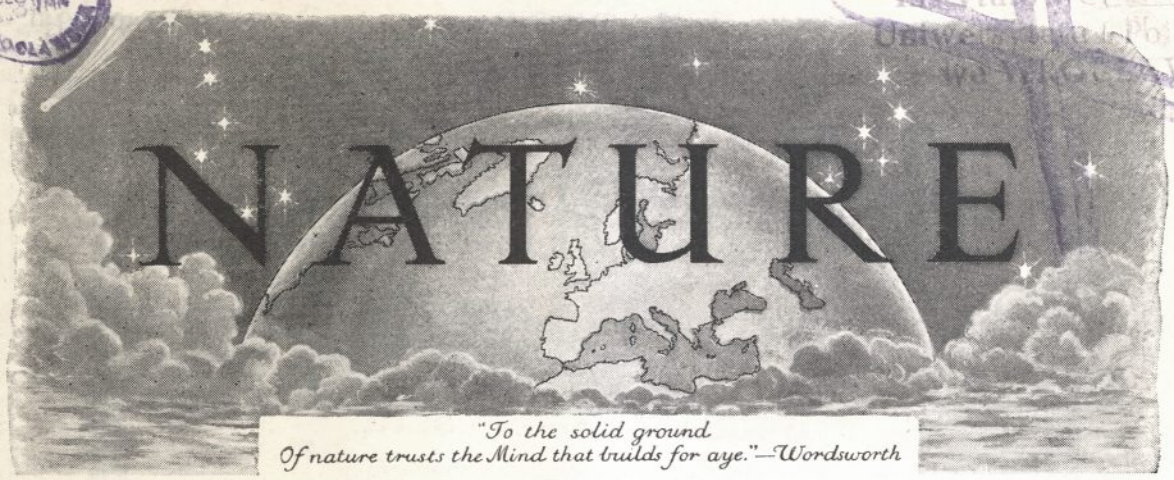

"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

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THE CHALLENGE OF SCIENCE

THE widespread utilization of science in both offensive and defensive warfare has brought into fresh prominence the old question whether science is a curse or a blessing. Such a discussion cannot even in these times be dismissed as purely academic. Behind many of the problems with which we are concerned in the war effort, such as food production and factory welfare, lies the major question confronting Western society to-day, that of harnessing science to human welfare. The misuse of discoveries and inventions must not be allowed to obscure their beneficent effects. As Prof. J. C. Philip pointed out in his recent presidential address to the Society of Chemical Industry, inventions, materials and machines are not in themselves good or evil ; the character of the part they play in the human drama is determined by man himself, and the tragedy is due to human weakness and failure.

On this, recent events in France may well make a vivid commentary. There is no need to subscribe to the view that widespread appreciation of science and better systematizing of human knowledge offer a panacea for the ills and maladjustments of humanity. But abandonment of extravagant claims on behalf of science does not affect the tremendous opportunities of using it as a tool for the benefit of humanity. The tragedy lies in that men have looked backward instead of forward. Realizing that neither physical science nor industry are ends in themselves and that material things cannot be allowed to dominate human life, they have sometimes thought they should be ignored—that because ends are more than means, means are of no account.

Scientific workers may well be grateful for Viscount Samuel's words on this subject in his Messel Lecture, "Science and Civilization", before the Society of Chemical Industry on July 9. Applied science, he asserts, is worth while not only for what its achievements are in themselves but also for the sake of the ends they make possible. To blame science for the present war is unreasonable ; as though there had been no warfare before the age of science. Even if the humane nations were to restrict or abolish industrial science, as an accessory to the crimes of war, we may be sure the inhuman nations would not. We cannot leave Justice with only her ancient sword to face Injustice armed with machine-gun and grenades.

A wider view, therefore, urges Viscount Samuel, will dispose of the hasty judgment that the world would be the better if it sought to discard the scientific altogether, and went back to the primitive. On the contrary, while recognizing that it should seek no monopoly in our activities, or even predominance, science, vindicated in its purposes, may rightly ask from society as a whole the conditions that will best develop its efficiency and ensure its success in tasks that are beneficent and indispensable.

A full realization of the possibilities which science has put into our hands, not merely in regard to production and leisure, but also through the lengthening of human life by the control of disease, the removal of the environmental causes in early life of many of the physical, mental and spiritual defects from which we suffer, as revealed by the new sciences of nutrition, eugenics and psychology, and the development of man's latent capacities of greatness and goodness, might well, as Sir John Orr has urged, prove a decisive factor in the development of some new system of world order. What is essential is that men should face the

development of the new order with the same courage, the same confidence and willingness to venture as they are displaying in the prosecution of the War.

A timely and valuable contribution to the discussion has been provided by Prof. H. Levy in a recent pamphlet.* Prof. Levy takes the view that lack of courage has been shown by many educated men and women who have realized the creative power which science has placed in their hands and yet are conscious of the havoc and destruction to which that power has been turned. The turning to mysticism is a turning away from a contribution to the reasoned understanding of the forces of Nature. It is failure at a critical moment in world history to concentrate the mind and brain-power of men on vital problems the solution of which is so urgent that every ounce of thought should be directed to their analysis. It is akin to the defeatism and moral paralysis which have contributed so largely to the overthrow of France.

This, as Prof. Levy points out, is treachery indeed to science, and deals a staggering blow to humanity. When men need strength and self-reliance they are offered insecurity; when men require to face realities they are offered illusions, presented in the terms of those branches of science most remote from the common understanding, trading on popular ignorance and exploiting popular fear and interest in the mysterious. It is this confusion, for which some men of science must share the responsibility, that has hindered the forward view, the resolute shaping of policy and the fruitful impact of science on philosophy itself.

Scientific laws have a twofold aspect which is apt to be overlooked at this time of confusion. There are laws of order and laws of accident as well, and even accidents taken in the mass can be studied systematically. If philosophy is to base itself on the fullest knowledge, it must begin with the established findings of science. It must see the historical evolution of men and the tentative nature of their knowledge. It must adopt the experimental method with regard to the discovery of new generalizations, and learn how to avoid the dangers involved in false formulations of its problems.

Prof. Levy rightly emphasizes this philosophical aspect, for here can be found the corrective to the narrow perspective which is one of the dangers to be guarded against in a struggle like the present, with its tremendous demands upon our energy and thought. It is not the least of the merits of his pamphlet that it assists us to view the struggle itself in a wider and truer perspective which may well fortify our resolution and inspire us with fresh devotion.

The coming of this catastrophe, Prof. Levy suggests, is, from the point of view of the utilization of science, the climax to a process of human and scientific frustration that had rapidly been making itself apparent for almost a generation, just when the most striking advances were being made in almost all branches of physics, chemistry and biology.

We have now to recognize that concentration on war-time problems has shut down almost completely what might be called the cultural side, and the more barbaric side has become dominant. If this position reminds us that science itself is an aspect of social change, and must bend to the more compelling social demand, and that the direction of scientific advance must align itself with needs other than those of the internal logic of the scientific subject itself, there are at least elements of hope in the situation.

It is no matter for regret that the false idea that science is an independent discipline of its own, owing nothing and giving nothing to society, should be exploded. Moreover, some of the war-time problems have emphasized the urgent need for scientific knowledge and further research at precisely those points in the front of science where we had already become aware that the uneven advance was handicapping scientific as well as social development. The survey of man-power at present being conducted by Sir William Beveridge will unquestionably be assisted by the studies of the location of industry already conducted by P E P (Political and Economic Planning) and by the report of the Royal Commission on the Distribution of the Industrial Population. The requirements of civil defence and now of defence against invasion have underlined the arguments in such reports in favour of co-ordination and regionalism, and many important problems in local government, decentralization and the like, have been raised, the solution of which on rational lines to meet war emergencies may well clear the way for further advance later.

Besides this, evacuation questions have emphasized the need for more sociological research and may well give an impetus to many much-needed investigations. The scientific study of the question of food supply and production is now

*Science—Curse or Blessing? By Prof. H. Levy. (Thinkers Forum, 4.) Pp. 48. (London: Watts and Co., Ltd., 1940.) 6*d*. net.

being undertaken on a much more adequate basis, and the elaboration of policy and measures designed to ensure at least an adequate 'iron ration' for the whole population may not only lead to the more scientific utilization of our resources but also to the further advance of agricultural and horticultural science, and to a frontal attack on the problems of malnutrition and under-nourishment. Other problems or needs of war-time have strengthened forces making for a more intensive attack on problems of disease or other matters of public health.

Preoccupation with the effort required to prosecute the War should not therefore lead us to overlook the fact that in the profound changes involved new opportunities and possibilities are opening up before us. Vested interests or embedded prejudices that have long blocked progress are being compelled to yield before national exigencies, and we should not allow them again to hold up social or scientific advance when the War has been won. The period of scientific frustration through which we have passed is evidence of the inability of the old system to avail itself constructively of the new knowledge to usher in a new level of social life. Repression of progressive ideas, whether in Fascist or in Democratic countries, is treason to science no less than to civilization and the abiding values of man's cultural and moral heritage.

This is indeed one of our gravest dangers—that our condemnation of War itself or concentration on immediate war tasks should lead us into the company of those who cannot believe that Europe is in the throes of the birth-pangs of a new society in which they are called to play an entirely new part. The chances which the War itself offers us of ultimately building a new and better world order will not be used by those whose minds are set in old-established grooves or are afraid to face new situations and use new methods.

Whether science is a curse or a blessing depends fundamentally on whether we are prepared to meet the challenge which it throws down to us in economic and in moral affairs. The individual basis for conduct in a modern complex society is inadequate. We have to face the reorganization and reorientation of industry, of society, and of ethics itself, on a social as well as an individual basis, if our democratic institutions are to stand the strain which is thrown on them now that science and its technical applications, by binding groups together as entities, have made them socially and economically interdependent.

The issue depends largely on whether we bring to that task a width of vision and openness of mind, a firmness of purpose and a courage and comradeship commensurate with those demanded of us in this present hour of trial. It also depends on whether even now we are prepared to undertake the preliminary thought and investigation, the linking up of the war effort with the task of reconstruction, so that the opportunity to rebuild when it comes to us is not missed for lack of vision or preparation as it was two decades ago.

A NEW TRANSLATION OF THE TELL EL-AMARNA LETTERS

The Tell el-Amarna Tablets
Edited by Prof. Samuel A. B. Mercer, with the assistance of Prof. Frank Hudson Hallock in the final revision of the Manuscript. Luxor edition. 2 vols. Vol. 1. Pp. xxiv+442. Vol. 2. Pp. iv+443–910. (Toronto: The Macmillan Company of Canada, Ltd., 1939). 84*s*. net.

IT is fifty-three years since the famous collection of cuneiform tablets known as the Tell el-Amarna Letters was discovered on the site of the ancient capital of Amenophis IV, better known as Akhnaton, the 'heretic' Pharaoh. Twenty-eight years after the discovery, a careful edition of the text, with translation, notes and glossary, was produced in German by Knudtzon, with the collaboration of Weber and Ebeling. In the interval an edition, of a somewhat provisional nature, had been published by Hugo Winckler, and translated into English by Mr. J. M. P. Metcalf, in 1896. But, until the appearance of the present edition from the hand of Prof. Mercer, English scholarship has produced no independent edition of these most important documents.

This is not to say that the Tell el-Amarna Letters have been ignored by English scholars, as may be seen from such studies as the late Prof. Burney's Schweich lectures on Israelite settlement in Canaan, and Prof. S. A. Cook's admirable chapter on Syria and Palestine in the light of external evidence, in

the second volume of the "Cambridge Ancient History". But Prof. Burney's book was written in 1917, and volume 2 of the "Cambridge Ancient History" appeared in 1924, so that a quarter of a century has elapsed since the last authoritative discussion of the significance of these documents from the pen of any English scholar.

Meanwhile, great advances have been made in our knowledge of the history and civilization of the ancient Near East. The archives of Boghazköi have been unsealed at last, throwing a flood of new light on the history of the great Hittite Empire during the first half of the second millennium B.C. The publication of the texts from Nuzi and Kirkuk, the discoveries at Ras Shamra, the site of the ancient city of Ugarit, mentioned in the Tell el-Amarna correspondence, M. Parrot's excavations at Mari, Sir Leonard Woolley's results from the excavation of Atchana, and Mr. Mallowan's recent work at Brak, have all combined to illuminate many problems raised since the appearance of the Tell el-Amarna Letters.

Hence it was full time to attempt an edition of the Letters for English-speaking students which should apply the gains of half a century to the elucidation of the many problems still awaiting solution.

In his preface, Prof. Mercer assures us that "wherever new light has been thrown upon unsolved problems, it has been recorded in full", and offers his edition of the Letters "to all students of the Tell el-Amarna tablets, and of the general field which they represent, as an attempt at the last word to date on the subject", adding the qualification that it is merely tentative, "a stepping-stone to a future and better edition whenever new material and new knowledge shall make that desirable".

The work before us consists of 815 pages containing the text and an English translation on opposite pages, with very brief footnotes. We have then 34 pages of Excursus, consisting of nine short essays dealing with various subjects, two of the essays being from the pen of Prof. Hallock. The book is completed by a glossary of 30 pages and indexes of personal and geographical names, and a map of the Tell el-Amarna world. The type and format are all that could be desired.

It must be said at the outset that many English students will be grateful for the boon of an English translation. But from the scholar's point of view (and Prof. Mercer assumes that those who use his edition are already familiar with Knudtzon) the question is bound to be asked whether Prof. Mercer's translation is an improvement on its predecessor in the many passages where the German pioneer version has been recognized to be at fault. A careful comparison shows that Prof. Mercer has followed Knudtzon very closely, even in his mistakes, and that there are several mistranslations which arise from a misunderstanding of the German. But a more seriously misleading feature of the present translation is the abandonment of all the diacritical marks whereby Knudtzon distinguished between the various degrees of probability in his version, so that we have now offered to us without any indication of uncertainty translations which Knudtzon offered only as doubtful conjectures. Hence the student cannot safely use Prof. Mercer's translation without having Knudtzon continually before him.

Students of the philological problems raised by the Letters will turn to the Excursus section of volume 2 in the hope of learning what advances have been made in this field during the last half-century. They will not even find a page devoted to the linguistic peculiarities of the Letters, and it is stated that the language of these documents is Akkadian, although it is now recognized that not more than twenty letters out of the whole collection can be correctly characterized as Akkadian. Indeed, it may safely be said that the language of the greater part of the letters bears the same relation to Akkadian that the language of the books of Esther or Ecclesiastes bears to classical Hebrew.

Another field in which enormous advances have been made is that of Hittite studies. Here, again, the student who consults Excursus V in the hope of finding the last word on the Hittites and their importance in the political activities of the first half of the second millennium B.C. will be disappointed, for the essay represents the state of knowledge about the Hittites which had been reached a quarter of a century ago, and has not even been brought into line with some of the author's footnotes and references to modern literature on the subject, or with the two excellent essays by Prof. Hallock on the Hurrians and the much-debated problem of the Habiru. One has only to compare the map of the Tell el-Amarna world at the end of volume 2 with the map of the same period given in Goetze's "Hethiter, Churriter und Assyrer" (1936) to appreciate the time-lag in knowledge there revealed.

It is with great regret that the judgment must be recorded that a book so much needed, and on which so much devoted labour has been expended, to say nothing of the gallant and generous support of those friends of learning to whom the book owes its publication, fails to meet the tests which modern scholarship will apply to it. None the less, the labours of the author and the loyalty of his friends call for some expression of admiration and gratitude.

S. H. HOOKE.

HISTORY AND SCIENCE

Historian and Scientist

An Essay on the Nature of History and the Social Sciences. By Gaetano Salvemini. Pp. ix+203. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1939.) 9*s*. 6*d*. net.

PROF. SALVEMINI has been very well known in Great Britain for more than ten years. He was arrested as an opponent of the Fascist system in 1925, and in the next year was dismissed from his professorship in Florence and had to leave Italy, all his property being confiscated. He has spent the greater part of the time since in Great Britain, made many friends and inspired many with a mind both broad in its grasp and subtle in its distinctions. Latterly, he has been lecturing in the United States, and the book before us consists of interesting reflections on the relations of history and physical science by one who pretends to no special knowledge of the latter but sees clearly that there is an intimate connexion between the two. He rejects early in the book the claim put forward by Cicero that history is not only the *lumen veritatis*, the light of truth, but also the *magistra vitæ*, the teacher of life. This claim cannot be admitted, because the historian and the social scientist have to solve problems of facts and laws like the physicist but not pronounce upon their value. Ethics stands on a pedestal above, and Prof. Salvemini would therefore separate himself from Lord Acton, to whom the moral goodness or badness of his subjects was the supreme object of study.

But if Salvemini limits the scope of history on this side, he widens it immeasurably on another. Directly or indirectly, all historical research aims at solving the basic problem of knowing how the present situation has come to be as it is. This aim clearly covers the state of the physical as of the human world. The whole universe as known to us has been developing from some earlier state, going back to incalculable or infinite ages; the methods used in discovering how it has changed must be similar, though not identical.

Prof. Salvemini is explicit on this point. He tells us that the laws of social life—which includes history—cannot be determined except by the method followed during the past three centuries by the sciences of the physical world—that is, by examining the greatest possible number of facts. The method is the same but the material is different. In each case the facts begin to acquire significance when they are grouped in a system of cause and effect. So far, history and science are alike. They both aim at constructing a system by which the sequence, as we know it, followed by a certain law from what has gone before.

Unfortunately, the remains of the past have very rarely come down to us in a perfect or even reliable condition. This makes the great gulf between the results of the scientist and those of the historian. While the biologist is studying an organ or the chemist analysing a substance or the astronomer observing a star, the historian has to restore the remains which he examines to their original form and detect frequent forgeries and the variations of the different observers who may be faithfully attempting to record what is going on around them. We know in all ages—even in our own of exact wireless reproduction—how widely the impression will differ of any given event which is being recorded. There must be an absolute truth, but it would seem to be beyond the reach of the human mind as it is now constituted to attain it. To take the latest different version of the same event—how much agreement should we find between that of the secretary of Mr. Chamberlain at Munich and that inspired by Herr Hitler or his companions?

We come then to three main results from Prof. Salvemini's survey:

(1) The universe contains an infinite number of objects and events, constantly changing; the neutron is one and the brain-cell another. All may be part of a universal life so far as we are aware. All are material for the study of the scientist and the historian. They are alike in their method of studying the facts, comparing them and attempting to draw some line of filiation from one state or moment to another. This was the method of science developed some three centuries ago and Salvemini would have it applied both to what we call 'organic' and 'inorganic'. So far we must class him with the positive school of thinkers.

(2) The immense difference arises when we consider the simplicity and apparent immobility of the inanimate and the incessant and baffling movement of the living. We do not take this as a final fact, but note it as the present supreme difficulty between the work of the physical scientist and the historian or student of human affairs. For the moment it makes their results incomparably different. We can direct our Blenheim bombers with the utmost accuracy to

the desired spot ; we have but the most generalized idea of what is meant when there is talk of an attack on a certain country, nor can we predict the result if such an attack took place.

(3) The parallel inquiries of the scientist and the historian or sociologist are constantly advancing and constantly finding points of contact between the non-living and the living. We are often, it would seem, on the threshold of discovering the point at which the inanimate became the living. It has not yet been found, but an infinity of time remains to breach the gulf and achieve the unity which the word 'universe' implies.

F. S. MARVIN.

HAMILTON'S DYNAMICS

The Mathematical Papers of Sir William Rowan Hamilton

Vol. 2 : Dynamics. Edited for the Royal Irish Academy by Prof. A. W. Conway and Dr. A. J. McConnell. (Cunningham Memoir No. 14.) Pp. xvi+656. (Cambridge : At the University Press, 1940.) 70*s*. net.

THIS is the second of the projected four volumes of the mathematical papers of Sir William Rowan Hamilton. The first volume, published in 1931, contained papers on geometrical optics, and the present volume is mainly devoted to dynamics, but includes also some papers on Hamilton's calculus of principal relations, which, as the editors state in the preface, is a natural and obvious extension of his method of the principal function. These volumes differ from most collections of the papers of a mathematician in the very large proportion of hitherto unpublished matter which they contain. Thus in the volume under review we find that the papers here reprinted comprise the two important papers on "General Method in Dynamics" from the *Transactions of the Royal Society*, of 1834–35, and in addition only thirty-five pages of British Association Reports on Hamilton's work and brief notes on such subjects as the dynamics of light, the composition of forces and the hodograph, while the matter now printed for the first time, a hundred years after it was written, runs to more than 460 pages. With a few minor exceptions the whole of the work was written between 1833 and 1839, the characteristic function having first been introduced in the paper on "Theory of Systems of Rays" published in 1827. The editors have told us that the Library at Trinity College, Dublin, contains more than two hundred volumes of Hamilton's notebooks in addition to unbound manuscripts. The selection of what is most suitable for publication and the editing of the papers can be no easy task, and we can only express our admiration for the skill with which the great work is being accomplished.

As in volume 1, the editors remind us that "Hamilton arrived at his conclusions by heavy and laborious preliminary work and by the working of many examples often reached the general results gradually through the particular. When he finally published his results, they appeared in very compact and condensed form, which made his published papers somewhat difficult reading and gave little indication of the labour by which he arrived at the end of his journey". This fact is illustrated by the opening paper of this volume, entitled "Problem of Three Bodies by My Characteristic Function", dated 1833, not hitherto published and preceding by a year the publication of the first of the two papers on "General Method in Dynamics" which follow in this book. The paper contains some interesting results, such as the characteristic function for two bodies, and we see how, by considering the special case of elliptic motion, Hamilton discovered the formula $\delta V/\delta h = t$. But to an average mathematical reader, who would welcome some light on the two following papers, this formidable article of 100 quarto pages with its 1,289 numbered equations may appear a rather forbidding proposition.

To revert to the general arrangement of the book, it consists of three parts. Part 1, "Dynamics of Material Bodies", is concerned almost entirely with the characteristic and principal functions and their applications, and contains a lengthy correspondence with J. W. Lubbock on the application of Hamilton's methods to lunar theory. It also shows us Hamilton inventing the hodograph, though in this Möbius had anticipated him, and Hamilton inventing a proof that the resultant of two rectangular forces is directed along the diagonal of the rectangle.

Part 2, "Calculus of Principal Relations". With the exception of a brief summary in the form of a report to the British Association (1836), this part of the book consists entirely of work not previously published. It is an extension of the method of applying the principal function by means of calculus of variations to the solution of total and

partial differential equations. The manuscripts are all of date 1836. It was Hamilton's intention to write a book on the subject, and the four papers now published were written with this aim in view; but like the projected text-book, which was to show students how to apply the characteristic function to problems in geometrical optics, it was not completed.

Part 3, "Dynamics of Light". This part consists of long papers on the propagation of light in crystals, researches respecting vibration connected with the theory of light, and propagation of motion in elastic medium – discrete molecules, all hitherto unpublished, some short notes on researches, and a correspondence on the dynamics of light with Prof. Powell and Sir John Herschel, all of date 1835–39. In one of these papers we find the theory of group-velocity as distinct from phase-velocity, though this theory has often been attributed to Stokes, who set a question on the subject in the Smith's Prize Examination forty years later.

These papers of Hamilton are prefaced by a useful introduction and followed by an editors' appendix, which contains a number of valuable explanatory notes elucidating difficulties in the text and giving references to modern developments. Among these is a short article which quotes Jacobi's criticism of Hamilton's method and explains a method of the editors of obtaining the Hamiltonian form of the principal function S and characteristic function V from Jacobi's complete integral, with several applications.

The first volume was edited by Prof. A. W. Conway and Prof. J. L. Synge. In producing the second volume Prof. Conway has had Prof. A. J. McConnell as his associate, and they are to be congratulated on the production of this further monument to one of the greatest of Irishmen.

A. S. RAMSEY.

THE INTERIOR OF THE EARTH

Physics of the Earth

7: Internal Constitution of the Earth. Edited by Prof. Beno Gutenberg. Contributors: L. H. Adams, Reginald A. Daly, B. Gutenberg, Harold Jeffreys, Walter D. Lambert, James B. Macelwane, *S. J.*, C. F. Richter, C. E. van Orstrand, H. S. Washington. Pp. x + 413. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 30*s*.

THE nature of the earth's interior has been a subject of speculation for thousands of years. Ancient philosophers, from the Babylonians onwards, firmly held the belief that the depths were largely occupied by water. Even in the volcanic regions of the Mediterranean, where the subterranean world was naturally associated with ideas of internal fire, this belief was not excluded. Moreover, the winds of the Aeolian Isles were regarded as draughts generated from immense air-filled cavities by the action of the volcanic hearths. These traditional views persisted unchallenged until well into the seventeenth century. In 1695, for example, we find them repeated with characteristic exuberance by John Woodward. But already less fanciful notions were beginning to be formulated. Leibniz in 1680 had clearly expressed the idea of a crystalline crust resting on a molten interior; and a century later (1788) Benjamin Franklin asks: "Can we easily conceive how the strata of the earth could have been so deranged if it had not been a mere shell supported by a heavier fluid?" However, before another century had elapsed, Hopkins and Kelvin had shown that a fluid interior was inconsistent with the phenomena of precession and the tides, and geologists were left to puzzle over Franklin's problem as best they could. With the present century has come the realization that 'non-fluid' or 'solid' does not necessarily imply the crystalline state; vitreous material would fulfil still better the conditions imposed on speculation by the earth's behaviour.

A growing band of geophysicists is now actively engaged in the attempt to solve the dark problems of the earth's interior. The volume under review records progress to date in a series of chapters written by some of the leaders in this field of research. The work is a collective one and certain differences of opinion and interpretation still remain among some of the collaborators. This is not unnatural, since the various lines of evidence do not always lead to unique conclusions. The hypothetical identification of sub-crustal material with dunite (olivine-rock) is a case in point. Here the evidence is that the sub-crustal velocities of earthquake waves correspond roughly with those calculated from the density and elastic constants of dunite under high pressure. But to identify the material with dunite is probably just as wrong as to assume that a substance with the refractive index of water is necessarily water. In the latter

case the substance might be cryolite. Geologists will notice with relief that in the present volume the 'dunite' hypothesis is no longer specially favoured.

In his editorial introduction Gutenberg is careful to point out one fertile source of confusion : the fact that the transition from solid to fluid need not be connected, as it has been popularly supposed to be, with the transition from crystalline to non-crystalline. Non-crystalline material, even above the melting point, may be a vitreous solid with high rigidity and viscosity. The problem of the distribution of crystalline and vitreous material in the solid part of the earth is not yet wholly solved.

Jeffreys provides an admirably lucid chapter on the origin of the solar system. He concludes with a succinct statement of the contribution of cosmogony to geophysics : "The earth was once liquid. In this state its free iron and materials soluble in it settled to the center, leaving the silicate shell outside. Since then the shell has become solid, but the core remains liquid to this day."

Daly reviews the approach from geology. He shows that the phenomena of isostasy and the lateral shortening of orogenic belts imply a weak asthenosphere. From the fact that enormous masses of basalt have flooded the surface he infers the existence of a world-circling sub-crustal layer of basaltic composition which, he thinks, at least in the lower part, is in the vitreous state. The trouble about the latter conception is the attendant probability that basaltic eruptions, once started, would fail to stop until the whole of the vitreous part had been expelled. This difficulty would not arise if the vitreous material were of ultra-basic composition. Overlying crystalline basaltic material would then be eruptible only when and where it became locally liquefied, as it might be by the action of sub-crustal convection currents. Daly considers that in Pre-Cambrian times the lithosphere was specially thin and that it was then invaded by magmas on a scale never since equalled ; he goes on to correlate these conditions with the probability that the radioactivity of the rocks was then considerably greater than at present. This raises many interesting problems, but they can only be discussed speculatively while we remain in doubt as to the origin of the continents and the reasons for their lateral limitations. Beyond a vague suggestion that the moon may be in some way connected with the absence of continental layers from the sub-Pacific crust, this fundamental question is barely referred to in the present volume.

Besides the introduction and a final summing-up, Gutenberg contributes five other chapters, dealing with the cooling of the earth, forces in the earth's crust, hypotheses on the development of the crust, and the elastic constants, viscosity, strength and internal friction in the interior ; in collaboration with Richter he also reviews the evidence from deep-focus earthquakes and summarizes our knowledge of the crustal structure of continents and ocean floors. As there is still no general agreement as to whether or not more heat is produced inside the earth than escapes from it, it is not possible to estimate the importance of thermal contraction in the tectonic history of the earth. Gutenberg thinks that sub-crustal currents, controlled mainly by radio-thermal processes, seem to play the most important part. He refers to seismic evidence suggesting that the transition from crystalline crust to vitreous substratum takes place at a depth of about 60–80 km. The viscosity of the substratum is not too high to prevent convection currents. Those interested in the recent development of the convection current hypothesis should refer to an illuminating paper by Griggs (*Amer. J. Sci.*, Sept. 1939), which appeared too late to be noticed in the present volume.

The elastic properties of crustal materials are reviewed by Adams and the seismic evidence on earth structures by Macelwane. Lambert writes on density, gravity, pressure and ellipticity in the interior. These chapters contain valuable tables of data not easily accessible elsewhere, as indeed does the book as a whole. The observed temperatures in the earth's crust are recorded and discussed by van Orstrand. Readers who are specially interested in this topic will appreciate two relevant papers on heat flow in Great Britain and South Africa that have recently appeared (*Proc. Roy. Soc.*, A, pp. 428–450 and 474–502 ; 1939). Geochemical aspects of the earth's constitution are discussed by Washington in a posthumous chapter prepared several years ago, but recently revised by Adams. It contains an interesting account of meteorites and tectites and also a brief section on terrestrial magnetism. The absence of a chapter dealing more systematically with the latter subject is probably to be ascribed to the fact that Vol. 8 of this series on the "Physics of the Earth" is devoted to terrestrial magnetism and electricity (see NATURE, Jan. 13, 1940, p. 47).

Finally, mention should be made of the very full bibliographies. Each chapter—except the final summary—has its own, and altogether there are 852 references, more than a quarter of which are to seismic evidence and its application to the exploration of crust, substratum and core. Prof. Gutenberg and his committee are to be congratulated on the production of a well-written, authoritative and most welcome book which will be highly and deservedly appreciated by a very wide circle of readers in many branches of science.

ARTHUR HOLMES.

CONSERVATION AS A FOUNDATION OF PERMANENT PEACE*

By The Hon. Gifford Pinchot,
Former Governor of the State of Pennsylvania

THIRTY-TWO years ago there was held in Washington a Conference which was the first of its kind. It was the first not only in America but also in the world. It was also the first conference in the history of this country of the Governors of all the States and Territories with the President of the United States. Since it included also the Congress, the Cabinet, the Supreme Court, scientific experts, representatives of national associations, and outstanding citizens, it was one of the most distinguished gatherings ever brought together in the United States.

But no one of these was the essential reason for its epoch-making importance. The reason why the meeting of the Governors with President Theodore Roosevelt in the White House in May, 1908, may well be regarded by future historians as a turning point in human history, the reason why it exerted and continues to exert a vital influence on the United States, on the other nations of the Americas, and on the nations of the whole world, is this: it was called to introduce, and it did introduce, to mankind the newly formulated policy of the conservation of natural resources.

Even at that time the profound significance of conservation was beginning to make itself felt. In announcing his intention of calling the Conference, the President said: "The conservation of natural resources is the fundamental problem. Unless we solve that problem it will avail us little to solve all others. . . . It [the Conference] ought to be among the most important gatherings in our history, for none has had a more vital question to consider."

This Conference set forth in impressive fashion, and it was the first national meeting in any country to set forth, the idea that the protection, preservation, and wise use of the natural resources of the earth is not a series of separate and independent tasks but one single problem. As the President said: "The various uses of our natural resources are so closely connected that they should be co-ordinated, and should be treated as parts of one coherent plan."

The Conference asserted that the conservation of natural resources is the one most fundamentally important problem of all. It drove home the basic truth that the planned and orderly development of the earth and all it contains is absolutely indispensable to the permanent prosperity of the human race. It spread far and wide the new proposition that the purpose of the conservation of natural resources is the greatest good of the greatest number for the longest time. It taught the people of the United States, and other peoples, the new meaning of the word conservation, which in its present application to natural resources was then generally unknown.

By defining, describing, and making known the new word and the new policy, by endowing it with the approval and support of the leaders of all the States, of the great industries, and of the nation itself, the Governor's Conference put conservation in a firm place in the knowledge and the thoughts of the people. From that moment conservation became an inseparable part of the national policy of the United States.

It is worth mention that this brilliant example of national foresight occurred not in a time of scarcity, not in a depression, but in a time of general abundance and well-being. The unanimous declaration of the Governors ended with this discerning admonition: "Let us conserve the foundations of our prosperity."

It may be difficult to-day, when conservation is accepted almost as widely as the Ten Commandments, to realize that only a generation ago there was no such thing as a conservation policy. The very word conservation, as we use it to-day, had no existence.

The conception which we know as conservation originated and was formulated in the United States Forest Service in the early winter of 1907. Conservation grew out of forestry. Thus, conservation was born without a name. But it had to be given a name before it could be introduced to the people.

After discussion among perhaps half a dozen men, the name conservation was tentatively decided on. Thereupon it was submitted to and approved by Theodore Roosevelt, and the infant was christened accordingly. We know the growing youngster, thirty-three years old but growing still, by that same name to-day. The hold conservation has gained in these thirty-three years upon the civilized peoples of the world is little less than amazing. To-day the soundness of the

*Substance of a paper read on May 11 before the Eighth American Scientific Congress at Washington.

conservation policy is everywhere accepted as a matter of course.

The Conference of Governors recommended and was followed by the appointment of conservation commissions by a majority of the States, and of the National Conservation Commission, which latter in January of 1909 submitted to the President the first national inventory of natural resources ever made. In February of the same year the North American Conservation Conference, the first international conference to consider the policy of conservation, met in Washington at the invitation of President Theodore Roosevelt.

In his address at the opening of the Conference in the White House the President made this highly significant statement:

". . . In international relations the great feature of the growth of the last century has been the gradual recognition of the fact that instead of its being normally to the interest of one nation to see another depressed, it is normally to the interest of each nation to see the others elevated. . . . I believe that the movement that you this day initiate is one of the utmost importance to this hemisphere and may become of the utmost importance to the world at large."

The North American Conservation Conference declared that the movement for the conservation of natural resources on the continent of North America "is of such a nature and of such general importance that it should become world-wide in its scope". Therefore it suggested to the President "that all nations should be invited to join together in conference on the subject of world resources and their inventory, conservation, and wise utilization".

What the Conference thus recommended was, however, already under way. The President had foreseen that the North American Conference would be the precursor of a world conference. Accordingly, to quote Elihu Root, then Secretary of State: "By an aide-memoire in January last [1909], the principal governments were informally sounded to ascertain whether they would look with favour upon an invitation to send delegates to such a conference. The responses have so far been uniformly favourable, and the conference of Washington has suggested to the President that a similar general conference be called by him. The President feels, therefore, that it is timely to initiate the suggested world conference for the conservation of natural resources, by a formal invitation."

With the concurrence of the Netherlands, invitations were sent to fifty-eight nations to meet at the Peace Palace in The Hague in September, 1909. Thirty of the nations, including Great Britain, France, Germany, Canada, and Mexico, had already accepted when President Taft, who succeeded Theodore Roosevelt on March 4, 1909, killed the plan.

Two attempts have been made to revive it. At the end of the War of 1914-18, President Wilson, at the suggestion of Colonel House, took steps toward securing world-wide co-operation in the conservation and distribution of natural resources. Unfortunately nothing came of it.

During President Hoover's administration a group of nearly two hundred leading citizens from all parts of the United States urged him in a public petition to take action along the same general line. Again nothing came of it.

But these checks notwithstanding, the conservation problem remains the fundamental human problem. Without natural resources, no human life is possible. Without abundant natural resources civilized life can neither be developed nor maintained. To the human race, land is the basic natural resource. The demand for new territory, made by one nation against another, is a demand for additional natural resources; and it is not necessary to point out how many times this demand has plunged nations into war.

In view of the foregoing, I have a definite plan to suggest—a plan for permanent peace through international co-operation in the conservation and distribution of natural resources.

National life everywhere is built on the foundation of natural resources. Throughout human history the exhaustion of these resources and the need for new supplies have been among the greatest causes of war.

A just and permanent world peace is vital to the best interests of all nations. When the terms which will end the present War are considered, the neutral nations should be in position to assist in finding the way to such a peace. That being so, it would be wise to prepare in time.

The proposal is that the nations of the Americas prepare now for an endeavour to bring all nations together, at the right moment, in a common effort for conserving the natural resources of the earth, and for assuring to each nation access to the raw materials it needs, without recourse to war.

In all countries some natural resources are being depleted or destroyed. Needless waste or destruction of necessary resources anywhere threatens, or will threaten, sooner or later, the welfare and security of peoples everywhere. Conservation is clearly a world necessity, not only for enduring prosperity but also for permanent peace.

No nation is self-sufficient in essential raw materials. The welfare of every nation depends on access to natural resources which it lacks. Fair access to natural resources from other nations is therefore an indispensable condition of permanent peace.

War is still an instrument of national policy for the safeguarding of natural resources or for securing them from other nations. Hence international co-operation in conserving, utilizing, and distributing natural resources to the mutual advantage of all nations might well remove one of the most dangerous of all obstacles to a just and permanent world peace.

The conservation of natural resources and fair access to needed raw materials are steps toward the common good to which all nations must in principle agree. Since the American nations are less dependent on imported natural resources than European nations, and since they are already engaged in broadening international trade through negotiated agreements, their initiative to such ends would be natural and appropriate.

The problem of permanent peace includes, of course, great factors which the foregoing proposal does not cover. But it does cover that factor which is certainly, in the long run, the most potent of them all.

If the foregoing proposal is adopted, facts in support of it will be needed, and a plan for assembling them. The formulation of a general policy and a specific programme of action would follow.

Facts for each nation separately, for groups of nations, and for the whole world might well be assembled under the general classes of forests, waters, lands, minerals, and wild-life. In very brief outline they should include: resources in existence; consumption; probable duration; waste; conservation, if any; necessary reserves; available surplus; present interdependence of nations in natural resources (raw materials), with the origin, destination, and quantities of imports and exports; present barriers to 'fair access'; and sources of pressure upon nations to acquire natural resources.

The information just outlined undoubtedly exists in sufficient detail for the present purpose, and can be put together without original investigation. It could well be done through a Commission appointed for that purpose representing all the American nations.

The gathering of information through the creation of such a Commission might, I believe, properly be recommended by the Eighth American Scientific Congress to the Governments of the American nations.

Formulation by the Commission of a plan and of recommendations to the American Governments for a general policy and a specific programme of action, including the presentation of the plan when prepared to neutral and belligerent nations, would follow.

Such a Commission would be of immense and lasting value to the American nations. It could not but advance their interests, both individual and mutual, in addition to opening a road toward a workable basis for permanent peace.

Finally, the situation in Europe and in Asia suggests that action for the purpose outlined above was never more necessary than at present.

THE UTILIZATION OF PETROLEUM GASES*

By Dr. A. E. Dunstan,
Anglo-Iranian Oil Company, Ltd.

IT is interesting at the outset to realize the quantities involved in the problem of the utilization of natural gas. In 1938 there was a production of about 270 million tons of crude oil. Superimposed on the oil and in solution there is natural gas, and that gas production is estimated at an almost astronomical figure which may be compared with the ordinary coal gas production in the United Kingdom.

World production of petroleum 1937 ..	276,000,000 tons
„ „ „ „ 1938 ..	268,000,000 „
Annual world production of natural gas (approx.)	3,000,000,000,000 cu. ft.
Annual world production of gas from cracking process	300,000,000,000 „
Coal gas produced in the United Kingdom in 1937	550,000,000,000 „

An oilfield has the following geological structure: an anticline, an impervious cap rock, gas dome and below that an oil-bearing structure, and farther down a water horizon the pressure of which forces the oil up into the drilled well. It is clear that a well drilled, for example, into the uppermost gas horizon will miss the oil and will lead to the diminution of gas pressure. It is, therefore, the business of the geologist and the geophysicist to indicate to the production engineers where to locate their wells.

The oil and gas coming up from the well pass into a separator, which may be upwards of 150 ft. in length; this takes off the high-pressure gas, up to two to three thousand lb. pressure, from the crude oil. Hence there remains a solution of gas in oil, together with free gas, mainly methane, coming off from it. The methane is thus separated, but obviously the oil itself must contain dissolved gas. There follows, therefore, a series of multi-stage

* Based on a Friday evening discourse at the Royal Institution.

separators in which the ethane, propane and butane can be removed from their solution in the oil. The various dissolved gases are thus released stage by stage. This low-pressure gas, which inevitably carries with it a certain quantity of low-boiling liquid hydrocarbon material, has now to be handled. The gas is passed up lofty towers counter-current to a stream of solvent oil passing downward. This dissolves all the volatile liquid matter that can ultimately be put into motor spirit; in effect, it is the removal of the last traces of liquefiable hydrocarbons from what might be called the true gases. There is a further stage; the volatile material thus recovered by distillation from the solvent contains material of low boiling point, and it is necessary, in order to make the recovered volatile spirit into motor fuel, to remove from it material of specially low boiling point which seriously affects volatility of the finished petrol and would cause vapour lock in a motor-car engine.

The gases thus obtained from the crude oil are methane, ethane, propane and the butanes. They belong to the class of saturated hydrocarbons called paraffins. Etymologically the word 'paraffin' is, of course, entirely wrong. The word 'paraffin' implies something without any reactivity, with 'no affinity', whereas these gases have a great deal of reactivity. A special application of the dry gas, mainly methane, lies in its partial combustion to carbon black. The gas is burned against a revolving cooled surface and deposits what is in effect a very fine soot. This is scraped off, and finds a considerable outlet as a component with rubber of motor tyres. Further, when incorporated with oil, it yields printer's ink. There is also a rapidly expanding market for liquefied propane and butane —'bottled gas'—as a convenient domestic and industrial fuel. In point of fact, 150,000,000 gallons were sold in the United States in 1938. Notwithstanding that the dry gas is essentially paraffinic, in certain crudes—very limited in number—occurs the rare element helium, isolated by intense cooling and used as a lifting medium in airships by virtue of its low density. Finally, mention should be made of the occurrence of carbon dioxide and hydrogen sulphide in certain cases.

By the impact of high temperature the paraffin gases can be decomposed, in the first place to olefines by simple dehydrogenation and then to a complex mixture containing, in the main, aromatic hydrocarbons. For example, when methane is treated at a temperature of about 1050° C., benzene, toluene, xylene and styrene are obtained, together with naphthalene and anthracene. In effect, a sort of coal tar is produced in so far as the high-boiling components are concerned.

But it must be realized that methane is the most recalcitrant of the paraffins, and to-day pyrolysis is practised on material which is more reactant, for example, butane and propane, not only for the production of aromatic hydrocarbons but also for the preparation of olefines. Further, there are vast amounts of gases produced by what is called the 'cracking' process, that is, the production of light hydrocarbons from heavier oil. This gas is made up of olefines (ethylene, propylene, and the butenes, associated with the corresponding paraffins), and these are much more important starting materials for synthesis than straight natural gas.

Cracking is a thermal decomposition; oil is converted by heat into material lighter, and into material heavier—into gas, motor-spirit and into heavy residue. The impetus to cracking actually began with the necessity of making more motor-spirit per gallon of crude oil. It was a quantity production.

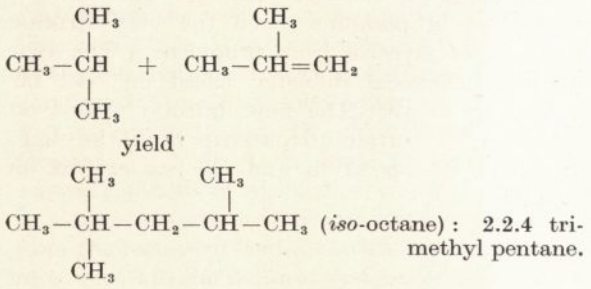
Cracking was first carried out to get more motor fuel. Times have changed, and to-day the concern of the industry is to get material of higher octane value, which gives better performance in the engine. In other words, quantity is sacrificed to quality. The tendency to-day is to get higher and higher thermal efficiency, and higher and higher octane values. Most straight motor fuels are heavily cracked to get this higher performance. By such intensive cracking—known as the 'reforming' operation, about 30 per cent of the spirit comes away in the form of gas. When that gas is submitted to fractionation to separate heavier material from lighter, a cut of the C_3 and C_4 fractions is obtained; this is a potential source of high octane motor fuel and other synthetic derivatives. Hence the problem of making full use of the olefines, either straight olefines from the cracking operation, or olefines produced by the dehydrogenation of the paraffins present in the gases from the well must be considered; and so a series of operations arises concerned with the utilization of these derived unsaturated hydrocarbons.

This production of gaseous and liquid material by thermal decomposition or cracking is an example of Faraday's pioneering spirit. Faraday took the product of the cracking of fatty oils and obtained a series of fractions from the product, among which is one that boils at 180° F. Faraday put the samples thus obtained into a mixture of ice and salt, and obtained from one a crystalline material which he purified by squeezing away the accompanying oily matter, and this was benzene.

It has already been stated that the term 'paraffins' is a misnomer. For example, when *iso*-butane is brought into contact with *iso*-butene or its dimer in the presence of sulphuric acid as a

catalyst, a remarkable combination takes place, for the tertiary atom of the *iso*-butane comes into reaction, and the result is a saturated hydrocarbon of a very high value in the internal combustion engine.

CATALYTIC ADDITION OF ISOBUTANE TO ISOBUTENE

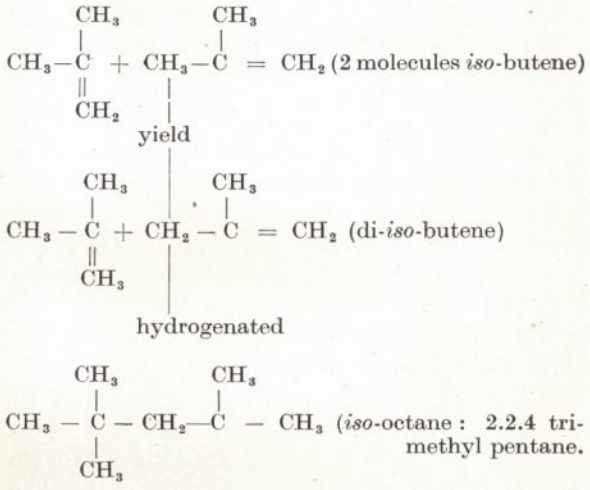


It has long been known that the addition of an olefine to the aromatic hydrocarbon benzene can be achieved by the use of such a catalyst as aluminium chloride, but the simple addition of an olefine to a paraffin containing a tertiary carbon atom, using ordinary strong sulphuric acid as a contact medium, is new, and will have the most far-reaching effects on the petroleum industry.

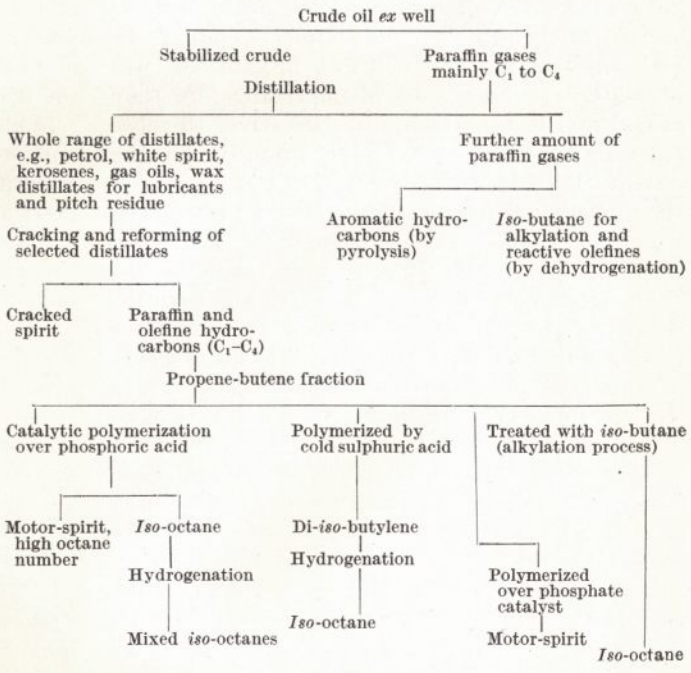
Consider the potentialities. In the cracking process vast amounts are made of unsaturated hydrocarbons containing C_3 and C_4 derivatives. The natural gas of petroleum contains also great volumes of *iso*-butane. Also, it is quite certain that the even greater amounts of *n*-butane can be isomerized to *iso*-butane. The product of this addition reaction is in the main a C_8 paraffin of specially high 'octane value', that is, it has the capacity of notably withstanding detonation in the internal combustion engine. Of course there are also supplementary reactions, but careful distillation analysis indicates clearly various sharp fractions, mainly, in point of fact, isomeric octanes.

Furthermore, the polymerization of cracked gases is readily effected; for example, ethylene (C_2H_4) can by the simple impact of pressure, temperature and time be converted into liquid fuel of the motor-spirit type. But a more effective way of converting C_3 and C_4 olefines into motor-spirit is by polymerization in the presence of a catalyst, and in particular one based on phosphoric acid. As a case in point, there has been used, with considerable success, copper cadmium phosphate. Such polymerization yields a motor-spirit of good quality, but if a selected cut or fraction of the total product is separated and submitted to hydrogenation, then again a C_8 mixed *iso*-octane is produced, just as it was in the case of the addition of butene to *iso*-butane. Further, if *iso*-butene also present in the C_4 cut from cracked gas is treated with cold sulphuric acid, it passes via tertiary butyl alcohol on warming to di-*iso*-butene (C_8H_{16}). This again, on being hydrogenated, yields *iso*-octane. So polymerization helps materially to increase the volume of high-octane gasoline.

DIMERIZATION OF ISO-BUTENE



Summing up then, a simple chart will illustrate how these various processes are effective in utilizing hitherto waste gases.



In so brief a résumé of the chemistry of these gases it is impossible to do justice to the development of a new synthetic chemistry based on the

lower hydrocarbons. It is clear that it is possible to look forward to the time when the petroleum industry will furnish the starting-out materials for a whole range of products so diverse as ethylene glycol—the familiar anti-freeze in the motor-car; sulphur from the crude gases at the oilfields; synthetic motor fuel prepared from methane oxidized into a liquid fuel; the isomerization of normal paraffins; explosives such as T.N.T. (actually in fact produced in 1916); synthetic rubber, which is got by intensive polymerization of ethylene; high polymers of value in increasing the viscosity of lubricants; a whole range of derivatives of the aromatic hydrocarbons obtained by pyrolysis or by the cyclization and aromatization of straight chain paraffins—resins and plastics from the polymerization products of olefines such as *iso*-butene; acetylene by the dehydrogenation of methane; ether and ketones as solvents and high anti-knock fuel; alcohols, esters and a whole range of solvents through the halogen derivatives of paraffins; and the very striking synthesis of glycerol from propylene. The vast synthetic chemical industry based on coal tar is familiar to all. The new industry, based on petroleum, is certain to outstrip it in the magnitude of its operation and the variety of its products.

FORMS OF SOCIETY AND EUROPEAN RULE IN AFRICA

FOR some time now it has been evident that a more intensive study of the political institutions and systems of native Africa was an increasingly urgent necessity. New and more searching methods of investigation have brought out the weaknesses and misconceptions of the older material, while of the more recent accounts of African economy complying with the standards of modern research, the extent is inadequate for the requirements of comparative study on the lines laid down in the development of sociological theory as applied in the study of the simpler societies. In such studies African political institutions will ultimately assume a place of importance, for they range from forms which ally themselves to those regarded as among the more primitive in the constitution of human societies, to those which in their extent and organization have been pronounced worthy to rank as great kingdoms and even empires, though of barbaric type, such as the West African emirates. In these, as well as in the details of the adjustment of social forces in the less advanced societies, there is abundant evidence of the political genius of Africa, which is not without its lessons for the study of more advanced communities.

Apart from the requirements of scientific and comparative study, there is a practical reason why more detailed and intensive investigation should be undertaken. The adoption of Indirect Rule throughout the greater part of British Africa, and the possibility that other Colonial powers, in that co-operation in native administration to which we are pledged, may wish to assimilate their methods in some degree to those of British administration, render it imperative that the application of the principle of utilizing and adapting native institutions to the requirements of European control should be based upon precise knowledge of the nature of those institutions, and even more important, of the consequences and implications of any changes or adaptations in the native social and political relations inevitable under the impact of European control. This is all the more important as the effects of social disharmony extend their ramifications beyond the machinery for the preservation of law and order to provinces of amelioration and reform affecting the land, its utilization and preservation in good heart, hygiene, the well-being and education of the individual, his employment, the health of his stock and the like.

While the anthropologist in dealing with political and social institutions is concerned solely with scientific and objective study of the facts, it is inevitable that maladjustments and misunderstandings which arise out of European contacts and control should come under his notice. From these maladjustments even Indirect Rule is not exempt. It is, in fact, well known that both misunderstanding and friction have arisen from insufficient grounding in knowledge of the facts in certain situations, no preliminary or an insufficiently intensive survey having preceded introduction of this system of rule, or administrative co-operation. Too great reliance has been placed upon an assumed universality of the authority of the chief in African society; and this has been allowed to warp judgment in assessing the bearing of facts not always perfectly understood. Comparatively unimportant individuals have been given official status, while the real seat of tribal authority, sometimes with native connivance, functions undiscerned behind a veil. In the result, what emerges is not Indirect Rule but a purely British bureaucratic system.

This applies also under the French administrative system, for which its admirers have sometimes claimed that it approaches Indirect Rule without some of its more obvious disadvantages.

Something more than a beginning—indeed a substantial contribution towards the detailed anthropological survey of African societies which should form the basis of future post-War administration in Africa—has been made in a volume issued by the International Institute of African Languages and Cultures under the joint editorship of Dr. E. E. Evans-Pritchard and Dr. M. Fortes*, with a foreword by Prof. A. R. Radcliffe-Brown on the general methods of sociological inquiry as applied to simple societies. Here are given in condensed form the results of field investigations by different observers into the political systems of eight widely distributed African peoples. These studies cover South Africa (Zulu, Ngwato of Bechuanaland, Bemba of North-Eastern Rhodesia), East Africa (Ankole of Uganda, and Bantu Kavirondo), West Africa (Kede, Tallensi), and Sudan (Nuer). Although not completely comprehensive as to type, as the editors point out, the eight societies afford a general picture of the main forms of African political systems.

The eight types of political systems here described fall into two groups. Of these, the first includes those in which the maintenance of law and order and the dispensation of justice are dependent upon a centralized organization culminating in a paramount chief who rules with the assistance of a council and through a number of regionally distributed subordinate chiefs. Such a system, obviously, lends itself to the requirements of European rule. In the second group there is no such centralized organization with a supreme head. The society is organized in accordance with lineage and is 'segmented', each group being autonomous and independent of the others. Law and order are maintained by a nice adjustment of interests at each and every point of contact between groups. In such a system, European control, either through lack of understanding or through administrative requirement—sometimes both—has constituted headmen functioning as do the chiefs of the first group in relations between administration and people.

In estimating the value and effect of Indirect Rule as a mode of administration which has as its object that of introducing the minimum of disturbance into the economy of tribal life through European control, there is a number of important considerations to be taken into account, of which the most important is the fact that the power of the paramount chief is by no means absolute. By an extensive system of check and countercheck—the council, queen's courts, the rights, duties and interests of officials and subordinate chiefs and the like—there is throughout the community a balance of power which not only limits the power of the chief, but also ensures the continuity and preservation of custom, secures the effective representation of every grade of society in the general direction of affairs, and in the ultimate analysis places what would correspond to 'sovereignty' in the hands of the people. It is inevitable that this delicate adjustment should suffer dislocation under European control. Even Indirect Rule cannot avert the disturbance involved in depriving the chief of the power of initiating legislation independently and of making war. In the result, in the societies of the first category mentioned above, the chief has become a buffer between administration and people, who on whichever side his sympathies lie—and usually and naturally they are with his own kin—is suspect to both, or at least his actions subjected to strict supervision on one side, carping criticism on the other, even or most often when officially dictated. No less important is the fact that the religious and symbolic bond centring in the chiefly office, which so often binds together African societies of the centralized type, is weakened beyond repair.

It is inevitable that some measure of friction and disturbance must arise in African societies when under European control ; and Indirect Rule, which aims at respecting African institutions, so far would seem to have been the most successful in minimizing its effects. Where we now stand, however, in our relations with other powers ruling in the greater part of Africa, opportunity will be afforded, when other preoccupations are less insistent, to consider what forms of control will best promote the future prosperity of the African. To attain this end there are certain essentials. First, full and free co-operation between all European powers administering African territory, not necessarily to secure uniformity in administrative method, but rather to ensure that such forms of rule as are applied should be most suitable to the character and circumstances of the governed in each instance. Secondly, and following from this, that decision should be made only after close intensive study of the respective native institutions, cultures and modes of thought ; and thirdly, since through European contact and control change must come, that that change should be canalized in such direction as sociological and economic research may indicate as likely to enable the African best to bear his part in world economy. The severest stricture on Indirect Rule which its critics are in a position to make is that it lacks direction.

* African Political Systems. Edited by Dr. M. Fortes and Dr. E. E. Evans-Pritchard. (Published for the International Institute of African Languages and Cultures.) Pp. xxiii+301. (London: Oxford University Press, 1940.) 15*s.* net.

OBITUARIES

Dr. R. J. Lythgoe

BY the death of Richard James Lythgoe, the subject of special sense physiology has suffered a most severe loss. Dr. Lythgoe was forty-four years of age, and received his education at Mercers' School and Trinity College, Cambridge, the latter phase being interrupted when, at the age of nineteen, he joined the R.G.A., in which he served throughout the War of 1914–18, experiencing heavy and nerve-shaking fighting.

Returning to Great Britain, Lythgoe studied medicine at University College Hospital, and took the Cambridge M.B., Ch.B. in 1924. Almost immediately afterwards he joined the staff of the Department of Physiology at University College, as Sharpey scholar, and held that post for a year. His first paper, published then, in collaboration with another, dealt with the pulse-rate and oxygen-intake during recovery from severe exercise. It was evident, however, that his interests lay in another direction, for in 1926 he was awarded a Beit Memorial research fellowship, and commenced the study of the physiology of the special senses, in which branch he worked for the remainder of his life, and gained international distinction. All his work was carried out at University College, London, and he was a part-time teacher, and later University reader in the physiology of the special senses, in the Department of Physiology, Pharmacology and Biochemistry of the College. He held Beit fellowships and senior Beit fellowships from 1926 until 1933, after which time his researches were in part financed by the Medical Research Council and by the Rockefeller Foundation.

It is no exaggeration to say that Lythgoe was one of a few physiologists in Great Britain who have done signal work for their subject by resuscitating an important branch of it from a state of neglect into which it had fallen during the preceding decades. In some two dozen papers he, with collaborators, covered many important aspects of special sense physiology, many of them of clear practical importance. For example, the work on the measurement of visual acuity, or that on the adaptation of the eye in relation to the critical frequency of flicker, had valuable practical bearings. Other work, particularly that on which he had been engaged just prior to the present War, and which was undertaken jointly with Dr. C. F. Goodeve, dealt with the photochemistry of visual purple, and was of outstanding theoretical importance.

Many advanced students during the past twelve years will remember Dr. Lythgoe's annual public lectures on the physiology of vision, and the practical instructions and demonstrations with which these were supplemented, and in which his flexible versatility in laboratory work was so strikingly illustrated. His wife, Dr. Katharine Tansley, whom he married in 1931, was one of his early pupils at these classes, and a constant collaborator with him in furthering the study of the branch of work in which he had engaged.

Lythgoe was an unexceptionable colleague, loyal, modest and always helpful and dependable; capable of fine and artistic appreciation and a consummate investigator. He could on many occasions have occupied a chair of physiology, but preferred the path of pure research unhampered by administrative duties or by the labour of teaching outside his real interests. When he was persuaded to undertake administrative work, however, he did it with the zeal and thoroughness which characterized all his doings. His work as a joint secretary of the Physiological Society, and as a member of the editorial board of the *Journal of Physiology* are instances of his faithful work. At the time of his death he was engaged on work of national importance.

Dr. Lythgoe died on February 28, and leaves a widow, a son and two daughters, the younger born in January last. To them we extend our very sincere sympathy in their bereavement.

Prof. Felix Plaut (1877-1940)

PROF. FELIX PLAUT, whose death occurred on June 27 at Epsom, where he had been engaged in research work on the reaction of vitamin C to neurological and psychiatric conditions, was born at Cassel on July 7, 1877. He studied medicine at Geneva and Berlin, and qualified at Munich in 1902. His principal work, which was carried out at the Robert Koch Institute for Infectious Diseases in Berlin and at the Psychiatric Clinic at Munich, where he was appointed to an additional professorship in 1915, was concerned with the study of the nervous system, especially the cerebrospinal fluid, and the serological and psychiatric aspects of syphilis. His chief publications were on the Wassermann reaction in psychiatry (1909), examination of the cerebrospinal fluid (1913), hallucinations in syphilis (1913), general paralysis in negroes and Indians (1926), and the treatment of syphilitic mental disorders. For several years he was one of the editors of the *Zeitschrift für die gesamte Neurologie und Psychiatrie*.

WE regret to announce the following deaths:

Mr. J. H. Fleming, formerly president of the American Ornithological Union, honorary curator of the Royal Ontario Museum of Zoology, on June 27, aged sixty-seven.

Prof. W. Frecheville, emeritus professor of mining in the Royal School of Mines, on July 30, aged eighty-six.

Surgeon Rear-Admiral E. L. Pearce Gould, formerly dean of the Middlesex Hospital Medical School, on August 1, aged fifty-four.

Prof. Hans Virchow, professor of anatomy in the University of Berlin.

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NEWS AND VIEWS

The Hon. Gifford Pinchot

THE idea of conservation of natural resources is of American origin, having been formulated by the United States Forest Service so recently as 1907. The history of the development of this idea since that date, and attempts to use it as a basis for international unity and amity, is described by the Hon. Gifford Pinchot on p. 183 of this issue. Dr. Pinchot continues with a valuable proposal to utilize and develop even further this idea at the peace which will follow the present conflict. No one is better qualified than Dr. Pinchot to press these proposals, which are very worthy of consideration not only by men of science but also by all who can justifiably claim a hearing when terms of peace are up for consideration. Dr. Pinchot was a forester in the U.S. Department of Agriculture during 1898–1910. He was commissioner of forestry, Pennsylvania, during 1920–22 and governor of that State during 1923–27 and 1931–35. For a long period he held the chair of forestry in Yale University and has served on several National Commissions of Conservation. Among his publications are books on forestry and one entitled "The Fight for Conservation" (1909).

U.S. National Defence Research Committee

IT is announced by Science Service that the following committee has been appointed in the United States to correlate "scientific research on the mechanisms and devices of warfare":

Dr. Vannevar Bush (chairman), president of the Carnegie Institution of Washington, formerly dean of the faculty of engineering at the Massachusetts Institute of Technology;

Prof. Richard C. Tolman (vice-chairman), dean of the graduate school and professor of physical chemistry and mathematical physics at the California Institute of Technology;

Dr. Irvin Stewart (secretary), formerly Federal Commissioner for Communications and chairman of the Committee on Scientific Aids to Learning;

Rear Admiral Harold G. Bowen, director of the Naval Research Laboratory, Anacostia, D.C.;

Conway P. Coe, U.S. Commissioner of Patents;

Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, formerly professor of physics at Princeton University;

Dr. James B. Conant, president, formerly professor of organic chemistry, Harvard University;

Dr. Frank B. Jewett, president of the Bell Telephone Laboratories;

Brigadier General G. V. Strong, assistant chief of staff, U.S. Army.

Assessment of Public Opinion

RECENT discussions in Parliament have directed critical attention to the use of 'market research' methods by the Ministry of Information for the purpose of assessing public opinion. The political aspects of the inquiries naturally loomed largest in the debate. It is well to remember, however, that the question is not one solely of the political repercussions of applying a mature scientific procedure. The scientific basis of such work also deserves scrutiny. In at least two important respects the method is scientifically still in its early stages. First, it has not fully explored the possibilities of error which lurk in its basic tool, namely, the question. Secondly, it seldom has any reliable criterion for testing the validity of its results. The work of Muscio (following Stern and Lipmann) demonstrated so long ago as 1916 that the form in which a question is worded has an important effect on the information which it elicits. Muscio showed the importance of points which go far beyond the avoidance of what common sense and legal rulings recognize to be suggestive questions. Unaccountably, Muscio's work has not been carried further by later psychology. Still more unaccountably, no means have been devised of putting his findings to practical account in social inquiries.

Measures of public opinion could be shown to be valid if they made possible the accurate prediction of public action. But this test can seldom be applied. Occasionally the results of elections have been predicted, sometimes with striking success, sometimes with inaccuracies which are traced to the underestimation of an apparently minor factor in the situation. Moreover, public opinion is fluid, a continuous activity rather than a state; and therefore a snapshot which is accurate at a given moment may not have predictive value for public action even a short time later. The importance of this factor will depend partly upon the extent to which the topic investigated has already been canvassed by the public. To take an example from the discussion in Parliament, public opinion on B.B.C. variety programmes is relatively mature; but on the question of whether it is better to fetch our own milk cheaply or to pay a little for delivery, opinions must have been collected from people to whom the question had never before occurred and who had never discussed it among themselves. (Further, the question seems to have been asked at a time of year when the mornings are light and the weather is fine.)

In the main, this method of inquiry has established itself through the belief of business men that market surveys do give them the information that they need for their sales policies. But it has to be remembered that in market research pure inquiry is never for long dissociated from efforts at moulding opinion. It is immediately followed by extensive advertising and propaganda which, in presupposing the truth of the survey findings, may in fact make them true. In the political field the same necessity to follow inquiry by persuasion will always make it difficult to test the findings of the inquiry. The uncertainty of these methods must not be exaggerated. But it should be realized that there is scope for much improvement before they can be regarded as scientifically mature.

Welfare of Aliens

AN Advisory Council of Aliens has been appointed by the Secretary of State for Foreign Affairs. This Council, which is under the chairmanship of Lord Lytton, and will work in close association with the Foreign Office and other departments concerned, will advise the Home Office on the general welfare of interned aliens, make recommendations on finding employment for internees, and suggest measures for maintaining their morale and binding them more closely to the cause for which Great Britain is fighting.

A Home Office White Paper (Cmd. 6217. London : H.M. Stationery Office. 1*d*.) has been issued showing the conditions under which German and Austrian refugees at present interned may be released. The regulations now issued apply only to "C Class" internees, but it is stated that they are not to be regarded as final. Among those who may now apply for release are those who occupied key positions in industries engaged in work of national importance, skilled workers in agriculture, commercial food-growing and forestry, and scientific and other research workers and persons generally with academic qualifications for whom national work in their own fields is available. With regard to the latter groups, special committees are being set up by the vice-chancellors of the universities, the Royal Society and the British Academy to consider applications and to submit recommendations to the Home Secretary. These new regulations seem to provide the necessary safeguards of national security required in any relaxation of the order for general internment of aliens, and should meet with general approval.

An International Labour Force

SPEAKING in the House of Commons on August 1, Mr. Bevin, Minister of Labour, announced that he has set up an International Labour Branch as part of the employment department of his Ministry. The purpose of this branch is to organize the man-power of allied nations and of other well-disposed persons of foreign nationality in Great Britain. It is hoped to obtain full knowledge of those available for employment and to seek suitable openings for them in industrial and other work. Co-operation is to be maintained with the Allied Governments and other national authorities in Great Britain, and Mr. Bevin also hopes to have the advice of representatives of trade unions of foreign countries. He was very emphatic that the new branch would have nothing to do with internees ; release of aliens and their supervision generally is a matter for the Home Office. Once an individual has been passed by the Security Department, then he becomes available for consideration by the Ministry of Labour. At this stage, Mr. Bevin said he proposed to dispense with the terms 'aliens' and 'refugee', and to refer to such individuals as an 'International Labour Force'. This development, coming at the same time as the announcement of limited release of German and Austrian refugees, shows that the problem of dealing with the unfortunate people who have been driven from their homes by Nazi and Fascist persecution is being given careful consideration. They have come to Great Britain for freedom, and while they will recognize that the special needs of the times make restrictions of various kinds necessary, they will appreciate the opportunity which is now to be given them of taking an active part in the struggle against totalitarian domination.

Sales Tax on Books and Periodicals

THE case for withholding the imposition of the proposed purchase tax from printed books and periodicals was put before a private meeting of Members of Parliament held on August 6. As a result of the meeting, Mr. Kenneth Lindsay obtained support for an amendment which he is to submit proposing to omit printed books, music, pamphlets and leaflets from the schedule of taxable articles, and P. J. Loftus put forward another amendment which would exempt weekly, monthly and quarterly technical, scientific and trade journals retailed at not less than 6d. An amendment to exempt newspapers and periodicals is to be moved by Mr. Mander. NATURE has already discussed the probable effects of the imposition of a sales tax on books and other publications (May 11, p. 719, and August 3, p. 160). On general as well as scientific grounds, the imposition of a tax on books is a bad thing, which even at the present time cannot be justified on grounds of financial expediency.

African Studies and the War

LORD LUGARD, as chairman of the Executive Council of the International Institute of African Languages and Cultures, announces in the current issue of *Africa* (13, 3 ; July 1940) that the work of the Bureau and the publication of its periodical *Africa* must now cease for the duration of the War. In October last it was stated that it was hoped to carry on the Institute's work without serious interruption. Recent developments, however, have made international co-operation impossible, and it has been deemed advisable in the circumstances to cease work until after the War. Certain of the special publications of the Institute, which have proved so valuable to students of African peoples, are in an advanced stage of preparation and will be published as soon as possible—a book on African political systems, recently published by the Institute, is discussed on p. 188 of this issue of NATURE. Further, several research fellows are engaged in writing up their field-notes. Dr. Nadel's notes on the Nupe of Northern Nigeria, and those of Mr. and Mrs. Krige on the Lovedu of the Northern Transvaal have been completed ; but Dr. Margaret Read is still engaged on the results of her research in Nyasaland, and more especially on the part she took in the recent nutrition survey of that territory.

While those who have followed the work of the Institute, more especially since the receipt of the generous grant for field-work from the Rockefeller Trustees, will deeply regret this interruption, temporary though it may be, in its activities, they must, of course, accept the facts of the situation and realize that the international co-operation which has given

its deliberations breadth and understanding is now an impossibility. At the same time, it would seem desirable that the intermission of activity should not be complete. It is generally conceded that the time for planning for peace is now, and not at the close of hostilities. This applies no less to Africa than to Europe. A planning that begins with the peace will be too late to cope with the changes in African societies, which if the aftermath of the War of 1914–18 is a criterion, will ensue all too rapidly.

Storage of Electric Power in the Ruhr

THERE has been a rapid increase in recent years in the use of electricity in steel manufacture in Germany. This 'electric steel' has a very uniform structure, but, if the cost is to be comparable with that produced by other means, the factor of safety has to be reduced. With so many high-frequency furnaces going intermittently, the power supply systems must be subjected to considerable peak demands. This is especially the case in the Ruhr, where, although there is a plentiful supply of coal, considerable reliance is placed upon the water-generated supplies from Austria to meet the heavy peak demands. The largest and one of the most interesting of the storage stations is situated at Herdecke on the banks of the Rhine about six miles south of Dortmund and nearly twenty miles east of Essen. It is connected with the control point at Brauweiler, which is on the Rhine between Cologne and Dusseldorf. By accumulating water in an elevated reservoir by means of pumps and the erection of the Herdecke power storage station and others in the district, the peak-load problem has been solved satisfactorily. Interesting details of this station are given in the *Electrician* of July 26.

The upper reservoir of the Herdecke plant, covering an area of 18 acres, is designed to permit the full development of the available power. The maximum variation in water-level from empty to full is 65 ft. The maximum pressure head between the lower reservoir, Lake Hengsty, and a full upper reservoir is 540 ft., and the minimum head available is thus 475 ft. The power house is 500 ft. in length and each machine has an axial length of 85 ft. The station can be automatically switched from pumping to turbine operation in two minutes, and during pumping the turbine discharges are closed by means of flaps. The upper reservoir is oval in shape and is about 800 ft. above sea-level; this necessitated the excavation of 1,300,000 cubic yards of rock. The entire concrete surfaces coming into contact with water have been rendered impervious by means of a bitumen spray treatment. The work was commenced at the beginning of September 1927, and the station was brought into partial operation in December 1929, full operation following about a year later. The characteristic feature of this type of station is that at times of low power consumption the waste current of the water stations, or the increased night output of the steam stations, is employed to pump water back into the storage reservoir.

This Season's English Herbs

MORE than usual interest will be shown this season in the English harvests of vegetable drugs, and it is now possible to judge from reports by herb farmers on the prospects of their crops what the harvests are likely to be, provided weather conditions for collection are favourable. Fair supplies are promised of those old-fashioned medicines such as hyssop, rue, wormwood, comfrey, balm and dill, but the same cannot be said of chamomile, the prospects of which are disappointing, an outlook that is all the more unfortunate since it is impossible to obtain supplies from Belgium. Indeed, it would seem that those who have pinned their faith, in the past, to chamomile tea will have to try one of the more modern remedies which are not so scarce. What is still more unfortunate is that on some herb farms the severe frost last winter destroyed the main belladonna plantations so that very little leaf—which is so badly wanted because of the absence of imports of the Continental plant—could be collected this season. It is satisfactory to know that the young belladonna plants of this year's sowing are looking well.

Growers of henbane report that there was a good crop of second-year biennial plants, and leaf and flower of good alkaloidal content have been harvested; after a time of drought, rain came to save the first-year seedlings, which will provide leaves for autumn drying. Prospects of a crop of high-testing digitalis leaf are favourable. Aconite is said to be looking well and there is a full crop of valerian. Having regard to the stoppage of supplies of lavender oil distilled in the Grasse district of the Alpes Maritimes, it is well to learn that English lavender plants stood up well to the hard winter and the flowers have bloomed earlier and, in some cases, better than usual; a fair yield of English lavender oil may be expected for this season; more of the flowers will go to the still and less to Covent Garden in bunches for street vendors, and thus at least part of the shortage due to the lack of French oil will be made good.

Notation for Tapping Systems of the Rubber Tree

THE scientific groups dealing with rubber production in Ceylon, Malaya and Netherlands East Indies have recently adopted a common notation for expressing the varied tapping systems by which the crop from Hevea is obtained. Attention was directed by Evan Guest, of the Rubber Research Institute of Malaya, to the confusion and ambiguity which existed because different centres had developed their own nomenclature without plan, and his suggested scheme, modified by the co-operation of others, has now been accepted (*J. Rubber Research Inst. Malaya*, **9**, 142–170; 1939: **10**, 16–33; 1940). This will mark a great advance in co-ordination of scientific records of yields from Hevea, for the fundamental factor, namely, intensity of tapping, is simply and accurately brought into the required prominence.

First the type of cut is identified by an initial letter, followed by the figure expressing the fraction of the tree circumference which is covered. Then the

periodicity of tapping and resting is expressed by further fractions showing the frequency of tapping and the relation of tapping to resting periods. Finally, simple conventions define the arrangement of the panels, a matter which assumes special importance for the multiple cuts of the so-called slaughter systems by which old trees are drained before re-planting. Standard intensity is defined as a half spiral tapped alternate days without rest (that is, equivalent to one quarter cut per day) and the relative intensity of the system is easily arrived at by scanning the formula. As examples: "$S/1$, $d/3$, $4m/6$, 89%" signifies a full-circumference spiral cut tapped every third day for a period of four months in a cycle of six (two months rest), giving 89 per cent of the standard intensity; or "$S/3$, d 2 ($3 \times 6m/18$) 67%" indicates three panels of one third spiral cut, each one being tapped every second day for six months taking them in rotation. The amount of tapping can be expressed in circumference units (fractional length of cut multiplied by number of tappings), using the actual instead of the ideal number of tappings.

Most rubber estates keep full records which should potentially be a voluminous source of information, but the variables are so many and have in the past been so hazily defined that the scientific value of such records has often proved disappointingly small. Guest's notation will mark a great step forward in the task of making records both intelligible and comparable.

Golf Green Research and the War

THE revised values which the war places upon various activities have caused the managers of the Board of Greenkeeping Research to review the position of the Research Station at St. Ives, Bingley, Yorks. The experimental plots at this centre have been built up over a period of eleven years, at a cost of more than £26,000, and have provided valuable new knowledge about the ecological interaction of plants grown in compact formation, and about the practical treatment of greens. Much of their scientific value lies in their long term of treatment, and it is gratifying to learn that they are to be carried on, even if the need for economies should curtail the Station's other activities. It is also useful to remember, in the present intensity of the war effort, that the Station has contributed to a fundamental understanding of grass ecology which could be applied to increase food production on some of the poorer grassland of British uplands. Its researches on pests and diseases of grassland could quickly be turned to the aid of agriculture, and the Station has further adapted itself to war conditions by working on the best methods of pasturing sheep on golf courses, and giving advice upon minimum upkeep during the present difficult times.

Practical Applications of Horticultural Research

IN time of war there is a special need for the dissemination of the findings of scientific research, and in no field is this more true than in agriculture and horticulture. The application of known facts is often more important than the making of new discoveries. Following this principle, the John Innes Horticultural Institution is preparing a series of leaflets embodying in condensed but adequate form the results of some of the most practically important lines of investigation which have been followed in recent years. The first three of these leaflets have already appeared and deal respectively with the John Innes composts, soil sterilization for pot plants and the John Innes soil sterilizer.

Every horticultural grower is aware of the valuable work done by the Institution in devising two standardized composts, one for seed sowing and one for potting. These composts replace the bewildering array of mixtures recommended in horticultural text-books and may be used with success for every class of plant. No less important is the work of the Institution on the sterilization of potting soils, which has amplified and extended that of the Cheshunt Experimental Station. The principles of sterilization as applied to the John Innes composts are outlined in Leaflet No. 2, while No. 3 gives details of the home construction and the use of the specially designed John Innes soil sterilizer.

Prof. Richard von Krafft-Ebing

PROF. RICHARD VON KRAFFT-EBING, an eminent German psychiatrist and a pioneer in the scientific study of sex, was born at Mannheim on August 14, 1840. He received his medical education at Heidelberg under Fredreich and at Zurich under Griesinger, and after qualifying at Heidelberg in 1863 spent five years as an assistant in the Illenau Asylum. In 1872 he was appointed professor of psychiatry at the recently founded University at Strasbourg, and in the following year he accepted an invitation to occupy the corresponding chair at Graz, where he remained until 1889, when he succeeded Leidesdorf at the First Psychiatric Clinic at Vienna. In 1892 he succeeded Meynert at the Second Psychiatric Clinic, which he directed until his retirement in 1902. He died on December 22, 1902.

Kraft-Ebing was equally eminent as a research worker and clinical teacher, and gained a well-merited reputation not only as a psychiatrist but also as a criminologist and neurologist. He is best known for the work entitled "Psychopathia Sexualis", of which the first edition appeared in 1886 and the seventeenth posthumously in 1924. It was translated into English, French and Italian. His other works were "Melancholie" (1874), "Lehrbuch der Psychiatrie" (1879) which was translated into English and French and went through seven editions, and "Eine experimentelle Studie auf dem Gebiete des Hypnotismus" (1888), which was also translated into English. At the International Medical Congress at Moscow in 1887 he read an important paper on the causation of general paralysis which, as the result of his own experience, he proved to be the joint product of "syphilization and civilization". He was an honorary member of the medico-psychological societies of London, Paris, Rome, Amsterdam, Moscow, New

York and Chicago. A monument was erected to him in Vienna in 1908, when an address was delivered by his successor, Prof. Wagner von Jauregg.

Palæozoic Coral Genera

A COMPLETE list of the Palæozoic coral genera has been carefully prepared, correctly named, and supplemented by references to authors, synonyms, localities and published works ("Index of Palæozoic Coral Genera." By William Dickson Lang, Stanley Smith and Henry Dighton Thomas. Pp. vii+231. London: British Museum (Natural History), 1940. 15*s*.). Genotypes are arranged in the alphabetical order of the trivial names, followed by the generic name and its author. In the list of literature it is useful to have a record of the genera described in each work. Dr. Lang presents the list as the foundation of future work on the phylogenetic classification of the corals. Although he examines critically the gradations and trends among Tabulate and Rugose corals, he and his collaborators leave the interpretation of the facts to others. The most laborious part of the task has, however, been performed for them. More than fifty generic names are pre-occupied by members of other phyla, and of the corals themselves, nearly twenty names are *nomina nuda*. This sifting and purifying should be of lasting benefit to workers on the group.

Intelligence among Australian Aborigines

THE difficulties of applying intelligence tests to primitive peoples with a view to comparative study are notorious, and much ingenuity has been employed in devising tests which are immune from the vitiating factor of differences in the cultural background of the individuals or groups which it is sought to compare. The pioneer work of Dr. S. D. Porteous among Australian aborigines may be recalled in this connexion. Even more remarkable results, however, have been obtained by a recent expedition to the north-western regions of the Continent, sent out by the University of Western Australia, and consisting of three members of the Psychology Department, Mr. N. G. Trayten, Dr. D. W. McElwain and Dr. H. L. Fowler. Under the advice and with the co-operation of Dr. D. S. Davidson, assistant professor of anthropology in the University of Chicago, experiments were made in the application of intelligence tests which had not previously been tried with the Australian aborigines.

Not only was it desired to determine whether these tests were likely to prove more suitable for work with primitive peoples than those generally in use, but also whether they appeared to confirm the low estimate of aboriginal intelligence afforded by previous investigations. In a preliminary report on the work of the expedition, Dr. Fowler (*Australian J. Ser.*, 2, 5; 1940) records that, of the various tests applied experimentally, the Alexander Passalong test, involving the arrangement of coloured blocks in boxes, the Ferguson form boards, in which insets have to be placed in proper position, and the cube construction test, proved the most suitable, the second being the most satisfactory. Eighteen males and thirteen females were tested. They were of different ages, all but four being adults. In the results the interesting point lies not so much in the average mental age attained as in the range over which the scores spread, while considerable variation was noted in the different tribes. Still more remarkable is the fact that eight of the subjects in one test and five in another scored a mental age of fourteen or over, which indicates that they are at least at or above the level of the average white adult. From these results, which are in agreement with opinions expressed by squatters as to aboriginal abilities, Dr. Fowler draws the conclusion that further investigations should be undertaken in order that, if these preliminary results are confirmed, steps may be taken to foster the development of such abilities.

Roadwork and Bridges in Hungary

FOLLOWING its established custom, the municipal administration of Budapest has again called for tenders for dust-proofing the macadamized roads in the city. According to *Roads and Road Construction* of July, the proposal was to treat 522,000 sq. kilometres of roads with oil while the remaining 320,000 sq. kilometres of road requiring dust-proofing treatment would have been treated with tar. The bids proved that the price of oiling would have been one third higher than last year, while contractors also insisted on various disadvantageous clauses and conditions. The municipality has therefore decided to apply dust-proofing treatment to a total of 550,000 sq. kilometres of road surface only, using tar throughout. The Ministry of Commerce has issued a series of important commissions for the construction or reconstruction of roads and for two new bridges spanning the Danube and the Tisza respectively. The total commissions amount to well over seven million pengoes.

The new bridge over the Danube at Medve will cost more than two million pengoes, while that over the Tisza, in the Hungarian lowlands, will cost nearly 860,000 pengoes. The Danube bridge will be erected by the Hungarian Waggon and Machine Factory, while that on the Tisza will be built by Ganz and Company, of Budapest. The number of road contracts so far allotted is fourteen, and they have been awarded to the same number of different firms, partly to joint stock companies and partly to individuals. The majority of the roads will have concrete surfaces, although a few will have stone surfaces. The total amount of the fourteen orders is about 500,000 pengoes.

Swiss Postal Railway

IT is stated in the *Bulletin* of the Oerlikon Co. that an underground railway has recently been built in Zurich for the conveyance of letters and express packets between the branch post office at the main railway station and the Sihl post office, which are about three quarters of a mile apart. The railway is practically automatic. A driverless electric track is set in motion by pressing a push button on the main

control panel. At the railway station terminus the track runs on to a lift, which operates automatically, rising to the level of the post office above. The railway is operated by a three-phase 220-volt, 50-cycle supply. This obviates the need for converter sets or special gear on the motor track for reversing. To reverse, all that is necessary is to interchange the connexions of two phases of the supply.

The motor-truck has two axles, one of which is coupled through gears to a 3·5 h.p. three-phase induction motor, giving the truck a speed of 14·4 ft. per sec. The other axle is driven by a 1 h.p. motor for running at low speed (0·98 ft. per sec.). The latter motor is brought into operation at the stations by means of an electro-magnetic coupling controlled by a change-over switch, which is actuated by a roller contacting with a third rail in the station sections. The truck is fitted with a mechanical brake operated by spring force. The order for the whole installation was placed with the Oerlikon Co.

Catalogue of Meteorites

THE British Museum (Natural History) Catalogue of Meteorites was issued in 1923 and a first appendix appeared in 1927. A second appendix, compiled by M. H. Hey, has now been published by the Trustees of the Museum (1940, pp. 136, price 5*s*. net). It includes particulars of all meteorites described since the appearance of the first appendix up to the end of September 1939. Additions and corrections to some of the earlier entries have been made and a separate list of meteorite craters has been included. It is interesting to note that the catalogue and its appendixes now contain entries for 1,251 reasonably well-authenticated falls, of which 758 are represented in the Museum collections, and for a further 98 'doubtful' and 'paired' falls, of which there are 24 in the collections. Of the 51 'doubtful' falls, a few may not be meteorites, others have never been adequately confirmed or described, and others may have names that may be synonymous with those of falls otherwise recorded. The 47 'paired' falls are pairs or groups of falls which are possibly or probably identical; these have been counted only once in the totals. Falls reported in ancient histories and objects of worship in ancient temples thought to have been meteorites have not been included, except in the case of *Jalandhar*, which fell in the Punjab in 1621 and was forged into sword blades; in other cases the data are too vague and uncertain.

Extra Fat Allowance for Diabetics

MR. BOOTHBY, Parliamentary Secretary to the Ministry of Food, has stated in the House of Commons that the Food Rationing (Special Diets) Advisory Committee of the Medical Research Council has advised the Minister of Food that persons suffering from diabetes mellitus should be allowed two extra butter and margarine rations, totalling 12 oz., each week. The necessary arrangements for the issuing of the supplementary rations by food executive officers has been made.

Recent Earthquakes

ON July 30, violent earthquakes occurred on the central plateau of Anatolia. Twelve villages including Peyk were destroyed near Yozgad, the shock also being felt at Ankara, Erzinjan, Tokat, Kayseri, Amasya, Sinop, Istanbul and intervening places. Three hundred people are reported to have been killed and several hundreds of others injured. The epicentre of the shocks appears to have been near Yozgad, which is not far from Erzinjan, the centre of the greatest of all Turkish earthquakes on December 27, 1939 (NATURE, January 6, p. 13). The present shocks cannot be considered as aftershocks of the December 27 earthquake nor are they so intense, but they point to the same general instability of the whole region at the moment, of which all the shocks are the result. It must also be noticed that such a terrific earthquake as that of December 27 would itself give rise to instability which would persist for a considerable time and give rise to earthquake shocks in general not so intense as the original one. Aftershocks of the earthquakes of July 30 were continued on the next day.

An earthquake of considerable severity was experienced in western Hokkaido on August 2. The full extent of the damage caused by the shock is not yet known, but more than a thousand fishing boats were damaged by a huge wave which followed the earthquake, seeming to point to an off-shore epicentre between Hokkaido Island and the mainland of the continent of Asia.

Announcements

MR. R. C. MORRISON, M.P., has been appointed chairman of an interdepartmental committee to secure greater liaison between the activities of the Ministry of Supply, which is responsible for the salvage campaign, and other services and departments.

THE Adelaide meeting of the Australian and New Zealand Association for the Advancement of Science arranged for August has been postponed. The position will be reviewed when it is considered that conditions may be favourable for the holding of a meeting.

AWARDS are made from the Sir George Beilby Memorial Fund at intervals determined by the administrators, representing the Institute of Chemistry, the Society of Chemical Industry, and the Institute of Metals. Preference is given to investigations relating to the special interests of Sir George Beilby, including problems connected with fuel economy, chemical engineering and metallurgy. In general, awards are not applicable to workers of established repute, but are granted as an encouragement to younger men who have done original independent work of exceptional merit over a period of years. The administrators of the Fund will be glad to have their attention directed to outstanding work of the nature indicated, not later than November 1. All communications should be addressed to the Convener, Sir George Beilby Memorial Fund, Institute of Chemistry, 30 Russell Square, London, W.C.1.

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.

Mucolytic Activity of Diffusing Factor Preparations

Chain and Duthie[1] have observed that aqueous testicular extracts contain a mucinase which rapidly reduces the viscosity of synovial fluid and causes an increase in the reducing power of this material. They suggested that the diffusing factor in testicular extracts might be identical with this mucinase and that the spreading effect in the skin might be due to rapid hydrolysis of interfibrillar mucin. This at first sight attractive hypothesis has been accepted by several workers[2,3,4], although no evidence has been advanced of the identity of the two effects, other than the known fact that snake venoms and bacterial filtrates, both well-known sources of diffusing factors, also show mucolytic activity.

Recent improvements in the biological test for diffusing factors[5] and an accurate viscosimetric method for the assay of mucolytic activity[6] have made it possible to compare the degree of activity shown by the various diffusing factor preparations when assayed by both methods. Dry preparations from bull testicle and rattlesnake venom were used and some results are given in the accompanying table.

Preparation	Diffusing potency (% standard)	Mucolytic activity (% standard)
Glaxo Laboratories standard (testicle)[5]	100	100
Madinaveitia standard (testicle)[7] ..	68	24·6
Dialysed extract (testicle)	48	80
$(NH_4)_2SO_4$ purified extract (testicle)	58	149
Crude *Crotalus atrox* venom ..	5·35	18·4
Purified *Crotalus atrox* mucinase ..	4·9	61·1

While these results are only of a preliminary nature we feel that they are sufficiently clear to warrant publication at this stage. It seems that there is no parallel between diffusing factor potency and mucolytic activity in the materials examined. Moreover, Meyer and his colleagues have recently encountered a similar absence of correlation[8]. While it cannot be said that diffusing factors are therefore not in some way related to mucinases, it seems certain that the method of assaying diffusing factors by merely measuring their mucolytic activity is open to grave objection. The possibility of a complete separation of diffusing factor from mucinase is the subject of investigations now in progress.

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A. L. BACHARACH.
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July 10.

[1] Chain and Duthie, NATURE, **144**, 977 (1939).
[2] Meyer and Chaffee, *Proc. Soc. Exp. Biol. and Med.*, **43**, 487 (1940).
[3] Favilli, NATURE, **145**, 866 (1940).
[4] McClean and Hale, NATURE, **145**, 866 (1940); *Chem. and Ind.*, **59**, 347 (1940).
[5] Bacharach, Chance and Middleton, *Chem. and Ind.*, **59**, 348 (1940).
[6] Madinaveitia and Quibell, *Biochem. J.*, **34**, 625 (1940).
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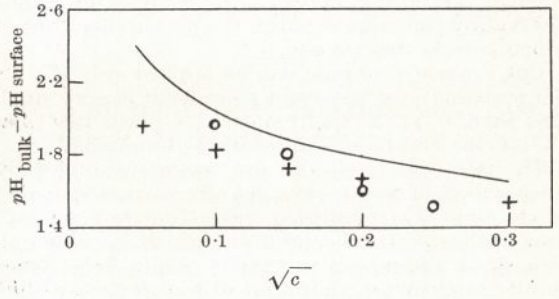
Concentration of Cations at Negatively Charged Surfaces

WHEN ions of one sign are fixed at a surface, the concentration of ions of the opposite sign in the surface phase may be calculated from the Gibbs-Donnan equilibrium between the surface and bulk phases[1], or from the electrokinetic potential. By both methods it is predicted that the *p*H at a surface containing fixed anions will be less than in the bulk phase, and Hartley and Roe have shown[2] that the *p*H at the surface of cetyl sulphate micelles, as calculated from the ζ potential (circles of accompanying figure) is in reasonable agreement with the values observed using a surface colorimetric indicator (crosses of accompanying figure). We have now calculated the *p*H at the same surface from the Gibbs-Donnan equilibrium (continuous line of accompanying figure) and find values in reasonable agreement with those obtained by the other two methods. The thickness of the surface phase was taken as that given by the theory of Debye and Hückel.



Wilbrandt has suggested[3] that the Gibbs-Donnan equilibrium can also be used to calculate the distribution of Na^+ and Ca^{++} between a surface and a bulk phase. We have studied this by chemical analysis of palmitate monolayers spread on solutions containing varying concentrations of Na^+ and Ca^{++}. As predicted by the Gibbs-Donnan relationship, there is a lower Na : Ca ratio in the surface than in bulk, but the ratio found is much less than the predicted value (see accompanying table), which suggests that Ca^{++} may be bound at the interface by other forces in addition to that of simple electrostatic attraction.

MOLAR RATIO Na : Ca IN MONOLAYERS OF PALMITATE SPREAD ON 0·1 *N* SALINE.

Ratio in saline	100 : 1	200 : 1	400 : 1	2000 : 1
Ratio found in monolayer	0·13 : 1	0·18 : 1	0·27 : 1	0·31 : 1
Ratio calculated from Gibbs-Donnan equation	4·5 : 1	8·2 : 1	15·5 : 1	109 : 1

The negatively charged surfaces act as reservoirs of divalent ions, and the discharge or dissolution of these surfaces will release a disproportionate amount

of divalent ions. Such reservoirs may be the source of the intracellular free calcium released by stimulated cells[4].

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July 11.

[1] Danielli, *Proc. Roy. Soc.*, B, **122**, 155 (1937).
[2] Hartley and Roe, *Trans. Faraday Soc.*, **36**, 101 (1940).
[3] Wilbrandt, *Verh. Schweiz. Physiol.* (July 1939).
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Cosmic Rays and Poisson's Law

LET us consider a great number n of events of a sequence the mean value of which is $\bar{n}$. If these events obey Poisson's law, the probability of actual realization of the nth event is

$$P(n) = \frac{\bar{n}^n}{n!} e^{-\bar{n}}$$

In the case of cosmic rays, $\bar{n}$ would be the mean value of the number of cosmic rays registered during the same interval of time by a counter during a long interval, and n any number of rays registered in one interval by the same counter, the probability $P(n)$ of which is to be ascertained.

But Poisson's formula can be applied only if: (1) the probability of the event considered is very small (less than 0·1); (2) the frequency is never less than 10; (3) the events considered are independent.

The two first conditions are certainly fulfilled by the numbers of cosmic rays, the second one depending on the time of computation only. Therefore we shall deal with the third condition, which is essential. Indeed, it often occurs that a slight dependence entails extensive modification in the theoretical distribution based on the independence.

We tried to show the independence of the numbers of cosmic rays registered during the same interval of time, which was a quarter of a minute. The following method[1] was adopted. The registered values were grouped in three series: 'chronological series' (sequence of values as obtained); 'ordinal series' (sequence of values classified in increasing order); and 'series of consecutive values' (sequence of values which follows each observed value). Each of the two latter series is decomposed into decils, that is, into ten equal parts, numbered from 1 to 10, and from I to X. The probability that one value taken at random in the chronological series should belong to either decil of either group must be 1 : 10. Consequently, if there is independence, the probability that the same value should belong at the same time to two decils, one in the 1–10 group, the other in the I–X group, should be 1 : 100.

We had 1,600 numbers registered. Therefore, should we have each number with two indexes, one taken from the 1–10 group and the other from the I–X group, the result would be 100 groups of values, allowing for Bernoullian fluctuation $\mu^2 = npq = 16$.

We arranged the following table:

	I	II	III	IV	V	VI	VII	VIII	IX	X
1	24	13	18	17	12	21	16	10	13	16
2	22	21	22	8	22	11	17	14	14	9
3	15	10	24	18	19	18	8	21	17	9
4	19	11	13	28	4	17	25	14	11	18
5	6	19	19	9	34	11	6	19	14	23
6	20	19	11	18	5	28	11	12	17	18
7	16	9	12	16	9	20	22	17	20	18
8	13	21	10	13	25	12	16	16	19	15
9	12	20	18	8	22	9	19	19	16	17
10	12	17	13	25	7	12	20	18	19	17

The table shows that 53 values are outside the theoretical limit 16 ± 3. The difference is of the same order of magnitude as the one M. Ferber found for the intervals between the emissions of the alpha particles of polonium[2].

The experimental proof of the hypothesis of independence has not therefore been obtained; and it seems that there is a correlation which, though feeble, renders doubtful the legitimacy of application of Poisson's law to the registered numbers of cosmic rays. On the other hand, the existence of four hypo-normal groups (5–VI, VII), (6–VII, VIII), (7–II, III), (10–V, VI) confirms our conclusions, as according to the hypothesis of independence only one of these groups was to be expected.

Finally, the high values in the squares of the main diagonal of the table suggest the existence of many pairs of consecutive values of the same order of magnitude.

I am indebted to Prof. A. Cyrillo Soares for much valuable advice and assistance, and to the Instituto para a Alta Cultura for material support.

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July 11.

[1] Eyraud, H., *Ann. l'Univ. de Lyon*, 3° série, Sciences, Section A, 30 (1936).
[2] *J. Phys.*, **10**, 134 (1939).

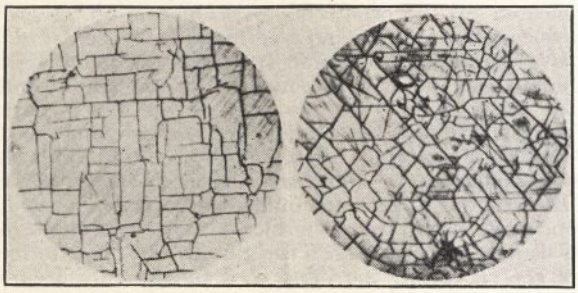
Etching Reagent for Chromite

THE resistant nature of chromite to all the usual etching reagents used in polished section examination is well known. Etch patterns on chromite would assist in the determination of the orientation of interlocking and anhedral grains in a rock and in the recognition of zoning. A search for a suitable reagent has revealed that chromite can be etched by treatment with concentrated perchloric acid, which is not mentioned in standard works on mineragraphy.

Polished sections approximately 2 cm. square were prepared on a billiard cloth lap or on a Graton-Vanderwilt polishing machine. The former method gives a satisfactory polish with most chromite specimens and is preferred, as it is necessary, before etching, to remove the bakelite mount used in the latter method.

The polished section is placed face downwards in a crucible of a size such that the specimen does not quite rest on the bottom. Sufficient perchloric acid

to immerse the lower part of the specimen is added. For the size of specimen used, a No. 0 Royal Worcester porcelain crucible and 2–3 ml. of 70 per cent perchloric acid are satisfactory. The crucible is heated until the acid begins to fume, and the temperature is maintained until all the acid has evaporated. It is desirable to continue heating for about five minutes longer.



ETCHED CHROMITE: LEFT, CUBE FACE; RIGHT, OCTAHEDRAL FACE. × 400.

A first treatment may reveal no etching effects, and the procedure may have to be repeated several times. The depth and width of the etch grooves seem to depend to some extent on the short period of heating after the acid has evaporated, and great care must be taken to avoid disintegration of the polished surface by prolonging this final stage.

The perchloric acid often affects the cementing minerals and causes the polished surface to become extremely fragile. Parts of a section may fall out and etched specimens require gentle pressure when being cleaned. While chromite rocks with but little interstitial silicate minerals are not greatly weakened, those containing much gangue become rather more difficult to treat; nevertheless, even if only a few isolated chromite grains remain in the section, they can afford such data as may be required.

Polished surfaces parallel to the cube, octahedral and rhombic-dodecahedral faces of a large chromite crystal were prepared. The first-named face etched more slowly than the latter two. Cube and octahedral etch patterns are shown in the accompanying illustration.

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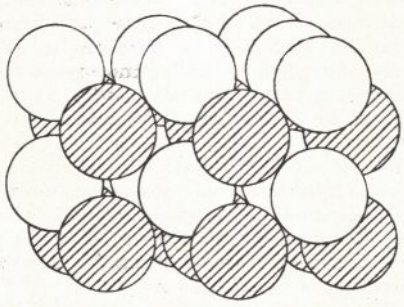
Symmetrical Arrangement of Equal Spheres

IN Barlow's paper[1] on the "Probable Nature of the Internal Symmetry of Crystals" he writes: "A fifth kind of symmetry . . . bears the same relation to the fourth kind as the second bears to the third; that is to say, it may be regarded as produced by the insertion of additional points in positions midway between points arranged in the fourth kind of symmetry". This is not so. Barlow did not describe or figure that arrangement which does bear the same relation to the fourth kind which the second bears to the third. It is shown in the accompanying figure. Its triangular base and first two layers are the same as those of Barlow's "second kind of symmetry"; but its third layer lies over the first, the fourth over the second, and so on. If now we insert additional points in positions midway between points in this structure, Barlow's "fifth kind of symmetry" is produced.



The new structure may be regarded as derived from the hexagonal close-packed assemblage by vertical compression and simultaneous dilation in horizontal directions. Similarly, compression of the cubic close-packed assemblage gives rise to Barlow's "second kind".

The elusive nature of the problem which Barlow set out to solve will be appreciated when it is recalled that P. G. Tait, examining the same subject, described two arrangements[2], supposed to be distinct, which are merely different aspects of the same thing (Barlow's cubic close-packed assemblage) and failed to discover the hexagonal close-packing.

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[1] Barlow, W., NATURE, **29**, 186 (1883).
[2] Tait, P. G., *Proc. Roy. Soc. Edin.*, **4**, 535 (1862), arrangements iii and iv.

Recombinants between Drosophila Species the F_1 Hybrids of which are Sterile

THE genetic analysis of species differences is of especial interest in precisely those cases where the sterility or inviability of the hybrids between the species stands in the way of such analysis. A notable case of this kind is that of *Drosophila melanogaster* and *simulans*, species which otherwise would present most favourable conditions for detailed analysis, on account of the already existing knowledge of the genetics of each species and the existence of abundant stocks providing suitable genetic tools ('markers'). We have found a means of circumventing the sterility of the F_1 hybrids between these species and thus obtaining types of the same kind as would be produced in a backcross of the F_1 hybrid, were it fertile, to *melanogaster*; it is at the same time possible to recognize, by means of the markers used, what combination of chromosomes is present in the pseudo-backcross progeny and thus to determine the effects of the different chromosome combinations.

The means used is to take triploid *melanogaster* females carrying recessive mutant genes in all their major chromosomes and to cross them with heavily irradiated *simulans* males bearing the dominant normal alleles of these genes. The triploid females produce eggs most of which have one or more of their chromosomes in diploid number. On the other hand the X-ray treatment, as we had found in earlier work with *melanogaster* alone[1,2], causes the loss of individual chromosomes, presumably by breakage, in some 5 per cent or more of the sperm-

atozoa capable of giving viable offspring, although sperm in which two chromosomes have been simultaneously affected by a mutual translocation resulting in acentric and dicentric combination-chromosomes are incapable of giving viable offspring. When an egg with an extra chromosome or chromosomes happens to be fertilized by a sperm in which the homologous chromosome or chromosomes have been incapacitated, a viable diploid results, in which the chromosomes in question are of homozygous *melanogaster* type and the others are heterozygous as in the species hybrid. The kind of recessive character shown by the individual indicates which chromosomes are of homozygous *melanogaster* type. The resemblance to a backcross fails only in that the chromosomes are inherited as units ; that is, there has been no opportunity for crossing-over.

Some 350 progeny have been obtained from this pseudo-backcross. The majority of the types of recombinants prove to be viable, although most have a viability considerably below normal. The inviability of hybrids bearing no *simulans* *X*, reported by Sturtevant[3] in 1920, proves to be due to interactions of genes in the *X* with those in both the second and third chromosomes, but more especially with the latter. Thus it has been possible to obtain viable adult hybrids without a *simulans* *X* but with a *simulans* II, and also (but not so readily) those without a *simulans* *X* but with a *simulans* III, when the other pair of major autosomes (III or II, respectively) is purely of *melanogaster* type. Study of the frequencies indicates the existence of several inter-chromosomal viability interactions. Similarly, it can be concluded that there are several interacting genes affecting fertility, as all viable recombinants of the major autosomes show sterility, although the degree of reduction of the gónad is (as shown by histological studies, carried out by Koller) different for the different chromosome combinations. The chief morphological abnormality of the hybrids—the bristle reduction and associated abnormality of the abdominal banding—proves to be due to interaction between a gene or genes in the *X* of *simulans* with an autosomal gene or genes of *melanogaster*, located at least in part in the second chromosome.

That the sterility and inviability effects are wholly chromosomal (and therefore Mendelian) in origin was shown by the obtaining of a single individual which happened to have all its major chromosomes from *melanogaster* and which alone, of all the progeny, proved to be fertile. The breeding of this individual to *melanogaster* has made it possible to transfer the fourth and the *Y* chromosomes into an otherwise purely *melanogaster* genotype. Here their *simulans* origin has been verified by cytological observations, carried out by Slizynski. Both chromosomes when in the *melanogaster* genotype show important genetic differences from their *melanogaster* homologues ; a detailed analysis of these differences is in progress.

A full account of the above experiments and of the bearing of the results on problems of speciation is being prepared by us, and accounts of the histological and cytological observations will be published by Koller and by Slizynski, respectively.

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July 18.

[1] Muller, H. J., *J. Genetics*, **40**, 1–66 (1940).
[2] Pontecorvo, G., Ph.D. thesis, University of Edinburgh. 146 pp. (also Muller and Pontecorvo, unpublished) (1940).
[3] Sturtevant, A. H., *Genetics*, **5**, 488–500 (1920).

Blind Seed Disease of Rye-Grass

REFERENCE has been made by Wilson, Noble and Gray[1] to the confusion existing in the nomenclature of blind seed disease of rye-grass. The causal organism has been referred to by Hyde[2] as Pullularia, and the trouble is often referred to as "Pullularia disease". It seems doubtful whether the conidial form of the causal fungus is Pullularia, and the position is complicated by the occurrence of Pullularia sp. closely associated with the blind seed fungus. Wilson *et al.*[1] have pointed this out and state that the blind seed fungus and Pullularia sp. may be present on one and the same seed. Our work confirms this ; both organisms may be found when examining seed samples. The conidia are distinct ; those of Pullularia are smaller in size and yeast-like in character, while those of the blind seed fungus are larger, allantoid, and more regular in size and shape. Whereas Pullularia is usually associated with the glumes and the exterior of the caryopsis, the blind seed fungus only occurs in and on the caryopsis. Pullularia has been isolated from the caryopsis, but not from caryopses surface sterilized before examination. It is always the blind seed fungus which has been obtained in such cases.

DEAD RYE-GRASS SEED BEARING TWO OF THE HELOTIUM-LIKE APOTHECIA, THE PERFECT STAGE OF THE BLIND SEED FUNGUS.

Experiments designed partly to determine the relative pathogenicity of these fungi have been concluded and the results are of interest. Turves of commercial perennial rye-grass were lifted and brought to the laboratory. When in full flower, a bunch of the heads in each turf was inoculated with spore suspensions in sterile water. The following spore suspensions were used : (1) conidia of Pullularia sp. isolated in Northern Ireland from rye-grass seed ; (2) conidia of the blind seed fungus isolated in Northern Ireland from rye-grass seed ; (3) conidia of the blind seed fungus isolated by Neill in New Zealand ; (4) suspension of ascospores from Helotium-like apothecia growing from dead rye-grass seeds in the rye-grass field from which the turves were taken. (These apothecia bear a marked similarity to those described by Neill and Hyde[3] in New Zealand ; this appears to be a first record of their occurrence outside New Zealand, and a photograph of a dead seed bearing two apothecia is reproduced herewith) ; (5) control heads immersed in sterile water.

Inoculations were made on June 4 and an examination for disease on June 24–25. Five hundred seeds were examined from each batch of heads. The young caryopses were extracted and examined microscopically for the presence of conidia. The following results were obtained.

The seeds from the control batch were all healthy. No conidia of either the blind seed fungus or Pullularia were found. No diseased seeds were found in the heads inoculated with Pullularia.

The heads inoculated with the Northern Ireland strain of the blind seed fungus showed 10·6 per cent of the seeds to be severely affected with the disease. At the time of examination, the diseased seeds were dull brown in colour, soft in texture and apparently quite dead.

Inoculation with the New Zealand strain of the parasite gave similar results; the percentage of diseased seeds obtained was somewhat lower, being 5·4.

The seeds examined from the heads inoculated with an ascospore suspension from the Helotium-like apothecia were affected to the extent of 7·6 per cent; the infection was typical. It would therefore seem clear that the Helotium-like apothecium found on dead rye-grass seeds in the early summer in Northern Ireland is the perfect form of the blind seed fungus. Cultures raised from single ascospores resemble those of the blind seed fungus in all respects.

Other apothecia resembling the type on rye-grass seed have been found on vegetable detritus, etc., in rye-grass fields. None has been tested for pathogenicity, but ascospores from them have not produced cultures similar to those of the blind seed fungus. Apothecia on the basal leaf sheaths of standing rye-grass have also been found, and it is believed that this form may be that referred to by Neill[3] as Lolium fungus No. 2.

These results show that the blind seed fungus is the parasite responsible for blind seed disease of rye-grass in Northern Ireland and, in the main, confirm the pioneer work carried out by Neill and Hyde in New Zealand. They also indicate that the Pullularia sp. commonly found associated with diseased rye-grass seeds is not parasitic, and that its role is probably saprophytic. It therefore seems desirable, for the present, to dissociate the name Pullularia from this disease, and to refer to it only by the name suggested by Neill, namely, blind seed disease.

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Ministry of Agriculture,
Plant Disease Division,
The Queen's University,
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June 26.

[1] Wilson, M., Noble, N., and Gray, E. G., NATURE, **145**, 783 (1940).
[2] Hyde, E. O. C., *New Zealand J. Agric.*, **57**, 301 (1938).
[3] Neill, J. C., and Hyde, E. O. C., *New Zealand J. Sci. Tech.*, **20**, 281A (1939).

Structure of *Hemimerus deceptus* Rehn, var. *ovatus*, and the Classification of Dermaptera

I HAVE carried out detailed work on the external and internal anatomy of Hemimerus, and find that the semi-parasitic mode of life of the insect has modified various structures in its anatomy, but that it still retains many primitive features.

The mouth parts have bilobed lingula. There is a prostheca on the mandibles, and a large pair of superlinguæ. Pleural sclerites are well developed, despite the apterous condition, and the mechanism of hiding the legs under the body is interesting. There is a well-developed peritrophic membrane in the stomach, and a complex grinding mechanism in the proventriculus. The spiracular openings have a primitive guarding apparatus and (with one or two exceptions) there is an absence of transverse tracheal commissures. The most remarkable feature of the reproductive system is the presence of two ejaculatory ducts opening separately on a single penis.

Jordan[1] was not sure of this dual nature of the ductus ejaculatorius, while Snodgrass[2] mentions the presence of two exit ducts. Burr[3] thought that one of these ducts was reduced and had created two separate sub-orders, namely, Hemimerina and Arixenina, for the reception of Hemimerus and Arixenia respectively. The classification of Dermaptera could be simplified by dividing it into two series only, namely, Protodermaptera (with two ejaculatory ducts), and Eudermaptera (one ejaculatory duct). Hemimerus could be amalgamated into the former and Arixenia into the latter, while the two sub-orders Hemimerina and Arexenina be eliminated.

The insect was procured from Tanganyika, and as it differs from the specimens of Rehn[4], it has been named *Hemimerus deceptus* Rehn, var. *ovatus*, and specimens have been deposited in the British Museum (Natural History). The intersegmental membranes of many specimens were full of the hypopial stages of a Tyroglyphid mite. It is hoped that a detailed account of this work will shortly be published.

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June 10.

[1] Jordan, K., *Novitat. Zool.*, **16**, 327 (1910).
[2] Snodgrass, R. E., *Smithsonian Misc. Coll.*, **96** (5), p. 42 (1937).
[3] Burr, M., *J. Roy. Micro. Soc.*, 413 (1915).
[4] Rehn, R. A. G., *Proc. Acad. Nat. Sci. Philadelphia*, **87**, 457 (1936).

Colonel Kenneth Macleod

IN the note on Colonel Macleod in NATURE of July 20, p. 90, there is one omission which, I venture to think, should not go unremedied, namely, his description in 1881 of what he thought was a "new disease", in fact he called it the "New Indian Disease", allied to, but at the same time not identical with, beriberi; he gave it the name of "epidemic dropsy". He had observed it in Calcutta and its suburb Howrah from 1877 onwards. Though the etiology is even now not quite clear, Macleod's clinical description was so full and accurate that little has been added to it, and nothing has had to be taken away. This shows how great were his powers of accurate clinical observation.

A more detailed account of the condition is given in "A History of Tropical Medicine" (London: Edward Arnold, 1939), vol. 2, pp. 897 *et seq.*

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RESEARCH ITEMS

Li Tribes of Hainan Island

A PRELIMINARY study of the origin of the Li tribes of Hainan Island by Chungshee H. Liu appears in the first issue (January 1940) of *Meridio-Occidentale Sinense*, a newly established journal for the scientific study of south-west China published by the South-West China Society at Kunming, China. The Li tribes are first mentioned in the "Annals of the Han Dynasties" (206 B.C.–A.D. 219), and since have been known by various cognate names, themselves adding a labial which by a phonetic change might suggest a relation with "Malay". In some localities *Moi* points to a common origin with other aboriginal tribes of Indo-China; or again an affinity with the Lao of Tonkin has been suggested. There is reason to believe that the present Li tribes are descended from the Lii family or clan; but whether they had settled in Hainan before the Han dynasty or came to the mainland through Hainan demands further research. Physically the Li are a fine race of stout or slender build and medium stature (160 cm.). The skin is yellowish-brown, red-brown, or pale yellow; hair black, straight and fine; eyes medium brown, rarely light brown, oval, semi-oval or round in aperture, the eyefold being absent, but rarely traceable; nose concave or straight with more or less flat apertures. The cheek-bones are not prominent. The cephalic index is 80·20, the nasal index 75·73. In all these characters they differ from the Chinese, but are akin to Tai (Shan) on the one hand and Malay on the other. There has been, however, a generous admixture of Chinese blood. Racially they may be classified as Oceanic or Southern Mongols or Nesiots, or as Palæomongolides of von Eichstedt's new classification. The cultural relationship is complicated, but they appear to belong to the Indonesian cultural cycle. Linguistically their language belongs to the Thaic family.

Nutritional Oedema and Dietary Deficiency

J. B. YOUMANS read a paper on this subject at the Eighth American Scientific Congress on May 14. Nutritional oedema, long ago described under such names as famine oedema and starvation oedema, has, since the War of 1914–18, been known to be due to a lowering of the serum proteins caused by a deficient intake or an improper absorption or utilization of food. The disease appears epidemically, endemically, or as sporadic cases. Epidemic and endemic cases occur in populations subsisting temporarily or permanently on inadequate diets, particularly diets low in protein. Sporadic cases occur in patients with other disease which affects the intake or absorption of food. The principal clinical manifestation of the disease is an oedema of varying degree with few other signs and symptoms in uncomplicated cases. Diagnosis is made by the presence of the oedema, otherwise unexplained, associated with a decrease in the concentration of serum proteins, and a drop in the colloid osmotic pressure of the blood. A determination of the serum proteins may reveal a latent or preclinical stage of the disease before the oedema becomes manifest. Observations on the incidence and manifestation of the disease in the southern part of the United States are to be reported.

Damaged Starch and the Diastatic Activity of Flour

THE shearing and crushing in the roller milling of flour results in a particular type of damage to starch granules characterized microscopically by a curious flat appearance and faint outline (C. R. Jones, *Cereal Chem.*, **17**, 133; 1940). Their attenuated outline in contrast to the boldness of some granules has suggested the term 'ghosts'. Congo red does not stain sound granules of starch, whilst 'ghosts' all stain orange pink. In general, it is found that in flours differently milled from the same wheat the order of abundance of 'ghosts' is in the same direction as the 'maltose' figure. The enzymes responsible for the diastasis in sound non-germinated wheat may be regarded as uniformly distributed over the endosperm. The soluble 'inner starch' is ordinarily protected by an envelope or skin of insoluble 'outer starch' surrounding the granule. The former alone is fermentable by the diastatic agent, which cannot act until the outer resistant skin of the granule is broken, and the 'ghosts' alone are therefore the source of sugar formation in dough. Differences in diastatic activity between flours from different types of wheat are not necessarily due to differences in amylase content or in starch susceptibility; they are at least partly to be explained by differences in the physical hardness of the endosperm, this in turn determining the extent of the damage to the starch during milling.

Origin of the Loganberry

THERE has been considerable debate as to whether the loganberry is a hybrid between the Californian blackberry, *Rubus vitifolius*, and the raspberry, as claimed by its raiser, Judge Logan, or whether the loganberry is an offshoot of *R. vitifolius*. M. B. Crane (*J. Genetics*, **40**, 129–140; 1940) and P. T. Thomas (*J. Genetics*, **40**, 141–155; 1940) have produced considerable evidence to support the theory of hybrid origin. Crane crossed *R. vitifolius* with a tetraploid raspberry and obtained a hybrid which resembles the loganberry in morphology, sex, fertility, and chromosome number. It, like the loganberry, is nearly true breeding. The dominance relationships in these polyploids and sex determination in the Rubi hybrids are interesting. The cytology of *R. vitifolius*, loganberry and diploid and tetraploid raspberries indicates that the Hailshamberry and Everbearing are autotetraploid raspberries *iiii*, *R. vitifolius* is an alloctoploid $v_1v_1v_1v_1v_2v_2v_2v_2$. The hybrid between *R. vitifolius* and Hailshamberry has completely paired chromosomes and has the chromosome constitution $v_1v_1v_1v_1$ *ii*, which is also believed to be that of the loganberry. Further cytological evidence indicates that the chromosome sets v_1v_2 and *i* are related to one another, but differentiation has taken place in the different species.

An Electromagnetic Microbarograph

To see whether microseisms might be caused by microbarographic oscillations of similar period, electromagnetic microbarographs have been set up at St. Louis and Florissant (*Trans. Amer. Geophys. Union*, 1938). The instruments were built by W. F. Sprengnether of St. Louis with the collaboration of D. C. Bradford and Father Vincent M. O'Flaherty. One consisted essentially of a large brass air

chamber (*ca.* 18·3 litres), over the open end of which was tightly stretched and clamped a rubber diaphragm. The drum stood on its side so that the plane of the diaphragm was vertical. A short solenoid was attached to the diaphragm at its centre with its axis normal to the rubber surface and its weight supported from the frame by two vertical wires balanced by pairs of rubber stays below, spaced at angles of 120° each and stretched parallel to the diaphragm. Into the air core of the solenoid was inserted without contact one pole of a cobalt steel bar magnet rigidly supported by the frame. The air chamber was provided with an adjustable needle valve so that the pressure within the chamber slowly adjusted itself at any predetermined rate to the average atmospheric pressure outside. It was found that a Leeds and Northrup type *R* galvanometer of seven seconds period gave the best registration. The galvanometer magnified the membrane vibrations about 6,600 times. The galvanometer and microbarograph coil were shielded from stray fields. Odd recordings were found to be due to the instrument behaving as a seismograph for very short period vibrations. Blasts and nearby earthquakes have been recorded by the microbarograph when the vibrations of the ground had more or less the same period as the natural vibration of the membrane (*ca.* 0·1 sec.). Distant earthquakes do not affect the microbarograph. The instrument has worked extremely well.

Interior of the Earth

R. STONELEY has published a paper in which he gives a short summary of the various lines of research that supply information on the interior of the earth (*Occas. Notes Roy. Astro. Soc.*, No. 8 ; March 1940). Wiechert's hypothesis that meteorites may be typical of the matter, considered from the chemical point of view, of which the planets are composed, suggested from the classification of meteorites into stony and metallic that rock and iron would be the chief constituents of the earth. On these grounds he proposed a core of specific gravity 8·2 and of radius 0·78 times that of the earth, surrounded by a shell of which the material had a density 3·2. Observations of variation of latitude, earth tides and horizontal pendulums supply important evidence regarding the interior of the earth, and a brief explanation is given of the application of these methods. The well-known h and k terms in the equilibrium tide cannot be derived by observation from the yielding of the earth, but k can be derived from the observations of the variation of latitude. Knowing the value of $1 - h + k$, h can be found, and as these quantities can be obtained by an independent method on the assumption of a certain constitution of the earth, a comparison can be made. Sir George Darwin deduced in this way a rigidity for the earth comparable with steel, assuming a homogeneous composition. The greater portion of the paper is occupied with a description of the evidence obtained from earthquake records. The primary and secondary phases of the preliminary tremors, denoted by *P* and *S*, have been identified with the arrival of compressional and distortional waves that have passed through the body of the earth, the times of travel being approximately 1 to 1·8. The behaviour of these waves for epicentral distances greater than 105° led Oldham in 1906 to suggest that the earth had a core of small or zero rigidity incapable of transmitting distortional waves. The subsequent work of Knott, Gutenburg, Wiechert and Jeffreys on the nature of this central core is briefly dealt with. Among other matters considered in the paper are the electrical conductivity in the interior of the earth and the distribution of the internal temperature ; this attains about 3,000° C. at a depth of 550 km., according to Jeffreys.

Adsorption at a Liquid Interface

IT has been shown by experiment that the adsorption at a gas-liquid interface does not always agree with that calculated from Gibbs's equation $\Gamma = -c(d\sigma/dc)/RT$. C. W. Gibby and C. Argument (*J. Chem. Soc.*, 596 ; 1940) have measured the adsorptions of five dyes (methylene blue, Congo red, Bordeaux extra, indigo carmine X and Solway ultra blue B) at a mercury-water interface. The last two include types of structure (indigoid and anthraquinonoid) not previously studied. In each case it was found that the measured adsorption passes through a maximum as the dye concentration increases and is always positive in the concentration range examined. The areas of interface per molecule adsorbed were calculated, together with the approximate areas of the molecules. The ratios of the two sets of values suggest considerable orientation of the molecules at the interfaces. Interfacial tension measurements were made and from them values of the adsorption calculated by Gibbs's equation. These are not in agreement with the measured values and in some cases are negative. In no case do the curves representing theoretical and measured adsorptions coincide at small concentrations.

Use of Eros to determine the Solar Parallax

THE Astronomer Royal has discussed the programme of observations of Eros near the favourable opposition of 1931 (*Mon. Not. Roy. Astro. Soc.*, **100**, 6 ; April 1940). Observations made at Bergedorf Observatory published recently by Dr. C. Vick (*Ast. Abh. Hamburger Sternwarte in Bergedorf*, **5**, No. 3, 1939) led him to conclude that Eros is unsuitable for the accurate determination of the solar parallax. Vick's conclusions are not corrobated by Dr. Spencer Jones. The short-period variations with periods 12·5311 minutes and 79·6845 minutes found by Vick are shown to be non-existent, and the explanation of the large probable errors of some of the Bergedorf observations is found in the unsatisfactory method of observation. Although these suspected short-period variations in the position of the centre of brightness of Eros are not confirmed, other apparent variations in position of the centroid of brightness with periods 5h. 16m. and 2h. 38m. are next investigated. Eros is known to be variable in brightness with a total period of 5h. 16m., and the period between consecutive minima of brightness is 2h. 38m. In the discussion of the 1901 observations, Hinks did not obtain conclusive evidence of such variations, from which it may be inferred that the effect must be small. The present investigation failed to detect any variation with period 5h. 16m., nor could any variation with period 2h. 38m. be detected in right ascensions. There is a small but well-confirmed displacement in declination with a period 2h. 38m., of total range about 0·05″. As this variation has no systematic effect on the determination of the solar parallax from the comparison between the observations in declination at northern and southern observatories, the conclusion is that Eros is a suitable object for the accurate determination of the solar parallax.

SOME ASPECTS OF AMERICAN CONSERVATION SCHEMES*

ROLE OF RECLAMATION IN CONSERVATION

BY JOHN C. PAGE, BUREAU OF RECLAMATION

THE biggest job for conservationists is to combat the habit of thinking in terms of limitless resources. The destructive results of this habit, seen in our dwindling forests, our abandoned mines, and our gullied fields, have not yet caused sufficient impression to turn us completely away from our foolish optimism as to the future.

The movement towards conservation, begun under Theodore Roosevelt four decades ago with the establishment of the National Forest Service and the Bureau of Reclamation, has received its greatest impetus under President Franklin Roosevelt. Mr. Harold L. Ickes, of the Department of the Interior, defines conservation as 'prudent use'. This is the sense of the word in which the Bureau of Reclamation has tried to carry forward its own particular field of conservation—irrigation in the West. One third of the United States—the West—is arid or semi-arid. Much of this third is desert. Streams periodically drop to tricklets in the dry summer. No agriculture is safe in this West without irrigation, and even irrigation is unsafe without storage reservoirs.

Irrigation in the West is old, was practised before the coming of white men, who took up and improved on Indian methods and thus founded their first settlements. Now twenty million acres have been brought under irrigation, through individual enterprise, co-operative endeavour, and State and Federal aid. Increasing size and complexity of irrigation works have thrust the Federal Government into the position of being the principal agent in the field of water conservation and desert land improvement.

Beneficiaries of this work, carried out by the Bureau of Reclamation, pay its cost. Out of concession to national benefits, the irrigators are not charged interest, but other beneficiaries, such as consumers of electric power, are.

The carefully thought-out conservation work of the Bureau of Reclamation contrasts with earlier methods of developing the West, to which part of our present difficulties are directly traceable. Once western land was regarded as merely a source of revenue. Later, 160 acres was arbitrarily selected as the proper homestead for a family. Still later, it was recognized that irrigation alone would provide the necessary security in most western areas.

With the exception of the Bureau of Reclamation, which plans conservation controls on water and land in advance of their use and development, conservation activity to-day is mainly corrective. The constructive work of the Bureau has resulted in 53,000 new farms, 258 new cities and towns where nearly 1,000,000 people live.

One fifth of the cost of Federal Reclamation projects has been repaid. The projects turn 100,000,000 dollars yearly into the channels of trade. The present programme will ultimately provide 850,000 people with homes.

The future of reclamation is limited by the West's water supply. Its horizon is placed at 42½ million acres, about 6½ per cent of the 700,000,000 arid and semi-arid acres in the West. Twenty million are already under irrigation, and 2½ million are in the Bureau's present construction programme, leaving but 20 million available.

CONSERVATION OF FOREST RESOURCES

BY C. L. FORSLING, U.S. FOREST SERVICE

Forests in great variety originally covered 7½ million square miles, or one half of the land surface of the Western Hemisphere. The area has been reduced to about 6 million square miles since the beginning of the sixteenth century. Growth of population and industries since the middle of the nineteenth century resulted in serious inroads into this rich heritage, especially in the United States, where the deliberate policy of the Government was to transfer ownership of the natural resources into private hands.

The forests of the United States and Canada, owing to their composition and the character of their principal woods, were cut heavily to supply world markets and to meet the needs of growing local populations. Extensive devastation and severe deterioration of the remaining forests resulted. A major problem now is the rehabilitation of these forests to restore them more nearly to their potential continuous productive capacity, which, for the most part, will be a slow process. Meanwhile, demands on the forests of the other American countries will probably increase. Unless steps are taken to prevent it, exploitation of these forests is likely to result in unnecessary destruction or impairment of their productivity, with economic and social effects at least as disastrous as in North America.

The experience of the United States suggests the following essential foundations for a sound policy of forest conservation and use:

(1) Systematic land-use planning to determine, in relation to other forms of land use and social and economic requirements, the amount and character of the available land resource that should be devoted to forestry.

(2) The formulation of policy as to the kind and extent of forest land that should be in public ownership and under public management.

(3) The determination of the means whereby the public may aid in keeping privately owned forest lands productive, and of the degree of public control needed to be exercised over privately owned forest land in order to safeguard the public interest in these resources.

(4) Broad education of people in general and forest owners in particular, as to the value of forests and the basic principles of a forest policy.

(5) A broader knowledge of suitable technique for harvesting and processing forest products, in order to minimize waste, enable efficient operation, and bring the highest sustained income in the long run.

* From papers presented at the Eighth American Scientific Congress meeting at Washington during May 1940.

(6) A broader knowledge of the science and practice of forest management and the underlying sciences, with adequate provision for research in these and related subjects, including better protection from fire, insects, and disease.

(7) Development of uses and markets for all manner of forest products, including research on the properties and utilization of wood and other forest products.

(8) Competent, adequately trained forestry personnel.

(9) A minimum of political interference with forestry personnel and policies.

Co-operation of all American countries is needed in order to advance the science and practice of forestry in the Americas; a Pan-American forestry institute is suggested for this purpose.

National Parks in Conservation

By Arno B. Cammerer, Director, National Park Service

The national park idea originated in the New World. In 1870, a party exploring the Yellowstone decided not to try to claim parts of the area for private exploitation but to work for its preservation as a national park to be preserved and enjoyed by the public for all time. Yellowstone, established in 1872, was, therefore, the first national park.

In 1906, the Antiquities Act recognized archæological material on public lands as public property and authorized the President to establish publicly-owned objects of prehistoric, historic, and scientific interest as national monuments, to be preserved intact. In 1916, Congress established the National Park Service to protect the national parks, monuments and similar recreational reservations and to promote their appropriate public use.

In 1933, all national parks, monuments and related historic sites were brought together under the jurisdiction of the National Park Service. In 1935, the Historic Sites Act enunciated the national policy to preserve historic sites and objects for public inspiration and benefit. In 1936, Congress authorized the National Park Service, in co-operation with other Federal agencies and with the States, to conduct a national recreational area study for the purpose of providing a co-ordinated national recreational programme.

The national park system now includes 158 historic and natural areas, totalling 21,515,000 acres. Recreational utility is the yardstick of good land management. Parks are a form of land use—not a type of scenery. The park type of use is equally applicable to the mountain tops, the great plains, the coastal forests, the deserts, or the seashores. Park standards refer to the type of reservation and not to the type of scenery included in it. In parks we attempt to preserve the land whole. To do so our management must rest upon a sound, scientific basis. Parks are for people to use, but we should not confuse the purposes of the wilderness park with the purposes of the city park. Each has its legitimate purposes and should be developed to achieve those purposes.

How many parks are needed? The answer cannot be given quantitatively because recreation is a quality of living. There would be more parks if it were not for the vain promises of the multiple use advocates. Multiple use is the theory that lands can be most profitably managed if used in a number of different ways simultaneously. Multiplicity, however, is not and cannot be an objective. Parks and recreational areas may provide multiple use, but multiplicity is merely an incidental phase of good land management. Multiple use as a descriptive term is not objectionable provided it is merely descriptive of that which is an incidental aspect of optimum use. The multiple use theory has been confused with sound land classification. It is believed that the exponents of multiple use really have optimum use in mind. The classification of resources for their best use would result in more adequate recognition of park and recreational lands.

Range Conservation

By R. H. Rutledge, Director, Grazing Service

In the aftermath of the War of 1914-18, expansion followed by drought, depression, dust storms and shifting populations, America began seriously to take stock of her natural resources. The inventory revealed that a sizable part of our economic and social problems were traceable to a dwindling of range resources. Among other things the evidence led to the conclusion that to ensure the foundation for a desirable standard of living in the range country and in the nation generally there must be an adequate area of forage-producing land and a range conservation programme designed to foster its continued productivity. To secure such a programme Congress passed a number of conservation Acts and placed the conduct and co-ordination of that programme in several Federal agencies. Through the guidance of the Federal Government and the co-operation of States and the citizens range conservation is going forward on a wide front.

The Western range country comprises about half of the total area of the United States. It consists of 11 far-western States and sizable portions of the 6 adjacent plains States. Its gross area of about 1,525,000 square miles is slightly greater than the total of Bolivia, Chile, Colombia and Ecuador, and its grazable land, containing about 1,137,000 square miles, is comparable to the area of the Argentine.

Three-fourths of the wool and mohair, half of the lamb and mutton and nearly one third of the beef and veal consumed in the United States is produced in the western range area. Nearly half of the land is in private ownership; the remainder is public land belonging to States, counties and the Federal Government. Collectively these lands comprise the nation's most important watersheds, and within their borders are found practically all of this country's irrigation projects.

Practically all the development and settlement of this vast area has occurred within the past seventy-five years. In a growing nation possessing seemingly unlimited resources there was no guidance, no general plan to assist the citizens in its development. It was inevitable, therefore, that under existing trial and error methods many mistakes occurred. In this area of variable climate, precipitation, altitude and soil texture there is a delicate balance between plant growth and these factors. There is likewise a delicate balance between plant growth and factors of land use.

Livestock numbers are limited to the safe carrying capacity of the land by the issue of licences and permits to resident users of the range. Studies

are made to determine proper seasons of range use, the class or classes of livestock that can use the range most beneficially, and the feasibility of withdrawing from use certain areas to effect rehabilitation by both artificial and natural means.

The problem of range management involves a study of the relationship between private and public land and the devising of plans to make the use of all the lands compatible with the available resources and the economic structure. Range improvements consisting of water development, re-seeding, erosion control works, trails and other facilities, and the elimination of undesirable elements such as rodents, predators and poisonous plants are included in the programme.

Units to facilitate particular administrative objectives and to localize problems in conformity with community and region welfare assure a broad attack on social and economic, as well as physical fronts. By this means the programme is enabled to outline and develop a type of land use that, in the end, will ensure the stability of the unit involved. In turn, this unit, whether it be a grazing district, a national forest, an Indian reservation, a game range, or any suitable allotment or portion thereof, will reflect the benefits derived on the public welfare generally.

LAND UTILIZATION AND FISH CONSERVATION

BY ELMER HIGGINS, BUREAU OF FISHERIES

Land utilization and water utilization are closely related. Water utilization affects aquatic life through changes in habitat. No other group of vertebrates is so delicately adjusted to environment as are fishes. Sudden changes in the nature of environment afford the fishes no opportunity to escape, and death is the only alternative.

Land uses and abuses that have contributed to the diminution of our resources in fresh-water and anadromous fishes, including the effects of agriculture and lumbering, mining operations, petroleum extraction, manufacturing, and the development of urban life and recreational areas are all important. Land restoration practices that do not conserve fish-life include irrigation, power development, canalization of streams, and the draining of sub-marginal lands. Land restoration practices that aid in fish conservation or can be adapted to conservation objectives include erosion control, flood control, pollution abatement, and properly designed water impoundments.

The diversity of interests in land and water utilization demands the development of a co-ordinated conservation programme, particularly with respect to water conservation. The objectives of such a programme may be summed up as follows: The adoption of general principles of water conservation will aid in fishery conservation if the requirements of aquatic life are taken into account when water utilization projects are being planned. In general, the water should be kept on the land, rapid run-off retarded, flood waters stored, erosion prevented, pollution prohibited, canalization of streams minimized, irrigation canals screened, impoundments operated with minimum fluctuation of water-level, dams constructed with outlets at base to improve circulation in reservoirs and provided with fishways where important runs of fishes are obstructed.

SOCIAL STATISTICS OF MERSEYSIDE

THE "New Handbook of Social Statistics relating to Merseyside" prepared by the Statistics Division, Social Science Department, the University of Liverpool (University Press of Liverpool, 1940. 1*s*. net), gives a statistical statement of the position on Merseyside in relation to trade, employment and other social conditions immediately before the outbreak of war. The sections on elementary education and housing have been omitted and rather more material is included relating to the changing state of employment. The first section on the trend of births, deaths and population directs attention to the continuous and steep fall in the birth-rate until the last few years, the level reached in 1938 being about two thirds of that recorded in the 1911–15 quinquennium. The trends of the general death-rate and infant mortality-rate show no evidence of great scope for a further reduction of the general death-rate, and infant mortality is unlikely to decline at the rate experienced in the earlier years of the century. In each of the four boroughs there appears to have been a more or less stable position by 1938, with even a slight tendency to a natural increase in population.

Figures given for the trade of the Port of Liverpool in comparison with that of London, Hull, Southampton and Manchester show that between 1932 and 1938 import values rose by 30 per cent in both London and Liverpool, while export values increased by 50 per cent in London but only by 24 per cent in Liverpool. Articles wholly or mainly manufactured account for £120 millions out of £139 millions exported from Liverpool in 1938, but represent only about one eighth of the goods entering Liverpool. In regard to imports of foods, certain foods touched their lowest point in 1935–37, afterwards rising to about two thirds of their value in 1927–29, whereas the value of every imported raw material listed was higher in 1935–37 than in 1930–32, generally receding again slightly in 1938.

Since 1927–29, the number of insured persons on Merseyside has increased from 362,000 to 424,000, while the number of unemployed rose from 57,000 in 1930 to the 100,000 level in 1935, declining to 80,000 by the middle of 1939. The tables indicate a decline in shipping and shipbuilding over the last ten years and in transport and distribution since 1932, with expansion in metals and engineering and in general service. Shipping and shipbuilding, transport and distribution, now account for only 41 per cent of the total of insured workers as against one half ten years ago. General service, however, has increased from 12 per cent in 1929 to nearly 18 per cent. Taking all industries, the number of insured workers employed in 1939 was 12 per cent above the 1929 level on Merseyside and 18 per cent above that level in the country as a whole. With regard to unemployment,

while in comparison with 1932 all industrial groups show decreases in the percentage of insured workers unemployed, varying from 22 in transport and distribution to 67 in metals and engineering, Merseyside shortly before the War had still a percentage of unemployment of 18·8 as against 9·6 in Great Britain and Northern Ireland as a whole.

Analysis of the unemployment situation indicates that out of nearly 80,000 unemployed, 35,000 may be regarded as normal, 8,400 must be attributed to the abnormal times from which all parts of the country have suffered, and 36,000 to the exceptional character of Merseyside. One half of the normal unemployment on Merseyside is accounted for by the shipping, shipbuilding and related industries, where a high proportion of the total is made up of dockers and other casual workers. The general rise in unemployment among women since February 1939, while unemployment generally had decreased by nearly 24,000 (February 1940), is attributed to the much greater transfer of men to the heavy industries and to other war-time production and to the services. The number of unemployed clerks, typists and bookkeepers increased from 592 in 1939 to 2,731 in 1940, due to the closing down or contraction of businesses engaged in the manufacture or distribution of commodities not essential for life and a moderate degree of comfort and for the prosecution of the War. Unemployed boys between 14 and 17 years of age decreased by 22 per cent and girls by 5 per cent when the average of 1939 is compared with 1938, while for boys the February 1940 figure was 18 per cent better than the February 1939 figure, the March figure being 39 per cent better than last year's. For girls the February unemployed total was 57 per cent greater than the 1939 figure, but for March 1940 the figure was only 34 per cent greater than that of March 1939.

For the combined unemployment benefit and unemployment allowances, the expenditure during four weeks in 1939 was £387,544 as against £280,530 in the corresponding weeks in 1940. The total number of persons in receipt of relief in the combined Merseyside boroughs fell from 58,000 in March 1939 to 48,000 in March 1940, with a decline in expenditure from £75,689 to £71,441 for the corresponding four weeks. The local rates have been increased only slightly for 1940–41, increases due to civil defence measures being offset to some extent by savings under 'black-out' regulations.

FISHERIES RESEARCH IN HONG KONG*

IT does not often happen that the official publication of a research station makes its appearance before the erection of the station itself has even begun; and certainly this enterprising inauguration of the *Journal of the Hong Kong Fisheries Research Station* will be most gratifying to those who have persistently advocated and worked for the establishment of fishery science throughout the British Empire. Tribute will be paid to Dr. Herklots, the editor of the *Journal* and honorary director of the Station, whose organizing ability and unbounded enthusiasm inspire confidence in the future of the work at Hong Kong, despite the tremendous difficulties occasioned by wars to which both the British and Chinese peoples are unhappily committed.

Since the primary purpose of the Station is to study the fishes of the South China seas and the fishing techniques employed by the local fishermen with a view to the future benefit of the fishing industry, it is appropriate that the early numbers of the *Journal* should be devoted to a general survey of the Hong Kong fisheries. Dr. Lin makes a good beginning with his detailed and well-illustrated account of the boats, gear and fishing methods. It is the story of a remarkable people who make their permanent homes and live their lives in the fishing junks with their families. Men and women, and girls and boys above the age of fifteen, form the fishing personnel; family life proceeds in specified quarters; and a shrine for worship is always to be found in the heart of the ship.

The junk trawlers, varying from 50 to 90 feet in length, are perhaps the biggest and most important fishing vessels employed in China. It is claimed that there are about a thousand registered in Hong Kong, all operated and many owned by the floating population of Kwangtung and Hong Kong. Save for the smaller forms, all the trawling junks are three-masted wooden vessels with the bow comparatively low and the stern very high. No wheel house is provided and the detachable, heavy rudder is manipulated by means of the tiller on the high stern. Sleeping places for the crew are located below deck in front of, or behind, the main mast; the shrine is always situated in a hold immediately in front of the aft hold. On the stern, several rooms are constructed above the poop to accommodate the owner's family and the galley. Drinking water is kept in holds either on both sides of the main mast or behind it. The fishing gear, ice, salt and the catches are stored in special holds between the main mast and the stern. A long roller for hauling in the trawl is fitted with 8–10 handles and operated by 8–10 members of the crew, and is situated either on the starboard side behind the main mast or transversely in front of it. The anchors are manipulated by capstan. The sails are constructed of mats in preference to canvas; the latter is the better material for sail-making but is too light to be easily lowered or swung from one side to the other with the speed required during fishing operations.

Giving equally interesting details, Dr. Lin goes on to describe beam-trawlers, purse-seine and drag-seine junks, and long-liners. Next he deals with the personnel, varying from 6 to 25 persons per junk, most of whom are hired on a time-wage basis with (sometimes) a bonus on the value of the catch. As most of the fishermen know the whole process of fishing and the different tasks on board are sufficiently straightforward, there is no special allotment of duties, and all interchange freely. Eight types of fishing gear are used, all of which should be of particular interest to students of British fisheries, since there is much to be learned from them which might well prove serviceable in home waters. E. F.

*Journal of the Hong Kong Fisheries Research Station. Edited by G. A. C. Herklots, Vol. 1, No. 1, Feb. 1940. Pp. 1–101 with frontispiece, 6 plates and 48 figs. in text. (Hong Kong: The South China Morning Post, Ltd.). 3 dollars.

CAST IRONS IN AUTOMOBILE CONSTRUCTION

DURING the last ten years the progress made in automobile development and production has been due, in very large measure, to improvements in the materials of construction. Of these, cast iron ranks as one of the most important. The great majority of the cars currently purchased in the United Kingdom are of the 'quantity production' class. It is the use of this type of car that is considered by E. C. Toghill and R. V. Dowle in a paper on the "Applications of Cast Iron in Modern Automobile Construction" recently published (*J. Inst. Automobile Eng.*, March 1940).

The object of the paper is to bring to the notice of the automobile engineer and designer some of the irons with special properties for specific applications, and to show that the grading of cast iron and the choice of the correct grade for the purpose are as important as in the case of steels.

The influence of nickel, chromium, molybdenum and copper in cast iron is summarized as follows. In connexion with the use of special elements, the important role of nickel in automobile cast irons is pointed out. Nickel is a graphitizing element, being in this respect about one third as powerful as silicon, but whereas silicon coarsens the grain and the graphite, nickel has a refining effect. In addition, the presence of the nickel renders the iron more uniform and less sensitive to sectional change. A correct balance of nickel and silicon is an important factor in the production of an alloy having the best properties. For example, if no allowance is made for the graphitizing influence of nickel, that is, if no proportionate reduction of the silicon is made, little increase in strength is observed up to about 1·5 per cent of nickel, after which, strength and hardness gradually increase. If, on the other hand, the silicon content is suitably adjusted, additions of 0·5–5 per cent of nickel will give 10–50 per cent increase in tensile strength.

Strength, hardness, depth of chill, and resistance to heat wear and corrosion are increased by the presence of suitable amounts of chromium, and provided that the carbide is not in massive condition, the shock-resisting ability of the iron is also enhanced.

Molybdenum refines the grain of the iron and the graphite, and has a very beneficial effect on shock resistance. Molybdenum stabilizes carbides and increases tensile and transverse strength; it also produces a slight improvement in corrosion- and heat-resistance and in machinability. In many respects, copper produces similar effects to nickel. Tensile and transverse strength are improved by the presence of small amounts of copper, the effect being most pronounced in low carbon irons. Fluidity of cast iron is also improved by the presence of copper.

Messrs. Toghill and Dowle direct attention to the extensive research in progress under the joint auspices of the Institution of Mechanical Engineers and the British Cast Iron Research Association, in which a collation is being made of the range of high-duty cast irons and of their properties and uses in general engineering. The aim of the work is to provide the automobile and other engineering industries with data which will facilitate the choice of the grades of cast iron suitable for widely diverse applications.

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REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Association of British Chemical Manufacturers. Directory of British Fine Chemicals produced by Members of the Association. Pp. 80. (London: Association of British Chemical Manufacturers.) Gratis. [187

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 2, No. 14: The Genetical and Mechanical Properties of the Sex Chromosome, vi. *Hexacentrus mundus*. By Dr. P. C. Koller. Pp. 174–181. 9*d*. Vol. 60, Part 2, No. 15: A Theoretical Atomic Distribution Curve for Liquid Argon at 90° K. By G. S. Rushbrooke. Pp. 182–191. 1*s*. Vol. 60, Part 2, No. 16: The Loss of Heat by Conduction from the Earth's Crust in Britain. By Dr. E. M. Anderson. Pp. 192–209. 1*s*. 6*d*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [267

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 1, No. 6: The Geology of the Highland Border from Glen Almond to Glen Artney. By Dr. Douglas A. Allen. Pp. 171–193+1 plate+1 map. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 4*s*. [267

Prospectus of the London School of Economics and Political Science (University of London) for the Forty-sixth Session, 1940–41. Pp. 146. (Cambridge: London School of Economics and Political Science.) 1*s*. [267

Sheffield City Libraries. Research Bulletin No. 4: Sheet and Strip, Part 2: Sheet and Strip Finishing Processes and Special Sheet Materials. Pp. 22. (Sheffield: Central Library.) 3*d*. [297

Other Countries

Field Museum of Natural History. Botanical Series, Vol. 22, No. 2: Studies of American Plants, 10. By Paul C. Standley. (Publication 472.) Pp. 63–130. (Chicago: Field Museum of Natural History.) 50 cents. [157

Observatoire de Zi-ka-wei. Annales de l'Observatoire astronomique de Zô-sè (Chine). Tome 21, Fasc. 4: Tables des planetes 296, 711, 736. Par le P. E. de la Villemarqué. Pp. 44. (Zi-ka-wei: Observatoire de Zi-ka-wei.) [177

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 132: The Wood Anatomy of some Australian *Lauraceæ* with Methods for their Identification. By H. E. Dadswell and Audrey M. Eckersley. (Division of Forest Products, Technical Paper No. 34.) Pp. 48+8 plates. (Melbourne: Government Printer.) [227

Burma Meteorological Department. Meteorological Organization for Airmen. Pp. iv+33. (Rangoon: Government Printing and Stationery Office.) [227

Agriculture and Animal Husbandry in India, 1937–38. Pp. v+416. (Delhi: Manager of Publications.) 5·14 rupees; 9*s*. 3*d*. [247

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 33: Selected Clinical Articles—1: A Few Cases of Johne's Disease in Sheep, by Muhammad Rahim-Ud-Din; 2: A Case of Pregnancy in the Mammary Gland, by C. D. Uttangi; 3: An Unusual Case of Microfilarial Granuloma on the Prepuce of a Bull, by R. C. Nathani and N. S. Sankaranarayanan. Pp. 10+4 plates. (Delhi: Manager of Publications.) 9 annas: 10*d*. [247

Imperial Council of Agricultural Research. Proceedings of the Third Meeting of the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry in India, held at New Delhi from the 20th to the 23rd February 1939, with Appendices. Pp. iii+307. (Simla: Government of India Press.) [247

Canada: Department of Mines and Resources: Mines and Geology Branch, Geological Survey. Paper 40–2: Wildcat Hills Map-Area, East Half, Alberta. By C. O. Hage. Pp. ii+9+1 map. 10 cents. Paper 40–3: Preliminary Map, Michiwacho Lake, Abitibi Territory, Quebec. By H. H. Beach. 1 map. 10 cents. Paper 40–4: Preliminary Map, Mechamego Lake, Abitibi Territory, Quebec. By H. H. Beach. 1 map. 10 cents. Paper 40–5: Preliminary Map, Fish Creek, Alberta. By G. S. Hume. 1 map. 10 cents. Paper 40–7: Preliminary Map, Gordon Lake South, Northwest Territories. By J. F. Henderson. 1 map. 10 cents. Paper 40–9: Preliminary Map. Gordon Lake, Northwest Territories. By J. F. Henderson. 1 map. 10 cents. (Ottawa: King's Printer.) [297

U.S. Department of Agriculture. Circular No. 547: Feeding Habits of the Adult Japanese Beetle. By I. M. Hawley and F. W. Metzger. Pp. 32. (Washington, D.C.: Government Printing Office.) 5 cents. [297

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