, 8·67, 12·1, 21·4 and 31·2 kgm. per sq. mm.

Some of the results are shown in the accompanying graphs, in which the curves drawn through the crosses are the I, H curves, the curves E represent the energy changes calculated from the I, H curves on the assumption that the expression $\int HdI$ is adequate, while the encircled points are the results of our direct measurements. Fig. 1 refers to the unstretched nickel rod, and here the agreement between the calculated and the measured results is extra-ordinarily close. In our view, it is fortuitous, as we have not found such close agreement with another, slightly purer, specimen. Fig. 3 refers to the same rod under the severe stress of 31·2 kgm. per sq. mm., and is very interesting because all trace of cooling on demagnetization has vanished and no reversible changes of any kind appear. Now, Becker[3] deduces that in the case of heavily stretched nickel the entire magnetization is caused by reversible rotation of Weiss domain vectors which are forced by the severe tension to set perpendicularly to the axis of the rod in the absence of a longitudinal field. Our experiments therefore show that such processes are unaccompanied by measurable heat changes. The results of Fig. 2 are for the same rod loaded to 8·67 kgm. per sq. mm., and represent a transition stage between those of Figs. 1 and 3.

In conclusion, we wish to direct attention to the proof of Warburg's law, the lack of correspondence between the calculated heat changes and those measured directly in step-by-step alterations of H, and the significance of the measurements on nickel under severe tension arising from these experiments. It is hoped to publish a complete description of the method and the measurements on nickel and several nickel alloys in the near future.

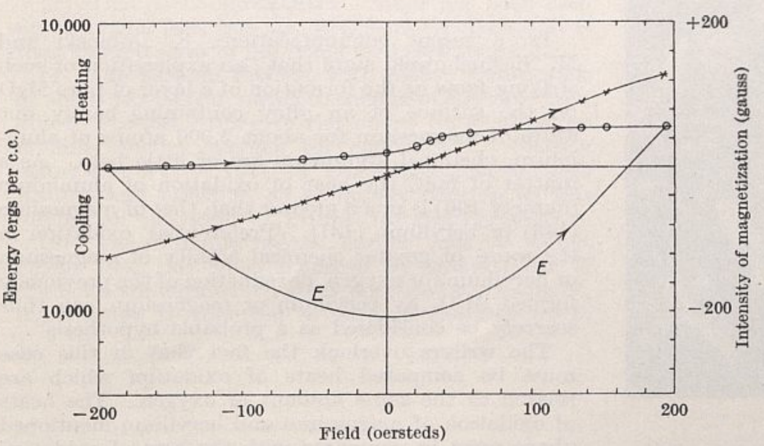

Fig. 3.

Stress 31·2 kgm./mm.².

University College,
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Dec. 20.

L. F. Bates.
J. C. Weston.

[1] Adelsberger, U., *Ann. Phys.*, **83**, 184 (1927).
[2] Hardy, T. C., and Quimby, S. L., *Phys. Rev.*, **54**, 217 (1938).
[3] Becker, R., and Döring, W., "Ferromagnetismus", p. 111 (1939).

Diffraction of Convergent Electron Beams

In a recent paper[1], Kossel and Möllenstedt describe some beautiful experiments on the diffraction of convergent electron beams by transmission through thin crystals. Whereas very thin crystal flakes (or flakes of not perfectly uniform thickness ?) show the diffraction pattern of a two-dimensional lattice, the diffraction spots of mica crystals some 500–1000 A. thick show a fine structure of approximately equidistant stripes (Fig. 1) which Kossel and Möllenstedt interpret as being due to the secondary maxima of the Laue interference function

$$\frac{\sin^2\left\{\frac{2\pi}{\lambda}\cdot\frac{N}{2}\,c\,(\cos\theta_m-\cos\theta)\right\}}{\sin^2\left\{\frac{2\pi}{\lambda}\cdot\frac{1}{2}\,c\,(\cos\theta_m-\cos\theta)\right\}},$$

where c is the identity period normal to the crystal surface, N is number of cells in this direction, θ is the angle between incident beam and c, θ_m is the angle between diffracted beam and c. With $\theta_m+\theta=2\theta_0$ (interference condition of the crystal surface[1]), where θ_0 is the Bragg angle of the reflection plane—which is perpendicular to the surface—and considering the smallness of all the angles, this may be written

$$\frac{\sin^2\left\{\frac{2\pi}{\lambda}Nc\,(\theta-\theta_0)\sin\theta_0\right\}}{\sin^2\left\{\frac{2\pi}{\lambda}c\,(\theta-\theta_0)\sin\theta_0\right\}}, \quad . \quad . \quad . \quad (1)$$

which function shows minima for

$$\theta-\theta_0=\frac{md_{hkl}}{D} \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where d_{hkl} is lattice plane distance, $D=Nc=$ thickness of the crystal, and m is any integer save 0, $\pm N$, etc.

However, this explanation based on the kinematic diffraction theory does not account fully for the details of the phenomenon: The distance between the minima $m=+1$ and $m=-1$ should be twice the distance between the minima m and $m+1$, whereas it is almost invariably much smaller than this expected value. Kossel and Möllenstedt, being fully aware of this fact, describe it qualitatively in terms of a dispersion with direction of the wave-length, as found in the dynamical theory of crystal diffraction. It seemed worth while to apply directly the formulæ given by this theory and, if possible, to test them.

The dynamical theory of electron diffraction by crystals has been given by Bethe[2], who, however, developed it only for the 'Bragg case' (reflection pattern); in working out the theory for the 'Laue case' (transmission diagram) along the lines followed by Ewald and others[3], a complete analogy to Ewald's *Pendellösung* is found, as might, of course, be expected. Neglecting terms of higher order, we find for the relation between the amplitude c_m of the diffracted c_0 of the incident beam :

$$\frac{|C_m|}{|C_0|}=\frac{|V_{hkl}|}{k^2}\,\frac{\sin\frac{1}{2}Dk\sqrt{(\theta-\theta_0)^2\sin^2 2\theta_0+\frac{|V_{hkl}|^2}{k^4}}}{\frac{1}{2}\sqrt{(\theta-\theta_0)^2\sin^2 2\theta_0+|V_{hkl}|^2/k^4}}, \quad (1a)$$

where $k=\frac{2\pi}{\lambda_{cr}}$, where λ_{cr} is the wave-length of the electron beam, modified by the average crystal potential; and V_{hkl} is the structure factor for the electron diffraction against the plane hkl.

In contrast to (1) it is seen that the argument of the sines in (1a) can no longer assume the value 0, its minimum value being $\frac{DV_{hkl}}{2k}$. Taking the experimental conditions of Kossel and Möllenstedt,

$D \approx 10^3$ A., $\lambda = 0{\cdot}058$ A., this will not exceed π unless V_{hkl} is greater than about 3 volts, which corresponds to a strong reflection. Minima are thus found at

$$\theta - \theta_0 = \pm\, d_{hkl} \sqrt{\frac{m^2}{D^2} - \frac{|V_{hkl}|^2}{4\pi^2 k^2}}\,, \quad . \quad . \quad (2a)$$

where $m = 1, 2, 3$ . . . etc.

With large m or small D, the second term under the root can be neglected compared to the first, thus leading to (2), Kossel and Möllenstedt's formula. It is easily seen that the dynamical correction term has the greatest relative influence on the distance between the first minima on either side of the maximum at θ_0; in the distances between minima on the same side of θ_0 the correction terms cancel to a great extent, in accordance with experiment.

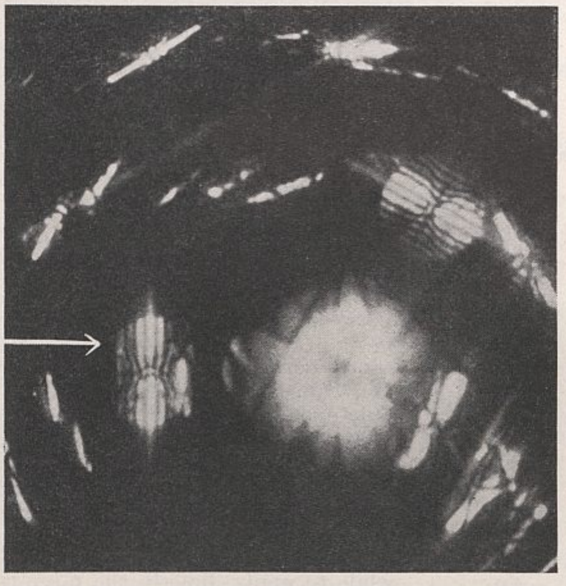

FIG. 1.

TRANSMISSION PATTERN FROM MICA WITH CONVERGENT ELECTRON BEAMS.[1]

To test (2a), V_{hkl} has been computed from the anomalous distances[4] in the diffraction spot on the left-hand side of Fig. 1, corresponding to the reflection (060). (In the figure it is seen that the position of the bands shifts when crossed by a Kikuchi line. This effect being caused by terms neglected in (2a), the distances between minima must be measured outside these regions.)

$$\frac{\theta_{+1} - \theta_{-1}}{(\theta_{m+1} - \theta_m)_{m=\infty}} = 2\sqrt{1 - \frac{|V_{060}|^2}{4\pi^2 k^2} D^2} = 1{\cdot}2,$$

where $(\theta_{m+1} - \theta_m)_{m=\infty}$ has, as a rather crude approximation, been taken from the average value of the bands $\theta_2 - \theta_1$ and $\theta_3 - \theta_2$. With $D = 900$ A. and $\lambda = 0{\cdot}058$, we find

$$V_{060} = 2{\cdot}3 \text{ volts.}$$

On the other hand, V_{hkl} was evaluated from the known atomic positions in mica, the data of Jackson and West[4] for muscovite having been used:

$$V_{060} = \frac{d^2_{060}\, e}{\pi\, a\, b\, c \sin\beta} \cdot \Sigma i\, (Z_i - F_i) e^{2\pi i . 6Y_i/b} = 2{\cdot}1 \text{ volts,}$$

in striking agreement with the value found above.

It is thus shown to be possible to determine structure factors simply by measuring *distances* between minima in the fine structure of a diffraction spot, without any *intensity* measurement. The applicability in practice of this very remarkable way of measuring structure factors will be confined to crystal flakes of sufficiently uniform thickness; when D is not sufficiently constant, the position of the minima will shift within the region of coherence of the beam, so that the fine structure will disappear.

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Dec. 21.

[1] Kossel, W., and Möllenstedt, G., *Ann. Phys.*, **36**, 113 (1939).

[2] Bethe, H. A., *Ann. Phys.*, **87**, 55 (1928).

[3] Ewald, P. P., *Ann. Phys.*, **49**, 1, 117 (1916); **54**, 519 (1917). v. Laue, M., *Erg. d. exakt. Naturw.*, **10**, 133 (1931). Kohler, M., *Ann. Phys.*, **18**, 265 (1933).

[4] Jackson, W. W., and West, J., *Z. Krist.*, **76**, 211 (1931).

Selective Oxidation of Aluminium Alloys

IN a recent communication[1], S. Dobiński and M. Niesłuchowski state that "an explanation of such striking facts as the formation of a layer of pure MgO on the surface of an alloy containing barely one atom of magnesium for about 3,000 atoms of aluminium, chemical arguments are of little help. As a matter of fact, the heat of oxidation of aluminium (namely 190) is much greater than that of magnesium (143) or beryllium (131). 'Preferential' oxidation in the sense of greater chemical affinity of magnesium or beryllium for oxygen, or reduction of the previously formed Al_2O_3 by beryllium or magnesium, can thus scarcely be considered as a probable hypothesis".

The writers overlook the fact that in this case must be compared heats of oxidation which are related to the same amount of oxygen. The heats of oxidation of magnesium and beryllium mentioned above must be compared with the heat of oxidation of aluminium, also related to one atom of oxygen (namely, 126). The chemical affinity of beryllium and magnesium for oxygen is thus greater than that of aluminium, and the preferential oxidation of magnesium and beryllium is in accordance with the difference in chemical affinity of the three oxides.

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Dec. 22.

[1] NATURE, **144**, 510 (1939).

The Primus Stove at High Altitudes

THE risk of carbon monoxide poisoning from Primus stoves, discussed by Prof. Yandell Henderson and Mr. J. McCullough Turner in NATURE of January 20, was realized at least eighteen years ago. The Mount Everest party of 1922 was warned about this, on Prof. Georges Dreyer's advice. He pointed out how the danger might be aggravated at high altitudes owing to oxygen scarcity, and consequently less complete combustion.

Further, the late Mr. R. P. Hope has pointed out that to melt snow quickly a little should be melted to start with, so as to get some water in the pot before filling it up with snow. This seems plausible, because air in contact with the bottom of the pot must delay heat transmission, and when a pot is filled with snow to start with, the first water to form moistens the bulk of the snow rather than settles on the bottom.

As exploration is at least as popular at high altitudes as in the Arctic, the factors affecting snow melting high up may be of equal interest :

(1) The water vapour from the flame condenses on the cold bottom of the pot. The pot must be slightly tilted, so that the water drains away to its edge. Otherwise it drips on to the burner, decreasing the efficiency, and at times extinguishing the flame.

(2) The fuel efficiency of the ordinary mountain cooker, which has a plain wind screen in place of the annular container of the Nansen type, remains constant up to 15,000 feet, at all events. With the petrol Primus it is about 60 per cent, as against 80–90 given for the Nansen cooker, the figure of 60 applying to heating of water, and not melting snow.

(3) This particular type of Primus has been used up to 17,000 feet, but Mr. Rickmers reported that it then showed signs of not being far below its ceiling.

(4) The paraffin Primus, with roarer burner, fails at about 22,000 feet, owing to cooling of the vaporizer, due to the gas having to rise above its level before it finds enough oxygen for combustion. Shortly before the War of 1914–18, Dr. Kellas tried to climb Kamet, and failed to do so largely because he was relying on this kind of Primus for melting snow.

(5) The ordinary silent burner fails at about 26,000 feet, but when modified by enlargement of the holes through which air is admitted to the flame, it continues to function in vacuum chamber up to 31,000 feet. As it approaches this level the flame becomes greatly weakened and enlarged, and clouds of blue vapour get detached, and wander upwards in search of oxygen. This modification was due to Dr. G. M. B. Dobson.

(6) The ordinary Primus pump entirely fails high up, and starts to do so comparatively low down. The safety device against excessive pressure in the container is the large clearance given to the pump barrel, combined with a spring-controlled delivery valve which only opens under a pressure of about two atmospheres. At 15,000 feet air is taken in at about half an atmosphere. It has then to be compressed to about two atmospheres above container pressure before it starts to pass the delivery valve, and the valve closes as soon as the pressure in the clearance space falls to that amount. At higher altitude the pressure may fail to attain the intensity requisite to open the valve. The solution is the substitution of a large nut, specially shaped to fill the clearance space, for the small one at the end of the pump rod.

(7) The rate of combustion with fuels not burnt under pressure rapidly decreases with altitude. Thus, comparative tests made in 1927 at 15,000 feet on Monte Rosa and at sea-level, showed that Meta took twice as long to burn in the Meta Co.'s burner at the former level. With methylated in Messrs. Falk Stadelmann's Ideal burner there was a 22 per cent increase in time. As speed is an important factor when wanting a drink, and thirst is much increased with altitude, there is an advantage in the Primus, in that the rate of fuel consumption is independent of altitude, at all events up to 15,000 feet, and presumably above.

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Points from Foregoing Letters

J. C. Mottram finds that long exposure of Paramecium to the tumour-producing hydrocarbon 3 : 4-benzpyrene results in the production of a few abnormal individuals. If these are picked out and cultured in normal medium, populations of cells result, presenting wide morphological variation from apparently normal through varying degrees of abnormality to multicellular monsters. This state of abnormality was retained during reproduction through many generations. These populations resemble in many respects the assemblage of cells forming a cancerous tumour, where also wide morphological variation is found.

J. R. Loofbourow and Sister Cecilia Marie Dwyer, in continuing their investigations of the proliferation-promoting intercellular wound hormones produced by cells injured by various means, give evidence suggesting that disintegration of dead cells cannot account completely for these proliferation-promoting substances. Further support is given for the hypothesis that one response to injury of cells takes the form of release of proliferation-promoting substances into the surrounding medium.

A. F. Barker shows that the medulla of wool fibre on treatment with caustic potash breaks up into short lengths, each possibly representing a day's growth. Further work on the fibre of the under coat of the platypus shows this to have a ladder structure, each division representing about a day's growth. These observations raise further queries that need answering.

L. F. Bates and J. C. Weston describe measurements of the thermal changes accompanying the magnetization of a nickel rod in a step-by-step hysteresis cycle, when the rod is unstretched and also when it is under severe longitudinal tension. The measurements provide an excellent proof of Warburg's law, and show that 90° rotations of the Weiss domain vectors are not accompanied by measurable heat changes.

The fine structure of diffraction spots obtained from mica with convergent electron beams is explained by Carolina H. MacGillavry on the basis of the dynamical diffraction theory. From the distances between successive minima the structure factor of the reflecting lattice plane can be computed in a very simple way.

RESEARCH ITEMS

Nomad Gypsies of Hungary

BIRTH, marriage, death, are the central incidents of gypsy life in the Sárrét of Hungary, as described by Istvan Nagy of Budapest (*J. Gypsy Lore Soc.*, Ser. 3, **19**, 1–2; 1940). The Sárrét, a territory of mighty morasses at the eastern end of the great Hungarian plain, which did not begin to be drained until the middle of the nineteenth century, was peculiarly adapted to their nomadic life; but social and economic circumstances forced them to settle in the villages at the beginning of the present century. Some still tend, however, to move from village to village. The Nomad or Tent gypsies were divided into tribes (now obsolete) and clans, with a head of the tribe and head of the clan, offices which have become mere titles without power. The names of the clans are derived from trades or from famous forebears, for example, the *Kolompára* clan (bell-founders) and the *Simonado* clan, so called from a famous ancestor. Some names are totemic, as the *Makara* or 'fish' family and the *Tsarneštyi* or 'fowl' family. Each clan had its specific trade and characteristics. The *Patrinara* clan are horse dealers, a distinguished, proud people of deservedly high repute. The gypsies are very prolific. Ten to twelve children in a family are quite common and sometimes there may be so many as sixteen or eighteen. Marriage is by elopement; consent of the parents is given and the marriage feast held after the return from the unofficial honeymoon. It may also be a child marriage contracted by the parents, when the two fathers enter into a binding contract kneeling before a lighted candle. The bridegroom, often not six years old, leads the bride, aged about four years, to his father's house and they grow up together. Formerly, marriage was matrilocal, the man sometimes even changing his name, but now marriage is patrilocal, owing to the influence of Hungarian laws. Divorce was easy, and no great importance was attached to virginity. The death ritual shows the double influence of the desire to be free of the dead person and his spirit, and the celebration of a joyous occasion. Hence on one side the dedication of personal possessions and gifts to the dead, on the other the wake or funeral feast at which the young people are permitted considerable sexual freedom.

Cultural Change Among Shoshoni Indians

THE importance of human ecology among hunting and gathering peoples is emphasized by Julian H. Steward in a study of changes in Shoshonian Indian culture in the western United States (*Sci. Monthly*, **49**, 6; December 1939). When Frémont crossed the Rocky Mountains in 1843 he recorded that the Indians of the semi-arid deserts exemplified humanity in its lowest form and its most elementary state. These Indians were Western Shoshoni, Northern Paiute and Southern Paiute, who lived as typical food-gatherers, "dispersed in single families, without fire-arms; eating seeds and insects; digging roots". The mode of life of the Northern Shoshoni of eastern Idaho and western Wyoming, however, was in marked contrast. They were organized in large bands, hunted bison and fought their traditional enemies, the Blackfoot and Arapaho. This difference was brought about by an interaction of culture and environment which can be traced for over a thousand years. The Northern Shoshoni acquired the techniques for procuring food which made life possible in their environment, while the acquisition of the horse enabled them to exploit it to the full. Owing to the enlarged facilities in transport, food could be concentrated at a central point; and hence it was no longer necessary to live in small isolated family groups. Tribal groups were formed under chiefs or leaders, whose individual reputation might lead to the aggregation of large but not necessarily stable or long-enduring bands. Communal hunting expeditions with or without a hunting 'shaman', according to the nature of the game, were organized on a large scale and extending to considerable distances; while warlike activities for material gain or fame were practised. There was a no less fundamental change in material culture. Not only did they adopt arms and weapons suitable for warfare and hunting, but also the skin *tipi* took the place of the brush and pole shelter, and basketry for containers and utensils was replaced by rawhide, while their clothing was of dressed skins.

Bantu Lexicography

IN view of encouragement now being given to the development of a literature in certain of the Bantu languages, it is essential, the Rev. C. M. Doke has pointed out, that serious thought should be given to the provision of adequate linguistic studies including dictionaries (*Scientia*, **34**, 1; 1940). After a review of existing material, the following principles of Bantu lexicography are suggested as among the essentials. (1) Alphabetical entry under the stem, without the prefix. (2) Derivative words should not have a separate entry, unless they have a special meaning not deducible from the plain function of their derivative formation. (3) Indications of the tone should be given, so far as possible, in all entries for those languages in which intonation is a significant feature. (4) Indication of the vowel-length should be given, especially in those Central Bantu languages where it is a semantic feature. (5) Phone values should be indicated where orthography is insufficient. (6) Idiomatic illustrations of the use of words should be included—of the utmost importance in any scientific dictionary. (7) Where dialectal variants are included the place of origin should be indicated. (8) Cognizance should be taken of a changing vocabulary. (9) Etymological and comparative material should be included so far as it can be afforded.

Orchis Tubercles

STUDY of the development of the tubercle of *Orchis mascula* I (B. C. Sharman, *J. Linn. Soc.*, **52**; 1939) directs attention again to the peculiar capacity for growth possessed by localized parts of leaves and internodes in certain monocotyledons. In Orchis the uppermost axillary bud is carried away from the parent axis by the extension of the first two scale leaves of the axillary bud to form the sinker tube.

This extending tube includes, on the side next the parent, axial tissues of the region of bud insertion. This construction is supported by anatomy, since the vascular strands of the foliar structures enclosing the tubercle bud run up the adaxial side of the sinker tube to connect with the vascular system of the parent axis. The main storage region of the tubercle is of the nature of a root, but is peculiar in being polystelic. This peculiarity is evidently associated with food storage, since after the period of swelling the distal part becomes monostelic. The tuberization of the bud is controlled by food supplies and may also be affected by fungal infection. The droppers of tulips are very similar but usually undergo greater extension and show less evidence of food storage.

Calculation of Linkage

THE estimation of the crossing-over value is efficiently determined by the method of the product ratio (Fisher and Balmukand, 1928). To save much calculation of the ratio of the products of the cross-over classes to the products of the non-crossover classes in the F_2, W. L. Stevens (*J. Gen.*, **39**, 171–180 ; 1939) has provided tables for direct interpolation, from which the crossing-over value, accurate to the fifth decimal, may be obtained, together with the variance of the crossing-over value.

Mineral Deposits of the Murchison Range

IN the eastern Transvaal a belt of basement rocks stretches from the escarpment in the west to the Kruger National Park in the east. Certain quartzites in this belt form a series of hill-ranges to which the name 'Murchison Range' is given. In a memoir of the Geological Survey of South Africa just published (No. 36, 1939, pp. 163 and coloured geological map) the mineral deposits of the belt are described by van Eeden, Kent, Brandt and Partridge. An igneous complex, hitherto unsuspected, is described as consisting of hornblende-granite and a variety of gabbroic types. The remainder of the Murchison rocks are shown to be intensely altered acid and basic lavas with an intercalated group of sediments in which occur the quartzites and quartz-schists that have determined the topography and controlled the mineralization of the belt. The whole schist belt, including the igneous complex, is invaded by the surrounding 'Old' granite, and the gold-bearing sulphide deposits of the belt are ascribed to hydrothermal processes related to the granite. The mineralization is predominantly of the arsenopyrite-pyrite-pyrrhotite type, except along a crush-zone, thirty-two miles long, known as the 'Antimony line'. Here, in addition to the normal minerals, a later suite of antimony minerals is also present. A number of minerals, of which emeralds are the most important, are associated with pegmatites. The emeralds occur in biotite-schists adjacent to pegmatites. Among the later rocks attention is directed to the exceptional abundance of dolerite dykes of Karroo age which cut the granite and schist belt and occur in two well-defined sets, one parallel to the range (N. 55° E.), the other trending N. 30° E.

Seismological Data from India

THE recently inaugurated quarterly seismological bulletin of the Government of India Meteorological Department has just been received for the quarter October–December 1938. It has been published under the direction of Dr. S. K. Banerji and consists of the interpretations of seismograms obtained at Agra, Bombay, Calcutta, Colombo, Dehra Dun, Hyderabad and Kodaikanal, all collected at Bombay, together with non-instrumental reports collected from voluntary observers by the meteorologist at Poona. The following numbers of earthquakes were registered : Agra 133, Colaba (Bombay) 103, Alipore (Calcutta) 115, Colombo 71, Dehra Dun 32, Nizamiah Observatory (Hyderabad) 72, and Kodaikanal 76. These numbers are probably not altogether indicative of the seismicity of the areas adjacent to the observatories named on account of the variation of the registering equipment. Eleven earthquakes between the intensities 4 and 6 (Rossi–Forel scale) were recorded by the observers, those of greatest intensity being one at Gauhati, two at Dibrugarh and one at Kalat.

Tsunamis

THIS is the subject of a paper by B. Gutenberg (*Bull. Seis. Soc. Amer.*, **29**, No. 4, 517–526 ; October 1939) who cites eighteen publications including some due to F. Montessus de Ballore, C. Davison and A. Imamura, and exhibits some original work of his own on the Atacama earthquake of November 11, 1922, in support of his hypothesis. This is that tsunamis ('tidal waves', 'maremotos') may be produced by submarine volcanic eruptions, submarine slides started by earthquakes, submarine faulting and atmospheric conditions. At least some of the largest tsunamis have been produced by submarine slides, with earthquake waves as a trigger force. The macroseismic and microseismic data of the Atacama earthquake of November 11, 1922, indicate that the fault movement occurred inland ; the tsunamis originated from a submarine slide near a relatively feebly shaken stretch of the coast where the surface slopes steeply to a considerable depth. On gently sloping coasts, such as those of California, large tsunamis are rare and the relatively small tsunamis there are probably produced by faulting at the bottom of the ocean.

Hydrolysis of Proteins by Pepsin

LIGHT on the mechanism of hydrolysis of egg albumin by pepsin has been shed by A. Tiselius and I.-B. Eriksson-Quensel (*Biochem. J.*, **33**, 1752 ; 1939) using electrophoresis, sedimentation and diffusion methods. A digestion mixture does not contain a number of products of continuously varying size and other properties but instead contains only unchanged large molecules and fully digested end products of molecular weight 1080. Pepsin is therefore assumed to attack one after the other of the protein molecules, breaking them down immediately to low molecular weight split products.

Formation of Urea

THE accepted theories accounting for the formation of urea in the organism, namely, (1) the cyclic reaction from ornithine via citrulline and arginine to urea and thus back to ornithine, and (2) urea from glutamine and ammonia, are linked up by S. J. Bach (*Biochem. J.*, **33**, 1833 ; 1939) who, from results of experiments on liver by the tissue slice technique, puts forward two other possible mechanisms. These are : (3) urea synthesis from citrulline by oxidative hydrolysis ; and (4) the possible oxidative conversion of ornithine and citrulline into glutamic acid and then glutamine and finally urea by the action of ammonia.

LONG-DISTANCE BROADCASTING

DURING the earliest years of the development of radio broadcasting in Great Britain, efforts were made to restrict the area over which reception was necessary, in order to build up a service giving speech and music reproduction of the highest quality. It was with this object in mind that the regional scheme of broadcasting stations was developed. The country was divided up into sections or regions, each of which was served by two transmitters, one providing the national programme and the other a local or regional programme. In this way the majority of listeners were provided with two programmes emanating from a broadcasting station within about one hundred miles, which was considered to be the limiting range at which a reliable service could be obtained free from interference or fading.

The possibilities of long-distance broadcasting on a considerable scale were not generally admitted until about 1932 ; but since then, many millions of pounds have been spent by the several countries which have decided to establish wireless stations for this purpose. A review of the general development of such long-distance broadcasting was given by Sir Noel Ashbridge, Controller of Engineering of the British Broadcasting Corporation, in a Friday evening discourse at the Royal Institution on January 26.

After summarizing very briefly the main facts accompanying the development of radio communication over hundreds and thousands of miles, Sir Noel pointed out that the short wave-lengths in the region of fifty metres offer the best possibilities of covering long distances, by reason of the comparative ease with which such radio waves travel through the ionosphere. There are, however, many disadvantages and complications with short-wave transmission, which are not encountered in the use of medium waves over moderate distances. For example, in order to attain anything in the nature of a reliable service, it is practically necessary to choose a special wave-length for each transmission, depending upon the geographical location of the sending and receiving stations, the time of day and season of year and the degree of sunspot activity on the surface of the sun.

Two advantages of the use of short wave-lengths are, first, that much less power is required to cover a given distance on account of the comparative ease of transmission through the ionosphere ; and secondly, it is practicable to design antenna arrays and reflectors so as to concentrate the radiated energy into a sector or zone in the desired direction. The difference in local time must be taken into account when considering the areas where reception is required, so that it is not normally necessary to transmit in all directions simultaneously.

It will thus be realized that the only really practicable means of giving a broadcasting service to any distant continent is by means of short-wave transmitters using directional aerials, so designed as to cover by zones the countries to be served. These zones can then be supplied with programmes simultaneously, by using several transmitters together, or successively for shorter periods, using one or more transmitters which can be changed over from one directional aerial system to another at suitable times. Provision must also be made for changes of wave-length to conform to the varying conditions of light and darkness, season and state of solar activity. It will be realized that in order to arrange for reception during the evening in all parts of the Empire, it is necessary to transmit almost continuously throughout the twenty-four hours.

After experimenting with a single transmitter as far back as 1927, the Daventry short-wave station was opened for service in December 1932, with two transmitters of 10–15 kilowatts in power, and five antenna systems directed towards Australia, India, South Africa, West Africa and Canada respectively. The width of beam varied with the direction of transmission, and provision was made for the necessary changes of wave-length in each case.

In order to develop the service to the greatest extent possible, systematic experimental work was conducted by the B.B.C. with the view of improving the aerial systems, and in addition the co-operation of manufacturers was obtained to develop transmitters of considerably higher power than any hitherto available for short-wave radio communication. The first improvement included the substitution of horizontal aerials for the vertical dipoles previously used, and also the arrangement of the whole antenna system with its reflector to project the radiation at a small angle above the horizontal so as to give the efficient reflection from the ionosphere in the desired direction.

At the Daventry station, as it existed before the War, about thirty separate antenna arrays were provided, supported from twelve masts 500 ft. to 150 ft. in height, the whole covering a site area of about 160 acres. Additional transmitters with outputs varying from 50 to 100 kilowatts were also installed, and facilities are available for further additions. During this expansion and development, the introduction of foreign language broadcasting changed the character of the service somewhat, in so far as it became necessary to cater for world coverage instead of British Empire coverage only.

As a result of improvements on the above lines, a broadcasting service has been established on a permanent basis, giving large numbers of people great benefit by direct listening on short-wave broadcasting receivers. In addition, however, the efficiency of the service has been increased in many colonies by the establishment of local relaying facilities, in which the signals from England are received on a high quality and somewhat elaborate central receiver, and relayed either by a separate medium wave broadcasting transmitter, or by line to subscribers connected to a central exchange.

From the engineering point of view, the main development described in Sir Noel's discourse has taken place in the astonishingly short period of five years. It has been based on many years research by some of the world's most eminent scientific workers, followed by much patient work by engineers ; and it is a matter of regret that temporarily many of the short-wave broadcasting services of the world have been directed to matters of international politics rather than to entertainment and the more peaceful type of informative programme for which they were intended.

R. L. S-R.

A NOTABLE METEOR

On March 24, 1935, a bright meteor fell through the atmosphere, in a direction apparently not far from the vertical, over the Cheviots in Northumberland, about twenty miles south of Berwick. The day was a Sunday and at the time, about 7 p.m. (G.M.T.), night was beginning to fall over England. Probably because the sky was still too light, the meteor seems to have almost escaped notice in England: one observation is reported from Scarborough, and several adults and children saw it from Oldham, falling down as a vivid shooting star with a flaming tail. From Holland, Denmark and southern Norway, however, where the twilight was almost ended, many observers saw either the meteor itself, or the bright train which it left behind it; this persisted for 20–30 minutes. Prof. C. Störmer (*Astrophysica Norvegica*, 5, 117–138; 1939), naturally with much help from others, has collected and discussed the observations, in order to determine the location of the meteor flight, and the height and other particulars concerning its train. At first, of course, the train was straight, but it gradually became very deformed; this was possibly partly on account of its sinking downwards, but mainly because of air currents, almost horizontal, but evidently varying very much in direction at different heights along the original train. The rare cases, such as this, of persistent luminous trains of large meteors, provide one of our chief sources of information concerning the velocity and direction of the wind in the atmosphere above 70 km., the other sources being the still rarer luminous night clouds, and the infrequent remains of polar auroras.

The most definite data obtained by Prof. Störmer for the meteor of March 24, 1935, were provided from a photograph of the train, already much distorted, taken at Grouw, in Friesland, at about 7.10 p.m., and three pastel sketches (in colours) of the distorted train, made at 7.0, 7.10 and 7.20 p.m.; these were made from a house in Stavanger, Norway. These sketches and the photograph were of special value because they showed an indented skyline (landscape or buildings) which enabled the azimuth of the meteor from Stavanger and Grouw to be determined afterwards (though with considerable labour). Other photographs showed the train as a spectacle, but contained no means of determining its azimuth so definitely.

The points Stavanger and Grouw together with the meteor train itself made an almost equilateral triangle of approximately 400 miles side. Yet from that distance the twisted trail as seen from Stavanger shone against the sky background with sharp outlines, and had the same colour and intensity as the moon. The light was steady, like electric light, and did not at all resemble the northern lights. It became increasingly distorted and at the same time it broadened and faded. By 7.30 p.m. (G.M.T.) it had entirely disappeared. It seemed to remain in the same spot all the time.

Prof. Störmer found that the top and bottom of the train were respectively about 60 and 50 miles above the ground, and that until about 7.30 p.m. it lay above the earth's shadow, so that it was illuminated by the sunlight; he concludes that the intense yellow colour of the train was due to this illumination.

As regards the meteor itself, it appears to have descended to a height of about 40 miles or less, and finally exploded with an intensely white light: the lowest part of its trail disappeared almost instantaneously. The meteor was said to have moved slowly like a rocket, its time of passage being about 5 seconds. As regards the colour of the train, one report gives it as fiery-red, another as red-yellow.

Prof. Störmer's discussion of this meteor and train is illustrated by plates showing the sketches and photographs.

ANCIENT WALL-PAINTING IN SOUTHERN INDIA

An investigation has been conducted by S. Paramasivan, archæological chemist of the Government Museum, Madras, with the view of determining the technical methods employed in the wall paintings of the Kailasanatha and Vaikunṭhaperumal temples of Conjeevaram, the ancient Pallava capital, and in the Bagh caves of the Vindhya Hills, Gwalior State. The last named paintings, though much mutilated and stained, still constitute "a priceless treasure comparable to those at Ajanta" (*Proc. Ind. Acad. Sci.*, 10, Section A, No. 2; 1939. See also Nature, 142, 757 and 143, 554).

Kailasanatha and Vaikunṭhaperumal Temple Paintings

The Kailasanatha paintings date from the seventh–eighth centuries A.D., and are on the inner walls of narrow cells lining the outer courtyard, depicting scenes from Hindu mythology. Those of the Vaikunṭhaperumal temple, erected by Nandivarman II (A.D. 725–790), probably date from the eighth–ninth century. They have all disappeared with the exception of a single head; but there are traces of paint everywhere.

The Pallava paintings are of the classical or Ajanta style of Hindu art. The subjects of the investigation were the carrier, the ground, the pigments and the binding medium.

Carrier. The inner walls serving as the mechanical foundation of the paintings directly supporting the ground are of sandstone, the rough surface holding the plaster fast.

Ground. Microsections showed two lines of cleavage separating three layers, (1) rough plaster, (2) fine plaster, (3) paint. Though paint and fine plaster could be separated with a sharp pin, no separation could be effected between fine and rough plaster. The respective thicknesses were: painted stucco, 2·1–4·7 mm.; rough plaster, 1·5–4·1 mm.; fine plaster, 0·3 mm.; paint, 0·3 mm.

By analysis it was determined that the fine plaster is a lime-wash, while the rough plaster is composed of lime and sand, the latter serving merely as inert material. A pure rich lime having no hydraulic properties has been used. No organic binding material, gum or glue, had been added. The strong binding of the two layers indicated that the lime-wash had been laid on while the rough plaster was still wet.

Pigments. These were yellow ochre, red ochre, terre verte, carbon, lime—the limited number being due probably to the desirability of avoiding pigments containing alkalis, and secondly, the limitations of local supply.

Binding Medium. There was no water-soluble binding medium nor drying oil, glue, albumin or casein in the paint. The technique is one of lime medium, but owing to the nature of the pigment, gum had been added to the black.

The Bagh Caves

Owing to the weight of the superimposed band of claystone, the walls of the sandstone caves, once completely covered with paintings, have crumbled badly. Percolating moisture has also damaged the paintings. They probably date from the early seventh century A.D. Like the Ajanta paintings they belong to the Golden Age of Indian classical art.

Carrier. The sandstone walls were left rough to hold the plaster wall; but the percolation of water has softened the plaster, while the white efflorescence on several of the paintings indicates the presence of gypsum, sodium sulphate, magnesium sulphate, etc. This efflorescence is not due to salts in the plaster, as is clearly indicated by analysis.

Ground. Three forms of plaster were used: a deep red ferruginous earth, a light red ferruginous earth, and a rough plaster of lime. Microsections here revealed three lines of cleavage in the earth stuccoes, and two in the lime, indicating four and three layers respectively. They were composed of paint, a white material serving as fine plaster, and two layers of rough plaster in the earth stucco, but one only in the lime stucco. The thicknesses were as follows. Earth stuccoes: rough plaster (1) 6·8–19·9 mm., (2) 1·0 mm.; fine plaster, 0·1 mm.; paint, 0·1 mm.; lime stucco: rough plaster, 3·4–6·5 mm.; fine plaster, 0·2 mm.; paint, 0·2 mm. The earth stuccoes are very much thicker than those of lime, while the paint film in the latter is twice as thick as that on the earth stucco and shows a certain lack of delicacy in the handling of the brush. It is probable, therefore, that the lime stucco does not belong to the palmy days of Bagh, or that the paintings on lime and earth stuccoes were the work of different groups of artists.

The fine plaster was a mixture of lime and calcium sulphate which had been applied to the surface of the rough plaster to serve as a fine plaster; but in the lime stucco the fine plaster showed no trace of calcium sulphate.

Thus the ground was prepared from naturally occurring ferruginous earth, or of artificially prepared lime plaster. The principal components of the earth plaster are silica, iron, alumina and lime, while of the lime plaster they are lime and silica. The plasters, in addition to their natural binding qualities, have been reinforced by vegetable fibres in the lime plaster in considerable quantities.

Pigments. The following pigments were identified: yellow ochre, red ochre, terre verte, lapis lazuli, carbon, lime. The colour scale is limited and evidently conditioned by local supplies.

Binding medium. No gum could be extracted by water, nor was the presence of any vehicle or organic binding medium in the paint film detected by various tests applied; but acid green indicated the presence of glue. Thus a tempera technique had been employed; but on all the paintings on plaster collected, treatment with hydrochloric acid gave a characteristic calcium reaction indicating a lime medium technique, and not a true fresco technique. The black paint gave the usual stain for glue to acid green.

THE BRITISH PHARMACOPŒIA

Proposed Innovations

IMPORTANT changes in the "British Pharmacopœia" are foreshadowed by reports of committees, appointed by the Pharmacopœia Commission, which have now been published by authority of the General Medical Council and are obtainable at the offices of the Council, 44 Hallam Street, London, W.1.

The most striking of the recommendations of the Advisory Committee in Pharmacy and Pharmacognosy are those which propose the inclusion in the next "Pharmacopœia", due to appear in 1941, of a large number of formulæ for medicinal preparations. These are quite distinct from the galenical products, such as tinctures, extracts and infusions of vegetable drugs, which always occupy an important part of pharmacopœias and from which medical practitioners build up their prescriptions. The object of the inclusion of these formulæ is to furnish medical practitioners with a choice of ready-made prescriptions which have been tested by laboratory and clinical experience. Prescriptions are included for compound digitalis pills, compound bismuth powder, cod liver oil emulsion, methyl salicylate liniment, calamine lotion, tannic acid jelly, acriflavine lotion and calcium gluconate injection, among some thirty proposed new monographs of the character of ready-to-use medicines.

It is understood that the Pharmacopœia Commission regards this innovation favourably, and there is no doubt that it is one which would be welcomed by the large body of general practitioners. The inclusion of these recipes in the "Pharmacopœia" would set up official standards with which the preparations would have to comply; thus a doctor prescribing, say, "Pulv. Bismuthi Co. B.P.", would have the satisfaction of knowing that the medicine supplied to his patient would be the same, wherever it was dispensed.

The Committee which was appointed to advise the Pharmacopœia Commission on the standardization of tablets has not as yet reached conclusions. Its report states that the possibility of defining tablets in the "British Pharmacopœia" has been explored and the general principles to be adopted have been worked out, but while good progress has been made towards the establishment of standards for composition, size and weight of a range of tablets in frequent use and the question of a test for disintegration has been investigated, further research is necessary before definite recommendations can be made. It is hoped, and expected, that an acceptable test for the rate of disintegration of tablets will be forthcoming before the next "Pharmacopœia" goes to press ; the need for one was clearly shown in papers read at the last meeting of the British Pharmaceutical Conference.

A curious recommendation is made to the Pharmacopœia Commission by the Committee on Pharmacy and Pharmacognosy as a test for the pungency of tincture of capsicum. It is that 3 millilitres of a solution of stated dilution "swallowed all at once produces a distinct sensation of pungency in the throats of at least two out of three individuals". Possibly the criticism will be made that this is more like a test for throats than a test for capsicum.

PETROLOGY OF EAST GREENLAND

By Dr. L. Hawkes
Bedford College, London

THIRTY years ago it might have been thought that the main forms of intrusive bodies in the North Atlantic Tertiary volcanic province were known. Then came the discovery by the Geological Survey of the cone-sheet and ring-dyke complexes, and now in a part of East Greenland very difficult of access Mr. L. R. Wager has had the good fortune to find, and, in association with Dr. W. A. Deer, the pluck and persistence to investigate, an intrusive mass which in form, composition and internal structure is unlike any hitherto known in the province. The work in the field and laboratory has been very thorough, and the results are now presented in a handsomely produced memoir which will be of absorbing interest to students of igneous rocks and doubtless a basis of lively discussion among them*.

The Skaergaard intrusive is finely exposed in a mountainous region, but as is so commonly the case with large intrusives, the original rock cover has been removed by erosion and the base is not seen. The mass narrows downwards and the 2,700 metres of its exposed thickness is interpreted as the upper part of an inverted cone some seven kilometres in diameter at its base and tilted 40° from the vertical—it belongs to the class of 'funnel intrusions'. The pre-existing rock displaced by the intrusion must have been forced upwards, and that without appreciable disturbance of the neighbouring rock. The authors suggest that the expulsion of this huge mass was a sudden act, and that the cover was shattered by expanding gases and strewn far and wide. Rather mysterious is the way in which an extensive gabbro sill, believed to have been enclosed within the cover, has become disembodied, to lie within the intrusive. Whatever the mechanism of emplacement, there came into being within the upper part of the earth's crust a volume of magma enclosed—to use Prof. Tilley's apt phrase—in a gigantic natural closed crucible, and the cooling of this perhaps unusually fluid melt proceeding under tranquil conditions has provided a remarkable demonstration of the course of differentiation in a basic magma.

Solidification first took place at the sides and top of the 'crucible' and then, more slowly, crystallization continued in the main mass within to give a series of rock layers likened to a pile of saucers, many of the layers being distinguished by a preponderance of dark minerals at their bases. This layering is so prominent that on first seeing the Skaergaard region from a ship, Mr. Wager surmised the rocks to be massively bedded sandstones. Any hypothesis of successive intrusion seems to be ruled out, and the solid mass is believed to have grown from below upwards, largely by accumulation of crystals carried down by convection currents. This postulated upward course of solidification is strongly supported by the nature of the minerals : with increasing height in the intrusive, the olivines, pyroxenes and felspars show a gradual passage from higher to lower temperature species.

The original magma, as deduced from the chilled border rocks, was of basaltic composition, and very little change in silica content is shown by the majority of the successive rocks formed, but they become unusually rich in ferrous iron, and ferro-gabbros are described composed essentially of pyroxene, plagioclase, fayalite and some quartz. Then finally and abruptly a relatively small amount of acid granophyre resulted. Notwithstanding the extreme rarity in the earth's crust of rocks of ferro-gabbro composition, the authors hold that the course of differentiation here followed is the normal one for a basic magma. But the 'crucible' was not a platinum one. Its lower part was of acid gneiss, and the magma has reacted with inclusions of granophyre. These inclusions are considered to be altered gneiss, although—somewhat strangely perhaps—the passage of gneiss to granophyre seems not to have been observed either in the wall rocks or in the inclusions. To this 'contamination' of the magma the emergence of part at least of the final acid granophyre differentiate is ascribed, and the authors subscribe to the view, now steadily gaining ground, that the normal calc–alkaline series of igneous rocks is not derived from the straightforward differentiation of a basic magma but results from the incorporation within that magma of acidic material. If this is accepted, the large granophyre intrusions of Skye and elsewhere in the province must owe their origin to the fusion of acid gneiss or crustal sialic rocks of like composition : this, however, is still a controversial matter.

* Geological Investigations in East Greenland, Part 3. The Petrology of the Skaergaard Intrusion, Kangerdlugssuag, East Greenland. By L. R. Wager and W. A. Deer. *Meddelelser om Grønland*, **105**, Nr. 4.

SEVENTY YEARS AGO

NATURE, vol. 1, February 3, 1870

Catching Cold

PROF. SYMES THOMPSON, Gresham professor of medicine, in one of his Gresham lectures discussed the cause of the common cold. After describing the cavities concerned, he pointed out that "the ordinary cold is simply, in the first instance, congestion of the warm, moist, blood-charged membrane, which lines all these cavities and is continuous throughout the series of them. . . . This congestion is apt to pass on, under unfavourable circumstances, to inflammation, and to consequent derangement of structure. The congestion merely means that more blood is thrust upon, and retained in, the minute channels and vessels of the membrane, than those channels can healthily accommodate. The first cause of this forced engorgement is that cold is extensively applied to the internal skin, which then, under the constringing and contracting influence, drives its own blood out, partly into these surcharged tracts of mucous membrane. The injurious effect known as 'cold' is now sure to be realised if this external chill is experienced when the general system is weakened by exhaustion."

Once a cold has been "caught", Prof. Thompson says that vigorous circulation of the blood in the skin should be restored, preferably by a Turkish bath, "reinforced by the administration of stimulants, first and foremost amongst which stands concentrated food. Indeed, the Professor's pet stimulant seems to be 'Whitehead's Solid Essence of Beef'. . . . This preparation differs from Liebig's Extract of Meat chiefly in containing the gelatinous as well as the fibrinous constituents of the flesh. . . . The Gresham professor scattered the little round cakes, out of neat half-pound cases, liberally to his audience, recommending them to begin at once to fortify themselves against the inclement atmospheric influences".

Deep Mining for Coal

MR. EDWARD HULL, F.R.S., director of the Geological Survey of Ireland, read a paper before the Royal Society on the temperature of the strata taken during the sinking of the Rose Bridge Colliery, Wigan, in 1868–69. This mine was 808 yards deep, "is the deepest in the world" and the temperature at the bottom was 93½°. It may be regarded, it is said, as an experiment towards a solution of the question of very deep mining and has "an especial interest for those who concern themselves about our supplies of coal".

"IT is no secret that the present régime at the Observatory of Paris has been rather more autocratic than could be patiently endured, even in a country subjected to eighteen years of personal government. Matters have at length reached a crisis, and the Minister of Public Instruction is placed in the awkward position of having to dismiss from the public service one of the most eminent of modern astronomers, or accept the resignation of the whole of the rest of the staff of the Observatory." [The Director was M. Le Verrier.]

BEFORE a meeting of the Berlin Chemical Society, Prof. Rose reported on the first diamond to be found in Europe. A small diamond had recently been found in Bohemia, in which garnets, hyacinths and sapphires had been found for years.

APPOINTMENTS VACANT

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

The Manchester Museum: The University of Manchester. Museum Publication 116: Report of the Museum Committee for the Year 1938–39. Pp. 32. (Manchester: Manchester Museum.) 6*d*. net. [111

Association of Special Libraries and Information Bureaux. Report of Proceedings of the Sixteenth Conference organised to be held at Nottingham University College, September 15th to 18th, 1939. Pp. 92. (London: Association of Special Libraries and Information Bureaux.) 5*s*. [161

Stonyhurst College Observatory. Results of Geophysical and Solar Observations, 1938; with Report and Notes of the Director, Rev. J. P. Rowland. Pp. xix+40. (Blackburn: Stonyhurst College Observatory.) [161

The *Chemist and Druggist* Year-Book, 1940. Pp. 355+Diary. (London: The *Chemist and Druggist*.) [161

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 1, No. 2: Cyclic Variations in the Vascular Architecture of the Uterus of the Guinea Pig. By Dr. P. Bacsich and Dr. G. M. Wyburn. Pp. 79–86+2 plates. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 1*s*. 9*d*. [181

A List of Books suitable for a School Science Library. Pp. 88. (London: Science Masters' Association.) 1*s*. 2*d*. [221

Other Countries

Conseil Permanent International pour l'Exploration de la Mer. Bulletin statistique des pêches maritimes des pays du nord et de l'ouest de l'Europe. Rédigé par Sir D'Arcy Wentworth Thompson. Vol. 27, pour l'année 1937. Pp. xxxiv+50. (Copenhague: Andr. Fred. Høst et fils.) 3.00 kr. [101

Bulletin of the Bingham Oceanographic Collection. Vol. 6, Art. 7: Quantitative Observations on the Pelagic Sargassum Vegetation of the Western North Atlantic, with Preliminary Discussion of Morphology and Relationships. By Albert Eide Parr. Pp. 94. Vol. 7, Art. 1: Acoel and Polyclad Turbellaria from Bermuda and the Sargassum. By Libbie H. Hyman. Pp. 26+9 plates. Vol. 7, Art. 2: Young Caranx in the Western North Atlantic. By J. T. Nichols. Pp. 10. (New Haven, Conn.: Yale University.) [161

U. S. Department of Agriculture. Circular No. 530: The Vegetable Weevil. By M. M. High. Pp. 26. 5 cents. Leaflet No. 192: Centipedes and Millipedes in the House. By E. A. Back. Pp. 6. 5 cents. (Washington, D.C.: Government Printing Office.) [161

Bulletin of the Geological Department, Hebrew University, Jerusalem. Vol. 2, Nos. 3–4: Outline on the Tectonics of the Earth, with Special Reference upon Africa. By Leo Picard. Pp. 66. (Jerusalem: Hebrew University.) [161

Egyptian University: Faculty of Science. Prospectus for the Academic Year 1937–1938. Pp. iii+60. Prospectus for the Academic Year 1938–1939. Pp. iii+68. Publication No. 3: Cucurbitaceae in Egypt. By Mohammed Hassib. Pp. x+173. (Cairo: Government Press.) [161

South Australia: Department of Mines. Mining Review for the Half-Year ended 30th June 1939. (No. 70.) Pp. 92+4 plates. Geological Survey of South Australia, Bulletin No. 18: The Pre-Cambrian–Cambrian Succession; the General and Economic Geology of these Systems, in portions of South Australia. By Ralph W. Segnit. Pp. 192+11 plates. (Adelaide: Government Printer.) [221

Fondation Universitaire. Dix-neuvième Rapport annuel, 1938–1939. Pp. xvi+166. (Bruxelles: Fondation Universitaire.) [221

Annuaire pour l'an 1940. Publié par le Bureau des Longitudes. Avec des notices scientifiques. Pp. viii+550+A16+B26+C54. (Paris: Gauthier-Villars.) 25 francs. [221

Handbook and Directory of the United States Office of Education, 1939. Pp. ii+26. (Washington, D.C.: Government Printing Office.) [231

Malta. Annual Report of the Working of the Museum Department during 1938–39. Pp. xxviii. (Malta: Government Printing Office.) [231

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