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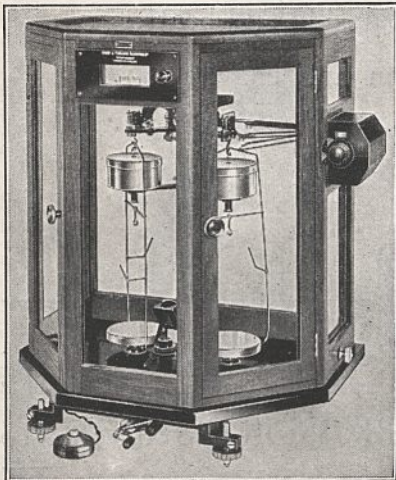
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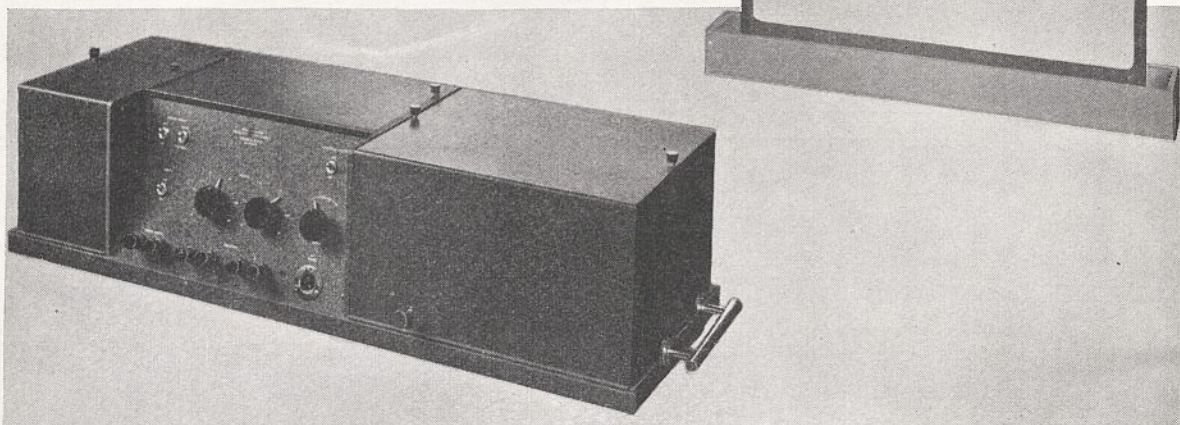
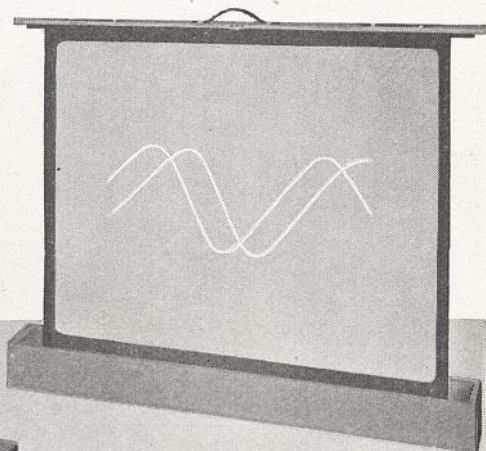
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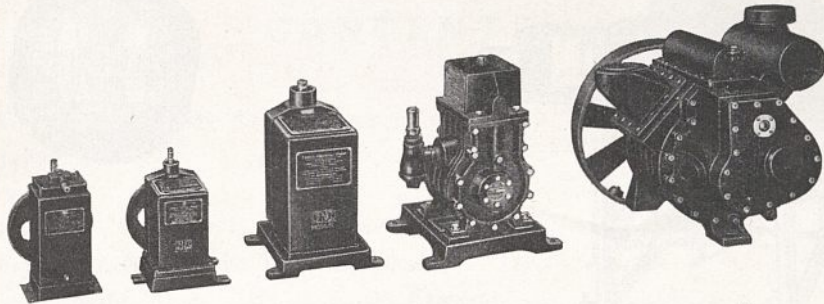
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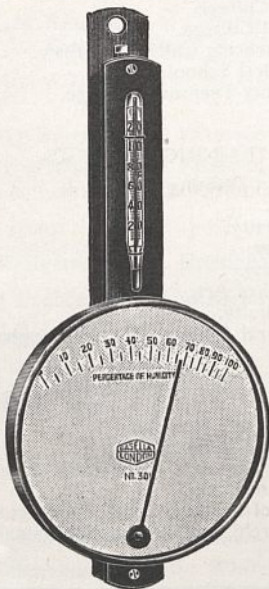
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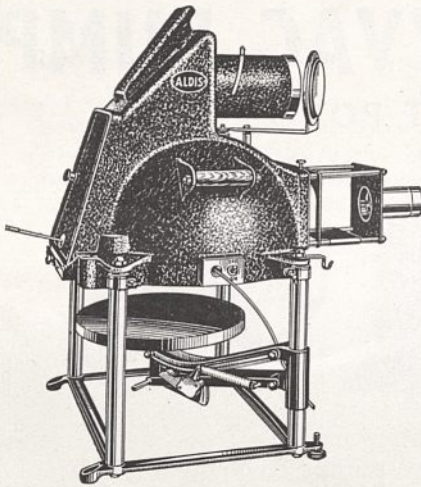


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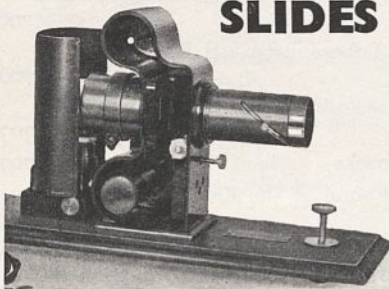
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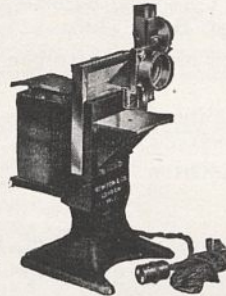
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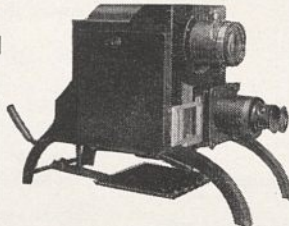
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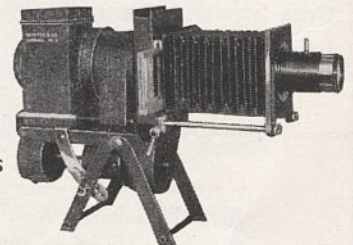
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Vol. 145

SATURDAY, MAY 4, 1940

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A MINISTRY OF RECONSTRUCTION

THE measures advocated by Sir Gwilym Gibbon in a recent issue of *Public Administration* for the co-ordination of departments into groups with a minister for each, the Cabinet consisting of the Prime Minister and these ministers-in-chief and a few other ministers with few or no departmental duties, recall the report of the Machinery of Government Committee, of which Lord Haldane was chairman. Little or nothing has been done to implement the findings of that report since it appeared so long ago as 1918; but Sir Gwilym, in urging that it is imperative that this Cabinet directorate "shall be relieved of all but the matters of most importance, and that above all, it and its members shall have enough freedom from pressing duties to think of coming problems (as well as of current) well ahead of their coming", is indeed only restating the arguments and views of that report.

Lord Haldane's responsibility for the drafting of the Committee's report is well known, and its major recommendation, that every Department of State should be provided with its general staff and that a Ministry of Information and Research should be created for this purpose, was reflected in his presidential address to the Institute of Public Administration in 1922. Under the title "An Organized Civil Service", he appealed not merely for efficient and scientific administration and for the high tradition of self-sacrifice for public duty, but also for the forward-looking mind.

Lord Haldane did not conceal his doubts whether this outlook was being sufficiently encouraged in the Civil Service of Great Britain or in the universities from which its administrative officers are largely recruited, just as on another occasion he questioned the capacity of the older universities to

train men of the requisite precise habit of mind. It is no reflection on the valuable work which in the last twenty years has been carried out by the Institute of Public Administration and elsewhere to suggest that we have no reason to be any more satisfied with the present state of affairs. In the organization of civil defence in the last few years, and also in the measures taken in the economic crisis of 1931, there has been all too little evidence of the forward-looking mind and appreciation of the importance of scientific management or a scientific outlook.

Better provision for inquiry, research and reflection before policy is defined and put into operation could undoubtedly have avoided some of the worst mistakes in evacuation and other operations. If, however, such mistakes can be overlooked, once they have been admitted and rectified, their repetition becomes intolerable, whether from the point of view of war effort or of the reconstruction to follow the War. It is this position which gives fresh pertinence to the report of the Machinery of Government Committee, the more particularly as some of the reconstruction proposals which were implemented after the War of 1914-18 were liquidated in the aftermath of the crisis of 1931.

In the first place, it will be noted that the Machinery of Government Committee was established under the Ministry of Reconstruction, and is itself an example of the organized thinking which was carried out in the last two years of the 1914-18 war period. A valuable feature of a recent broadsheet issued by PEP (Political and Economic Planning) on Reconstruction, 1916-1919, is the reminder it gives of the many reforms in law, in local government, in power supply and other fields,

which we owe to men who during those harassing years and in such unfavourable circumstances proved themselves competent, not merely to organize victory, but also to think ahead boldly and with a precision justified by results when their proposals have been put to the test of practice.

The most cursory survey of the work of the Ministry of Reconstruction established in July 1917 and of the outcome of its activities will testify to the value of such work even in time of war, when victory is far from being in sight, and, indeed, of its essential importance if we are to realize the new world order which we look for after the present struggle. Unless the main underlying trends are analysed now and directed to constructive purpose in the light of possibilities and limitations which must persist whatever the outcome of the War, we may be once again in danger of losing the peace when we have won the war.

The Ministry of Reconstruction itself was liquidated in 1919, but in the Forestry Commission, the Electricity Commission, the Central Electricity Board, to mention only three public bodies, we are still able to benefit from the outcome of its deliberations. The grouping of the main-line railways, the reorganization of local government in 1930, and the Law of Property Act, 1925, were further results, and the work of the Whitley Committee on labour relations is another outstanding achievement, which has now provided a firm framework for industrial relations in Great Britain.

Besides its own particular activities, the Ministry of Reconstruction aimed at co-ordination as well as planning, and whether in dealing with the problems immediately following the cessation of hostilities—demobilization of man power, decontrol of raw materials and productive capacity, and generally setting the wheels of trade and commerce going again—or in those of the succeeding period of settled peace, it made contributions for which we owe a great debt to Lord Addison and his colleagues. During those years the country was equipped for the first time with a department devoted to research into questions of political science and to the encouragement of action on the lines ascertained.

The subsequent twenty years, however, afford no grounds for easy optimism concerning the extent to which the primary importance in reconstruction of organized thought, as distinct from executive action, is more widely recognized. Certain of the organizations brought into being by the Ministry of

Reconstruction have already been discarded—for example, the Economic Advisory Council, which in 1930 was formed out of the Committee of Civil Research, itself a child of the Machinery of Government Committee. Moreover, in this very field, refusal to make full provision for co-ordinating economic policy is at least causing profound uneasiness in many minds. So, too, as a valuable article in the *Political Quarterly* by Dr. W. A. Robson shows, is the neglect to deal with such long-term problems as the location of industry, although the Barlow Commission has already reported.

These indications of *laissez-faire* mentality are profoundly disturbing. We cannot assume that refusal to face long-term problems involves the more vigorous and efficient handling of short-term problems. There is plenty of evidence of timid and unintelligent treatment of important short-term issues. Indeed, as Dr. Robson points out, the abandonment of the reports of the Royal Commission on the geographical distribution of the industrial population of Great Britain deals a fatal blow at the development of a scientific treatment of the problems of evacuation. Unless even greater mistakes are to be avoided, some attempt must be made at central control. Town and country planning have acquired a new and more important status. They should, as Dr. Robson urges, be placed in the hands of a strong central department, competent not only to deal with the special needs of the Service departments and the Government offices, but also to take over the task of directing the location of industry and formulating a national plan for the whole country.

The experience of the Ministry of Reconstruction affords evidence of what is possible and indeed essential even in the stress of war, and its achievements will well repay study at this time. All the experience of the last twenty years, however, reinforces the plea for planning ahead. The task cannot and should not be avoided in war-time. It is in no way an impediment to victory. On the contrary, so many of our war-time exigencies are entirely consistent with socially desirable peace-time purposes that the same planning ahead which best serves our immediate war-time purpose will contribute most to subsequent reconstruction. The many factors which in the last two decades have intensified the need for bringing to bear organized thinking and the acquisition of facts as a basis for action into the affairs of State, emphasize the need for adequate attention now to the problems of reconstruction

MR. FISHER'S VARIOUS ESSAYS

Pages from the Past

By H. A. L. Fisher. Pp. viii+238. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 10s. net.

THIS delightful book may easily become the most popular of Mr. Fisher's writings. It is wholesome medicine for the times in which we live because it takes our minds away from them. The longest essay is one dealing with the "Whig Historians", and, of course, for the most part defending them. Macaulay, Mackintosh and Sir George Trevelyan are the most prominent figures in it, and Macaulay never found a more stalwart—yet withal a discriminating—admirer. The cleverest paper is a sketch of what might have happened had Napoleon made his escape to North America and afterwards attempted the setting up of a new empire in the New World, which was at that time disturbed by many revolutions, centring round the figure—rather more heroic than Mr. Fisher presents him—of Simon Bolivar. There are charming pictures of the "Beauty of England", and a very curious account of a New College 'progress' when the Warden, accompanied by his junior outrider, used to drive round visiting all the neighbouring College farms, taking the homage of the respectful tenants and being solemnly entertained by the dependent folk of the holding. It is to be feared that this picturesque custom has now fallen into disuse, and we are the more obliged to Mr. Fisher for putting it on record. He says quite truly that the public—even the College public—are not aware of the extent of the agricultural interests of the colleges of Oxford and Cambridge. In our days the picturesqueness has been worn off by the motor-car, but science has come in to improve the agricultural methods by which the bursars guide the operations of the college tenants.

There is another essay in the volume which has a rather surprising title and will appeal especially to readers of this review. It is called "The Real Oxford Movement" and deals with the group of men who in the middle of the seventeenth century happened to come together in Oxford and formed the nucleus of what was afterwards removed to London and became the Royal Society. Mr. Fisher calls it the Real Oxford Movement, but he admits the existence of many others and would be the first to allow that other places, especially London and Cambridge, have a claim to pre-eminence in science. The latter will always stand first on the roll with the names of Newton and Darwin, and it was in the former that this "invisible

college" first met which was transferred to Oxford during the years of 1648–1659.

The movement began with a small group of doctors and other earnest inquirers who sought the quiet of Oxford during the tumult of the Civil War, and it found in Oxford members of the University who had already begun "a free way of reasoning" of their own. It is these men whom Mr. Fisher describes so vividly and who were later to form the nucleus of the Royal Society, when it came into permanent public and authorized notice. They seem to have met mostly in Wadham, of which Wilkins, one of their members, was warden during 1648–59. He was primarily an astronomer, son of an Oxford goldsmith and with clever hands as well as mechanical tastes. He was a "most obliging and universally curious Dr.", who afterwards became bishop of Chester and the first secretary of the Royal Society.

But there were other men of greater originality who left more notable evidence of their scientific powers. William Petty was one of these. By turns cabin-boy, hawker and seaman he came back to England in 1646 after having become a physician by studies abroad. He ranks as an English classic by virtue of his "Essays on Political Arithmetic", which were the first attempt to apply to political problems the notions of number, quantity and measurement. He was an ancestor of Lord Landsdowne and would rank as the most brilliant of the group, had it not been for Christopher Wren, whose accomplishments entitle him to be considered the most versatile and famous of the group.

A great geometer and astronomer and anatomist, Wren added many buildings to medieval Oxford before he gave London its most conspicuous church after the Great Fire of 1665. He was at that time Savilian professor of astronomy at Oxford. When we add to these names that of John Evelyn who visited Oxford in 1654 when the group was in full activity, Robert Boyle who went to Oxford in 1654, and Robert Hooke who competed with Wren for the design of St. Paul's, one may wonder whether so brilliant a group of young men ever adorned English science at the same time before. They were all at Oxford about the same time at some period of their career and they well justify Mr. Fisher's title of the "Real Oxford Movement". It is a strange catastrophe in English history that so bright a growth should have died away into the apathy and ignorance which are described in the Oxford of Adam Smith and Gibbon in the next century.

There are several other essays, largely biographical, for example, Lord Balfour, John Morley, Philip Snowden and politicians in general, which make up a fascinating volume. Mr. Fisher was, of

course, uniquely qualified to bring together recollections of Oxford, history and politicians, and it is done here with a special charm.

F. S. MARVIN.

PREHISTORY OF JERSEY

The Archæology of the Channel Islands
Vol. 2: *The Bailiwick of Jersey*. By Jacquetta Hawkes. Pp. xvii+320+12 plates. (Jersey: Société Jersiaise, 1939.) 25s. net.

THIS survey of the archæology of the Channel Islands was projected by Mr. T. D. Kendrick, by whom the first volume, dealing with the Bailiwick of Guernsey, was published in 1928. Other interests supervened, and in 1934 Mr. Kendrick passed his material relating to Jersey—field notes, and analyses of manuscript and published sources—to Mrs. Hawkes. This material she has re-interpreted and expanded in the light of the revolutionary ideas and discoveries which have supervened in European archæology since the first volume appeared, and now publishes as a review of the prehistory of the Bailiwick of Jersey.

The relics of the remoter past of the Channel Islands have long attracted the interest of antiquarians; while the island of Jersey earned no little notoriety of a less enviable kind in the annals of archæology by the mistaken, if grateful, act of generosity of the States of the Island when, in the early years of the nineteenth century, they made the embarrassing gift of one of their finest megalithic monuments to General Conway, the Lieutenant-Governor of the Island, by whom it was re-erected complete on his estate at Henley.

No little interest, of a more honorific character, has been aroused by these megalithic monuments, of which the Channel Islands present an astonishing assemblage, in view of the small size of the islands—Jersey, 44 square miles, and Guernsey, 24½ square miles only—while Guernsey can show two remarkable examples of the anthropomorphic sculptured menhirs characteristic of the cult of the Mediterranean goddess. This interest, however, was eclipsed by the discovery in 1910 of the teeth of Neanderthal man, associated with relics of a pleistocene fauna—mammoth, woolly rhinoceros, elk, horse and several deer—in the cave of La Cotte de St. Brelade then under excavation, but from the deposits of which Mousterian implements had been extracted so long before as the nineties of the preceding century.

Since the War of 1914–18, Jersey has not been passed by in the enhanced interest attaching to

archæological investigation in the field; and the enthusiasm of the members of the Société Jersiaise, the local scientific society, has added much to knowledge of the facts of the island's prehistory, some of which is of wider than local bearing, as Mrs. Hawkes points out: notably Dr. A. Mourant's investigation of peat deposits and the quaternary geology of the island, the examination of the mound of La Hougue Bie, or Prince's Tower as it is known in local legend and popular parlance, which the Society purchased in the interests of scientific research, and the remarkable habitation site of Le Pinnacle, excavated by Father Christian Burdo and Major A. D. B. Godfroy in 1930–35, important for its contribution to stratigraphic evidence of a positive and negative bearing on the archæological story of the island, of which Mrs. Hawkes makes use with convincing effect.

The archæology of Jersey differs from that of the islands of Guernsey and Alderney in certain respects, of which some are of paramount importance to archæological interpretation, as Mrs. Hawkes demonstrates. In the first place, Jersey is the only one of these islands in which palæolithic man appears. Nor is Neanderthal man of the caves, with his Mousterian implements of the Middle Palæolithic, the earliest of his compatriots to which the Jerseyman can point. Four palæolithic flint implements, unfortunately of unknown origin, have been found on the beaches of the island, of which two are undoubtedly Acheulean. Why palæolithic man with his associated fauna should appear in Jersey and not in Guernsey, distant only 18 miles away, is explicable only on the inference from the evidence of a fauna which could not be maintained on a small island and the depth of intervening channels, that whereas in part of the quaternary period Jersey must have been affected by a land elevation which joined it to the adjacent mainland of France, Guernsey was not so joined. The absence of Upper Palæolithic man from Jersey, and the failure of intensive search to produce any certain evidence of mesolithic man even on the habitation site of Le Pinnacle, argues a subsidence in which Jersey once more became an island; but a further elevation and consequent union with France again is argued as possible for the megalithic period. This would account for

certain differences observed in the culture of the island, upon which Mrs. Hawkes enlarges.

Whether Jersey was already occupied on the arrival of the megalithic culture, which is the most conspicuous element in the cultures of the Channel Islands, is a question which Mrs. Hawkes argues with much acumen on the complex evidence by excavation on occupation sites and mounds. For here, with the megalith and its associate the bell beaker, which, as Mr. Kendrick has pointed out for Guernsey, belong to the Morbihan and are derivate ultimately or in certain instances possibly more immediately from the Iberic peninsula, are also associated elements of the Chassey culture, the vase support being conspicuous in Jersey by the frequency of its occurrence, and another strain of the megalith, the long cist with holed stone, which is characteristic of the Seine-Oise-Marne culture. Arguing from an analysis of the culture of the adjacent Normandy-Breton mainland, Mrs. Hawkes sees in the characteristic culture of Jersey a culture peripheral to this region—assuming that Jersey was then joined to the mainland in which Chassey, SOM and the megalithic culture of the Atlantic coalesce, while the megalithic culture of Guernsey, in which the two former are absent, becomes a touchstone of a western origin for the elements of any given cultural complex.

That the megalithic culture of the Channel Islands persisted in degenerate form for a prolonged period and long after it died out elsewhere

is more than probable. After this rich, not to say extravagant, efflorescence—a manifestation of local prosperity—dies down, neither island has anything to show down to Roman times that is at all comparable, with the exception of the remarkable gold torque found in Jersey, a find which is as puzzling to the archaeologist as it is unexpected. The torque is in itself almost unique, for its length of 4 ft. 7½ in. makes it almost the largest known, being second in length only to the Tara torque, which is 25 cm. longer. Its weight is 476 grams. It belongs to a class which in Britain is assigned to the Middle Bronze Age; but its presence in Jersey, Mrs. Hawkes holds, is explicable only if its introduction into the island took place not in a period when the island was culturally poor, but rather in the later Late Bronze Age, when intercourse with Britain was intensified.

The remaining detail of the record must be passed over. Enough has been said to indicate the power of cultural analysis which Mrs. Hawkes has successfully, if as she admits not finally, brought to bear upon a cultural complex which is something in the nature of a jigsaw puzzle. She pays a just tribute to the work of the members of the Société Jersiaise, which in its turn has published her work with a lavish but deserved generosity, while in the honorary secretaries of the Society, Major Lacy Rybot and Mr. Emile Guiton, she has had as collaborators an artist and a photographer worthy of her text.

TRAVELS IN PERU

A Forgotten River

A Book of Peruvian Travel and Botanical Notes. By Christopher Sandeman. Pp. xii+300+15 plates. (London: Oxford University Press, 1939.) 12s. 6d. net.

A "THREE-MONTHS Odyssey" is told in diary form, a thousand miles circular tour through northern Peru, starting from Lima, following old trails better known in the seventeenth century than to-day. The Andean divide crossed at 16,000 ft., the Huallaga River was reached where it becomes navigable by rafts and canoes at 2,640 ft. above the sea. Four hundred miles here were practically forgotten; the last navigators were Smyth and Lowe in 1834, and Herndon in 1850. A raft was built of the light balsa (*Ochroma*) wood simply by lashing long poles together by lianes, the whole rather irregular and loose so as to give to the frequent collisions with banks and fallen trees as well as the strandings in shallow water.

The three weeks voyage was exciting enough, rapids, whirlpools, canyons and waterfalls using up three rafts in succession, but it did not give much scope to the botanical proclivities of the passengers. The river showed remarkably little change in the hundred years that had elapsed. Its course was through tropical forest, part of the once Jesuit empire that continued throughout the seventeenth century to the expulsion of the order in 1768. It is useful to observe that this conquest was based on the natives' natural love for music, used in the first place as a lure and later as the governing feature of each community.

At Yurimaguas, 580 ft., the old east-to-west trail was reached and this was followed westward across the Andean Cordillera. It started as a mule trail through the tropical rain forest, innumerable streams and no bridges. Then from Moyobamba at 2821 ft. it became much worse as it crossed the first ridge at 12,000 ft., often in deep gullies created by the feet of traders from Inca and

earlier civilizations, the higher parts of the ridge scored by the winds so that only stunted bushes and grass could grow. A descent to Chachapoyas, 7638 ft., strengthened the travellers to cross the Calla Calla Pass, then the descent to the Maranon River, whence the Amazon falls 3000 ft. to the sea in about as many miles. Again a further pass and finally the last part of the journey by motor along the completely bare and barren coastal plain.

There is little of scientific interest in this book of a plant-collector; but its simplicity, complete honesty and pleasant sense of humour cause it never to weary. The reader will form a better idea of this almost forgotten country from it than from a more pretentious work. The task of opening it up, with its numerous parasitic diseases and its unwanted products, is enough to depress any Government.

APPLIED AERODYNAMICS

Applied Aerodynamics

By Prof. L. Bairstow. Second edition. Pp. xviii + 808 + 27 plates. (London, New York and Toronto: Longmans, Green and Co., 1939.) 63s. net.

THE first edition of this book was reviewed in NATURE of March 25, 1920. In general the appearance of a second edition of a standard text-book calls for little comment, but in the present case the changes are so far-reaching that the book is practically a new work. The period immediately before and during the War of 1914-18 was one of intensive pioneer research both on the theoretical and experimental side, and in this research Bairstow took a leading part. The first edition, based on the work done during that period, omits all reference to boundary layer theory, the Kutta and Joukowski theory of two-dimensional aerofoils, the circulation theory of lift, and the Lanchester-Prandtl theory of finite aerofoils. All this is remedied in the present edition, and for that reason alone it can be seen that the author's statement that about three quarters of the book is new material is easily justified.

The author has adhered to the general plan of the first edition, namely, to provide principles to interpret the results of experience, and to give adequate experimental results to illustrate the subject-matter.

The book opens with a short but interesting chapter on the history of the development of applied aerodynamics. Then follow chapters on the principles of flight, aerodynamic measurements, laboratory tests, aerial manoeuvres, similarity and scale effect. The next five chapters start from first principles to build up the theory of aerofoils at moderate speeds when compressibility of the air is unimportant, and at high speeds when the properties of aerofoils are materially different from those at low speeds. These chapters contain detailed development of a large amount of ordinary hydrodynamical theory, potential, viscous, and two-dimensional boundary layer flow, including

the detailed application to an actual aerofoil. There is also a short chapter introducing the statistical theory of turbulence.

The three remaining chapters deal with air-screws, performance, and stability. In connexion with stability the author explains that during the past twenty years economic pressure has led to intensive activity directed to increase of speed and load, and as a consequence a very large amount of information is available from which to choose illustrative examples of steady flying. The experimental investigation of more complex motions has been less thoroughly pursued and in particular there has been less systematic study. It has therefore not been possible to use modern examples to illustrate adequately the principles of stability, and for these sections the examples of the first edition have been retained. Nevertheless, an account of Glauert's non-dimensional system of equations would have been welcome here, as developed, for example, in the excellent study of stability given by B. Melville Jones in volume 5 of Durand's "Aerodynamic Theory".

In the preface the author states that this book is in no sense an attempt to produce a text-book of designs, but aims at the extraction from the great mass of data of those elements which necessarily form the basis of all design. That this aim has been attained in full measure cannot be doubted. The book is full of apt numerical tables, graphs, and diagrams. There are also twenty-seven excellent plates, including one of the kite balloons now so prominent in the sky of London and elsewhere. Incidentally, an interesting conclusion from the investigation of the aerodynamic force on these balloons, is that the balloon is blown to a definite position by light winds, and will then maintain this position as the wind velocity increases.

The reviewer may perhaps be permitted two grumbles: (i) the apparent absence of definitions of common terms such as *aspect ratio* and *camber*, (ii) the very high price of this excellent volume.

L. M. MILNE-THOMSON.

THE THEORY OF NUCLEAR FORCES*

BY PROF. R. PEIERLS,

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THE forces between the constituents of a nucleus are 'short-range' forces, which have no appreciable effect over distances of more than a few times 10^{-13} cm. Hence it is impossible to find the laws of force by extrapolation from large-scale observations (as in the case of Coulomb's law) and the only possible lines of attack are either, to deduce the law of force from direct observations on the properties of nuclei, or to derive them from some simpler, and more general, laws.

Using the direct experimental approach, it is best to start from phenomena which involve only two particles, since only these permit an unambiguous theoretical interpretation. This group consists of the properties of the deuteron, including its disintegration, and the scattering of protons and neutrons by hydrogen.

Practically all experiments are carried out in conditions in which the de Broglie wave-length of the particles is greater than the range of the forces, and this has the effect that one need consider only those states of motion in which the motion of one particle with respect to the other has no angular momentum. (In all other states of motion the centrifugal force prevents the particles from approaching sufficiently close for any interaction to take place.) Moreover, so long as the wave-length is greater than the range of the force, the effect of the field of force is largely independent of the exact variation of force with distance within the range, and depends approximately only on one constant, which may be called the 'strength' of the field of force. (In the case of a potential of the type of a potential well, this strength is approximately proportional to the depth times the square of the width.)¹

In the experiments on proton-neutron interaction two possible cases are discussed, according to whether the spins of the two colliding particles are parallel or opposite (in the case of like particles, Pauli's principle ensures that, so long as there is no orbital angular momentum, the spins are necessarily opposite) and the strength of the interaction may be different for these two cases. For the case of a proton and a neutron with parallel spin, the strength constant can be obtained from the binding energy of the deuteron; for those with opposite spin, it follows from the scattering of neutrons by protons, since in this scattering

the effect of the neutrons with parallel spin can be allowed for once their strength constant is known. The very high cross-section for slow neutrons is an indication that the strength constant of the interaction for neutrons with opposite spin is either just sufficient or just insufficient to give rise to a bound state of the deuteron with no resultant spin². The choice between these alternatives can be made by means of the scattering of neutrons in *para*- and *ortho*-hydrogen where, because of interference, the results depend on the phase of the wave scattered by each proton. The result is that the force is just insufficient to give a bound state³.

For the proton-proton force, the strength can be derived from measurements of the scattering of protons in hydrogen.

Once these strength constants are known it is possible to calculate all other observable quantities, namely, the energy variation of the proton-proton and neutron-proton scattering, the photo-effect of the deuteron, etc., to the degree of approximation in which the ratio between the range of the forces and the de Broglie wave-length is negligible. The fact that these calculations give approximate agreement with observations serves as a check on the initial hypothesis of short-range forces.

Actually, all results of this simple theory have to be supplemented by correction terms involving the range. If the experimental data were accurate enough, it should thus be possible to estimate the range of the forces. The use of these correction terms requires greater accuracy than is at present available in the data on neutron-proton scattering, and the determination can only be carried out in the case of the proton-proton scattering, in which more accurate data have been obtained. The result of this is that the 'range' for this interaction is about 1.2×10^{-13} cm. The experimental data are even accurate enough to yield a certain amount of information on the actual dependence of the force on distance⁴.

More information on these points would be obtained by measuring the neutron-proton scattering at medium energies with higher accuracy, or by observations at higher energies including, in particular, the angular distribution of the scattered particles.

An important contribution to the problem was the discovery by Rabi and others of a quadrupole moment of the deuteron⁵. This proves that the

*Based on lectures given at the Royal Institution on January 17, 24 and 31.

neutron and proton have a tendency to have their spins in the direction of the line joining them, rather than at right angles to it. This implies obviously that the forces are not central, but that the potential energy depends on the angle between the spin direction and the line joining the two particles. Although all the calculations referred to above were carried out on the assumptions of central forces, the results remain practically unchanged. For opposite spins, which is the only case of interest for proton-proton interaction at low energies, the force must still be central, since the resultant spin is zero and hence does not set up a preferential direction; for parallel spin, the fact that the force is not central means that the angular momentum due to the motion of the particles is no longer constant but fluctuates. Hence the motion in the state of lowest energy is no longer one with zero orbital angular momentum; it can be shown that the state of motion is a mixture of a state with zero angular momentum and one with two units (*S* and *D* states in spectroscopic notation). From the electrical quadrupole moment one can estimate that the contribution of the *D* state amounts to only a few per cent.⁶

However, an appreciable non-central force is required to produce even this small effect, since in the *D* state a very strong centrifugal force has to be overcome. It seems probable, therefore, that the non-central forces must represent an appreciable fraction of the total force. Yet, again owing to the effect of the centrifugal force, no appreciable influence of this *D* state should be expected on the other observable phenomena, except possibly on some finer features which have not yet been thoroughly investigated. Thus the approximate agreement with the experimental evidence, and the estimate of the range remain practically unaffected by the correction terms.

The data on the strength and the estimate of the range give the same answer, within the experimental error, for the proton-proton and proton-neutron interactions for opposite spins, and the suggestion has therefore been made that these two forces are exactly the same, except for the electrostatic interaction between the protons ('charge-independence hypothesis').⁷

From the fact that the charge of stable light nuclei is about half their mass, and that only a small change is produced in the energy of a light nucleus if in its constituents the number of neutrons and the number of protons are interchanged, has further led to the belief that the nuclear forces are symmetric in proton and neutron, that is, the neutron-neutron interaction is exactly the same as the proton-proton interaction, except for the effect of the electric forces.¹

Turning now to the evidence from nuclei

containing more than two particles, this is usually discussed on the basis of the assumption that the forces are additive; that is, that the interaction force between two particles is not affected by the simultaneous presence of a third particle. Beyond its simplicity and the fact that it holds in the atom, this assumption is not founded on any evidence, and, in fact, there are certain theoretical arguments against it.⁸ However, without this assumption the available evidence is insufficient to draw any conclusions at all, and one must therefore use the assumption of additivity as a working hypothesis, which may at a later stage be disproved. Moreover, most of the theoretical work on the nuclei of weight 3 and 4 was done before the discovery of the quadrupole moment of the deuteron, and hence central forces were used. It is likely that the directional dependence of the force will not be negligible in these problems, but its precise effect has yet to be investigated.

So far as the calculations go, they show that the mass defects of the nuclei of mass 3 and 4 are very sensitive to the range of the force, and that the range required to give the right values is roughly of the same order of magnitude as that obtained from scattering experiments^{1,9}. Quantitative agreement, however, was not obtained. The laws of force used in these calculations were usually restricted by adopting the charge-independence hypothesis, and also by assuming that the range of the force was the same for parallel and for opposite spins. Whether the remaining discrepancy is due to these restrictions, or to the assumption of central forces, or whether it represents a failure of the additivity, remains to be seen.

For nuclei beyond ⁴He, the observed binding energy ceases to rise rapidly with the number of particles. This fact, often briefly referred to as 'saturation', obviously means that the constituent particles of a large nucleus do not *all* attract each other with the same forces with which the constituents of a helium nucleus attract each other. This may be due to several reasons. For one thing, the additivity of the force might fail, and the attractive force between two particles may depend on the number of other particles in the immediate neighbourhood. This dependence might be such as to ensure that the total potential energy per particle always remained below a certain saturation value. A possible description on these lines has been put forward by Teller, Critchfield and Wigner¹⁰, but the idea has not yet been pursued very far.

Another possibility is that the attraction may turn into repulsion at very close approach, in analogy with the forces between the atoms of a liquefied inert gas. In this case the repulsion might ensure that any one particle can, within the

range of its forces, be surrounded only by a small number of others, and hence the binding energy per particle is again limited. This possibility has not been fully explored, but it has the disadvantage that, owing to the wave mechanical penetrability of potential barriers, an extremely strong repulsion would have to be assumed to make this explanation possible.

The most attractive explanation is no doubt that the forces are 'exchange forces' which depend on the symmetry of the wave function describing the motion of the particles, like the valency forces between the constituents of organic molecules. On this idea the neutron is trivalent, capable of forming a 'bond' with one other neutron and two protons, and correspondingly for the proton. This would give a very natural explanation of the helium nucleus as a saturated structure¹.

The directional properties of the forces, which must be inferred from the existence of the quadrupole moment of the deuteron, may have a bearing on this question, since in a large nucleus different particles must necessarily be arranged in different directions relative to a given particle, and the forces may quite well be attractive for some pairs of particles and repulsive for others, if the directional dependence of the forces is strong². This effect will give rise to some kind of saturation; whether this saturation is of the right kind, and in particular whether it leads naturally to the α -particle as a stable structure, remains to be seen.

Of the attempts to derive the nuclear forces from a more elementary phenomenon, the most interesting is the meson theory, which is based on an idea of Yukawa¹¹. Yukawa supposes that the nuclear forces are due to a 'nuclear field' in the same manner in which the electromagnetic forces are caused by the electromagnetic field. This field must, however, satisfy different field equations in order to produce short-range forces, and if this requirement is coupled with that of the principle of relativity, there is only one possible type of wave equation, and the law of interaction is limited to laws of a particular type, of which the simplest has the potential:

$$V = g \cdot e^{-kr}/r, \quad (1)$$

where k and g are constants, and r is the distance between the particles. (Coulomb's law is a special case of this with $k = 0$). In quantum theory, just as the electromagnetic field is associated with light quanta, the 'nuclear field' will be associated with a new type of particle; the fact that the wave equation differs from that of light indicates that the rest mass of these particles is not zero, like that of light quanta, but has the finite value $hc/2\pi c$, where k is the same constant as in (1). In order to obtain a range of the right order of magnitude this

mass has to be assumed to be a few hundred times that of the electron. The subsequent discovery of 'mesons' of just such a mass in cosmic rays has very much increased our confidence in the 'meson theory' of nuclear forces.

If we try to fit a law of the form of (1) to the observations on proton-proton scattering, we obtain very good agreement, but we have to choose a value of k which corresponds to a meson mass of about 300 electron masses. This is almost certainly higher than the mass of the mesons found in cosmic rays. The origin of this discrepancy is not clear.

On the meson theory of nuclear forces, mesons are capable of being absorbed and emitted in nuclear reactions provided sufficient energy is available for their creation, and they may be exchanged (that is, temporarily created by one particle and absorbed by another) even if the available energy is insufficient to liberate them. If this view is taken, conservation of angular momentum in the process requires the mesons, like light quanta, to have integral spins. (The electron, which has a half-integral spin, can only be absorbed or produced in pairs.) Zero spin would make the nuclear forces repulsive when they should be attractive, and the most likely assumption seems that of a spin of one unit, as for the photon¹².

This assumption fixes the equations of the meson field completely, but not its interaction with the proton and neutron. This interaction is governed by two terms which, by analogy with the electric charge and magnetic moment, one may term the 'meson charge' and the 'meson moment' of the heavy particles. The law (1), in particular, is obtained if the heavy particles have only a meson charge g , but no meson moment. This law does not agree with experiment in detail, since it gives neither a spin dependence of the force (as required to explain the properties of the neutron-proton scattering) nor a directional dependence that would account for the quadrupole moment of the deuteron. The introduction of a 'meson moment' would help to give the right dependence¹³, but the force would then increase so rapidly at short distances that the proton and the neutron would fall into another, producing an infinite binding energy. Probably this result should not be taken too seriously, since the methods of quantum theory are likely to fail for too close approach, but it would mean in any event that the quantitative study of nuclear forces would have to be abandoned until an exact description of this failure of quantum theory is available.

It has also been suggested that two kinds of mesons might exist, of which one has the spin one, the other zero spin, and with such properties that the singular terms in the interaction energy just

cancel. In the crude approximation to which such calculations are usually carried out, the directional dependence of the forces would then also just cancel, together with the infinities, but it is possible that finer effects would give a sufficiently large directional variation.¹³

Lastly, there arises the question as to the electric charge of the meson. The mesons observed in cosmic rays are charged, and if one of them is emitted by one nuclear particle and absorbed by another, this will involve an exchange of charge, thus ensuring that the forces are of the exchange type, as required by the most widely accepted explanation of the saturation of nuclear forces. Such an exchange will, however, be possible only if one of the heavy particles is a proton and the other a neutron, but not for two like particles. In order to account for the equally strong forces between like particles, one has to assume the existence of neutral mesons in addition to the charged ones¹⁴. There is certain independent evidence for the existence of neutral mesons in cosmic rays¹⁵. If we take the view that the saturation of the nuclear forces is due to their directional dependence and not to their exchange character, it is, in fact, possible to attribute all nuclear forces to neutral mesons⁶. This would

have the advantage of removing the discrepancy between the mass of the charged mesons from cosmic rays, and the range of the forces as determined from proton-proton scattering. It would mean, on the other hand, that the particles, the discovery of which was hailed as a confirmation of Yukawa's theory, had actually no connexion with the particles postulated by Yukawa.

This summary of the present state of the theory¹⁶ closes with a number of questions to which the answer is not known. But the fact that it is possible to ask these questions at all is a sign of the rapid progress that has been made in this field in the last few years.

¹ Bethe and Bacher, *Rev. Mod. Phys.*, 8, 82 (1936).

² Simons, *Phys. Rev.*, 55, 793 (1939).

³ Brickwedde, Dunning, Hoge and Manley, *Phys. Rev.*, 54, 266 (1938).

⁴ Hoisington, Share and Breit, *Phys. Rev.*, 56, 884 (1939).

⁵ Kellogg, Rabi, Ramsay and Zacharias, *Phys. Rev.*, 55, 318 (1939).

⁶ Bethe, *Phys. Rev.*, 55, 1261 (1939).

⁷ Breit, Condon and Present, *Phys. Rev.*, 50, 825 (1936).

⁸ Primakoff and Holstein, *Phys. Rev.*, 55, 1218 (1939).

⁹ Rarita and Present, *Phys. Rev.*, 51, 788 (1937); Rarita and Slawsky, *Phys. Rev.*, 54, 1053 (1938).

¹⁰ Wigner, Critchfield and Teller, *Phys. Rev.*, 56, 530 (1939).

¹¹ Yukawa, *Proc. Phys.-Math. Soc. Japan*, 17, 48 (1935).

¹² Fröhlich, Heitler and Kemmer, *Proc. Roy. Soc., A*, 166, 154 (1938).

¹³ Möller and Rosenfeld, *NATURE*, 144, 241 (1939); 144, 476 (1939).

¹⁴ Kemmer, *Proc. Cam. Phil. Soc.*, 34, 354 (1938).

¹⁵ Arley and Heitler, *NATURE*, 142, 158 (1938).

¹⁶ Cf. also Peierls, R., *Ann. Rep. Chem. Soc.*, in the press.

BREEDING DISEASE-RESISTANT PLANTS

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THE possibility of raising varieties resistant to virus, bacteria, fungi, and insects is an attractive prospect for the practical plant breeder. Potatoes immune to wart disease, beans resistant to anthracnose, wheat resistant to rust, vines resistant to *Phylloxera*, and wheat, barley, and oats resistant to Hessian fly, eelworm, and frit fly are sufficiently well known to encourage the investigator to work on other crops. Several publications (Roemer, Isenbeck and Fuchs, Lesley and Wallace, Reddick, Painter, Jones, Johnston and Parker) have recently directed attention to different aspects of this question. The following short account is based on these publications. The accompanying table lists a few commercial crops which contain disease-resistant varieties.

There are several points of interest in the relationships of the hosts and diseases enumerated in this incomplete table. There is a large number of cases where the genetics of resistance is complex. Several times (wheat, tomatoes, beans, etc.) the character was shown by the early workers to

TABLE I

Potatoes:	<i>Synchytrium endobioticum</i> , <i>Phytophthora infestans</i> , <i>Alternanthera solani</i> , <i>Bacterium phytophthorum</i> , <i>Actinomyces scabies</i> , <i>Leptinotarsa decemlineata</i> . Virus A, B, C, X, Y.
Tomatoes:	<i>Cladosporium fulvum</i> , <i>Fusarium lycopersici</i> , curly-top virus.
Cabbage:	Yellow virus, <i>Fusarium</i> .
Turnip:	<i>Plasmiodiophora brassicae</i> .
Cotton:	<i>Bacterium malvacearum</i> , <i>Fusarium vasinfectum</i> , leaf-blisters mite, black scale, jaccid insects.
Beans:	<i>Colletotrichum Lindemuthianum</i> , <i>Phytomonas medicaginis</i> , <i>Erysiphe polygone</i> , <i>Fusarium solani</i> , <i>Uromyces appendiculatus</i> , <i>Heterodera</i> .
Celery:	<i>Fusarium Orthoceras</i> , yellow (virus).
Antirrhinum:	<i>Puccinia Antirrhini</i> .
Apple:	<i>Venturia inaequalis</i> , <i>Eriosoma lanigerum</i> .
Vines:	<i>Plasmopara viticola</i> , <i>Uncinula necator</i> , <i>Phylloxera vitifolii</i> .
Wheat:	<i>Puccinia graminis</i> , <i>P. glumarum</i> , <i>P. triticera</i> , <i>P. coronifera</i> , <i>Tilletia</i> , <i>Ustilago</i> , <i>Phytophaga destructor</i> , <i>Erysiphe graminis</i> .
Barley:	<i>Heterodera Schachtii</i> , <i>Puccinia graminis</i> , <i>P. glumarum</i> , <i>P. dispersa</i> , etc., <i>Erysiphe graminis</i> , <i>Ustilago nuda</i> .
Oats:	<i>Oscinis Frit</i> , <i>Puccinia</i> spp., <i>Ustilago avenae</i> , <i>U. levis</i> .
Pisum:	<i>Grapholita</i> sp., <i>Bruchus pisi</i> , <i>Ascochyta</i> .

behave in a monofactorial Mendelian manner. Later, the mode of inheritance was found to depend on interacting, cumulative, or duplicate factors. Thus resistance against *Synchytrium*, *Phytophthora*, *Puccinia graminis*, *Plasmopara*, *Erysiphe*, *Cladosporium fulvum*, and woolly aphid is inherited in

a complicated manner. Polyploidy of potatoes, wheat, oats, and apples will account for some of the complications, and to some extent the geneticist can cope with such problems. They could be dealt with by normal breeding procedure if resistance were an easily diagnosed trait, and behaved as a stable characteristic. Resistance, however, varies continuously in some cases, from high resistance to susceptibility, and frequently resistance has to be measured quantitatively. For example, the percentage of plants which are attacked, the percentage which prevent the normal development of the larvæ, and the percentage which survive attack, all determine the resistance of a strain of wheat to Hessian fly. A more serious difficulty, however, is the fact that the attacking agent is also a living thing and consequently productive of variations. Biffen showed that black rust resistance in wheat behaved in a simple Mendelian manner. Pole Evans and others questioned the stability of the resistant forms. The apparent breakdown of the resistance is accounted for when it is realized that black rust consists of a considerable number of different strains—physiological races. These races are in large part due to mutation and segregation during sexual reproduction. They differ from one another in their virulence and in their comparative effect upon the different varieties of the host species. The establishment and the specialization of these races is a most interesting problem. For example, the resistance of varieties of beans to three physiological races, α , β , γ , of *Colletotrichum Lindemuthianum* is :

Bean variety	α	β	γ
Wachs Protecta	0	++	++
Doppelte Hollande Princess	++	0	0
Krummschnabel	±	++	0

(After Schreiber.)

When the number of physiological races is increased (see Table 2), the specialization of the fungal races may upset much of the plant breeder's work. On several occasions (for example, wheat, potatoes) a variety resistant to a fungus has been produced, but soon this variety comes into contact with another physiological race of the fungus against which it is not resistant.

TABLE 2.
MINIMUM NUMBER OF PHYSIOLOGICAL RACES
FOUND IN SOME FUNGI.

<i>Puccinia graminis</i>	160
<i>Puccinia glumarum</i>	31
<i>Puccinia triticina</i>	91
<i>Helminthosporium graminium</i>	4
<i>Erysiphe graminis</i>	15
<i>Venturia inaequalis</i>	111+
<i>Colletotrichum Lindemuthianum</i>	50
<i>Phytophthora infestans</i>	4
<i>Tilletia</i> spp. (on cereals)	20+
<i>Ustilago</i> spp. (on cereals)	20+

The diagnosis of immunity, resistance, or susceptibility would be facilitated if some anatomical or physiological characteristic of the host plant could be found to be the cause of, or to be strongly associated with, immunity. The cutinization of the epidermis of *Pisum* and distribution of sclerenchyma in cereals are associated with resistance to *Aschochyta pisi* and *Puccinia graminis* respectively, while the degree of attack of *Gibberella Saubinetti* upon wheat and maize is proportional to the state of the sugar in the transition of hexose-pentose (J. G. Dickson). The more pentose the more resistant is the crop. Resistance and immunity are, unfortunately, often bound up with the biochemical and physiological reactions of the living plant. Further research work is required before the identification of these reactions can be attempted.

Commercial breeding usually does not wait for the results of the analysis of the relationship between host and fungus, but it is rarely possible to obtain success in breeding for resistance without the help of the scientific worker. The evolution of methods of testing resistance as in wart disease, of methods of crossing based on cytology as against *Phytophthora infestans*, the introduction of new species and the study of the environmental conditions under which resistance is increased are essential to the success of the practical breeder. One or two accounts of recent breeding work will indicate the wide field and problems that are normally encountered.

Blight due to *Phytophthora infestans* causes considerable damage to the potato crop. Reduced cropping, costs of spraying and other palliative measures would be greatly alleviated by the existence of varieties of potato resistant to the disease and equal to the present susceptible variety in quality and yield. Obviously, one of the first problems in the attempt to breed disease-resistant varieties is to discover whether any potato or relative of the potato shows resistance to the disease. The analysis of collections from South America made by Baur and Schick, Reddick, Hammarlund and the Russians have shown that *P. infestans* is not epiphytotic in South America, and therefore, in the absence of a basis for natural selection, we do not expect to find, except by accident, a resistant variety. All evidence indicates that the great *Phytophthora* epidemic of 1845 was of European origin and was the first occasion on which *P. infestans* and the potato met. Various non-tuberous species of *Solanum* and neighbouring genera contain immune varieties, so it does not seem unreasonable to expect that species hybridization might achieve the end in view.

Many attempts in hybridization and selection have been made by Müller, Salaman, Sutton,

Reddick, Kattermann, Schick, and others. Immunity and resistance are inherited and transmitted to the progeny of crosses within *S. tuberosum*, or between *S. tuberosum* and other species, notably *S. demissum*. The mode of inheritance is variable, like immunity to wart disease. Where *S. demissum* is used as parent, the F_1 and most of the F_2 generations are immune; when resistant varieties of *S. tuberosum* are crossed, the F_1 is susceptible, but some of the F_2 are resistant (see Schmidt, Salaman, Reddick). It is probable, as pointed out by Müller, that the polyploid nature of the potato and its relatives is the cause of the peculiar dominance, and segregation results. The potato is notably difficult to breed since many varieties have almost inviable pollen, and breeding is restricted to a few of the commercial varieties. The potato is tetraploid, while *Solanum* species may be diploid, triploid, tetraploid, or hexaploid; *S. demissum* is hexaploid and has fertile pollen and ovules. Unfortunately, the cross $6n \times 4n$ (where the pollen of the potato, such as it is, has to be used) is the only way in which much success can be obtained in making this cross. When the F_1 is obtained, it is immune to blight and self-fertile, but very dissimilar from any potato. The long stolons of *S. demissum* are even longer in the F_1 and the tubers are very small and few (Reddick). The F_2 and succeeding generations are quite useless for selection (Reddick, 1940). Back-crossing to the potato is laborious but does produce more promising results. Immunity is now restricted to about 40 per cent of the progeny, but the immune plants are not of much value as potatoes. Continued back-crossing, like selfing, greatly reduces vigour, and one is rewarded by weak, dwarf plants with no power to form tubers.

These methods would be difficult enough if blight was a stable entity, but it is a fungus which is even more plastic than the rusts. New biological races are being formed frequently; in Europe the formation of sexual oospores gives an opportunity for segregation, but in America, where oospores are apparently not formed, new races are also produced asexually. Berg and Röder showed that tomato late blight was a different physiological race from those of the potato, and recently (Mill) it has been shown that this tomato blight is synthesized annually from potato blight. Therefore there are true biological races and peculiar strains with distinct degrees of infection potency. For example, Reddick states that one artificial infection of the varieties President and Green Mountain will show few lesions on the President and large ones on Green Mountain, which is susceptible. But if two passages through President are made, the degree of virulence of *P. infestans*

is increased so that lesions on Green Mountain and President are both large and indistinguishable. Further, Reddick and Mills have shown that even after twenty passages through the susceptible Green Mountain the higher virulence is maintained. Reddick has shown that, if there are bridging varieties of intermediate susceptibility, the virulence of *P. infestans* can be stepped up to a high degree from a culture which originally would only infect the most susceptible. Thus Reddick suggests that it is probably feasible to break down the immunity even of *S. demissum* if bridging varieties for stepping up the virulence were available. The presence in Europe of definite physiological races which possibly have arisen from sexual reproduction further complicates matters. Müller, Schick, Kattermann, and others have isolated races which are specialized in respect to the varieties which they do or do not attack.

Although these complications are encountered, several workers have succeeded in raising potatoes of fair commercial value which are resistant to the present condition of *Phytophthora infestans*. It is unfortunate, however, that the prevalence of virus disease among potatoes probably leads to greater difficulties in the commercial growing of potatoes in Great Britain than attacks of blight. Some varieties are immune, some are carriers without showing infection and others are susceptible to one or more identified viruses. Craig's Defiance, produced by the Scottish Society for Research in Plant Breeding, is field-immune to viruses A, B, C, and X. The combined study of the etiology of the disease and of the reactions of potatoes to the different viruses is yielding highly important results. Resistance to virus diseases is inherited in sugar cane, cucumber, sugar beet, cabbage, celery, tomato, and other crops.

The reaction of the host plant to attack by virus is a peculiar one (see K. Smith). Lesley and Wallace have shown that some strains of the tomato may exhibit 'recovery' from an attack of curly top virus. The appearance of 'curly-top' appears about twelve days after infection in the field. Sometimes recovery by the regeneration of new shoots takes place, and if this is early enough the tomato may produce fruit. The degree of recovery is a racial characteristic, but is also influenced by environment. Clones from a recovered plant also show a resistance to further infection by curly top. For example, out of twenty-three recovered plants which were inoculated again, nineteen showed no symptoms of the virus. On the other hand, nineteen out of twenty-seven fresh plants showed curly top symptoms after inoculation. The virus is present in the recovered plants

and its virulence on fresh plants was unchanged. Similar effects can be found in the tobacco ring-spot virus disease.

The saving of the sugar-cane in Java by synthesizing hybrids of several species including wild *Saccharum spontaneum* and crossing these to *S. officinarum* is now historic. The immunity to virus derived from *S. spontaneum* could not be introduced into *S. officinarum* until the effects of the chromosome constitution upon hybridization were realized. The 'ennobling' of the sugar-cane has increased its yield, sugar-cane control, and created immunity to diseases (Banner, Janaki-Ammal).

Parker, Jones, Johnston and Painter have recently reported the results of combining resistance to Hessian fly attack with resistance to other pests and diseases in commercial wheat. There are strains of wheat which are resistant to Hessian fly, which lays its eggs in the seed, about the end of March; the larvæ bore between the stalk and leaf sheath, and the plants shrivel and die. Resistance to Hessian fly attack is heritable, but the mode of inheritance is involved. In some cases, the larvæ develop without the plant showing damage, and in others a low amount of oviposition takes place. Of 327 American varieties, 106 gave resistant strains (only 10 per cent attack, as compared with 40 per cent susceptible in Kanred). Painter and his collaborators have recently combined the high Hessian fly resistance of Marquillo wheat with the best winter wheats. Forms are now known which show resistance to stem rust, rust, mildew, joint worm, and Hessian fly, and are equal to the best commercial winter wheats. The combination of these strains into one variety promises to give highly important commercial results. Already the Marquillo hybrids of winter wheats show low survival of larvæ of Hessian fly, low percentage of plants attacked, and a high survival rate of plants attacked under high fly infestations. These Marquillo wheats are the first to combine resistance to insect and fungus attack, and to show resistance to Hessian fly in all the wheat belts of America.

It is interesting to note that physiological races are also present in other animal enemies of commercial crops. *Heterodera Schachtii*, *Phylloxera*, for example, have been found to have races specialized for certain varieties of a species or to certain species (*Heterodera*) (see W. H. Thorpe).

The occurrence of physiological races in insects, fungi, and, for all we know, in virus diseases, deserves special consideration by the geneticist. We know from the work of Stakman and others that the characteristics which differentiate between

physiological races in rusts and smuts segregate in crosses between these different races. Also we know that mutation occurs both in sexual and in asexual generations. Rarely is there any morphological difference between these races; but fungi such as *Venturia inaequalis* produce many morphological variants on one apple. The nature of the resistance of the host variety is not simply a quantitative degree of virulence, but there is a qualitative difference respecting host varieties attacked. The simple example of *Colletotrichum*, quoted above, may be extended to the larger number of varieties available in the host species.

How did these physiological races spread after their origin by mutation or segregation? The origin of new physiological races in the asexual generation, as in the *Phytophthora* case of Reddick, mentioned earlier, is intriguing. It will be noted that virulence is only stepped up when bridging strains of the host variety are present. It might appear, therefore, that environment was creating the new variant. It is more probable that somatic mutation is continually going on. In a susceptible variety *A*, selection is neutral, and the size of the population of a more virulent mutant is small; therefore, as shown by Sewell Wright and Dobzhansky, the variant will tend to disappear. If, on the other hand, there is a bridging variety, selection for the virulent variant becomes positive, and the population grows in size. Therefore the more virulent strain of fungus is ready in the bridging variety in sufficient amount to infest the more resistant host variety *B*. Once established there, the less virulent race of fungus tends to be swamped. Specialization of a fungus race to a particular variety would arise if the virulent race of fungus became modified by mutation and selection in such a way that it would not attack the original susceptible variety *A*.

REFERENCES

- Berg, A., West Virginia Agric. Exp. Stat. Bull., 205 (1936).
 Biffen, R. H., *J. Agric. Sci.*, 2, 109-129 (1907).
 Crane, M. B., Greenslade, B. M., Masee, A. M., and Tydeman, H. M., *J. Pom.*, 14, 137-163 (1936).
 Dickson, J. G., *Sci. Agric.*, 13, 213-224 (1932).
 Honig, K., *Gartenbau Wiss.*, 5, 116-125 (1931).
 Lesley, J. W., and Wallace, J. M., *Phytopath.*, 28, 548-553 (1938).
 Müller, K., *Angew. Bot.*, 12, 299-324 (1930).
 Painter, R. H., Jones, E. T., Johnston, C. O., and Parker, J. H., H.A.E. Ento. (1939).
 Roemer, T., Fuchs, W. H., and Isenbeck, K., "Die Züchtung resistanter Rassen der Kulturpflanzen", P. Parey (1938).
 Reddick, D., Amer. Assoc. Adv. Sci. (1939).
 Salaman, R. N., Rep. II. Int. Cong. Path., 436-437 (1931).
 Schick, R., *Züchter*, 4, 232-237 (1932); 8, 65-70 (1936).
 Schreiber, F., *Phytopath. Z.*, 4, 415-452 (1932).
 Smith, K., *Biol. Rev.*, 8, 136-179 (1933).
 Stakman, E. C., *Genetica*, 13, 372-389 (1936).
 Stakman, E. C., Levine, M. N., and Cotter, R. U., *Sci. Afri.*, 10, 707-720 (1930).
 Thorpe, W. H., *Biol. Rev.*, 5, 177-212 (1930). Imperial Bureau of Plant Genetics, "Breeding Resistant Varieties" and Supplement.

OBITUARIES

The Right Hon. H. A. L. Fisher, O.M., F.R.S.

DEATH has been taking a heavy toll of eminent Oxford men within the last few months. First, Prof. Joachim died about a year ago; then his intimate friend Prof. J. A. Smith; then Prof. Samuel Alexander, who had made his name at Lincoln College before he went to Manchester. Then, on April 18, came the death of Mr. H. A. L. Fisher, who was, of course, much the best-known public man of the group. In one way he must surely have been unique, in giving many years of service as a Minister of the Crown and then having a long tenure of the wardenship of New College, Oxford.

Fisher was taken into the war cabinet as Minister of Education by Mr. Lloyd George—to whom he was always much attached—in the year 1916 when the great changes were made which displaced Lord Asquith. He remained as Minister of Education until 1926 and used his position to make the most vigorous efforts to raise the standard of national education by raising the age for leaving school and in other ways improving the chances of education for young people when they came to leave. In these efforts he gained the hearty support of the whole teaching profession, whose status he considerably improved by raising the salaries of masters and mistresses in secondary schools.

No one perhaps has ever deserved so much of the whole body of teachers and scholars as did Mr. Fisher. It will be remembered that it was found impracticable to carry out at once the raising of the age which his Act proposed. The matter was left in abeyance and in constant dispute until the present Government took it up again two years ago and—with certain reservations—at last made the Fisher Act a living thing. How it will work remains to be seen when the modifying Act is at last to be put in operation.

On leaving the Ministry in 1926, Fisher went back to his old College, this time as head, for he had been by education a Winchester and New College man. He remained as warden of New College until his death, and was one of the best-known and respected figures in Oxford.

In the world of letters he became best known by his "History of Europe", which quickly rose to the distinction of a best-seller. It was published in 1936 after intense labour which reduced Fisher to a chronic state of weak health for the last three or four years of his life. He tells us in the preface that his subject is "Man from the neolithic age to Stalin and Mustapha Kemal, Mussolini and Hitler". But he damps the hopes of believers in progress by saying that "one intellectual excitement has been denied me. Men wiser and more learned than I have discerned in history a plot, a rhythm, a predetermined pattern. These harmonies are concealed from me.

I can only see one emergency following upon another as wave follows upon wave. There can be no generalization, only one safe rule for the historian; that he should recognize in the development of human destinies the play of the unforeseen and the contingent". It was true indeed in the course of his own life, for who could have foreseen that the best-known historian in England and the leading figure in Oxford academic life would have been struck down at last by a lorry on Millbank. His friends had been anxious for his health for some years. They thought that he would yield to the strain of excessive and prolonged intellectual work. But no! It was the contingent, a passing lorry, which might have carried away any insignificant citizen of London, which ended one of the most active and distinguished lives of our day.

F. S. MARVIN.

Prof. S. M. Dixon, O.B.E.

PROF. STEPHEN MITCHELL DIXON, who died on March 25 at Nice at the age of seventy-four, was a leader in civil engineering education. Born in Dublin, he studied experimental physics and carried out research under Fitzgerald at Trinity College, and then qualified in civil engineering. After experience as contractor's engineer on railway works in England he was appointed to a newly established chair of civil engineering at Fredricton, New Brunswick, in 1892. Ten years later he moved to Dalhousie University, Nova Scotia, and in 1905 was called to Birmingham to organize the Department of Civil Engineering. When, in the general re-organization following the formation of the Imperial College of Science and Technology, the Mechanical and Civil Department of the City and Guilds (Engineering) College was divided into two autonomous departments in 1912, Dixon was called to the chair of civil engineering there.

Dixon was a great teacher who had the gift of infecting those around him with some of his own unlimited enthusiasm and of getting the best out of his students and staff without apparent effort. He had the probably unique record of having started four university departments of civil engineering. Dixon's approach to his subject was practical rather than theoretical, and he combined a sound foundation of the mechanical principles with a deep distrust of complicated theories and involved calculations. His fertile and active mind led him to devise many new ways of tackling well-known problems—a typical example was the use of a sand core for moulding pre-cast hollow concrete blocks. Old students will remember how he built a house, almost unaided, to prove the practicability of this pre-cast block.

In his earlier years, Dixon carried out research on terrestrial magnetism and on surveying instruments,

but the ampler resources at Birmingham enabled him to begin the large-scale experiments on structural members which were perhaps his most important contribution to engineering science. This method of investigation was first applied to reinforced concrete beams, slabs and arches, and afterwards, at the Imperial College, to mine supports—steel and concrete arches for roadway lining, and cogs, chocks and packs for face support.

At Birmingham, Dixon carried out investigations on wire ropes and on supports for the coal mining industry, and this work was resumed when he was appointed to the Safety in Mines Research Board in 1923. He acted as chairman of the Wire Ropes Research Committee, and organized international co-operation in these investigations. Dixon was also a member and sometime secretary of the Institution of Civil Engineers Committee on the Deterioration of Structures in Sea Water, and carried out a long series of investigations on the preservation of Empire timbers from attack by Teredo. He served on the British Standards Committees dealing with wire ropes and steel arches for mines, and also on the testing of timber and the rating of rivers. In the large hydraulic laboratory at the Imperial College various investigations on current meters, syphons, and river models were carried out under his direction. For his work describing the measurements of the flow of the River Severn in 1921–36 he was awarded a Telford Premium of the Institution of Civil Engineers.

No record of Dixon's life would be complete without a reference to his outstanding services during 1914–18. In the very early days of the Ministry of Munitions he became personal assistant to Sir Henry Fowler, director of production, and was actively engaged in the organization of the great department until relatively stable conditions were reached in 1917, when he resigned to join the Royal Engineers. After ten days training he went to France on railway construction, and was demobilized as a captain in 1919. Dixon retired from his chair at the Imperial College in 1933. M. A. HOGAN.

Prof. Jan Włodek and Adam Różański

PROF. JAN WŁODEK was one of the seventeen Cracow professors who recently died as a result of ill-treatment by the Germans in the concentration camp at Sachsenhausen, near Berlin. This was a disused brewery, had no accommodation for human beings and, although not quite as bad as the notorious Dachau and Buchenwald camps, was utterly unfit for human habitation. Along with 149 of his colleagues, he was arrested by the Gestapo, the accusation being, to quote the official Polish report:

“(1) vu que les professeurs ont essayé de reprendre les cours de l'Université sans que les autorités allemandes en aient connaissance;

“(2) vue qu'ils ont continué leurs travaux dans les institutions et séminaires dont ils étaient à la tête et

faisaient passer des examens sans en demander l'autorisation;

“(3) vue que, pendant 5 siècles, l'Université de Cracovie a été un bastion de l'esprit polonais. . .”

He was by no means a robust man and as soon as his friends heard that he had been arrested it was feared he could not survive the cruelties to which he would be exposed, nor did he.

Prof. Włodek belonged to the old Polish nobility, had studied in Poland and in Switzerland, working especially on plant nutrition and soil problems and also on plant breeding. When the new Polish State was set up he, as one of the followers of Pilsudski, was appointed to consular work in Holland, but soon returned to the University of Cracow as professor of agriculture. Here he set up a large laboratory and was put in charge of the University Experimental Farm of Mydlniki. He was an excellent teacher and attracted many pupils, two of whom had already become professors at other Polish universities. Almost from the outset he was attracted to Willstätter's investigations on chlorophyll and was especially interested in the ratio of chlorophyll *A* to chlorophyll *B*, which he considered played an important part in the development of plants. He studied the relation between this ratio and the environmental conditions, particularly variations in the amount of nitrogen and of potassium supply. The other branch of his work was ecological and dealt with the distribution of plants in the Tatra Mountains in relation to the humus and calcium conditions of the soils and their pH values.

He had travelled widely in Europe and was a remarkably good linguist, speaking and writing English perfectly. He was a delightful host and those who have been privileged to visit him in his attractive ancestral home at Dabrowica will not easily forget his wide culture, good taste and charming personality.

Another victim has been Prof. A. Różański who, before the War of 1914–18 had held an important post in the Government in connexion with land surveying and improvement. After the War he was appointed professor of agricultural engineering and surveying in the University of Cracow and did a good deal of work on land drainage, particularly important for the development of agriculture in many parts of Poland. He showed considerable ingenuity in designing inexpensive and efficient methods of draining. He rendered great service to Poland in a quiet and unobtrusive way and was much liked by his students. E. J. RUSSELL.

We regret to announce the following deaths:

Dr. Carl Bosch, president of the I. G. Farbenindustrie, the German dye trust, on April 27, aged sixty-six years.

Dr. Charles Davison, the authority on earthquakes, on April 28, aged eighty-one years.

Sir William Meade-King, the well-known civil engineer, on April 10, aged eighty-one years.

NEWS AND VIEWS

Dr. T. A. Henry

THE Wellcome Foundation recently made a presentation to Dr. T. A. Henry to mark the completion of his twenty-first year of service as director of the Wellcome Chemical Research Laboratories. Dr. Henry began his research career as a Redwood scholar in the Research Laboratories of the Pharmaceutical Society, whence he moved to the Scientific and Technical Department of the Imperial Institute, where he held a Salter's Company research fellowship and ultimately became superintendent of laboratories. He was appointed to his present post in 1919. Dr. Henry has done much original work on natural products, particularly cyanogenetic glucosides and alkaloidal drugs, while in his applications of chemistry to progress in medicine he has covered a very wide range of subjects.

During his directorship of the Wellcome Chemical Research Laboratories, Dr. Henry has given considerable attention to the chemotherapy of tropical diseases, including hookworm, leprosy, kala azar and malaria. This has involved investigations on the chemistry of organo-metallic compounds of arsenic, antimony and mercury, and has led, among other things, to a thorough examination of apoquinine, apoquinidine, niquidine and niquine and to the elucidation of their chemical constitution. Recently, the laboratories under his direction have been exploring the relationship of chemical structure and bactericidal action in the new group of drugs starting from sulphanyl amide. In 1927, Dr. Henry was awarded the Hanbury Medal, which is given periodically by a committee including the presidents of the Chemical, Linnean and Pharmaceutical Societies for "high excellence in the prosecution or promotion of original research in chemistry and natural history of drugs". He is the author of the well-known text-book on the "Plant Alkaloids", of which a third edition was issued last year.

Scientific Research and Taxation

At a time when the financial position of learning and scientific research is a matter of serious concern, no little interest is attached to the decision of a Divisional Court when Mr. Justice Hawke, Mr. Justice Charles and Mr. Justice Tucker on April 25 dismissed an appeal by the School of Oriental and African Studies of the University of London (*The Times*, April 26). The appeal was from the decision of the County of London Quarter Sessions that the School was not exempted under Section 1 of the Scientific Societies Act, 1843, from the payment of rates in respect of certain premises occupied by it. The provisions of this Act, by which a "society instituted for the purposes of science, literature, or the fine arts exclusively" may be exempted from the payment of rates, but of which full advantage had not been taken for some time, were successfully

invoked by a number of learned and scientific societies in the financial stringency which followed on the War of 1914-18. It was a further manifestation of the favourable attitude of the authorities towards learning and research at this time, when not only was exemption from income tax allowed or continued to scientific societies which in addition to serving the interests of their members could be shown to be carrying out work of public utility, but also an additional concession made income tax recoverable on subscriptions guaranteed over a period of years.

It may seem that there has been a change in the spirit which prompted this last concession in Sir John Simon's statement last week that he is not prepared to propose an alteration of the law, which at present makes no provision for exempting benefits for research from estate duty. At the present time this decision is not surprising; but it is a matter which scientific bodies and organizations interested in research should not allow to go by default when a more favourable occasion arises. The trend of the application of financial legislation in the last hundred years has been to free the pursuit of learning from the burden of taxation so far as possible. In the days of financial stringency which the future will bring, estate duty will inevitably prove a heavy burden on posthumous endowment of research, unless a change is made.

Family Allowances

THE question of family allowances is discussed by a recent broadsheet issued by Political and Economic Planning (P.E.P.), and in a new pamphlet by Miss E. F. Rathbone, "The Case for the Immediate Introduction of a System of Family Allowances and Alternative Proposals for such a System", issued by the Family Endowment Society, 72 Horseferry Road, London, S.W.1. The broadsheet points out that family allowances have become a live issue to-day for three main reasons: the need to restrict civilian consumption while safeguarding basic standards of health and nutrition; the claim for 'equal pay for equal work' which may arise sharply in the munitions industry if large-scale replacement of male by female labour occurs; and the need, intensified by new types of war-time distress and the multiplication of assistance scales, for codification of the numerous regulations. To relate income to the extent of family responsibilities is the only way of preventing the general reduction of consumption, however effected, pressing unfairly on large numbers of children. Wages are not only a payment for work done but also the means for rearing and maintaining a family, and all agencies by which consuming power is diverted from the social pool for the benefit of dependent wives or children are, in fact, agencies for family endowment. Miss Rathbone contends that

family allowances offer the best means of meeting unavoidable increases in living costs simultaneously for workers in all occupations with similar family needs, without stimulating a race between prices and wages.

Both Miss Rathbone's review and the broadsheet discuss systems and experience in other countries, and favour a national service, State-regulated and State-administered. Tabular statements included in Miss Rathbone's pamphlet show that the charge on the Exchequer ranges from £118 million for a State-paid scheme, covering all children under fifteen years of age in Britain at 5s. per child, to £6½ million for the State share of a contributory insurance scheme, covering only the population insured for unemployment at 3s., beginning with the second child. Miss Rathbone prefers a bold imaginative scheme, covering the entire child population at the rate of 5s. a child, on the grounds of justice, for eugenic reasons and because of the greater simplicity of administration. If this is considered too costly, a contributory insurance scheme is urged involving an Exchequer contribution of £6½-£32½ million. Whatever the scheme, payment of the allowance to the mother is strongly recommended, partly to diminish the attraction of the labour market to married women and partly to emphasize that the allowance is not part of the remuneration of labour, but a recognition of the child's value to the community.

An International Air Force

A PLAN for the organization of an International Air Force is outlined in the report of the Military Research Committee of the New Commonwealth Institute, which was printed just before the outbreak of the War but has only now been issued. The scope of the proposed Force is as a reinforcement of the self-defence of States, adequate to give each the sense of security from attack that its unaided strength, alliances, or guarantees of neutrality are unable to ensure. The scheme could only operate if a sufficient number of States consented to co-operate, and the report points out that absolute neutrality is inconsistent with co-operation against war by any plan. Associated States would make an annual contribution to a common pool, in equal proportion to their total resources or war budgets. The assistance afforded to each assured State would be the maximum possible and not determined by the amount of its contribution. After discussing the advantages and disadvantages of the alternative systems of a Force composed of national quotas and an independent organic Force recruited by voluntary enlistment, the report strongly recommends the latter. It is essential, that the Force should be as efficient, as homogeneous, and as certain to act when required as is humanly possible.

In regard to language, the Committee recommends the adoption of Spanish, and it is suggested that each contributing State should provide a base with extra-territorial status in its territory for the Force, this distribution of bases giving a wide area of protection, while the Force should have the maximum

possible freedom of movement both in peace and in war. In regard to the supply of aircraft, the Committee contemplates drawing on the manufacturing resources of private firms in all States sufficiently prominent in aviation, and manufacture would be directed and supervised by a design department, a research department and an inspection department serving the Force. The contributing States would be represented on the Board of Control, although the Force would have complete internal autonomy and the power of executive initiative. In addition to an intelligence service, the High Command would be provided with simple standing orders to ensure rapid action after determination of the facts. The scheme is regarded as well within the ability of European and adjacent States to finance, organize, equip and recruit.

Regional Organization and Local Government

In a paper entitled "Regional Organization during and after the War" read before the Royal Society of Arts on February 7, Brigadier Sir Edward Tandy described the regional organization developed for defence purposes and discussed its adjustment to meet peace-time requirements after the War. Reviewing our existing peace-time machinery for local government, which he urged must be accepted but reinforced by regional organization to meet emergencies like that of war, Sir Edward Tandy suggested that the easiest way to establish the regional organization required for peace would be to accept the system established for war and retain a suitable nucleus of staff at each regional headquarters. These headquarters would be available almost at once to form advisory committees to consider how new measures of reconstruction could be best applied to each region, or the best distribution within each region of any funds which might be allotted by the central Government for particular purposes. They could also assist as liaison officers in smoothing difficulties between the central Government and local government authorities and the like, and Sir Edward suggested that the commissioners should be designated Commissioners of Public Welfare, to indicate the wide general scope of their activities. Such regional organization could easily be discarded if it proved to be superfluous, but Sir Edward indicated the difficulties which are at present continually arising in the absence of a regional system for peace-time purposes.

The Zoo during War-time

THE report of the Zoological Society of London presented at the annual meeting on April 29 shows that after the first great drop in public visitors last September to 11.3 per cent of the figures for the corresponding period of the previous year, there has been a healthy recovery. The Society is to continue its publications at about half the normal scale; 180 animals have been 'adopted' under the Society's war-time scheme to cover feeding costs and there have been developed photographic competitions to encourage amateur photography at the Zoo, and

exhibitions of war-time utilities in food production in the way of goat, poultry, rabbit, pig, pigeon and bee keeping. A committee has been formed to revise the more obsolete of the by-laws, and the alterations will be put before the ordinary general meeting this month and balloted upon in August. Notable changes in staff have been the retirement of the curator of mammals and birds, and of the librarian, with temporary termination of the duties of the director of the aquarium (who is now working at the War Office), and of Mr. Bushby and Mr. Fisher.

British Museum (Natural History): Recent Acquisitions

THE Zoological Department has received from Mr. I. R. P. Heslop two skulls of the pigmy hippopotamus (*Chæropsis liberiensis*) which came from the Owerri and Warri Provinces in southern Nigeria. The interest in these two specimens lies in the fact that the distribution of this species was formerly held to be confined to a comparatively small part of West Africa, namely, to Sierra Leone, Liberia, and the French Ivory Coast. The Museum has received rumours from time to time during the past few years of the existence of the pigmy hippopotamus over a much greater range than was formerly thought to be the case. The occurrence of this species in southern Nigeria shows that its distributional area is very much greater than was assumed.

Major J. F. E. Bowring, of Ickingham Hall, Bury St. Edmunds, has presented to the Department of Mineralogy an exceptionally fine specimen of Burmese amber, probably the largest preserved in any museum. The specimen has a rich, dark brown colour, and is brightly fluorescent in ultra-violet light. It measures 22 in. × 14 in. × 7 in. and weighs 33 lb. 10 oz. The largest specimen of amber so far recorded is one weighing 21½ lb., of lighter coloured Prussian amber, preserved in the Mineralogical Museum of the University of Berlin. The Department of Mineralogy has also acquired some crystals of pale green actinolite from Mogok, Burma. These are the first specimens of the amphibole family from that locality to be represented in the collections. The crystals are of gem quality, and, although they possess the good characteristic prismatic cleavage, the mineral more usually occurs in fibrous aggregates like tremolite asbestos.

Large-Scale Plankton Cultures

H. Pettersson, F. Gross and F. Koczy have published an account of large-scale plankton cultures using the plankton shaft of Pettersson's new institute (*Medd. Oceanogr. Inst., Göteborg, No. 3; 1939*). The shaft is cylindrical, 12 metres deep and 2 m. in diameter. Interaction between the concrete walls and the sea-water has been avoided by coating the latter with a British rubber composition 'Semtex', on which a cellulose white paint had been sprayed to lighten the dull grey. The tank was filled with a mixture of sea-water from the Bay of Biscay and fresh water, and was manured with nitrate, phosphate, silicate and filtered soil extract. The water was run in from the bottom after sterilization by passage over

a mercury arc lamp. Layers of different salinity and temperature were formed, the temperature being kept down in the upper less saline layer by means of cooling coils. Illumination was supplied by sodium and mercury lamps and was usually maintained at 30–40 kilolux at the surface.

With a large crop of phyto-plankton or flagellates in the water the light intensity was reduced to 50 per cent in a depth of rather less than a metre, and at the lower limit of the culture medium layer, 550 cm. thick, the light had fallen to the level of the compensation intensity, about 500 lux. Samples of phyto-plankton and zooplankton from the Swedish coast were introduced into the upper layer, which was usually at 7°–9° C. Good growth was obtained and observations were made upon the vertical distribution of the animals as a phototropic response. Quantitative measurements were made at intervals of the changes in the diatoms, autotrophic flagellates and copepods. Thus the first steps have been taken in the development of a valuable method for the study of plankton in an immobilized water column in which the physical and chemical conditions can be varied at will. An observational is thus transformed into an experimental science.

Phenology of 1939

THE Royal Meteorological Society's Phenological Report for 1939 has been issued with its usual abundance of statistics and diagrams (Roy. Meteor. Soc., London. 3s.) It is interesting to note that the work is to continue, despite the War, and that other organizations like the British Empire Naturalists' Association and the Rothamsted Experimental Station are co-operating. There is a total of 385 observing stations compared with 439 in the previous report, and a scheme has been prepared to meet the growing demand for a simple method of assessing and demonstrating, at intervals throughout the year, the state of the season in the British Isles, making use of the Society's organization. In order to replace some unsatisfactory plants on the list, flowering dates are being made for the first time of *Cardamine pratensis*, *Acer pseudoplatanus*, *Viburnum opulus*, *Digitalis purpurea* and *Calluna vulgaris*. The historic phenological observations at the Marsham district of Norfolk, which have been made since 1736, are being continued.

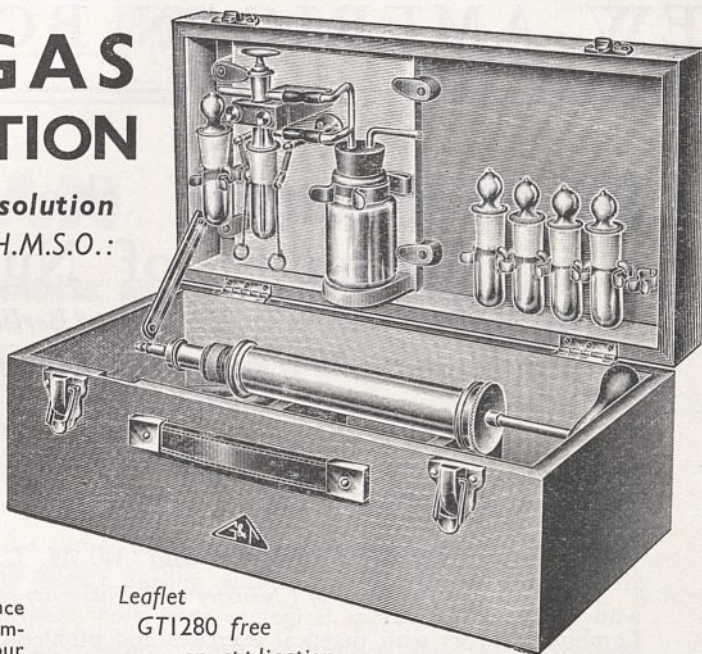
With regard to meteorological effects in Great Britain during 1939, the severe December-January cold did not affect plant-life generally; the subsequent warm spells produced forwardness with a tendency to persist, especially with regard to insects, the larvæ of which experienced early favourable conditions for feeding up after hibernation. The general influence of the year, so free from extremes, was favourable to fruit, cereal and root crops (in striking contrast to the previous year), and wild fruits were also plentiful; absence of severe gales and early frosts resulted in brilliant autumn tints and the second flowering of many plants. Spring bird migrants generally tended to lateness in arrival. Of migrant insects, *Vanessa cardui* appeared

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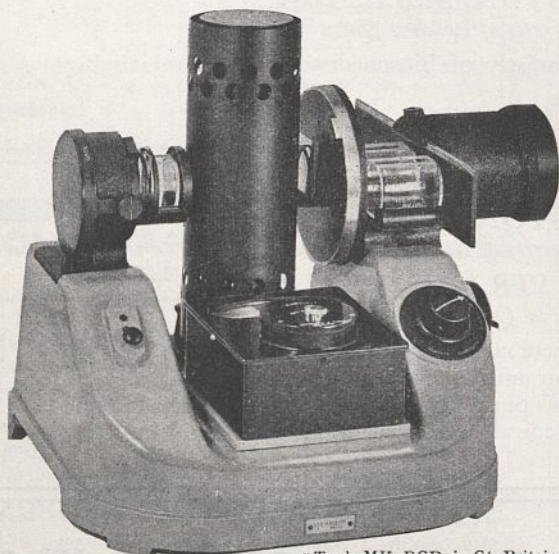


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in considerable numbers, but the weather was unsuitable for the larvæ to produce many autumn specimens. *V. atalanta* and *Colia croceus* were scarce, but striking immigrations of *Pieris rapæ* and *P. brassicæ* from all parts caused great damage to greens. Generic names in full have now been added to the index table and nomenclature is brought up to date. The promptness of the appearance of the report under the difficulties of present conditions is most encouraging to all the voluntary workers concerned.

Australian Aboriginal Artist

ILLUSTRATIONS accompanying the printed report now available of a communication presented at the Canberra meeting of the Australian and New Zealand Association for the Advancement of Science which dealt with aboriginal sculpture render possible an independent judgment on material the discovery of which is hailed by the author, E. P. Goddard, as "one of the most noteworthy finds in many years" (*Report. 24th Meeting Aust. and N. Zealand Assoc. Adv. Sci. 1939, Sect. F., Anthropology*). The sculpture is the work of a woman of about thirty-two years of age, Kalboori Youngi by name, and a member of the Pitta-Pitta tribe. She is obviously a sculptor of natural genius, producing carved human figures remarkable both for their modelling and their detail, as well as their feeling for the disposal of mass and line. She works in two kinds of clays, of which one is used in the composition of the 'widow's caps' used in mourning rites. Her tool at first was a fine flake of quartzite, but she now employs a pocket-knife which has been given to her.

Although the Pitta-Pitta are now in contact with station-life, Youngi has not come under mission influence, nor has she seen sculpture of any kind. The Pitta-Pitta tribe is described as "virtually a tribe of hereditary artists", apparently on the ground that that part of the Diamantina of central western Queensland, more especially Brighton Downs station, contains numerous rock-drawings, paintings and carvings in caves and on rocks "executed long before the white man took up his pastoral holdings". The familiarity with graphic art may suggest the orientation of the aboriginal sculptor in seeking a form of self-expression, unusual and unexpected though it may be, but the derivation of the medium of expression, the sculptor's art, still seems obscure. The sculptures consist of human figures, male and female, singly and in groups, with horses and dogs as accessories rather than main elements in the composition in a manner which suggests the technique of European portraiture. The author compares this work with early Mesopotamian and Egyptian, but the comparison which suggests itself is with Sumerian, and notably the statue of Gudea.

Electrical Development in Ireland

FOLLOWING the reading by Mr. P. G. Murphy of a paper on "The Electricity System of Eire" at a meeting of the University College (Dublin) Engineering Society, Mr. Sean McEntee, Minister for Industry

and Commerce, said that he agreed with the author's estimate that in normal circumstances the demand for electricity in Eire might be expected to double itself within a decade, so that the country would then be using about 800 million of electric units yearly. By interconnecting the electricity systems of Eire and Northern Ireland this was quite feasible. It did not necessarily follow that in normal circumstances the exchange of normal power would be very large, but the interconnexion would undoubtedly help to reduce the amount of stand-by plant to meet emergencies, and would enable provision to be made for security of supply at a far lower cost than could be made by either system independently. Perhaps this development may be hastened by the present abnormal situation.

From the experience of the Electricity Supply Board, a combination of water-driven stations and fuel-burning stations is essential in Eire. The Shannon scheme has reduced the dependence of Eire upon foreign fuel to about 220,000 tons of coal yearly. On the other hand, the Electricity Supply Board's accounts still show that during the year ended March 31, 1939, £95,000 was spent on fuel, most of which was imported. Next to the Shannon and the Liffey, the Erne and the Boyne appear to be the most important rivers from a hydro-electric point of view. The Boyne might produce an additional 100 million kwh. per annum, but its development might be very unsatisfactory owing to high rates of compensation to landowners. The Erne, if satisfactorily developed, might give an annual output of 200 million kwh., but its storage facilities and a large part of its catchment area lie within the six counties of the north—a fact which has created a very difficult problem in drainage for the Government of Northern Ireland. Mr. McEntee believes it possible to develop the hydro-electric potentialities in such a way as to improve considerably the drainage in the area affected, but any such proposals would require the active co-operation of Northern Ireland and Eire.

Roads with a Cotton Fabric Basis

IN the United States of America there is a widespread interest at present in the new 'cotton roads' which are being made across the continent from New York to California and from Florida to Maine. According to an article published in *Roads and Road Construction* of April 1, the modern procedure in construction is to lay the cotton fabric on a surface treated with bituminous material. The bituminous material is then applied to the fabric and completely covered with crushed mineral aggregate. The crushed cover material is rolled in and a lighter application of bituminous material is applied and covered with a layer of chips, which are rolled in with a heavy roller. The best results in cotton roads have been obtained from cloth of comparatively open weave. The breaking strength varies between 25 and 45 lb. (grab method) according to grade. The most practicable fabrics cost between 450 and 750 dollars a mile for a road 18 ft. wide.

In New Jersey, cotton fabric and tar were applied on 600 linear ft. of a gravel road in South Brunswick township. After a year of service an inspection was made. Due to snow and light rain for two days the road and adjoining ground was saturated. On the part of the road where the fabric had not been used, the surface was broken in twelve places. Broken areas were 0.5-1.5 sq. ft. in area and were quite soft. In other places the surface was resilient and water would ooze to the surface under pressure with a blunt instrument. On the other hand, there were no broken places in the section which had been treated with cotton fabric, and the surface was tougher and less easily punctured with a screwdriver. Recent reports sent in from a number of highway departments indicate that short test sections of bituminous-surfaced roads, having cotton as part of their construction, have decreased maintenance costs and require less patching. The South Carolina Highway Department has used cotton fabric on bridge surfaces also with a marked degree of improvement in maintaining a satisfactory bituminous surface.

Progress in Stereo Plate Casting

A PAPER on stereo plate casting published in the *Electrical Review* of March 8 gives a survey of the progress made in the application of electric heating to autoplate machines for the production of stereo plates for rotary printing presses. For several years past much has been done in the United States, and pioneer work in England took place so long ago as 1930 at the *Daily Mail* offices in Manchester, where four electrically heated autoplate machines loaded at 120 kilowatts each represented, it is claimed, the first electric printing works foundry in Europe. The next major move was not until about a year ago, when Allied Newspapers Ltd. decided to electrify completely the autoplate installation at their Manchester offices.

The electric autoplates are fitted with baths each having a capacity of about $7\frac{1}{2}$ tons of stereo metal, which, when casting is in progress, is kept molten at about 650° F. and at about 450° F. during stand-by periods. It takes about two minutes to raise the temperature from 450° to 650° F. The special immersion heaters are of grid construction, and in the largest machines have an installed heating load of 264 kw. This is probably the first time that metal-sheathed tubular heaters have been directly immersed in cast metal, and the result has been most efficient operation. Since the completion of the Allied Newspapers installation, electric heating has also been introduced at the foundries in Manchester of Odhams Press, Ltd., and the *Manchester Guardian*. In the later units there is automatic temperature control.

Carnegie Trust for Scottish Universities

THE latest report of the Carnegie Trust for the Universities of Scotland shows the varied and substantial aid given. The grants are arranged in quinquennial distributions, the seventh of which covers the years 1935-1940. An aggregate of £257,300 was

allocated to the universities and extra-mural institutions. The Trust is generally associated with libraries and students' fees, but it also does a good deal for specialists engaged in scientific research, and it is satisfactory to read the good reports of their work, which is as wide as in former years, and maintains an excellent standard. Several of the fellows and scholars have secured places which render them independent of the Trust. The subjects studied range from the Atlantic grey seal in the Western Islands to protein metabolism and a new synthesis of compounds of therapeutic value. The Trust subscribes to the production of good books not likely to have a popular sale and to such enterprises as a further study of the Roman occupation of southern Scotland, aided by spotting from the air.

We notice in detail that in the Glasgow, Edinburgh, and Aberdeen centres agricultural colleges have received £200 a year each. St. Andrews has had £33,150 for alterations and extensions in the five years, and Glasgow, towards the cost of the new Chemistry Institute, £59,000. The Edinburgh accounts include £13,000 for a lecturer in English, also large sums for the endowment of prehistoric archaeology and ethnology, while the Men's and Women's Unions are each put down for £3,000. Equipment for medical departments of the University comes to £7,250. Arrangements have been made to meet the difficulties caused by the War.

Chemical Research in Australia

THE Commonwealth Government has approved a further addition to the activities of the Council for Scientific and Industrial Research. A division of industrial chemistry is to be established with headquarters adjoining the recently erected Aeronautical Research Laboratory at Fisherman's Bend, Port Melbourne. £50,000 has been provided for the initial building and its equipment, and abundant space is available for later extensions. After prolonged discussions with leading industrialists, it has been decided to concentrate upon study of certain aspects of each of the following major lines: (1) non-metallic minerals and their utilization; (2) metals and alloys, particularly from the point of view of corrosion; (3) leather, hides and fellmongery; (4) dairy products; with (5) a miscellaneous group where work will begin on paints and varnishes. Dr. I. W. Wark has been appointed to control the work of the division.

Minerals of Canada

A USEFUL publication which has made its annual appearance is "The Canadian Mineral Industry in 1938" (Dept. of Mines and Resources, Mines and Geology Branch, No. 804. 25 cents). It gives the output of all important mines in Canada and the destination and use of the product. It is noteworthy that Canada, in its pitchblende deposit near the Great Bear Lake, shares with the Belgian Congo the source of nearly all the world's radium. The Canadian output has caused a considerable fall in the price of radium in recent years.

The International Seismological Summary

THE International Seismological Summary for January, February and March, 1934, has just been received. Apart from individual studies of earthquakes it gives the final determinations of the epicentres and starting times of all earthquakes sufficiently recorded at seismological observatories to make such determinations reasonable. The criterion has now been made "three consistent observations of *P* and *S*" to justify the determination. During the first quarter of 1934 there were 127 earthquakes whose epicentres were found; 47 of these were new and 80 were repetitions from old epicentres, showing the tendency of earthquakes to recur in any one place where an earthquake had once happened. All except six of the earthquakes had a normal depth of focus. The six exceptions were all of deep focus. The deepest recorded earthquake during the quarter was on January 18, 1934, with a depth of focus of 0.09 of the earth's radius, or about 360 miles. Its epicentre was lat. 22° S., long. 180° , which is in the Pacific Ocean to the south of the Fiji Islands, a well-established zone for deep-focus earthquakes.

Recent Earthquakes

THREE earthquakes of considerable severity have recently been recorded at European observatories, and a fourth has been experienced. The first was on April 13 and was recorded at De Bilt (Holland) at 6h. 34m. 56s. G.M.T. The epicentre was at a distance of rather more than 20° from De Bilt. The second was registered at De Bilt on April 16 at 6h. 19m. 30s. and at Kew at 6h. 19m. 33s. G.M.T. Dr. G. van Dyk considers that the epicentre of this shock was likely to have been in the region of the Aleutian Islands. It gave rise to ground amplitudes of 0.031 mm. at Kew. The third shock, which caused ground amplitudes of 0.05mm. at Kew, was registered there on April 16 at 6h. 54m. 53s. G.M.T. It also appears to have originated near the Aleutian Islands. The fourth earthquake was felt on the night of April 26 at Gropperia in Calabria, Italy. The same shock was felt at Soverto and Vivo Valentia, but no damage was done. Calabria has been the scene of intense seismic activity on numerous occasions in the past; but notably between February 5 and March 27, 1783, when 181 towns and villages were completely destroyed and more than 30,000 people killed. These Calabrian earthquakes were, according to Lyell, "the first example of a region visited, both during and after the convulsions, by men possessing sufficient leisure, zeal, and scientific information to enable them to collect and describe with accuracy such physical facts as throw light on geological questions".

Announcements

AFTER due consideration, it has been decided not to abandon the next meeting of the Australian and New Zealand Association for the Advancement of Science, which is due to be held in Adelaide in August. The meeting will, however, be shorter than

usual and few of the normal social engagements will be included. The meeting is expected to commence on August 12 and end on August 16. The incoming president will be Dr. Patrick Marshall, testing officer in the Public Works Department, New Zealand, in succession to the late Sir Ernest Scott, whose death last year was a severe blow to the Association.

THE following officers of the North East Coast Institution of Engineers and Shipbuilders have recently been elected: *President*, Mr. W. A. Woodeson; *Vice-Presidents*, Mr. J. Ramsay Gebbie, Mr. N. M. Hunter and Mr. John Neill; *Hon. Treasurer*, Mr. W. H. Pilmour.

MESSRS. FREDERICK WARNE & CO., LTD., Chandos House, Bedford Court, Bedford Street, London, W.C.2, have published a leaflet giving advice on how to assist in saving the lives of wild birds around our coasts, which have landed in patches of oil and have become helpless. The leaflet can be obtained free of charge.

AN arrangement has been made between Messrs. Newton and Co., of 72 Wigmore Street, London, W.1, and Messrs. Newton and Co., Ltd., of 43 Museum Street, London, W.C.1, under which the two businesses, which until twenty years ago were one, will be amalgamated. The former manufacture optical lanterns, epidiascopes, projection microscopes and similar instruments, while the latter are well known as manufacturers of lantern slides and lantern filmstrip. The combined firms will carry on business under the style of Newton and Co., Ltd., and for a short time both branches will continue at their respective addresses, after which the whole business will be transferred to the Museum Street address.

THE Coopers Hill War Memorial Prize and Medal, which was founded by members of the Royal Indian Engineering College, Coopers Hill, in commemoration of members of the College who fell during the War of 1914-18, is awarded annually by the Institution of Civil Engineers and triennially in turn by the Institution of Electrical Engineers, the School of Military Engineering, Chatham, and the School of Forestry, Oxford. The prize consists of (a) a bronze medal, (b) a parchment certificate of award, and (c) a money prize of the value of about £20. The triennial award falls this year to the Institution of Electrical Engineers, which has decided to invite members to submit for consideration a paper on any subject coming within the scope of electrical science or electrical engineering and their applications. Further information can be obtained from the Secretary, Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2.

DR. K. R. POPPER has pointed out a misprint in his letter "Interpretation of Nebular Red-Shifts" published in NATURE of January 13, p. 69. Formula (1) should read: " $(d\lambda/\lambda)_{T+\Delta T} = (\Delta c_T/T)_{T+\Delta T}$ ". Formula (7) is not very clear as printed; it should read: " $v_{\tau} = v_p dT_{\tau}/d\tau = v_p e^{\tau/T_p}$ ".

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. 709. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Colloidal Electrolytes

COLLOIDAL electrolytes are among the commonest of substances, probably more numerous than acids and bases. I have defined this class as electrolytes in which at least one of the ions is replaced by colloidal particles¹. Examples are the family of soaps and the closely related sulphated compounds and the modern synthetic detergents, the bile salts, the dyes, biocolloids and many others. For no one of these solutions have we complete physical chemical information, and the various members show such characteristic differences that the following general statements serve only as a guide.

I based my conclusions that colloidal electrolytes exist upon osmotic or thermodynamic data, which were far lower than corresponded to electrical conductivity. Hence much of the latter had to be ascribed to colloidal ions. The details were naturally interpreted in terms of the then prevailing doctrine that all electrolytes were only partially dissociated.

Lottermoser², in 1933, showed that in extremely dilute solution alkyl sulphates followed the behaviour of completely dissociated ions. Hartley³, in 1936, showed by transport measurements that the rather abrupt departure from this simple behaviour is accompanied by a corresponding change in transport number which occurs over a ten-fold range in concentration, and must definitely be ascribed to formation of colloid. Hartley, as I did at first, attempted to get along with only one form of colloid, but I found that this could not be reconciled with the quantitative data for conductivity, transport, and freezing point simultaneously. Hartley's further evaluation of transport numbers as "conductivities" has misled many subsequent readers. My lamellar colloid was unhappily named "neutral" to contrast it with the small, more spherical, highly charged and highly mobile ionic micelles. M. E. Laing McBain⁴ showed, in 1926 and in 1935, that the lamellar micelle conducted as well as crystallized soap curd fibres; that is, about 7 per cent as well as an equivalent concentration of sodium chloride. Her diffusion data⁵ give striking support to the presence of both ionic and lamellar micelles.

The existence of lamellar micelles has recently been demonstrated beyond peradventure by X-ray measurements, especially those of the collaborators of Hess and of Thiessen⁶. Stauff finds them to be liquid crystals consisting of double sheets of molecules in parallel array. Stauff's "*Grossmizellen*" are identical with my "neutral" or lamellar micelles. Thus it is definitely settled that there are two kinds of colloidal particles in, for example, soap solution.

Stauff⁶, Hess⁶ and Hartley⁷ have each recently summarized the views of their respective groups.

The chief remaining divergence of opinion is as to the Debye-Hückel effect of a conducting colloid particle. Hartley maintains that it has the activity and ionic effects of a highly multivalent ion. This, as Hartley shows, should effect an enormous lowering of thermodynamic activity as well as conductivity, even in great dilution. Van Rysselberghe⁸ and I prefer to suggest that the charges are so far apart (16 Å. according to Hartley) that their influence is as little as in solutions of uni-univalent electrolytes. This view accords with the fact that admixed electrolytes produce an additional lowering of freezing point or increase of conductivity or an electromotive force about the same as if they had been dissolved in pure water as solvent.

Meyer and van der Wyk⁹ have shown how with simple assumptions it is possible to build up extensive lamellar micelles by equal steps beginning with the simplest aggregates, namely, ion-pairs, so that a proportion of all sizes will be simultaneously present. This appears especially evident when examining the freezing point and other data for the lower members of the homologous series where ion-pairs become appreciable. After a certain size, further growth of lamellar colloid has but little influence upon the properties of the solutions.

A most important and unexpected property of many colloidal electrolytes is their detergent action. For example, a dilute soap solution dissolves appreciable amounts of hexane, lowering its vapour pressure to a value far below that of free hexane. Bile salts exhibit this property of dissolving otherwise insoluble materials, essential to physiological function. Hess has shown that the X-ray spacings of the lamellar micelles expand to incorporate sheets of the hydrocarbon just as they normally contain sheets of water. Such detergent action is noticeable at concentrations far below those at which lamellar micelles are shown by X-rays and even below the critical concentration of ion association. The amounts taken up bear in general no relations to the chemical nature of detergent and substance dissolved or to ordinary solubilities.

Finally, most colloidal electrolytes, like their non-electrolytic relatives, are highly surface active. Many exhibit remarkable anomalies in surface behaviour, in some cases at a concentration below that at which micelles are recognized to form, and in others in a higher range of concentration.

I am of the opinion that in accordance with the mass law the ionic micelles begin to form in very dilute solution and steadily increase throughout parallel to the thermodynamic necessity that the concentration of simple ions likewise must increase throughout the range of stable solution. The lamellar micelles arise from ion-pairs and higher aggregates

formed at the "critical concentration for micelles", increasing in size and amount until their development is sufficient to produce an X-ray pattern in the solution.

J. W. MCBAIN.

Stanford University,
California.
March 23.

- ¹ McBain and collaborators, *J. Chem. Soc.*, **101**, 2042 (1912); **105**, 417, 957 (1914); **113**, 825 (1918); *J. Amer. Chem. Soc.*, **42**, 426 (1920); *Proc. Roy. Soc., A*, **97**, 44 (1920).
- ² Lottermoser et al., *Kolloid Z.*, **63**, 175 (1933); *Kolloid Beihefte*, **45**, 253-412 (1937).
- ³ Hartley, Collie and Samis, *Trans. Faraday Soc.*, **32**, 795 (1936).
- ⁴ M. E. Laing McBain, *J. Phys. Chem.*, **28**, 673 (1924); *Trans. Faraday Soc.*, **31**, 153 (1935).
- ⁵ M. E. Laing McBain, *Proc. Roy. Soc., A*, **170**, 415 (1939); *J. Amer. Chem. Soc.*, **61**, 3210 (1939).
- ⁶ Krishnamurti, *Indian J. Phys.*, **3**, 307 (1929); Hess et al., *Ber.*, **70**, 1808 (1937); *Naturwiss.*, **27**, 593 (1939); *Kolloid Z.*, **88**, 40 (1939); Thiessen, Stauff et al., *Naturwiss.*, **27**, 213 (1939); *Kolloid Z.*, **89**, 224 (1939). Cf. McBain's diagram, *J. Chem. Educ.*, **6**, 2121 (1929).
- ⁷ Hartley, *Kolloid Z.*, **88**, 22 (1939).
- ⁸ Van Rysselberghe, *J. Phys. Chem.*, **43**, 1048 (1939).
- ⁹ Meyer and van der Wyk, *Helv. chim. Acta*, **20**, 1321 (1937).

Cosmic Ray Intensities and Cyclones

In a recent note¹, we have pointed out that cosmic ray intensities in Japan show a noticeable change under different air mass conditions. In this letter we should like to direct attention to the effect of cyclones on cosmic ray intensities.

The cyclonic structure, after the Norwegian school, is shown in Fig. 1, where solid lines represent isobars. The right-hand discontinuity of the cyclone becomes a warm front, where the warm tropical air is forced to override the cold wedge of air underlying it. The left-hand portion of the cyclone becomes the cold front, where the head of cold air is displacing the warm air. In normal cases the cold front travels faster, so that it soon begins to overtake the warm front, resulting in an occlusion. In Japan proper, the air behind the cold front is generally colder than that ahead of the warm front, having had a shorter trajectory over relatively warm sea areas.

In order to see the influence of cyclones on cosmic rays, the following procedure is adopted. We choose for the present purpose thirteen typical cases of developed cyclones during the year 1937, the centres

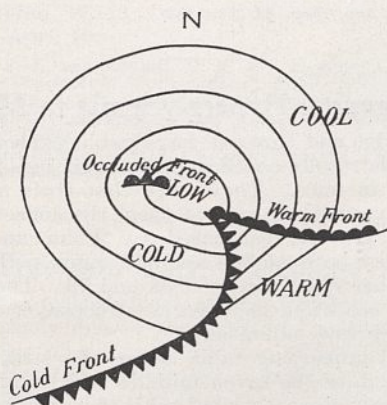


Fig. 1.

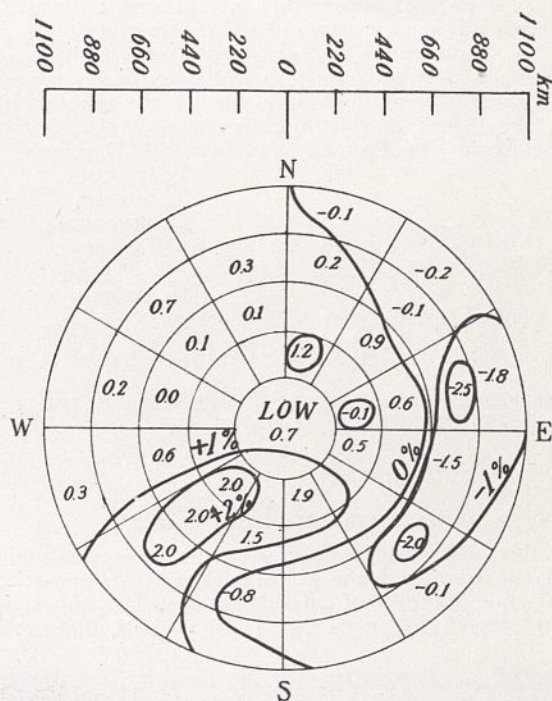


Fig. 2.

of which were determinable within a radius of about 1,100 km. (or 10° latitude) from Tokyo. Corresponding hourly means of cosmic ray intensity, 359 in number, are picked out from the data obtained with a Steinke cosmic ray meter inside 10 cm. of lead. The observed intensities are then reduced to the values at the standard pressure 755 mm. mercury using a true absorption coefficient $\mu = 9.5 \times 10^{-3}$ /cm. mercury for air.

Taking the centre of the depression as the origin, we now consider the position of Tokyo relative to it, representing it on a polar diagram which is divided into 49 sections (Fig. 2). Cosmic ray intensities in Tokyo at its various relative positions from the cyclonic centre are then written down on the corresponding sections of the diagram and the average intensity is determined for each section. Fig. 2 shows the percentage difference thus obtained of each average from the mean of the total.

The diagram shows, as a general feature, that the intensity of cosmic rays is highest when Tokyo lies to the south-west, lowest when it is to the east-south-east, and intermediate when it is to the north-west of the cyclonic centre. This means, from Fig. 1, that the passage of a cold air mass tends to increase the cosmic ray intensity, while that of a warm air mass tends to decrease it. Variations of exactly the same character have been shown in our recent note¹ to take place under various air mass conditions of the year, the effect in both cases being of about the same magnitude, ± 2 per cent.

Since we find low values of cosmic ray intensities in the warm-front face and high values in the cold rear as shown in Fig. 2, we can deduce the presence of active warm air overriding the thin cold wedge of air far out into the cool sector and extending high up to the upper troposphere or even to the stratosphere. It is interesting to note that cosmic ray data

provide us with knowledge on the upper air conditions rather than those of the lower atmosphere.

The explanation of these results on the basis of the instability of the meson will be given elsewhere.

This work was done as a part of the programme of the Cosmic Ray Sub-Committee of the Japan Society for the Promotion of Scientific Research.

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Feb. 24.

¹ Nishina, Y., Arakawa, H., Sekido, Y., and Simamura, H., *Phys. Rev.*, in the press.

A Lead Etching Effect

THE observations described below have been made in the course of the metallographical examination of some samples of ancient lead of Roman origin (*ca.* second century A.D.). These leads, hailing from



A B C
MICROGRAPHS OF LEAD CONTAINING INCLUSIONS OF LITHARGE ($\times 25$).

Corbridge, Northumberland, and Pentre Ffwrndan, Flintshire, appear to have been left in the furnaces in which they were produced, and were evidently, at the end of furnace operations, in an oxidized condition, for they now contain patches of red litharge, which occupy blow-holes and rifts in the metal. This litharge has been isolated and its identity proved by tests and also analytically, two preparations from different sources being found to contain 95.6 and 97.7 per cent of PbO, the balance being mainly infiltrated carbonates of iron and calcium.

For etching sections of these samples, an extremely dilute solution of hydrochloric acid, at the boiling temperature, proved satisfactory, since its attack on the litharge is limited and, at the same time, the surface of the lead is cleansed by it. A striking result of this mode of operating is that the lead in contact with litharge, whether embedded in it, or surrounding an inclusion of the oxide, becomes fringed with dendrites of lead. This is illustrated in the accompanying micrographs ($\times 25$), *A* being that of a polished surface of lead, with inclusion of litharge, *B* and *C* the same area after immersion in the etching medium for 10 and 30 seconds respectively.

At first sight, these appearances suggest that a pre-existing relationship of the two constituents, such as would arise from the solidification of the metal in a fluid lithargic medium, had been unmasked

by etching; but this is obviously impossible since the freezing point of the litharge is about 600°C. above that of lead. Further, the perfection of the dendritic forms at various stages of development should be noted, which suggests continuous growth of the lead crystals during the etching process.

Such considerations led to the conclusion that the phenomenon resulted from chemical changes taking place during the etching process; and it happens that my attention had already been directed, by other observations in this field, to the fact that when lead and litharge are placed in contact, covered with water, and the water slightly acidified with one of the common acids (hydrochloric, nitric, acetic), a lead-tree is formed, the deposition of the lead being sometimes in the form of delicate dendrites, sometimes in compact masses of equiaxial crystals, among which well-shaped cubo-octahedrons can occasionally be discerned. The appearances shown by these ancient leads can be imitated perfectly by binding together a piece of sheet lead with a tablet of litharge (either cut from the massive material, or made by compressing the powder), or even with a plate of tabular cerussite, then cutting a cross-section through the two and etching in the manner described above.

These reactions are obviously related to those which have been observed on the precipitation of lead from solutions of its salts by lead itself, which result in the formation of what has been termed an autogenous lead-tree. Nearly a century ago, Wöhler¹ observed this to happen when a rod of lead was immersed in a concentrated solution either of nitrate or acetate of lead over which water was poured carefully, so that the liquids did not become mixed; precipitation then occurs on the part of the metal in the concentrated solution. There can be little doubt that the explanation of the etching effect described here is to be sought in a similar difference of concentration of the lead solution produced by the action of the etching acid on the litharge. It is remarkable that the action should be so speedy and should take place even when the specimen is held in an inverted position and moved continually to and fro.

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¹ Wöhler, F., *Ann. Chem.*, **83**, 253 (1853).

Congenital Hyperglycæmia in Mice

Cambridge and Howard¹ have published some very remarkable results concerning the genetics of hyperglycæmia in mice. They state that their mice fell into two groups. In one of them the concentration of blood glucose, estimated by Folin and Wu's method, lay between 124 and 114 mgm. per 100 ml. In the other it lay between 88 and 74. The hyperglycæmic condition behaved as a recessive, and was not linked with albinism.

The accompanying table shows the striking fact that in each of the seven families which segregated, the observed figures agreed with the expectation to the nearest unit. The expectations in each column are given in italics immediately after the observed

Family	Coloured normal	White normal	Coloured hyper-glycæmic	White hyper-glycæmic	Probability
B	6, 5-5	5, 5-5	—	—	0-4512
E	—	17, 17-5	—	18, 17-5	0-2641
F	8, 7-75	8, 7-75	7, 7-75	8, 7-75	0-02159
G	6, 5-75	6, 5-75	6, 5-75	5, 5-75	0-03281
H	26, 26-44	9, 8-81	9, 8-81	3, 2-94	0-005179
J	18, 18	6, 6	6, 6	2, 2	0-009292
K	16, 16-9	6, 5-6	6, 5-6	2, 1-9	0-03472

results. The last column gives the probability of obtaining so good a result. As an example of the calculation, the following observations would have given as good a fit or a better one in the case of family K: 16, 6, 6, 2; 17, 6, 6, 1; 17, 6, 5, 2; 17, 5, 6, 2. Since the expectations are $\frac{9}{16}$, $\frac{3}{16}$, $\frac{3}{16}$ and $\frac{1}{16}$ of the total of 30, the respective probabilities are :

$$\frac{30!3^{44}}{16!6!6!2!16^{30}}, \frac{30!3^{46}}{17!6!6!1!16^{30}}, \text{ and } \frac{30!3^{45}}{17!6!5!2!16^{30}}$$

in the last two cases. The sum of these is 0-03472.

In all cases except the last, the fit was as good as possible. We are therefore justified in multiplying the probabilities together, and find that, for the first six families, the probability of obtaining the best possible fit is $4 \cdot 06 \times 10^{-9}$. We cannot make an estimate of the joint probability of so good a fit for all seven families without using a criterion such as χ^2 , which is not wholly suitable in such cases. But it is clear that Cammidge and Howard's results cannot reasonably be explained on a basis of random sampling.

Other workers on mouse genetics, even when their totals agreed very well with expectation, have always observed a considerable amount of divergence in individual families, which was sometimes greater than that to be expected on a basis of random sampling, and never much less. The results obtained by Cammidge and Howard² in the case of congenital hypoglycæmia are not quite so striking, but they too are difficult to explain on the basis of sampling theory. Both sets of data would be fully explicable had the authors selected for publication out of a much larger number those data for which the agreement between theory and observation was closest. We therefore consider that, as in the case of Moewus' results, discussed by Philip and Haldane³, those of Cammidge and Howard should not be accepted until they have been confirmed by other workers.

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J. B. S. HALDANE.

Department of Biometry,
University College,
London, W.C.1.
April 10.

¹ Cammidge, P. J., and Howard, H. A. H., "Hyperglycæmia as a Recessive Character in Mice", *J. Genet.*, **16**, 387-392 (1926).

² Cammidge, P. J., and Howard, H. A. H., "The Hereditary Transmission of Hypoglycæmia in Mice", *Proc. Roy. Soc. Med.*, **23**, 1341-1343 (1930).

³ Philip, U., and Haldane, J. B. S., "Relative Sexuality in Unicellular Algae", *NATURE*, **143**, 334 (1939).

True and False Teleology

THERE has recently been a considerable revival of interest, largely due to the work of Darlington¹, in the teleology of different systems of reproduction. The logical status of teleological arguments is very different in this connexion from that in other spheres, since the 'purpose' which is brought forward is the fulfilment of the conditions for rapid evolutionary

advance under the influence of natural selection. That is to say, a genetic system which achieves its 'purpose' provides in so doing the mechanism for its survival. The considerations which have led to the rejection of teleological arguments in other connexions therefore do not apply; though one might still question whether the teleological phraseology is the most convincing in which the arguments can be framed.

There is, however, a danger that the teleological method of argument will be carried over, by association, into regions in which it cannot be sustained. This seems to have occurred, to some extent, in the valuable article by Mather² in which he discusses the evolutionary significance of the formation of two different sexes in the diploid phase. He is not content to point out that the separation of the sexes is a mechanism for encouraging cross-breeding, but he contrasts this statement with some sentences, taken from a recent work of mine³, on the developmental mechanisms involved, from which he deduces that "the sexes are separated supposedly in order to ensure that the gametes are differentiated". Such a view, he states later, must be rejected.

But such teleological statements should never arise in a discussion of developmental mechanisms. It is not sufficient to recognize that the development of two distinct sexes may be an evolutionary advantage; we have still to find out how it is done, and the "developmental-genetical idea" cannot be "dismissed". At the same time, this does not invalidate the arguments which Mather brings forward as to the evolutionary consequences of such a differentiation; in fact, he will find a statement of his main point, that the evolutionary advantage of having two distinct sexes is that it ensures cross-breeding, in the sentence immediately preceding the ones he chooses to quote. But if the new teleology is to be received with the respect which is its due, it is of the greatest importance that it should not stray outside its own legitimate fields.

C. H. WADDINGTON.

Department of Zoology,
Cambridge.
April 1.

¹ Darlington, C. D., "The Evolution of Genetic Systems". (Cambridge: University Press, 1939.)

² Mather, K., *NATURE*, **145**, 484 (1940).

³ Waddington, C. H., "An Introduction to Modern Genetics". (London: Allen & Unwin, 1939.)

DR. WADDINGTON'S criticisms seem to be two. In the first place, I am taken to task for the unwarrantable use of teleological expressions, particularly in the specific case of my paraphrase of his own discussion of sex separation. Inasmuch, however, as the discussion was originally Waddington's and not mine, I can scarcely be called to account for its nature, whether teleological or otherwise. In any event, the point is trivial, as I feel confident that Darlington and Waddington would agree with me in regarding adaptation as the outcome of selection and in denying that it was purposeful, whether the discussion concerned genetical or morphological questions.

Secondly, I am criticized for wishing to "dismiss" the "developmental-genetical idea". This I have no desire to do in general as, clearly, developmental studies can contribute much to our understanding of genetics. But I do disagree with the specific idea,

apparently held by Waddington in common with many others, that separation of the sexes in the diploid phase is essentially a reflection of gametic differentiation. They may be related developmentally in dioecious organisms, but this should not blind us to their wholly dissimilar genetical consequences. Gametic differentiation cannot of itself lead to regular outbreeding, as is well shown by *Triticum* and *Pisum*, where the two kinds of gametes are strikingly different but where self-fertilization is the rule. On the other hand, crossing between different individuals must always follow from dioecism. As Waddington, in the section of his book which I quoted, and in the previous sentence which I did not quote, relates outbreeding primarily to gametic differentiation and thence secondarily to separation of the sexes, I must disagree with him. Differentiation of the gametes has no place in the genetical relation between outbreeding and unisexuality.

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Moisture-Relation as a Determining Factor in the Transformation of the Basidia of Certain Polyporaceæ

BASIDIA of many Polyporaceæ at the end of the rainy season and during intervals between two showers of rain have been observed to be gradually transformed into hyphal elongations with terminal spores that are exactly like basidiospores. Conversely, on the advent of rain in the middle of a dry season, the hyphal elongations soon become reconverted into regular basidia.

Such conversion has been reproduced under experimental conditions. When a piece of the fruit body of a thin and desiccated specimen was placed under the running water of a laboratory tap overnight, the hyphal elongations entirely disappeared from the pore-tubes and the majority of the pore-tubes developed mature basidia with sterigmata and spores. When a piece of the same fruit-body was stuck to the lid of a moist agar-plate and examined daily under the microscope, it was found that, as the water of condensation gradually disappeared from the plate in the course of three or four days and the plate became comparatively dry (the relative humidity becoming reduced to about 85 per cent), the pore-tubes displayed a development of a large number of clamped and elongated hyphæ with terminal spores and a few abnormal elongated narrower basidia. The experiment was repeated several times and sometimes in reverse order, and in each case the same result was obtained. Such experimental conversion was quite successful with thin and easily desiccated specimens of *Polyporus*, *Polystictus*, and *Hexagonia*. It did not succeed well with very thick specimens of *Polyporus*, *Dædalea*, *Fomes*, *Trametes*, *Lenzites*, etc., as it is known that all specimens cannot withstand desiccation to the same degree.

From the experiments described above it is concluded that it is mainly the water-relation which controls the transformation of basidia into hyphal elongations with clamp-connexions and terminal spores and *vice versa*. None of the previous workers

(Patouillard, Matruchot, and Heim) has correlated this change of form of basidia with the varying external conditions.

Details of the work will be published elsewhere.

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March 20.

Urinary Excretion of Combined Ascorbic Acid in Pulmonary Tuberculosis

IT has been shown before¹ that several plant tissues contain ascorbic acid in a combined state (ascorbigen) besides free ascorbic acid. This substance has since been considerably concentrated from cabbage². The presence of combined ascorbic acid in urine was observed by Scarborough and Stewart³ and by ourselves⁴. Evidence has been presented from this laboratory⁵ which indicates that ascorbic acid may have a detoxicating action both in the normal system and also in the infected condition. Thus after the injection of diphtheria and tetanus toxins into guinea pigs, excretion of free ascorbic acid in the urine was found to be diminished, associated with an increase in the output of combined ascorbic acid. Abbasy, Hill and Harris⁶ also showed that in certain infected conditions the excretion of free ascorbic acid was decreased, but the fate of the disappearing ascorbic acid is unknown. We have recently been able to investigate the relative excretion of free ascorbic acid, dehydro-ascorbic acid and combined ascorbic acid of nine normal individuals and of sixteen patients suffering from acute pulmonary tuberculosis. The mean values are given below and are expressed in terms of ascorbic acid (mgm.) excreted during a 24-hour period.

	Free ascorbic acid	Dehydro-ascorbic acid	Combined ascorbic acid	Total ascorbic acid	Combined ascorbic acid as percentage of the total
Tuberculous	5.82	3.52	8.11	17.45	42.24
Normal	44.62	7.41	15.93	67.96	23.82

A statistical analysis of the detailed individual figures, kindly carried out by Mr. K. C. Basak, gave the following results :

Difference of mean rates	=	18.42
Standard error of difference	=	7.56
t	=	2.44

The probability of obtaining such values of t by chance alone is less than five in a hundred. The proportion of combined ascorbic acid excreted is therefore significantly higher in tuberculous patients than in normal healthy individuals.

From these results it appears first that there is a large reduction in the urinary output of total ascorbic acid in tuberculosis, and secondly that in tuberculosis there is a tendency to a relatively greater excretion of combined ascorbic acid. Apart from the simple destruction of ascorbic acid in the infected condition owing to increased metabolism, this evidence appears to support the view that ascorbic acid probably functions as a detoxicating agent, combines with certain toxins or toxic metabolites produced in the infected condition and tries to eliminate them.

Our thanks are due to Dr. B. K. Paul and his staff of the National Infirmary, Calcutta, for the facilities provided for this work.

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March 27.

S. BANERJEE.
P. B. SEN.
B. C. GUHA.

- ¹ Guha and Paul, *NATURE*, **137**, 946 (1936); **139**, 844 (1937).
² Ghosh and Guha, *J. Indian Chem. Soc.*, **16**, 505 (1939).
³ Scarborough and Stewart, *Biochem. J.*, **31**, 2231 (1937).
⁴ Guha and Sen-Gupta, *NATURE*, **141**, 974 (1938).
⁵ Ghosh, *J. Indian Chem. Soc.*, **16**, 241 (1939); **16**, 657 (1939).
⁶ Abbasy, Hill and Harris, *Lancet*, *ii*, 1413 (1936).

Economic Importance of the Australian Ant, *Chalcoconera metallica*

WHILE in Queensland during the southern winter of 1939, I took advantage of an opportunity to observe the daily activity at a number of nests of the Greenhead ant, *Chalcoconera metallica*. An analysis of the data obtained in regard to the feeding habits of this species would seem to indicate that, in southern Queensland at least, it is of very considerable economic value.

The Greenhead is a small species, the worker measuring only *circa* 8.5 mm. The colonies also are small, and are very simply organized, the nests taking the form usually of a number of irregular galleries excavated in the earth about grass-roots, or under a stone or log. The species is notable for the remarkably severe sting it can inflict, considering its small size. Observation shows that *Chalcoconera* is almost exclusively insectivorous like most of the Ponerinae; the animals upon which it preys prove to be for the greater part agricultural pests. It is a significant fact that these latter are deliberately attacked and killed by *Chalcoconera*, several ants combining in the attack when the victim is large. In Table 1, set out below, are given the percentages by weight of the chief classes of food, the figures being the average for three colonies.

TABLE 1.

Larvæ. (Lepidoptera, Coleoptera, Diptera)	77.5%
Small Arachnids	11.2%
Microlepidoptera (adults)	6.8%
Other Insects (Termites, Diptera, Ants, Ichneumons, etc.)	4.5%

If the actual numbers of the insects preyed upon be tabulated, a rather different order of importance is seen, but larvæ still occupy the first place. Table 2 shows the average collection of a single colony during a working day of eleven hours.

TABLE 2.

Larvæ	125 per day
Small Arachnids	22 " "
Termites	16 " "
Dipterous flies	14 " "
Microlepidoptera	7 " "
Ichneumons	6 " "
Red Ants	5 " "

It is evident from the foregoing that plant-destroying insects, particularly larvæ of Lepidoptera and Coleoptera, form the bulk of the diet of this species. As these figures were obtained during the winter months they are likely to indicate a minimum rather than an average for the year as a whole; but calculation even from these winter figures shows that *Chalcoconera* must do an immense amount of good in the active destruction of grubs, whatever other damage to roots may be caused by the ants themselves. If these observations are typical, it would appear that a single colony of *Chalcoconera*, numbering only a few hundred individuals, will destroy more than 45,000 grubs in a year.

Wheeler has already pointed out that "the economic value of the Ponerinae in tropical countries can hardly be over-estimated", largely on account of their destruction of termites¹. He regards specialization in other insect food as exceptional in the group, citing in Africa *Platythyrea arnoldi*, which feeds mainly on small beetles, and *Plectroctena mandibularis* on millipedes and beetles², and in America *Lobopelta elongata* on isopods³. *Chalcoconera metallica* must now be added as an Australian example of this exceptional specialization.

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April 2.

¹ Wheeler, W. M., *Bull. Amer. Mus. Nat. Hist.*, **45**, 57 (1922).

² Wheeler, W. M., "Ants, their Structure, Development and Behaviour", 233 (New York, 1910).

Sulphanilamide and Glucose Antidote

THE production of methæmoglobin in the blood by oxidation of hæmoglobin by sulphanilamide has been discussed by Shaffer¹, Locke and Mellon² and Mayer³. Locke and Mellon attribute the oxidizing action to the *p*-nitroso benzene sulphonamide and not to the hydroxylamine derivative. They further state that the hydroxylamine derivative is not an oxidizing agent at the pH of the blood, and believe that the chemotherapeutic action is due to its power of inactivating catalase (Sevag and Maiweg⁴).

In cases where there is severe oxygen-want, by the production of too much methæmoglobin and subsequent danger of damage to tissues or death, attention is directed to the fact that intravenous injection of isotonic glucose solutions immediately reduce methæmoglobin to hæmoglobin (Brooks⁵), thereby permitting the blood to carry oxygen again, and relieving the symptoms. In the case of methæmoglobin formation by sulphapyridine, the same therapy is indicated.

MATILDA M. BROOKS.

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April 5.

¹ Shaffer, P. A., *Science*, **89**, 547 (1939).

² Locke, A., and Mellon, R. R., *Science*, **90**, 231 (1939).

³ Mayer, R. L., *Bull. l'Acad. Méd.*, **117**, 727 (1937).

⁴ Sevag, M. G., and Maiweg, L., *Biochem. Z.*, **288**, 41 (1936).

⁵ Brooks, M. M., *Proc. Soc. Exp. Biol. Med.*, **32**, 63 (1934); *Calif. and Western Med.*, **41**, 131 (1934); **43**, 327 (1935).

Effect of the Severe Frost of the Winter of 1939-40 on the Fauna of the Essex Oyster Beds

THE severe frost in the winter of 1939-40, some details of which were recorded in *NATURE* (145, 376; 1940), caused great destruction of oysters on the Thames Estuary oyster beds. Temperature readings in the Blackwater showed that the water reached 0° C. on January 1, and remained at about this level until February 19. Ice began to form on January 17, eventually forming floes which persisted for a month. Thick ice blocks were formed earlier in the shallow water of Whitstable (see accompanying illustration).

In a recent inspection (February) of the oyster beds on the Rivers Blackwater and Roach some indication has been obtained of the high rate of mortality of oysters (*O. edulis*) to date.

The entire stocks of imported Brittany oysters, all of saleable size, have been virtually lost. Sample dredgings on nine different grounds yielded in all 5,920 Brittany oysters, of which only 206 (3.5 per cent) were alive. A high percentage had died recently, as was shown by the presence of flesh in the gaping valves; in a sample count of 202 dead, 137 (68 per cent) retained dead flesh. Of those still living most were in the hockly condition, that is, not able to keep the valves tightly closed; a large number contained mud, apparently accumulated from a more or less permanent gape. A sample of 27 hockly Brittany oysters dredged on March 1 and transferred to water in dishes (at Liverpool) on the same night were all dead on March 7 except two. It seemed probable, therefore, that a small proportion of them on the beds might recover if the sea-temperature should rise high enough to permit the ciliary rejection mechanism to work satisfactorily. Dredge hauls on March 12 and 13, when the temperature had risen to 4.5° C., however, failed to yield any living Brittany oysters.

On the same rivers in localities adjoining parts of the beds where Brittany oysters were relaid, estimations were made of the mortality rates in native oysters, mostly brood and half-ware. Among 5,312 natives dredged, 2,734, or 51 per cent, were recently dead, the percentages ranging from 42 to 69. A large proportion of the dead still contained oyster meats. A striking feature was the selective mortality of the larger individuals, which had mostly succumbed. On one bed where a large stock of ware natives was stored in 5½ fathoms at low water, the mortality was as great as 58 per cent. Great losses have also occurred in the store pits, where stocks are often held for convenience at this time of the year. It is certain that there will be further additional mortality.

There can be little doubt that this heavy loss of life is due to the severe frost and its consequences. The temperature of the estuarine water fell to 0° C. by January 1, and ice began to form on the surface on January 17 during the cold period January 20-24. Thick ice blocks formed later and persisted for a month; these prevented continuous navigation, caused ships to drag or to part from their moorings,

and marking beacons to be carried away or beaten down into the ground.

It is not clear what the actual cause of death is. The survival of fewer Brittany oysters on the Roach, and of fewer natives in the creeks of both rivers, suggests that the persistent low temperature and melted snow water produced their greatest effects in the shallower and more enclosed waters. Greater mortality on the inshore grounds off Whitstable is a similar phenomenon.

The probable causes are: (a) a gaping condition due to relaxation and paralysis of the adductor muscle as a result of a prolonged period of low temperature, for example, six weeks round about 0° C., and (b) great reduction in salinity at a low temperature by melted snow, causing grave disturbances in the tissues. Relaxation of the muscles permits accumulation in the mantle cavity of mud which cannot be evacuated by normal means at this temperature.



THE FROZEN SEA AT SEASALTER ABREAST OF THE POLLARD OYSTER FISHERY, JANUARY 23, 1940. Photo by courtesy of S. D. West and Son, Whitstable.

The American slipper limpet, *Crepidula fornicata*, was weakened everywhere by the severe cold conditions. It was possible to separate six out of the ten members of a good chain with fingers weak and numb with cold. Ordinarily, separation is effected with considerable difficulty with a knife. Broken chains exhibiting the flesh of exposed individuals were common in the dredgings, and the flesh had a peculiar watery appearance. There can be little doubt that great numbers of slipper limpets will have perished. A chain of limpets from the Roach transferred on March 1 to warmer conditions in the Liverpool tank room recovered by March 7 to form a fairly strongly united chain. It is clear that a rise in temperature on the beds would quickly revive the affected limpets.

On the other hand active *Carcinus* (a few in berry), *Hyas araneus* (quite common in newly extruded berry), *Eupagurus* sp. juv., *Buccinum undatum* (with abundant masses of recent spawn), *Solaster papposus* juv., one *Asterias rubens*, *Ascidella aspersa*, other simple Ascidiarians and *Alcyonidium mytili* were fresh and had apparently withstood the rigours of the winter.

Specimens of *Urosalpinx cinerea*, the American tingle, were taken and quickly began to crawl when transferred to warmer water in dishes at Liverpool. No *Purpura* or *Murex* (*Ocenebra*) were captured. In

the severe weather of 1929-30 *Murex* was definitely almost annihilated¹, and *Urosalpinx* gained the ascendant; it is not clear yet to what extent, if any, the recent frost has affected *Urosalpinx*. Information may be obtainable by special dredging later in the year.

It is clear from the data that there is selective mortality among relaid oysters; the Brittany's having suffered virtual total loss and natives to the order of 50-60 per cent; also natives relaid from other rivers, for example, Kent relaid in the Roach, show a slightly higher mortality (47 per cent) on adjacent grounds than local natives (42 per cent). In the most resistant groups the mortality at the time of the survey ranged from 42 to 45 per cent.

It is clear that the stocks of oysters in the Thames Estuary are now reduced to a seriously low figure. As stocks on the Fal beds² are also low, English native oysters can seldom have been rarer than they now are, and the culture in as precarious a position. To improve the stocks it is probable that Government loans will be needed for the purchase of French

brood and half-ware, and it is desirable that the excellent progress made by the Government in experiments on artificial production of oysters in ponds should be continued for the purpose of supplying cheap spat. It is an interesting fact that when stocks were at a very low ebb in 1935 an exceptionally good spatfall occurred in the summer of that year. Such good fortune may not always occur.

It is, moreover, highly desirable that researches be undertaken on (a) the effect of prolonged low temperature on the native oyster, *Ostrea edulis*, with and without varying salinity, and (b) the effect of deficiency of oxygen (as might occur in the store pits) in continuous low temperature. These problems have an intimate relation to successful oyster culture.

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March 30.

¹ Orton, J. H., and Lewis, H. M., *J. Mar. Biol. Assoc.*, 17, 2 (1931).

² Orton, J. H., *J. Mar. Biol. Assoc.*, 24, 1, 331-335 (1940).

Points from Foregoing Letters

J. W. MCBAIN surveys present knowledge of the so-called colloidal electrolytes. He believes that ionic micelles begin to form in very dilute solution and increase steadily with the concentration of simple ions; lamellar micelles arise from ions-pairs and higher aggregates, and produce X-ray patterns in the solution as soon as they have grown sufficiently large.

Y. Nishina and his collaborators of the Institute of Physical and Chemical Research, Tokyo, in association with H. Arakawa, of the Central Meteorological Observatory, Tokyo, have examined the relation of cosmic ray intensity at Tokyo to the position of developed cyclones during 1937. They find that the intensity is low in the warm front and high on the cold front. Thus cosmic ray data can give information on conditions in the upper air.

When polished surfaces of some ancient leads containing inclusions of litharge are etched with boiling, dilute hydrochloric acid, dendritic crystals of lead appear at the junction of lead and litharge and grow outwards from the lead continuously during the etching process. J. A. Smythe finds that these appearances are the result of reactions taking place during etching, whereby lead is autogenously precipitated from the solution of its salt formed by the action of the etching acid on the litharge.

Cambridge and Howard have published certain results concerning the genetics of hyperglycæmia in mice and suggest that the hyperglycæmic condition is recessive and is not linked with albinism. H. Grüneberg and J. B. S. Haldane now produce results and conclusions which indicate that the results of the former two workers should not be accepted until other workers have been able to confirm them.

S. R. Bose has succeeded in reproducing experimentally the behaviour of the basidia of many

Polyporaceæ, which at the end of the rainy season and during intervals between two showers of rain gradually become transformed into hyphal elongations with terminal spores; conversely, on the advent of rain in the middle of a dry season, the hyphal elongations revert to regular basidia. Thus the author concludes that this behaviour of basidia is controlled chiefly by their water relations.

S. Banerjee, P. B. Sen and B. C. Guha have shown experimentally that in tuberculosis there is a large reduction in the urinary output of total ascorbic acid but a tendency to a relatively greater excretion of combined ascorbic acid. The ascorbic acid probably, therefore, serves as a detoxicating agent, combining with the toxins and becoming eliminated in that condition.

According to H. Barraclough Fell, it is found that the Australian ant *Chalcopterona metallica* preys principally upon larvae of Lepidoptera and Coleoptera. A single colony of a few hundred individuals can destroy more than 45,000 grubs in a year. It is thus of considerable agricultural importance.

On the Blackwater and Roach Rivers (Essex) J. H. Orton found that the whole of the stocks of imported Brittany—and more than 50 per cent of native—oysters were dead in a survey of February 29-March 1; more natives succumbed later. The causes of mortality are discussed. Temperatures about freezing point prevailed continuously for about six weeks and ice-flows were present in the estuaries for about a month. The effects of these conditions on other marine bottom fauna are noted. It is shown that oyster-culture in England is in a precarious position, that the help of the Government is needed for its recovery, and that certain researches might very well help towards more successful oyster culture.

RESEARCH ITEMS

Travellers in Tibet

A SERIES of communications by the late H. Hosten, S.J., dealing with records of Jesuit missions in India in the seventeenth and eighteenth centuries, published recently by the Royal Asiatic Society of Bengal (4, 1938, No. 4. *Letters*, 1939) includes correspondence, for the greater part unpublished, of the Jesuit missionary, Fr. Ippolito Desideri, with the authorities of his order at Rome in the years 1713-21. He left Rome at the end of September 1712, and arrived at Joa in August of the following year. On June 26, 1715, accompanied by Fr. Manoel Freyre, he arrived at Leh (Ladakh) by way of Srinagar, Kashmir. Up to this point Desideri was aware only of the existence of two Tibets, a Little Tibet (Baltistan) and Great Tibet (Bhutan). In Ladakh he heard of a third, a Great Tibet, U-Tsang, of which the capital was Lhasa. Desideri's object in visiting Tibet was to re-establish the Jesuit Mission of de Andrada (1624-1640) which he now erroneously concluded had been in Lhasa, but in fact had been in Tsaparang. Desideri reached Lhasa on March 18, 1716, but as the Capuchin Mission claimed priority there he was recalled in 1721. He returned to India and finally reached Rome on December 23, 1727. While from the point of view of evangelization his career in Tibet was a failure, he learned Tibetan, which he wrote in both prose and verse, translated Tibetan books, and may have composed, as he intended, a catechism, grammar and a dictionary for the use of the Capuchin Fathers. In addition to interesting material relating to Tibetan society, Desideri records how "this great kingdom of Great Tibet fell into the hands and power of the Tartars", an event which took place during his stay in Lhasa.

Kurds of the Rowanduz Area, Iraq

AN account of the Kurdish social organization in the Rowanduz area of Iraq by E. R. Leach (*Monographs on Social Anthropology* No. 3: London School of Economics, 1940. Pp. 74+16 plates. 5s.), based upon evidence collected in a five weeks survey carried out in 1938, records data relating to a people and an area concerning which information is scanty. Although linguistically of 'aryan' rather than 'semitic' stock, a close correlation undoubtedly exists between Kurdish social forms and those of Arabia in general. The study, which deals with contrasting factors of cohesion and conflict that affect the lives of this small group of people, rather than with "manners and customs", in other words ethnographic facts, illustrates once more the futility of attaching psychological labels to cultural groups. Again and again the Kurds as a group have been labelled treacherous, bloodthirsty, lazy, virile, stupid and a dozen other things besides; this study at least shows that there is no such easy classification, but that while the structural pattern of a society does impose upon individuals some standardization of behaviour, it affects the interests of individuals in widely different ways, and their resulting reactions differ accordingly. There can never be absolute conformity to the cultural norm. Until ten years ago the Rowanduz area was extremely inaccessible. Investigation was

confined mainly to the Soran and Balik tribes of the mountainous region in which poverty of soil, severity of the winter and difficulties of inter-communication between the valleys are the most prominent characteristics. Tribal organization has been much affected by contact with external authority and to-day is undergoing extremely rapid and at times violent changes.

Biology of Parasites of Teak Defoliators

IN *Indian Forest Records*, Entomology, 5, Nos. 4-6, 1939, are three papers on the above subject. P. F. Garthwaite and M. H. Desai deal with one hundred and sixteen species of parasites reared from two moths, namely, *Hapalia machaeralis* Walk., and *Hyblaea puera* Cram., the larvæ of which are common defoliators of teak trees in Burma. They include both primary parasites and hyperparasites. Of the latter, most of them are Chalcids, while the primary parasites are mainly Ichneumonidae and Tachinidae. Some further notes on the biology of these parasites are contributed by C. F. C. Beeson and S. N. Chatterjee. The third paper, by P. N. Chatterjee, is a detailed study of the biology and morphology of a single species of parasite, namely, the braconid *Apanteles machaeralis* Wlkn. The work embodied in these three papers is a contribution towards a knowledge of the natural controlling agencies of teak defoliators. This survey of the parasites aims at assessing the value of each species, with the ultimate object of examining whatever possibilities there may be of increasing any desirable species by silvicultural and biological methods. The two moths referred to are the most important of the teak defoliators. Each passes through thirteen or fourteen generations in a single year, and control by other than biological means is stated to be impracticable. Considerable difficulty has been experienced in getting the parasites identified owing to the great paucity of specialists in the groups concerned. The result has been that only thirty-three out of the one hundred and sixteen species dealt with had been named at the time of publication.

Japanese Gephyrea

UNTIL 1904 only four species of Gephyrea had been recorded from Japan, but in that year Ikeda brought the number up to thirty-seven, twenty-four of which were new. As the result of the examination of three collections, twenty-three species from Formosa, eight species from the Riukiu Islands and fifteen species from Korea, Hayao Satô (*Sci. Rep. Tôhoku Imp. Univ.*, 14; 1939) has been able to add eight new species. This brings the total number of Gephyrea now known from Japan and Korea up to ninety. The author not only describes the new species, but also makes it an opportunity for reviewing the whole of the group in Japanese seas. The paper thus provides a most useful survey of our present knowledge, and is furnished with full keys to groups, genera and species. It is provided with five plates illustrating by photographs many of the species. There are also a large number of text-figures.

Amphipod Bathyporeia in Tow-nettings

E. EMRYS WATKIN has studied the migrations of four species of Bathyporeia at Millport (*J. Marine Biol. Assoc.*, 23; 1939). The species represented live in a sandy bay, burrowing an inch or less into the sand between tide marks. A distinct zoning was found from high-tide mark to low-tide mark. *Bathyporeia pilosa* occurs above the high-water mark of neap tides, *B. pelagica* is a mid-tidal form and *B. elegans* a low-water form. The latter, together with *B. guilliamsoniana*, extends beyond low-water mark. Tow-nettings taken at night over the same area show that these amphipods come out of the sand and swim about, although none is taken in the daytime. The same zoning of the species occurs. The reasons for these migrations are by no means clear, but in his detailed discussion the author suggests that the nocturnal vertical movements into the waters of the tidal flow may be determined, in part, by the influence of the tides, which has some relation to the double breeding cycle in each month. These problems require much further investigation.

Temperature of Grain Heaps

A METHOD of storing grain in Egypt, that has persisted from the times of Ancient Egypt, is the 'shouna' system, in which various types of grain are simply exposed in heaps in the open on a small piece of enclosed land. The method is particularly utilized by banks and money-lenders, part of the value of the grain having been borrowed against this security. Such heaps are built up of most various samples and must be contaminated by pests; the question then arises whether the pests will multiply in the grain under such storage conditions. The possibility has been stressed by Willcocks that under Egyptian conditions hard dry grain in well-ventilated conditions which permit of the powerful drying action of the sun may prove the most practicable method of controlling pests. Rizk Attia has, therefore, recently published (*Bull.* No. 192, Technical and Scientific Service, Cairo, 1939) a very full study of temperature distribution in such a heap of stored grain, associated with studies of pest distribution in the grain heap. The kind of grain and especially its colour will modify the range of temperatures, which rise generally in the sun, though loss of water from the heap may produce a considerable cooling effect. All factors found to affect the temperature are tabulated and they are numerous, but in general the results show a marked fall in the number of pests in the deeper layers of an unstirred heap, and especially species of Calandra seemed to be kept under, as the result of the high temperatures, in heaps stored in the sun. In general, wheat at humidities higher than 32 per cent will absorb water and increase in weight; at lower humidity it usually loses water.

The 'Rhizosphere'

UNDER this term A. G. Lochhead, Dominion agricultural bacteriologist, includes the soil in the immediate neighbourhood of a growing root system, and in a series of recent papers (*Canadian J. Res.*, 16, 152-161; 1938: 16, 162-173; 1938: 18, 42-53; 1940) he has examined the influence of the root system upon the bacterial flora. In the rhizosphere gram-negative rods are proportionately increased, gram-positive rods, coccoid rods and spore-forming types less abundant. In the rhizosphere there is a notably greater proportion of motile

forms and a pronounced increase in chromogenic types, also a higher incidence of liquefying bacteria and of those fermenting glucose. To date, Mr. Lochhead concludes that his results suggest that plant varieties resistant to soil infection may exhibit a more selective action through root excretions upon the saprophytic soil microflora.

Origin of Maize

P. C. Mangelsdorf and R. G. Reeves (*Bull.*, 574, Texas Agric. Exp. Stat.) provide a fascinating story concerning the origin of maize. This thorough and penetrating analysis of the taxonomy, history, archaeology, genetics and cytology of the Maydeae summarizes the previous work on the subject and puts forward a novel theory of the origin of maize. Zea is definitely of New World origin, and is closely related to *Tripsacum* and *Euchlæna*. It had been assumed either that these three genera are segregates of a large aggregation or that Zea arose from *Euchlæna*. The authors bring forward the view that maize arose from a wild Amazonian progenitor, and was brought into domestication in the Andes. The secondary large distribution centre is Mexico and is believed by the authors to have arisen from crossing between *Euchlæna* and Zea. The most interesting hypothesis is that wild *Euchlæna* arose originally from crosses between wild *Tripsacum* and cultivated Zea. The wealth of data derived from actual cytogenetical experiments, taxonomy and history make this theory highly plausible. If one prefers to follow the older theory that maize originated from wild *Euchlæna*, this well-designed monograph still provides a standard source of reference on the origin of maize.

Exchange between a Metal and its Ions in Solution

IN experiments with radioactive lead, Hevesy and Biltz in 1929 showed that there is an exchange of atoms between metallic lead and a solution of a lead salt: in an hour, the quantity of lead exchanged corresponded with a depth of about a thousand atomic layers in the metal. B. V. Rollin (*J. Amer. Chem. Soc.*, 62, 86; 1940) has prepared radioactive silver ^{106}Ag by bombarding palladium with deuterons, using a cyclotron. By treating a silver plate with a solution of the radioactive silver nitrate, it acquired an activity corresponding with an exchange with the solution of about 150 atomic layers after some hours. Sheets of gold and platinum also acquired an activity corresponding with about 100 atomic layers. When an active silver surface was shaken with silver nitrate solution, an exchange of silver corresponding with ten atomic layers was found in two hours. The exchange was increased by a factor of ten if the surface was pretreated with sodium nitrate solution, which may be due to some kind of activation of points on the surface of the silver by sodium ions.

Separation of Isotopes

THE method of Clusius and Dickel for the separation of gases of different molecular weights, and particularly isotopes, using simultaneous thermomdiffusion and convection, has proved of considerable value in the separation of mixtures of gaseous isotopes into light and heavy fractions. In its simplest form the apparatus consists of a long vertical tube, cooled on the outside, along the axis of which passes an electrically heated wire. The apparatus was used by Clusius and Dickel to alter the isotopic composition of chlorine, ^{35}Cl : ^{37}Cl , from

77 : 23 to 0.6 : 99.4. Many light elements contain very small concentrations of isotopes which are of interest from the point of view of nuclear physics, and their enrichment is therefore a matter of some importance. R. Fleischmann (*Phys. Z.*, 41, 14; 1940) reports experiments carried out with nitrogen. With two separation tubes of 9 mm. and 11 mm. diameter and 12 m. long, 770 c.c. of gas containing 9.2 per cent of $^{14}\text{N}^{15}\text{N}$ were obtained in six weeks, and from this, 110 c.c. of gas containing 18 per cent of $^{14}\text{N}^{15}\text{N}$ were obtained. The band spectra of the products indicated that separation had occurred. W. Groth and P. Harteck (*Naturwiss.*, 28, 47; 1940) have recently carried out separation experiments with krypton using an apparatus of a similar type. After 5-8 days separation, the atomic weight of the krypton was 1.51 units less than normal, and after 9-14 days it was 1.74 units less. The large amount of work done on isotopes is reflected in an article by O. Hahn, S. Flüge and J. Mattauach, appearing in a recent issue of *Phys. Z.* (41, 1; 1940). It includes a table giving all relevant data for each element up to the end of 1939. The isotopic weights, and relative abundance of all known isotopes, together with packing fractions and mass defects, and the chemical atomic weight calculated from the isotopic composition of each element, are given. The maximum abundance of isotopes at present undetected is also given.

High Temperature Photolysis of Acetaldehyde

G. K. Rollefson and D. C. Grahame (*J. Chem. Phys.*, 8, 98; 1940) report that the mechanism of the photolysis of acetaldehyde vapour is almost identical with that put forward to explain the thermal decomposition of acetaldehyde. Photolysis was carried out by 3130 Å. and 2652 Å. mercury radiation at 96°-350° and by 3303 Å. at 60°-300°. The mechanism, by which methyl and formyl free radicals are formed and through them further decomposition of acetaldehyde is brought about, can be represented as: (i) $\text{CH}_3\text{CHO} + h\nu \rightarrow \text{CH}_3 + \text{CO}$; (ii) $\text{CH}_3\text{CHO} + h\nu \rightarrow \text{CH}_3 + \text{CHO}$; (iii) $\text{CH}_3 + \text{CH}_3\text{CHO} \rightarrow \text{CH}_4 + \text{CH}_3\text{CO}$; (iv) $\text{CH}_3\text{CO} \rightarrow \text{CH}_3 + \text{CO}$; (v) $\text{CHO} \rightarrow \text{CO} + \text{H}$; (vi) $\text{CH}_3\text{CHO} + \text{H} \rightarrow \text{CH}_3\text{CO} + \text{H}_2$; (vii) $\text{CH}_3 + \text{CH}_3 \rightarrow \text{C}_2\text{H}_6$. Photolysis of the mixed vapours of acetaldehyde and acetone at 200° and 300° has also been studied. At 3130 Å. more free radicals are produced from acetaldehyde than from acetone, whilst at 2652 Å. acetone yields more free radicals than acetaldehyde. Neither acetone nor acetaldehyde shows any afterglow $\frac{1}{100}$ sec. after irradiation with 3130 Å., indicating either that their fluorescence does not arise from recombination of acetyl radicals (that is, from activated diacetyl molecules) or that the life-time of acetyl radicals is less than $\frac{1}{100}$ sec.

A New Ionization Gauge

THE requirements of an ionization gauge to measure pressures of the order 10^{-8} mm. of mercury are: a wide connecting tube, ease of removing occluded gas, electrical leakage to the plate small, and reasonably high sensitivity. R. S. Morse and R. M. Bowie, of Distillation Products, New York, claim that their new gauge fulfils these demands more thoroughly than any gauge previously described (*Rev. Sci. Inst.*, March 1940). The bulb of the gauge is 5.5 cm. in diameter, of Pyrex glass, with an exit tube of 1.6 cm. diameter. The plate or collector is a

platinum film deposited on the inner wall and is connected to an outside deposited ring by a fine wire embedded in the glass. The grid is a double wound spiral of tungsten wire, each end having a terminal. The filament is pure tungsten. Owing to the large volume between grid and plate and the open form of the grid, the sensitivity is higher than usual. Below pressures of 10^{-4} mm. the plate current is found by comparison with a McLeod gauge to be proportional to the pressure.—The best working conditions are 3.5 volts for the filament, 150 for the grid and -25 for the plate.

New Method in Quantum Mechanics

A NEW method for determining eigenvalues and eigenfunctions has recently been developed by E. Schrödinger (*Proc. Roy. Irish Acad.*, A, 46, 9; 1940), which, he considers, gives the most direct insight into the way the line spectrum depends on the structure of the wave equation. This method avoids cumbersome transformations and expansion in power series, using instead the factorization of the second order operator occurring in the wave equation into two mutually adjoint operators of the first order. For the problem of Planck's oscillator, it gives one eigenfunction by integration of a very simple differential equation, and then derives all the other eigenfunctions and their corresponding eigenvalues by application of a differential operator of the first order. Prof. Schrödinger also applies the method to the Kepler motion of the hydrogen atom, and also to Kepler motion "in the hypersphere" (that is taking account of the curvature of the universe). This last problem is a new one, which appears difficult when treated by any other method. It has some interesting features, such as the obliteration of the sharp distinction between elliptic and hyperbolic orbits, and the resolution of the continuous spectrum into an intensely crowded line spectrum.

Solar Eclipse of October 1, 1940

A COMMUNICATION from the U.S. Naval Observatory, Washington, D.C., published as a supplement to the American Ephemeris of 1940, gives much useful information concerning the total eclipse of the sun on October 1. The booklet is designed especially for use along the paths of totality in South America and South Africa; but the entire region covered by the eclipse on both continents is indicated on two large-scale maps (c. 150 miles to the inch) contained in a pocket on the cover. Red lines overprinted on these maps show the times of beginning and ending of the eclipse at 5- or 10-minute intervals, so that even for points not in the path of totality the times of beginning and ending of the partial phase can be estimated to a fraction of a minute. Data are given dealing with the meteorological conditions that prevail in or near the paths of totality, and the most favourable locations for observing the eclipse are suggested. In addition to the usual astronomical data, eight pages are devoted to the convenience of those who plan to make ionospheric observations during the partial and total phases, for the purpose of testing various hypotheses underlying the theory of origin of the E region of the ionosphere. In an appendix are reprinted special temperature, rainfall, and cloudiness data compiled from volunteers' observations made within the African totality belt at 3, 4, and 5 p.m. local time during September and October for a period of five years since September 1933.

FOREST MANAGEMENT AND EROSION

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THE criticism has been made that Government administration annual reports from overseas often appear so belatedly that their perusal bears little relation to the probable actual position at the time. Two annual reports of the Forest Administration of Nigeria for the years 1937 and 1938 were published in 1939 (Sessional Papers Nos. 3 and 34 : Government Printer, Lagos). Nigeria has been notorious for the delay in appearance of her forestry reports. That such delays are not insuperable would appear from the fact that the report for 1938 is dated by the writer February 27, 1939, and is published in the same year !

Although a chance, it is perhaps of some significance that these two annual reports should have appeared so opportunely within a short space of time ; for taken together they may well be said to mark an epoch in the history of the progress (or in some cases want of progress) of forestry administration in that country. Both reports were written by the acting chief conservator of forests, an officer with long acquaintance of Nigeria, and especially of the northern regions. A vast improvement of form is achieved by the relegation of statistics to appendixes.

As the chief conservator says, the year 1937 was marked by several events of considerable importance. Early in the year the Anglo-French Forestry Commission completed its investigation of desiccating conditions in the Northern Provinces and the French territories beyond on the edge of the Sahara. Its report did not fulfil the high hopes which had been placed upon the Commission, whose investigations were unfortunately of too hurried a nature to afford material of great practical value. In the following July the Nigerian Government convened a Conference which met in Lagos, consisting of high officials representing several Departments, the object being to examine and make recommendations on the future policy of the Forestry Department. Great hopes were placed on the resolutions of the Conference, and 1938 opened out with very great promise for the Department. The optimism was, however, soon quenched. Once again, as so often before, a depressed financial situation at once reacted on the Forestry Department, the prospective increases were withdrawn, and the basic funds at the Department's disposal had, says the report, "necessarily to be reduced".

The reports throw into a strong light what has often been pointed out, the vacillating methods upon which forestry administration has been carried on by the Governments of Colonies. In 1937, as a result of a conference at which some of the highest members of the administration were present, a forest policy was determined upon and provision made to put it into force the following year. Almost before the ink of the attached signatures was dry, funds were withdrawn and once again stagnation was to supervene.

That in the interests of the country as a whole,

continuity of the work of the Forest Department should be maintained, is illustrated by the following remarks in the 1937 report :

"The general examination of forests by field officers has revealed the immense importance and urgent necessity of planning. The continued and universal damage to unreserved forest and the indiscriminate encroachment in reserves emphasise the necessity of distributing the available staff to the best advantage. . . . Reservation and consolidation of the existing reserves must, of course, take first place. . . . In areas where reservation has not yet reached the required percentage and where cocoa is a popular crop, planning is all the more necessary. Many such areas are unfitted climatically to maintain cocoa as a permanent crop and the wildly unbalanced expansion which takes place after a boom must not only lead to disaster in the area itself but must also have repercussions in adjacent climatic 'tension' areas."

In his 1938 report the acting chief conservator writes that "Reservation, management and research ; each must play its part" ; but adds, after stating that forest reserves established must as soon as possible be placed under some form of management, "no unavoidable delays can be permitted to stand in the way of building up the total of reserved forest required".

The acting chief conservator does not appear to have quite made up his mind as to whether the most important of the duties of the Department at the present time are "to secure the existing forest estate" or the "building up of the total reserved forest required". He rightly says that no great progress in forest management can be made until the necessary percentage of forest estate is secured, and continues : "It is nevertheless equally necessary, because of the limited area of merchantable forest in Nigeria, to place under management such a proportion of this area as has been secured, without diverting to the purpose an undue proportion of the staff or funds available. Comparisons, invidious sometimes, are made with India and other Colonies in the matter of relative progress in the different branches of the Forest Department, but there is no real analogy. Our merchantable forest wealth, which is an Imperial asset as much as a Nigerian one, must be put under management as soon as possible and cannot wait for the completion of the whole framework of reservation throughout the country, a task which may take anything from fifty to eighty years at the present rate of progress."

Why ? Is this logical ? How much of the forests of these proposed future reserves will remain, and what will be the condition of the area left (and that of the surrounding countryside) at the end of this period of 50-80 years ?

As to this comparison with India and Burma, the Burma teak forests were very much of an Imperial asset when the late Sir Dietrich Brandis began, as soon as he joined in Pegu, his enumer-

ation surveys to ascertain the stocking. By this work he was able to maintain the continuity of supply to the European and Indian markets, which was imperative, whilst at once putting an end to unchecked fellings. But this work did not hold up forest reservation either in India or Burma. By the end of the century, a period of little more than thirty years, the framework of reservation throughout Indian and accessible Burmese forests had been accomplished, whilst considerable management had been introduced into the forests. The pity is that after about the same number of years of forestry in Nigeria the Forestry Department should have much forest reservation still to be undertaken, owing to the fact that its real position in the Administration has never until recently been understood, save to be regarded primarily as a revenue producer.

Perhaps one of the most important and progressive pieces of work the Department has undertaken during the last few years has been an outcome of the Anglo-French Commission, on the British side. Two special anti-desiccation and vegetational survey teams were appointed to carry out desiccation investigations in the Northern Sokoto, Katsina, and Kano Provinces. A special report on the Sokoto area has produced, says the chief conservator, "a very interesting set of conclusions, which are briefly that 'desiccation' in Sokoto in the form of encroachment of the Sahara is not apparent, but that all the conditions present are due to the activities of man and of domestic animals". If the writer will study the history of parts of the south-west Sahara, he will find, to quote one instance, that the howling Desert of Mauretania, situated some 400 kilometres to the west of Timbuctoo, was the centre of the great Empire of Ghana from the ninth until the eleventh centuries, when the region consisted of smiling fertile lands. It now forms part of the Sahara. The great desert did not advance over the area in sand-waves. As the writer says above, "the activities of man and domestic animals" gradually produced the result, and the region was added to the Sahara; just as the areas comprised in Sokoto and Katsina, if the present-day activities continued unchecked in the two provinces, would infallibly be added to the great desert, which would have thus 'encroached' on the area.

Members of the Society of American Foresters met in San Francisco last November. Charles A. Connaughton, of the U.S. Forest Service, discussed (Science Service, Nov. 21, 1939) problems of watershed control; they were difficult, he pointed out, because owners of watershed areas seldom receive the benefits of control measures, which cost money and labour on the spot but go mainly for the help of lands farther downstream! . . . He continued: "Rangeland research is needed for the solution of problems arising out of overgrazing, which not only brings about the displacement of good forage species by weeds but even the destruction of the soil itself through erosion. Research now in hand has already suggested that native grasses and other plants, rather than exotics, may be the best for rangeland restoration, but more research is needed to arrive at really definite conclusions. Another possible result of researches now in progress is the upsetting of the old idea, accepted almost as an axiom, that livestock and larger game animals cannot use the same range without robbing each other. Apparently, both livestock and wildlife can be produced without serious conflict on most ranges."

The forestry remedial measures (given in the 1938 Nigerian report) to be put into force in Sokoto are excellent, and indicate that this serious problem is now to be tackled with understanding; and, unlike the American rangeland and watershed problem (though Africa has the same elsewhere), the amelioration work to be undertaken in Sokoto, and extended eastward, will benefit alike the people within the area and others situated to the south.

In the Forest Report for Palestine for the period 1936-39 (Printing and Stationery Office, Jerusalem, 1939), it is stated that the total land area is some 10,000 square miles; the hills are mostly composed of limestones, with basalt intrusions in the north-east, whilst the plains are deeply covered with alluvium. The climatic desert accounts for something less than half the area; of the remainder, 45 per cent are plains and 55 per cent hilly country. The state of the hills is considered to be unsatisfactory, as most of the surface is eroded, and probably less than 1 per cent is agricultural land in good condition. The hills, it is said, were undoubtedly once covered with soil and forest, whereas they are now an artificial desert due to overgrazing. The river valleys are desolated by floods and the deposition of infertile detritus, the river beds are choked, and road and railway embankments and bridges frequently damaged.

The Forest Department, formed only in 1936, owing to the outbreaks and unrest which supervened so soon after, has scarcely had time to get well into the saddle. Moreover, promised grants were withdrawn, inevitably, perhaps, owing to the unrest. But the Department has already been able to contribute some valuable information on the subject of erosion in the Middle East. On the question of reservation of land areas for afforestation the report states: "In the course of time previous to 1936, the natural vegetation was cleared from nearly all the fertile areas of Palestine, and such vestiges as remained were on the most rocky and barren land. Even there the vegetation was almost ruined by excessive grazing and uncontrolled cutting. In consequence, the present value of the vegetation and of the land on which it stands is very low, and most of the Forest Reserves cannot be made highly productive without many years of careful management. Closure and protection, however, will very early result in the checking of erosion and flooding, and are therefore of the utmost value."

Man's old habits—fire and excessive grazing—have probably been the chief two causes for the present condition of so much of Palestine. On the subject of fire, the report says that the climate of the country, with its long summer drought, atmospheric desiccation, and dry, hot winds, is very conducive to forest fires, which would be more serious but for the sparseness of the vegetation in most places—which tells its own tale as to the downgrade of the country as a home for man, or even for his goats. The present position of grazing shows the determining factor in this latter question. The following paragraph might have been written of other areas within the British Empire; but here it possesses its own significance: "Except for the well-bred cows on a few modern dairy farms which grow fodder in irrigated fields, the grazing animals of Palestine have to depend on the grass, shrubs, and young trees which Nature provides on uncultivated land. Their only change of diet is the stubble on the cereal lands after harvest. Centuries of such

treatment have produced a tough and agile goat which can consume organic matter of almost any type. The sheep, mostly of the fat-tailed breed, are also very hardy. The camel, fortunately less common in the northern districts, eats what the goat cannot reach. No attempts have been made to estimate the permanent carrying capacity of the land, the number of animals grazed is limited only by drought, starvation and disease; and the vegetation is destroyed over large areas, which have become artificial deserts in spite of good climatic and geological factors. Soils were nearly everywhere excellent before they were removed by erosion. All other forms of damage fade into insignificance beside the destruction caused by grazing, though the process is accelerated by cutting and uprooting."

Yet there are still some who dispute that obvious factor on the globe, the man-made desert—both of the past, and those of more modern origin, and in the making.

Forestry problems of increasing magnitude and importance are many in the British Colonial Empire.

The welcome and wide-voiced Colonial policy recently announced by the Secretary of State offers, it may be hoped, opportunity that in the future continuity in a forest policy, duly drawn up and sanctioned, may be persisted in, whatever vicissitudes befall the Colonial budget; and, above all, that recognition should be accorded to the factor that the scheme for reservation of the forest areas in any Colony considered needful to its economic progress, the protection of its water supplies, etc., upon which the agricultural prosperity depends, should take precedence of other work. The policy, as laid down for Nigeria by the 1937 Committee, that foreshadowed in the Palestine Report, and those so often voiced for other Colonies, should now become practical politics in view of Mr. Malcolm Macdonald's masterly White Paper.

ECONOMIC PROBLEMS OF INDUSTRIAL SCIENTISTS

A SERIES of regional conferences to discuss the economic problems of men of science and engineers employed in industry has recently been held in London, Liverpool and Manchester. Others are to follow, and it is intended that a national conference shall be held in the autumn in order to collate the information obtained at the regional conferences. The conferences are being organized by the Association of Scientific Workers, but many members of other professional organizations attended the meetings and took part in the papers and discussions. It is hoped that this collaboration will continue and increase as a result of the interest aroused.

The London regional conference, held on March 9, with Prof. F. G. Donnan in the chair, was opened by Mr. Hugh N. Linstead, with a general discussion on the place of the scientific worker in industry and on the role of professional organizations. He pointed out that, in view of the great importance of the role of the scientist in modern industry, the discrepancies between the salaries of scientists in industry as compared with those in administrative positions can only be rectified by scientists organizing themselves. Such an organization must protect the interests of the scientific worker, but be broad enough to consider the problems of the industry and the employer as well. In spite of the prejudice against trade unionism among professional workers, the trade unions play an essential part in industry, and both the scientist and the community suffer from lack of this type of organization among scientists.

This was followed by a paper by Mr. J. Stewart Cook on the question of salaries, increments, overtime, etc. His paper consisted of a factual analysis of the data available in these questions as they affect both graduate scientists and assistants, and was based on the results of a questionnaire sent out by the Association of Scientific Workers, and on data published by the Institute of Chemistry. He considers that salaries will only be uniformly adequate and satisfactory when scientists are organized on such a basis that they can and will refuse to take jobs below prescribed rates. He pointed to the good

record of the British Association of Chemists in this respect, attributing its success to the policy of maintaining an appointments board, backed up by an unemployment scheme.

The rights of publication were discussed by Mr. H. T. Rhodes, and the question of holidays and opportunities for study by Mr. J. L. Pinder. The latter stressed the necessity for adequate holidays and opportunities to attend scientific lectures, if the scientist is to produce his best work. He is in favour of a 5-day week. The question of adequate time for study as well as for recreation is essential for assistants studying for degrees. He considers their position in this respect is often unsatisfactory.

The problems of the assistant were dealt with by Mr. R. Peter, himself an assistant. The assistant is faced with the double task of satisfying the employer by day and the examiner by night. The principal requirements of assistants are (1) standardization of working hours throughout industry, (2) standardization of wages based on some grading system of age and qualifications, (3) a definition of work expected on engagement and a limitation of this, in general, to technical matters, (4) allowance of adequate time for study and recreation and provision of financial assistance where necessary for the cost of study.

A paper was then given by Mr. F. W. Adams dealing with the legal side of scientific employment, in which he discussed the questions of contracts, of copyright and the right to seek alternative employment.

Prof. J. D. Bernal, in summing up, pointed out the similarities and the differences in the position of scientists in this War and that of 1914-18. Since 1918 the scientist and the laboratory have become an integral part of industry, but there has not been the development of organization of scientists which has occurred in other spheres of industry. Bad conditions for scientists mean a depression in productivity of industry. The increasing number of assistants entering the ranks of qualified scientists means that the whole range of the problem from assistant to directorate must be tackled, as an anomaly in any

one section would be felt by all other sections of industrial scientists, and also by academic and Government employees. He considers that scientists as salaried workers require some type of trade union organization which would include organization of assistants. The details of such an organization would require special study, but the immediate consideration is the building up of organizations such as the Association of Scientific Workers and the British Association of Chemists.

The Liverpool Conference was held on March 4, and was opened by Mr. J. P. Lawrie with a general discussion of the questions involved. This was followed by a factual paper on assistants, their status and problems. A survey of contemporary professional organizations was then given. It was pointed out that a very large number of professional workers, such as teachers, medical men and journalists, are already organized in trade unions. In purely scientific fields the degree of organization is comparatively very low. The learned societies are precluded by their charters from activities affecting the economic conditions of their members, and the field is still open for vast development. The British Association of Chemists, with 2,000 members, has been registered as a trade union since 1920. The Association of Scientific Workers, with 1,500 members, is not now a trade union, but interests itself in economic activities. Mr. Lawrie then gave a survey of advertisements for scientific posts and a statistical analysis of the material collected regarding salaries was given. The position of women scientists was considered and the discrepancy in wages pointed out. It is realized that this question has increased in importance since the War began.

The Manchester Conference was held on March 16, with Prof. Willis Jackson in the chair. Prof. H. Levy, in opening the discussion, said that scientists are not brought up in an industrial atmosphere, and the idea of trade unionism is, consequently, foreign to them. He showed that the same forces operate with industrial scientists as with manual workers. He then analysed the different types of scientific work and discussed the impact of the War on science and on scientists. This was followed by a paper on basic salaries, increments, cost of living adjustments, etc. The question of contracts was the subject of the next paper, and the anomalies and lack of standardization were pointed out. After this, the problems of students were discussed, especially under the conditions of the War. The effect of conscription and the increase in the cost of living due to the evacuation of universities were dealt with.

The final papers dealt with the rights of publication and the problems of the laboratory assistant. In the latter, the main problems were considered to be: diversity of labour, lack of standardization, salaries, absence of status, promotion and unskilled labour, especially since the outbreak of war.

All three conferences were very well attended and were accompanied by lively discussion from the floor. The two salient features of the conferences were the realization of the growing role which the laboratory assistant takes in industrial science, and the feeling that the War is raising acute economic problems for scientists and an active organization is needed capable of protecting their interests.

A full report of the conferences will be given in the April-May number of the *Scientific Worker*, the organ of the Association of Scientific Workers.

DRUG STANDARDS FOR INDIA

THE ambition of those enlightened practitioners of medicine in India who, under the leadership of Dr. Chopra, have sought for many years past to bring that country into line with the rest of the civilized world in the matter of standardized drugs now seems to be near achievement. A comprehensive measure providing for the uniform control of the manufacture and sale of drugs as well as the importation of drugs is now before the Legislative Assembly; the introduction of such a Bill is, in itself, no small advance towards the desired goal, since the Bill is backed by resolutions from every one of the provincial legislatures empowering the central authority to pass an Act to regulate the manufacture, distribution and sale of drugs throughout India. No such resolutions were necessary for the purpose of a measure to regulate the importation of drugs, but such limited control would fail to bring about the desired purpose, namely, to create a clean business in medical supplies in every province. It would be of little use to prohibit the importation of inferior drugs if there were no means of preventing the sophistication of imports or the domestic production of inferior preparations. The Bill, when it becomes law, will extend to the whole of India.

So far as imports are concerned, the Bill makes it an offence to import misbranded drugs, by which

term is meant, briefly, drugs different from what they are represented to be by the labels on their containers. It specifically prohibits the importation of "any drug which is not of standard quality", and it is interesting to find that the standards with which compliance will be necessary are as follows: (1) proprietary medicines: the list of ingredients described on the label or the formula disclosed to the Central Drug Laboratory, as the case may be; (2) vaccines, sera, toxins and other biological products of a like nature: the standards maintained at the National Institute for Medical Research, London; (3) vitamins, hormones and analogous products: the standards maintained at the National Institute; (4) other drugs: the standards of identity, purity and strength specified in the latest edition either of the British Pharmacopœia or the British Pharmaceutical Codex or any other prescribed pharmacopœia, or adopted by the Permanent Commission on Biological Standardisation of the League of Nations. On the principle of what is "sauce for the goose is sauce for the gander", the part of the Bill which relates to domestic manufacture and to the sale and distribution of drugs is in effect the same as that which applies to the importation of drugs; the standards to be complied with are identical in each case.

IRRIGATION THROUGH THE AGES

ON February 16, Mr. E. Bruce Ball, president of the Institution of Mechanical Engineers, delivered an address in the course of which he surveyed "The Influence of the Mechanical Mind on the Development of Irrigation through the Ages".

From the dawn of civilization there is evidence of the activity of the mechanical mind in devising means of watering those tracts of land which could in this way be made highly fertile. Something here might have been said of the skill with which these unlettered people constructed the small channels by which the water was distributed to the fields.

The mechanical devices were introduced at the points at which the water was raised from some stream or well into the basins which supplied the system of channels. The earliest of those was probably what is known as the 'basket scoop', a hemispherical vessel operated by two men by means of two ropes each so that it could be swung up with its load of water and tilted to discharge it. The method is still in use in India and China and gives a lift of about 3 feet. The need for higher lifts and for making better use of available labour led to developments showing great ingenuity in the application of the only available material, timber. The hollowed tree trunk nicely balanced so as to enable one man to operate it, and the moving counterpoise on a balanced beam showed a keen appreciation of mechanical principles. Further improvements on these designs gave increased lift, or effected a saving of energy—no doubt that of the user himself—or again added a simple automatic device to discharge the water when it had reached its full lift or, as in another case, made use of gravity by means of a sloping path to assist tractive effort.

All these methods gave intermittent deliveries—a bucketful at a time—and we then see an important development in the production of a crude wheel carrying a number of buckets and giving an almost continuous delivery. Operated by an ox or a camel through a rough and ready form of gearing, this shows the conception of the machine being evolved. Several illustrations of different pumping or water lifting machines were shown, including one of the gigantic wheel on the Yellow River, and portable link chain pumps. While these and even the most primitive methods of irrigation can still be seen in use in many parts of Asia, and appear but puny efforts as compared with the great engineering works of to-day, it must be borne in mind that the latter have only been made possible by the new materials of construction now available and the machines and power units at the disposal of the great constructors of recent times.

Examples of the great barrages were referred to and illustrations of them and of the machinery essential to their operation shown. The different types of sluice gates and shutters and the system by which the waters are controlled were explained, thus showing how the mechanical mind has harnessed the waters to the purpose of assisting Nature to maintain the population of the world; and although much has been done there are vast resources still awaiting development. Mr. Bruce Ball claims this as but a single illustration of the dependence of human life on the creative work of the mechanical engineer.

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NATURE, vol. 2, May 5, 1870

First Number of the Second Volume of NATURE

SIR NORMAN LOCKYER, founder and editor, opens No. 27 of this journal with a short article referring to the achievements of the past six months. He remarks on the encouragement, and criticism, which he has received. "It has been our endeavour to carry out our programme by making the journal useful to workers in science; worthy therefore of their perusal, and therefore, again, worthy of their contributions: and by thus extending our appeal beyond the limits of the scientific world on the one hand, and endeavouring to keep up the dignity of science herself on the other, we have already met with an encouraging response. Our subscribers now number nearly five thousand; that is, we have, on a moderate estimate, fifteen thousand readers. . . ."

"We state this, not only because the statement is almost due to our contributors as a justification of our demands on their time, but because it indicates the work—we almost said the noble work—which lies before them. Surely at a time when England would gain so much by the scientific education, not only of her Workmen but of her Ministers, an attempt to place Science before the Public, week by week, as Politics, Art, Music, and a hundred other things are placed before them, must not be suffered to flag; when the number of science-teachers and science-students is daily increasing, and the necessity for combined action and representation among scientific men themselves is being more and more felt, the popularization of science becomes more important than ever."

Why is the Sky Blue?

"H. A. N." has a letter under this title. He remarks: "Is it that the predominant colour of sunlight being orange, the regions devoid of sunlight appear of the complementary colour? . . . Or, again, is the blueness merely the colour of our atmosphere, as Prof. Tyndall's experiments have led some to believe? In favour of the former explanation, is the fact that the maximum intensity of the light of the solar spectrum is in the orange, and indeed that the sun *looks* orange, and if we close our eyes after gazing a moment at him when high up in the sky, we see a blue image. When the sun is low, his colour changes from orange to red, and this would explain the green tints so often seen in the cloudless parts of the sky at sunset."

At a meeting of the German Chemical Society on March 28, Prof. Rammelsberg read a paper on the phosphates of thallium, in which he stated that isomorphism exists between certain hydrogen thallium and hydrogen ammonium phosphates. He claims this is the first proof of the isomorphism of hydrogen with monatomic metals.

Mr. (afterwards Sir) E. B. TYLOR read a paper "On the Philosophy of Religion among the Lower Races of Mankind" before the Ethnological Society on April 26. He said that the conception of the soul as recognized by the lower races is the starting point of their religious philosophy, which he described as 'animism'.

A NATURAL History Society has been established at Winchester College.

FORTHCOMING EVENTS

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

Tuesday, May 7

ZOOLOGICAL SOCIETY OF LONDON, at 5 p.m.—Dr. E. L. Taylor: "On Pseudo-rumination in the Rabbit". Dr. J. S. Huxley, F.R.S., and J. Fisher: "Hostility Reactions in Black-headed Gulls".

ROYAL INSTITUTION, at 5.15 p.m.—Sir John Orr, F.R.S.: "National Food Requirements".*

Wednesday, May 8

INSTITUTE OF METALS (at the Institution of Mechanical Engineers).

At 2 p.m.—Dr. L. Northcott: "The Influence of Alloying Elements on the Crystallization of Copper, Part 2, Large Additions and the part played by the Constitution"; Dr. Maurice Cook and Dr. T. Ll. Richards: "The Structural Changes in Copper affected by Cold Rolling and Annealing"; Dr. Marie L. V. Gayler and R. Parkhouse: "The Ageing of High-Purity 4 per cent Copper-Aluminium Alloy".

At 7 p.m.—Prof. J. D. Cockcroft, F.R.S.: "The Cyclotron and its Applications" (Thirtieth Annual May Lecture).

Thursday, May 9

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 4 p.m.—Prof. E. D. Adrian, F.R.S.: "The Nervous Mechanism of Pain."

INSTITUTION OF ELECTRICAL ENGINEERS, at 6 p.m.—Annual General Meeting.

ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS (Thirty-first Annual Conference, at the Hotel Russell, Russell Square, London), May 11–12.

May 12, at 10 a.m.—S. H. Moorfield: Presidential Address.

APPOINTMENTS VACANT

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

LECTURER IN ELECTRICAL ENGINEERING SUBJECTS at the Cardiff Technical College—The Director of Education, City Hall, Cardiff (May 9).

LECTURER IN ENGINEERING—The Principal, County Technical College, Stoke Park, Guildford (May 11).

TEMPORARY CIVIL ENGINEERING ASSISTANTS in the Borough Engineer's Department—The Borough Engineer, Town Hall, West Ham, E.15 (May 11).

ASSISTANT SUPERINTENDENT, Mathematical Instrument Office of the Survey of India, Calcutta—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (quoting Appointment 290/1C) (May 14).

HEAD OF THE DEPARTMENT OF CHEMISTRY—The Secretary, School of Metalliferous Mining, Camborne, Cornwall (May 15).

CONSTRUCTION ENGINEER for the Irrigation Department of the Government of Ceylon—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9322) (May 17).

A SENIOR LECTURER IN CIVIL ENGINEERING, A LECTURER IN CIVIL AND MECHANICAL ENGINEERING, and a LECTURER IN MECHANICAL ENGINEERING, at the Henry Lester Institute of Technical Education, Shanghai—Viney, Price and Goodyear, Empire House, St. Martin's-le-Grand, E.C.1 (May 18).

PRINCIPAL OF THE WELLINGBOROUGH TECHNICAL INSTITUTE—The Secretary for Education, County Education Offices, Northampton (May 20).

ASSISTANT ENGINEER for the Malayan Public Works Service—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9306).

ASSISTANT ENGINEER to the River Avon (Bristol) Catchment Board—The Clerk and Solicitor to the River Avon Catchment Board, 11 Marsh Street, Bristol 1 (quoting 'Assistant Engineer').

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Herbage Publication Series. Bulletin 27: The Control of Weeds: a Symposium on the Prevention and Eradication of Weeds on Agricultural Land by Cultural, Chemical and Biological Means. Edited by R. O. Whyte. Pp. 168+26 plates. 7s. 6d. Bulletin 28: Technique of Grassland Experimentation in Scandinavia and Finland; a Symposium on the Technique employed in Pasture Studies, Botanical Analyses, etc. Pp. 52+2 plates. 2s. 6d. Bulletin 29: Grassland Investigations in Australia. Pp. 107. 5s. (Aberystwyth: Imperial Bureau of Pastures and Forage Crops.) [84]

Other Countries

The Engineering Foundation: a Department of United Engineering Trustees, Inc. Annual Report, October 1, 1938, to September 30, 1939. Pp. 47. (New York: The Engineering Foundation.) [34]

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 93: Studies on the Marketing of Fresh Fish in Eastern Australia. Part 1: Field Observations and Quantitative Bacterial Results. By E. J. Ferguson Wood. (Fisheries Section, Report No. 2.) Pp. 24. (Melbourne: Government Printer.) [34]

Indian Lac Research Institute. Bulletin No. 37: Measurement of Gloss, Transparency and Colour. By N. N. Murty. Pp. 14. 2 annas. Research Note No. 21: Shellac-Casein Moulding Powder. By M. Venugopalan and H. R. Sen. Pp. 4. (Namkum: Indian Lac Research Institute.) [34]

Connecticut Agricultural Experiment Station. Circular 126: Control of the Rosy Apple Aphid in Connecticut Apple Orchards. By Philip Garman. Pp. 16. Circular 127: Soil Testing Methods—The Universal Soil Testing System. By M. F. Morgan. Pp. 16. Circular 128: Control of Tobacco Mildew (Blue Mold) in Seedbeds. By P. J. Anderson. Pp. 6. Circular 129: The Sand Culture of Seedlings and Mature Plants. By A. A. Dunlap. Pp. 12. Circular 130: Control of the European Corn Borer by Sprays and Dusts. By Neely Turner. Pp. 4. Circular 131: Soil Testing in Connecticut. By M. F. Morgan, T. R. Swanback and J. S. Owens. Pp. 8. Circular 132: Control of the Japanese Beetle. By J. Peter Johnson. Pp. 14. Circular 133: Control of European Corn Borers on Dahlias. By Neely Turner. Pp. 4. Circular 134: Control of Termites in Buildings. By Neely Turner and James F. Townsend. Pp. 14. Circular 135: The Law concerning Concentrated Commercial Feeding Stuffs and Regulations pertaining Thereto. Pp. 6. Circular 136: Report on Commercial Insecticides and Fungicides, 1939. By H. J. Fisher. Pp. 10. (New Haven, Conn.: Connecticut Agricultural Experiment Station.) [34]

New South Wales: Department of Mines, Geological Survey. Mineral Resources, No. 37: The Coal Resources of the Southern Portion of the Maitland-Cessnock-Greta Coal District (Northern Coalfield). By Leo J. Jones. Pp. v+225+4 plates. (Sydney: Government Printer.) 9s. [44]

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 854: Surface Water Supply of the United States, 1938. Part 4: St. Lawrence River Basin. Pp. v+149+1 plate. 25 cents. Water-Supply Paper 859: Surface Water Supply of the United States, 1938. Part 9: Colorado River Basin. Pp. vi+285+1 plate. 35 cents. Water-Supply Paper 864: Surface Water Supply of the United States, 1938. Part 14: Pacific Slope Basins in Oregon and Lower Columbia River Basin. Pp. v+184+1 plate. 25 cents. (Washington, D.C.: Government Printing Office.) [44]

Commonwealth of Australia: Council for Scientific and Industrial Research. Handbook of Structural Timber Design. Prepared by Ian Langlands and A. J. Thomas. (Division of Forests Products: Technical Paper No. 32.) Pp. 283. (Melbourne: Government Printer.) [44]

Antarctica. Produced by the Property and Survey Branch, Department of the Interior, Canberra. 2 sheet Map, 60 in. x 40 in., 7s. 6d., including Handbook. 1 sheet Map, 30 in. x 40 in., 5s., including Handbook. Handbook and Index by E. P. Bayliss and J. S. Cumpston to accompany a Map of Antarctica, 1939. Pp. 90. (Canberra: Department of External Affairs.) [44]

Ministry of Public Works: Irrigation Department, Hydraulic Section. Hydraulic Features of the Nile Flood of 1938. Pp. vii+30+17 plates. (Cairo: Government Press.) [54]

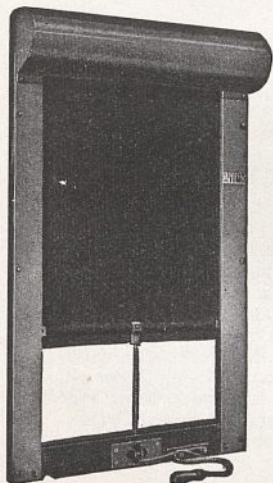
Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 224: Control of Smut Diseases in Egypt with Special Reference to Sowing Depth and Soil Moisture. By G. Howard Jones and Abd El-Ghani Seif El-Nasr Eff. Pp. iv+46+7 plates. (Cairo: Government Press.) P.T. 6. [54]

India Meteorological Department. Scientific Notes, Vol. 8, No. 84: A Statistical Analysis of the Monthly Rainfalls in the Amraoti District (Berar). By N. Rajagopalan. Pp. 9-16. (Delhi: Manager of Publications.) 5 annas; 6d. [54]

U.S. Department of the Interior: Geological Survey. Bulletin 898-G: Spirit Leveling in Missouri. Part 7: Central Missouri, 1896-1938. Pp. ix+871-1004+xi-xiv+1 plate. 25 cents. Bulletin 898-H: Spirit Leveling in Missouri. Part 8: West-Central Missouri, 1896-1938. Pp. x+1005-1106+xi-xiv+1 plate. 20 cents. Bulletin 900-B: Subsurface Geology and Oil and Gas Resources of Osage County, Oklahoma. Part 2: Townships 22 and 23 North, Ranges 8 and 9 East. By C. T. Kirk, H. D. Jenkins, Otto Leatherock, W. R. Dillard, L. E. Kennedy and N. W. Bass. Pp. iv+47-82+plate 2. 40 cents. Bulletin 900-C: Subsurface Geology and Oil and Gas Resources of Osage County, Oklahoma. Part 3: Townships 24 and 25 North, Ranges 8 and 9 East. By N. W. Bass, L. E. Kennedy, J. N. Conley and J. H. Hengst. Pp. iv+83-129+plate 3. 40 cents. (Washington, D.C.: Government Printing Office.) [84]

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Further particulars and form of application may be obtained on request by postcard (quoting Appointment 290/1C) from the High Commissioner for India, General Department, India House, Aldwych, London, W.C.2. Last date for receipt of applications May 14, 1940.

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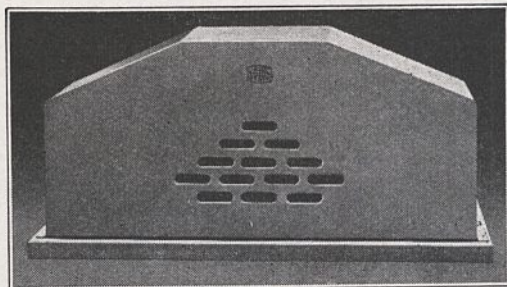
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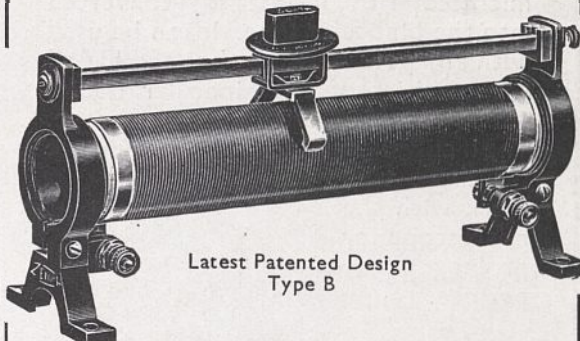
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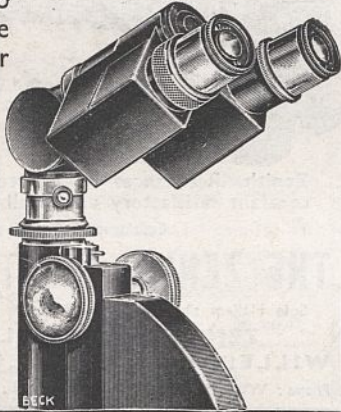
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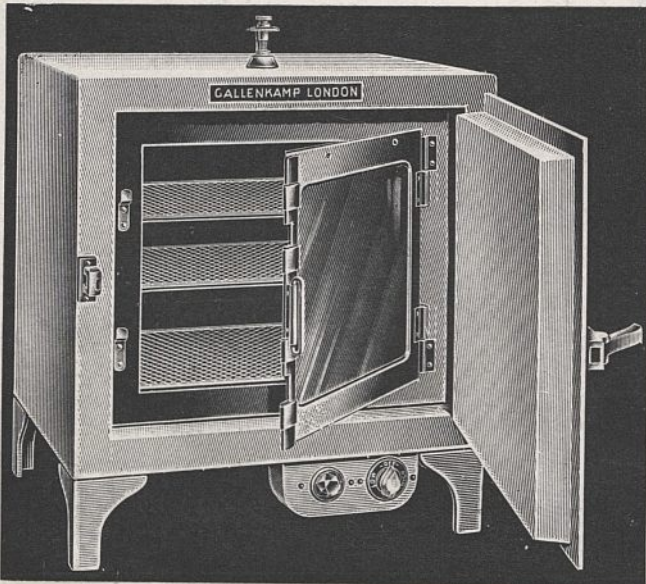


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