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The Organization of Social Research

EVERY year the social services of Great Britain tend to attract increased attention and generally to demand increased expenditure of public money. This may be all to the good ; but from time to time it is desirable to attempt to survey the situation and to consider whether in practice these services are being adequately directed by controlled and informed social research. In a field of this kind, where the boundaries are extremely wide and the claims in every direction are most insistent, constant and wise research is particularly necessary if undue waste is to be avoided and if merely sectional interests are to be held in reasonable control.

As things are at present, our problems of public health have been placed upon a sound foundation, mainly through the organization and activities of the Ministry of Health and later of the Medical Research Council. Research in agriculture is now being similarly promoted by the more recently established Agricultural Research Council. The National Physical Laboratory and the Department of Scientific and Industrial Research, likewise subsidized by the State, have brilliantly developed the contributions which can be made by physics and chemistry to a great variety of industrial and even social problems. The Industrial Health Research Board, with far more slender resources and with a less independent status, has made valuable contributions to some of the problems of industrial life. So far as national organization goes, that is all. Other problems—economic, educational, biological, psychological, sociological—are left to advisory or to consultative committees, which can receive 'evidence' and issue reports (but do little else), or to private enterprise and sporadic effort.

It is high time to alter this state of affairs—to establish a new scientific body, with adequate endowment from the State, which will do for human social research what the Medical Research Council does for public health, what the Agricultural Research Council is beginning to do for agriculture, and what the Department of Scientific and Industrial Research does for the applications of physics and chemistry. Such a body must be nationally constituted ; for most of the problems which it would be asked to study are the immediate and practical concern of existing government departments.

Everywhere, and in all directions, the most prodigious efforts are now being made to bring differently organized social groups into peaceful and lasting co-operation. But we have much yet to learn about the nature and extent of these differences ; for example, of class-differences and of class-conflicts. In industry, in education, in politics national and international, in science, and in religion, it is essential that bases of successful co-operation be found—or the world as we know it must disappear in faction, enmity and confusion.

Scientific invention and popular education have combined to bring groups widely different in language, or tradition, or custom, or aim, or all of these, into close contact ; and every day potentialities of conflict threaten to become actual or even to break into sharp strife producing lasting irritation and lamentable waste. Many of the best minds are set to devise all manner of elaborate machinery for promoting and preserving friendly relations between groups. Yet if but a fraction of the intelligence that has been put to work upon this problem of machinery had been devoted to a study of those human conditions

which will inevitably wreck even the most wisely devised machinery, there would have been great economy and far more to show for the effort. The methods for a controlled study of the bases of group co-operation—and of consequent government by consent—are to hand. They can be made as scientific and as definite as those of the investigation of any other human problem. They require wide application, for which centrally and nationally organized effort is necessary.

It is clear that at the present day the great mass of the work of the world can be performed efficiently with a relatively slender equipment of intelligence, and—what is probably more important still—with only a small basis of acquired knowledge. This is due to the enormous advances of physical science and especially to the modern applications of engineering. The great requirement now, so far as the working-day activity of the masses goes, is for specialized skills, not for extensive knowledge. Moreover, the time during which these specialized skills must be kept continuously in operation in order that the basic needs of civilization may be satisfied is all the while decreasing. We may even say, with an approximation to truth, that, apart from the institutions devoted to technical training, modern popular education is now designed mainly for leisure, not for work.

We know, however, extraordinarily little of how, if at all, the majority of workers in any section of a modern community utilize their education for their leisure, and even less about how and how wisely leisure occupations are chosen and how they affect social and workaday behaviour. There can be no doubt that the views, opinions and beliefs which influence public policy in many directions are stimulated and developed chiefly during periods of leisure. Consequently, the most stable community in modern social life appears likely to be the one in which leisure is ample and most ably employed; and as science still further advances its techniques, the truth of this will become even more obvious. It is not, therefore, surprising that serious attention is at length being given to stimulating the study of leisure and of its influence in human affairs; but this study needs adequate control and organization.

Bound up with the increasing importance of leisure is the fact that leisure has itself become possible largely as a result of a great speeding-up in the *tempo* of work and in the specialization of routine processes. There is a general impression

that these two conditions—speeding-up and increase of routine—are exerting profound influences upon human behaviour and consequently upon social policy. They may be responsible for special occupational difficulties or disorders, the study of which overlaps the field of medical research. They may give rise to a degree of dissatisfaction which inevitably results in various forms of group conflict. They may encourage individual maladjustments to an extent which has wide repercussions upon family and social life. Whether or no they do these things, in what directions, how and when, are all matters for speculation at the present time; but they could be made matters of far more certain knowledge.

The general drift of social development for many years past seems to have been for more and more of the functions which were formerly those of small groups to become the direct practical concern of larger ones. Thus the functions of the family—so often in a vague way said to be disastrously breaking down—in regard to education, health, industrial training, and many everyday regulations of behaviour, have passed largely to some wider authority constituted within the nation group. Similarly, the functions of local religious, industrial and general administrative groups have in many instances been lost or become strictly controlled. Coincidentally, human loyalties, partly by training and propaganda, partly by natural drift, seem to have been diverted from the smaller to the larger groups, or to have changed in character as regards the smaller groups. On one hand, any more forcible and competent social group must be able to perform functions on behalf of its members better than any smaller, less organized group can do; and on the other hand, every large modern society, such as the nation group, must necessarily contain and maintain in very great variety internal social differentiation. A study, therefore, by experimental and observational methods, of the place and functions of small groups in a large society, would have a close bearing upon many urgent problems of practical social control.

These are a few only of a large number of other general problems (for example, those of population and of crime) upon the solution of which the effectiveness and stability of present and future social organization depend. They are matters of daily debate and speculation; and in that stage they will remain, unless they are conceived, as they properly should be, as problems in higher human biology, to be attacked, not by dialectic

alone, but by experiment when possible and by controlled observation. Methods for such an attack are already being devised and applied. But they will have little chance of success, unless they can attract the attention of, and be refined and sharpened by, the best scientifically trained minds available.

Besides these general problems, there is a mass of more specialized questions which call for immediate and organized research. Much brilliant recent physiological investigation, on 'conditioning', on habituation, on adaptation, on inhibition and on the development of co-ordinated motor activity, has its most significant application to human behaviour. The last ten years have seen the study of the operation of incentives and 'drives' placed upon a much firmer basis in so far as the behaviour of animals is concerned; but virtually nothing is known, except in a speculative sense, about their conditions and mode of operation in human society. Modern civilization depends to a considerable extent upon skills of one kind and another, yet we are only at the outset of ascertaining the principles which determine how different skills can best be acquired and maintained. In region after region, throughout the British Empire, wherever native populations are being rapidly caught up in modern Western ways of life, urgent practical difficulties concerning education, administration, and the swift transformation of manners and customs arise and cannot be postponed. As things are, the administrator is forced to do his best to meet such problems *ad hoc* and in a hurry. There are principles underlying the correct solution of them

all; but these principles demand organized research for their discovery, and hitherto the State has given no systematic support for such research.

Indeed, at the present time in Great Britain, if a government department, or any outside person or body, is brought up against some research problem underlying the administration of any branch of the social services, there is little that can be done beyond referring it to the Medical Research Council or to an advisory committee. This is scarcely fair. The Medical Research Council is usually sympathetic; but many of the problems thus proffered are remote from its terms of reference, and in any event its resources are insufficient to do much more than meet its own immediate concern with public health in the specifically medical sense of the phrase. Also, though an advisory committee can inquire into whatever research may be in progress and can collect opinions, it cannot initiate original investigations on an adequate scale.

A new, centrally constituted scientific body is urgently needed, to survey the field of social research and to set on foot considered programmes of actual investigation on higher biological lines. The questions demanding study are most of them border-line problems, at the growing points of research in different departments of science, involving organized and many-sided efforts for their solution. There is no government department that could not profit vastly from such an enterprise. Ultimately the public purse would be saved from much wasteful expenditure, and the country's social services set upon a firmer foundation of well-attested knowledge.

Exploration in Iran

Archæological Reconnaissances in North-Western India and South-Eastern Irān

Carried out and recorded with the support of Harvard University and the British Museum by Sir Aurel Stein. Antiques examined and described with the assistance of Fred H. Andrews and analysed in an Appendix by R. L. Hobson. Pp. xx + 267 + 60 plates. (London: Macmillan and Co., Ltd., 1937.) 63s. net.

AFTER forty years of research and exploration in and around Central Asia, Sir Aurel Stein found himself constrained by the intolerable character of the conditions imposed on his activities

by the Chinese Government to cease from further investigation in a field which he had regarded as the major objective of his studies. While he has every sympathy in his personal disappointment and frustration when the expedition in Inner Mongolia was abandoned, the loss to science by the diversion of his experience and knowledge to other regions is felt to be a calamity. Nevertheless, there is compensation of a kind in the fact that by an arrangement with Harvard University and the British Museum, which were his sponsors, he was able to turn to the exploration of regions of the Middle East, which were still archæologically unexplored and geographically imperfectly known.

By October 1931, Sir Aurel's arrangements for the first of his journeys in southern Iran were complete, excepting for the official permit to travel in Persia. Pending its receipt, which was delayed until the end of the year, Sir Aurel revisited the northern Punjab and the Salt Hills, where he began his career as a field archæologist in 1889. The purpose of this interlude was to round off his studies of the invasion of India by Alexander the Great by examining the scene of the last phase of that adventure at the point where the invading forces turned back, and to determine the exact spot at which the defeat of Poros on the banks of the Hydaspes (Jhêlum) took place, a problem of which, after prolonged examination of previous theory on the ground, he concludes that a final and exact solution is improbable. In the account of his present journey in the Salt Hills, he includes the first full statement to appear, after nearly fifty years, of the detailed topographical and archæological argument by which he identified the Jain temple mentioned by the early Chinese Buddhist traveller Hsüan-tsang, and the site of the ancient Simhapura.

Early in January 1932, Sir Aurel left India for Makrân; and a few days later he crossed the frontier from the British post at Suntsar, and began under escort his long journey through Persian Makrân and Baluchistan to Kermân, where the advancing season, too hot for further archæological exploration, brought his first journey to a close. Re-assembling his party after he himself had spent a brief period in England, he set out from Kermân in October 1932, his purpose being to explore the coast of the Persian Gulf in search for early historic and prehistoric sites. He travelled south to Mînâb at the mouth of the Persian Gulf and thence proceeded along the inhospitable coast; but before his journey as planned was completed, all further exploration was forbidden by the Persian authorities owing to tribal unrest, and his second journey came to an end at Bushire.

In the two journeys of the period 1931-33, Sir Aurel had covered two thousand four hundred miles of country, almost the whole of which was, for archæological studies, virgin territory. Of this he had also made a topographical survey, except for an interruption of his observations for a time by the officious, and as it proved, unauthorized veto of the commander of his escort. The course of his journeys was determined by archæological 'points', the occurrence of burial mounds and occupation sites of prehistoric or early historic age. It is to be noted that though historic sites were found along the actual coast line, there was none here of prehistoric age, a fact of which Sir Aurel discusses the significance and suggests that it may be due to submergence.

A large number of sites, both of prehistoric and early historic age, were examined and recorded. Time was not available for an intensive study of any one site, and there are several on which the author insists upon the urgent necessity for systematic and exhaustive excavation. It was possible, however, by surface finds and trial trenches to collect and determine the sequence of a large quantity of ceramic evidence and other material—stone and bone, copper, bronze, iron and glass (beads and bangles)—in date extending from the chalcolithic age down to the close of the pre-Islamic period, several centuries after the commencement of our era. An idea of the richness of some of the sites in archæological data may be gathered from the fact that at Damba-kôh, a hillock-site in the alluvial plain of the Bâhû river, about sixteen miles only from the frontier, there were at a rough estimate seventeen hundred cairn burials, or if those scattered nearby are taken into the account, some two thousand. The practice of cairn burial shows a considerable variety in construction, but the skeletal remains are invariably those of bodies which have been exposed previously to burial. In this area, the author infers, it must have persisted for a very considerable period, extending from the close of the pre-Islamic period back to, at least, the Iron Age.

On the prehistoric or chalcolithic sites there is abundant evidence, in the painted pottery in particular, of affinity on one side with the chalcolithic civilization traced by Sir Aurel on his expeditions to Baluchistan in 1926-28, which in turn links up with the civilization of the Indus valley, and on the other, with early western Asia. Finds from the Tal-i-pîr (Hara), for example, especially the painted pottery and the 'button-seals', are compared with those found at Persepolis, Arpachiyah and Fars. Further, the designs in monotone of the yellowish-grey ware from this site provide a link between Persepolis and the chalcolithic site at Fars and Baluchistan, where most of the designs appear, while the bands of horns found here as a form of decoration relate Baluchistan, Iran and Susa.

Sir Aurel has modestly given to this elaborately produced and detailed account of his first two journeys in Iran the title of "Reconnaissances"; and so these journeys must be regarded, as providing both a strong incentive and guidance for further and more intensive archæological investigation—this not only for its own sake, but also for the light it will throw on the relations of early civilizations in India and Mesopotamia. At the same time, the topographical and archæological record, as well as the magnificent series of plates of the pottery and other finds, ensure its permanent standing as an authoritative work of reference.

Men and Mathematicians

Men of Mathematics

By Prof. E. T. Bell. Pp. 653. (London: Victor Gollancz, Ltd., 1937.) 12s. 6d. net.

PROF. E. T. BELL has written a fascinating book. The amount of biographical details and of mathematics that he has compressed into a volume of 650 pages is extraordinary; but he is never dull; his style is lively, at times even 'snappy'; he carries the reader along; he whets the appetite. No doubt the mathematician of a certain age who remembers little more mathematics than what he learnt at school and at the university will wish that the modern theories and developments could be more fully described so that he could get a better general idea of them; and the reader who is mainly interested in the personal and human side, while reading with enjoyment the biographical details, which are not easily accessible elsewhere, will wish for more. This is as it should be; but, if the writer has set himself what is (in such a compass) a wellnigh impossible task, we are not the less grateful to him.

Prof. Bell explains that he has applied two criteria in selecting names for inclusion: first, the importance for modern mathematics of a man's work, and, secondly, the human appeal of the man's life and character. Some, as he says, qualify under both heads, for example, Pascal, Abel and Galois; others, like Gauss and Cayley, chiefly under the first, though both had interesting lives. When the two criteria clash or overlap as between several claimants for inclusion on account of a particular advance, he has given the second the precedence, as his primary interest is here in mathematicians as human beings.

In his first chapter Prof. Bell deals with the Greeks—Zeno, Eudoxus and Archimedes; then, with a bound over eighteen centuries, he passes to Descartes and Fermat, the founders of analytical geometry. This is because, throughout the book, "the emphasis is wholly on modern mathematics, that is to say, those great and simple guiding ideas of mathematical thought that are still of vital importance in living creative science and mathematics". The particular Greeks dealt with are those whose work makes, as it were, a continuous story with that of the moderns. The story properly begins with Zeno of Elea. Zeno did not indeed claim to be a mathematician, and next to nothing is known of his life; but he put forward the four famous paradoxes which have exercised the acutest minds ever since, and even now, notwithstanding the labours of Weierstrass, Dedekind and Georg Cantor, cannot be said to be disposed of finally.

Though some of the great mathematicians were born in the humbler walks of life, they are not in a majority. Monge was the son of a pedlar and knife-grinder, Fourier of a tailor, Fermat of a leather-seller; Gauss's father worked as a gardener, canal-tender and bricklayer. Laplace was the son of a peasant and became a complete snob; he examined Napoleon as a candidate for the Military School, and afterwards, in recognition, Napoleon 'pushed' him in every possible way; he was Minister of the Interior for six weeks; under Louis XVIII he sat as Marquis de Laplace in the chamber of peers. Most of the others were sons of professional men, chiefly in the law, officials, pastors, and so on. Some were miserably poor or became so; Kummer tramping back and forth every day between Sorau and Halle with his food and books in a knapsack on his back reminds us of Eudoxus trudging from the Piræus to Athens and back to hear the lectures of Plato.

Only a few of the subjects of the book seem to have been exceptionally precocious. Though the legends of Pascal's precocity are no doubt overdrawn, he discovered his famous theorem before reaching the age of sixteen years. Lagrange is said to have become professor of mathematics at the Royal Artillery School in Turin at sixteen years of age. Gauss, before he was three years old, spoke up and corrected an error which his father had made in calculating the weekly wages of some labourers; in his tenth year he produced in a few seconds the answer to an addition sum set to his class, in which a hundred numbers beginning with 81,297 and ending with 100,899 were to be added, because he instantly saw that the numbers formed an arithmetical progression with 198 as common difference. Sir William Rowan Hamilton must almost have rivalled John Stuart Mill: he was a good reader and advanced in arithmetic at three years of age; at five he read and translated Latin, Greek and Hebrew; at eight he added Italian and French and wrote an original poem in Latin hexameters. Euler ("analysis incarnate") was, like Gauss, a marvellous calculator. Two of his students summed a complicated convergent series in specific numbers and disagreed only by a unit in the fiftieth place of the result. To decide between them Euler did the whole calculation in his head; his answer was found to be correct.

Prof. Bell has strong likes and dislikes. He cannot forgive Newton for accepting, at the age of fifty-four years, the post of Warden of the Mint, nor Leibniz for spending so much of his life in the trivial service of the Brunswick family.

Citrus Diseases

Citrus Diseases and their Control:

By Prof. Howard S. Fawcett. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Second edition, completely revised, rewritten and enlarged. Pp. xv + 656. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 36s.

A SECOND edition, after ten years, by the senior author of Fawcett and Lee's well-known book must be welcome to a great industry and to citrus pathologists. Lee, being engaged on other investigational work during recent years, generously withdrew from joint authorship of the new edition. The arrangement of the matter is the same as in the first edition, but with fifty-three additional pages of text (apart from the bibliography) and two new chapters. Significant of the notable extension of citrus planting outside of the United States during late years and the attention given by trained pathologists to the diseases and means of control, is the expansion of the chapter on the geographical distribution of citrus diseases from six to thirty pages.

A new chapter has been added on 'diseases due to deficiency or excess of inorganic constituents' in collaboration with Haas of California, and the parts treating of sweet orange and Australian scab and of citrus blight have been written with the help of Miss Jenkins of Washington and Rhoads of Florida respectively. Descriptions are given of about a score of diseases either not mentioned at all or only cursorily dealt with in the first edition; among these Mal Secco, a specific disease as understood now (due to *Deuterophoma tracheiphila* Petri), and of serious moment in the lemon plantations of eastern Sicily, is probably the most out-

standing. Of the diseases fully treated in the first edition, Fawcett now records that no cases of canker (caused by *Bacterium citri* (Hasse) Doidge) have been detected in Florida since 1927, and that it appears to have been eradicated from all commercial plantings in the other Gulf States. The great campaign aiming at the total eradication of canker, begun in Florida in 1914 and extended to the neighbouring States, seems, therefore, to have been wholly successful: it has cost about two and a half million dollars. A similar campaign of eradication against canker in the Union of South Africa, begun in 1918, has been equally successful. These two effective campaigns against a highly infectious disease (the very susceptible grapefruit was the variety mainly concerned), seem destined to become classical in the history of plant disease control.

The author presents strong evidence, based mainly upon his own investigations, in support of the view that psorosis, a disease of wide distribution, the etiology of which baffled pathologists for many years, is due to a virus.

The bibliography has been enlarged from seventeen to forty-one pages, due in part to the filling of gaps in the references recorded in the first edition and to the very complete list of those of the last ten years (to the end of 1935).

The make-up of the book corresponds with the high standard of the first edition; the plates in colour, remarkable products of the technique of reproduction, are the same as those in the earlier edition. Should the new edition be reprinted, it would seem an added convenience if the plates could be numbered and listed in the table of contents.

Physiology of the Parasitic Nematodes

Nematodes Parasitic in Animals

By Dr. Geoffrey Lapege. (Methuen's Monographs on Biological Subjects.) Pp. x + 172. (London: Methuen and Co., Ltd., 1937.) 4s. 6d. net.

THE scope of this excellent little book is not, as its title might suggest, systematic or faunistic. It is addressed primarily to the experimental biologist, and the author's chief concern is with the physiology of the parasitic Nematodes, upon which, as he points out, their relationships with their hosts depend, and a better knowledge of which might enable us to control their harmful activities in man and domestic animals.

There is an introductory chapter on the structure, life-histories and classification of the group. Here, in so condensed a work, it is perhaps inevitable that a few errors and questionable statements should creep in. It is doubtful whether "most nematodes are parasitic"; while it seems a pity to find the common misspelling of Filarioidea as "Filaroidea" constantly repeated.

The main part of the book, however, is a useful review of the mass of recent literature dealing with the mode of life and metabolism of the Nematodes, their effects on their hosts and the problems of

resistance to infestation. A bibliography of more than 400 references is given. His review leads the author to the conclusion that "in spite of every effort, no efficient control of any nematode parasitic in animals is known. . . . Work, therefore, which seeks to understand the physiology of nematodes is urgently needed. . . . No group of animals presents problems more interesting to the experimental biologist, nor a challenge more exacting to his skill. . . . If every biological laboratory in the world employed one experimental biologist on the study of parasitic nematodes, the reproach that neither biology nor medicine can cope with these parasites would soon be removed."

Our great ignorance of the physiology of these organisms, in spite of the work that has been done on them, is well brought out. The difficulties in the way of exact experiment are great. No one

has yet been able to keep alive a Nematode parasitic in a warm-blooded animal, outside its host, for more than a few days. It is also very difficult to exclude bacteria and other contaminating factors. As Dr. Lapage says, "the products of nematode-metabolism cannot be accurately determined until a completely sterile nematode can be studied".

After discussing the known facts concerning the resistance of animals to infestation with Nematodes, the author says that "the available evidence suggests that . . . the three kinds of resistance are different only in degree and not in kind", and is of the opinion that comparisons between such resistance and bacteriological immunity should be made with caution. Some possible methods of controlling infestation, mainly in grazing stock, are briefly discussed in the last chapter.

H. A. B.

Practical Hints in Horticulture

The Horticultural Note Book :

a Manual of Practical Rules, Data and Tables, for the use of Students, Gardeners, Nurserymen and others interested in Flower, Fruit and Vegetable Culture or in the Laying-out and Management of Gardens. Compiled by J. C. Newsham. Fifth impression. Pp. xx + 418. (London: The Technical Press, Ltd., 1937.) 7s. 6d. net.

THE new edition of this book follows on the lines laid down by its author in the original work. For conciseness and lucidity in pocket-book form, it would be hard to improve upon. Its data and practical details can be fully relied upon and the wealth of information crowded into its 418 pages covers the whole of the operations of any up-to-date garden. In this respect the author has a genius for imparting—in tabloid form—his wide knowledge to others.

A very large number of subjects bearing upon horticulture are ably dealt with. There are chapters on such widely different items as weights and measures, sizes of pots, land measures in detail, valuable information and full descriptions on the formation of kitchen and fruit gardens, lists of plants for each, costs of digging, trenching and drainage. The making of lawns and their upkeep, lists of grasses to use in various soils, buildings, sheds, fruit rooms, greenhouses and heating apparatus, are all dealt with separately in a thorough and practical manner.

Soils and geological formations are given a full chapter, and the chemical contents of various soils and manures are clearly defined.

Propagation by seeds, layers, grafts and cuttings is described in detail. There is a long chapter on fruit culture, which includes a useful list of varieties of all the best fruits grown in the British Isles. The best stocks to use for grafting, planting of various fruits, choice of sites suitable for each kind, picking, storing and even details as to packing and marketing are all fully discussed. No important item or detail has been left out and the whole work is brimful of most valuable information, all collected together under separate headings, and very easy to look up by the aid of a full and complete index.

In the 92 pages devoted to flowers and their culture, full lists of plants for the herbaceous border, greenhouse, stove and house decoration are given, and a feature of this is that all the principal florists' flowers are dealt with separately, with valuable notes on the time of flowering, height and colour of the flowers. A select list of ferns for stove, greenhouse and hardy conditions; cultural notes on orchids; lists of trees and shrubs for various soils and conditions; notes on economic plants; weeds of various kinds, and notes on the best method of eradication are included; also, the rotation of crops, and even such out-of-the-way subjects as "The Natural Food of Wild Birds"; "Points to be Observed in Judging"; "The Economic Value of Timbers", and a whole chapter on "Insecticides and Fungicides".

For its size and completeness, there is nothing like this book as a valuable aid to both the amateur and professional gardener, and it is one that should be on every garden-lover's bookshelf.

The Nation's Intelligence

By J. L. Gray. (Changing World Library.) Pp. iv + 154. (London: Watts and Co., 1936.) 2s. 6d. net.

The Menace of British Depopulation

By Dr. G. F. McCleary. Pp. 148. (London: George Allen and Unwin, Ltd., 1937.) 4s. 6d. net.

THESE two books, both conceived on scientific lines, and both written in the scientific spirit, are concerned with two momentous issues. One of them asks the question: Are we heading for national stupidity? The other asks the still more stirring question: Are we heading for national suicide?

In dealing with the first of these questions, Mr. Gray confronts the school of writers who hold that the offspring of the prosperous classes are on the average abler than the children of the poor in virtue of their superior mental inheritance, and who do not shrink from the inference that our high expenditure on social services, including education, simply encourages the perpetuation of inferior types, and ought, therefore, to be restricted. Arguing, as we have said, on strictly scientific lines, and without any social and political prejudices, Mr. Gray gives reasons for believing that there is no cause for alarm, that there is no ground for supposing that the average intelligence of the community is decreasing, and that, so far from being a blunder, the raising of the physical and intellectual level of the masses is of vital importance.

As to the menace of depopulation, Dr. McCleary sounds the definite note of warning. The population of Great Britain is still increasing, but at a rate so greatly reduced as to point to the beginning of decrease in the near future. If, says he, our present fertility and mortality rates remain at their present level, we shall enter upon a period of decline which must end in extinction. Most people, by the way, do not realize the position, because they are misled by an unscientific and superficial view of the relevant statistics. As the same process is going on in most of the Overseas Dominions of the British Empire, and as the mother country will soon be able to do nothing to help them, the outlook for the Empire is a black one. The author is in no doubt that the main cause of the decline is voluntary birth-control. He sees little hope of stimulating the growth of population by such artificial expedients as family allowances and marriage loans. Yet he does not close on a note of despair. The effective remedy, he holds, lies in making life better worth living for all classes of the community.

Vakuumspektroskopie

Von Dr. Hans Bomke. Pp. x + 248. (Leipzig: Johann Ambrosius Barth, 1937.) 17.70 gold marks.

SINCE the publication of Lyman's monograph "Spectroscopy of the Extreme Ultra Violet", there has been a steady development of technique and accumulation of results in the field of vacuum spectroscopy. Improved glass gratings and the use of grazing incidence have enabled the limit of the spectrum to be pushed to shorter wave-lengths, until now it is well within the long-wave limit of soft

X-rays. Many spectra have already been studied. It has thus become desirable that a new survey should be made of the investigations which have been carried out in this field. In his valuable little book "Vakuumspektroskopie" Dr. Hans Bomke has set himself this task.

Dr. Bomke opens with a brief historical review, then proceeds to describe in considerable detail the design of various types of vacuum spectrographs, their method of use and the construction of light sources suitable for them. About two thirds of the book are devoted to these topics. The remaining third is concerned chiefly with work which has been done on the spectra of atoms, although eight pages at the end briefly summarize results obtained with molecules and solid bodies. The appendix contains useful constants and a very full bibliography.

This book should prove of great assistance to those desirous of becoming acquainted with recent researches in the extreme ultra-violet.

A Text-Book of Inorganic Chemistry

Edited by Dr. J. Newton Friend. Vol. 11: Organometallic Compounds. Part 4: Derivatives of Selenium, Tellurium, Chromium and Platinum. By Archibald Edwin Goddard. Pp. xxviii + 292. (London: Charles Griffin and Co., Ltd., 1937.) 20s. net.

THE subject-matter of the present volume is concerned with the aliphatic and aromatic derivatives of selenium and tellurium and the organic compounds of chromium and platinum. It is almost entirely of interest from the point of view of organic chemistry, and it may be suggested that vol. 11, dealing with organo-metallic compounds, four parts of which making up a total of 1,632 pages have already been published, is out of proportion with the rest of the work. In the present volume, very minute details of preparation are given and the text will be of interest mainly to the specialist. The literature appears to have been very well covered and there are good indexes. For those who wish to inform themselves of the subject of which it treats the book will be a very useful guide. The preparations are nearly always given in sufficient detail to make reference to the original publications unnecessary.

Practical Stereoscopic Photography

By J. Moir Dalzell. Pp. xv + 224. (London: The Technical Press, Ltd., 1936.) 10s. 6d. net.

DR. MOIR DALZELL's book deals with the minutiae of a single branch of photography. The subject is for the most part clearly treated, but the complete absence of illustrations renders some parts difficult to follow. In the early chapters the author discusses the characteristics of binocular vision, describing the psychological effects of various muscular actions and their relation to our interpretation of what we see. There follows a very complete treatment of apparatus and technique. Much of the part dealing with technique is applicable to general photography, and will be found very valuable to the 'one lens' workers as well as to stereo workers.

The Voyages of the *Discovery**

ABOUT forty years ago, the first *Discovery* lay abuilding in Stephen's yard at Dundee, for Captain Scott's Antarctic Expedition. She was built like a Dundee whaler, but of the finest African oak, and finished as a labour of love; her timbers, spars and full barque-rigging were all as

Office built a new ship under her old name, less beautiful, but equipped as no other ship had ever been for the naturalist and the hydrographer. A much smaller vessel was added later on, bearing the name of that great scientific navigator and whale-fisher William Scoresby. She was built as

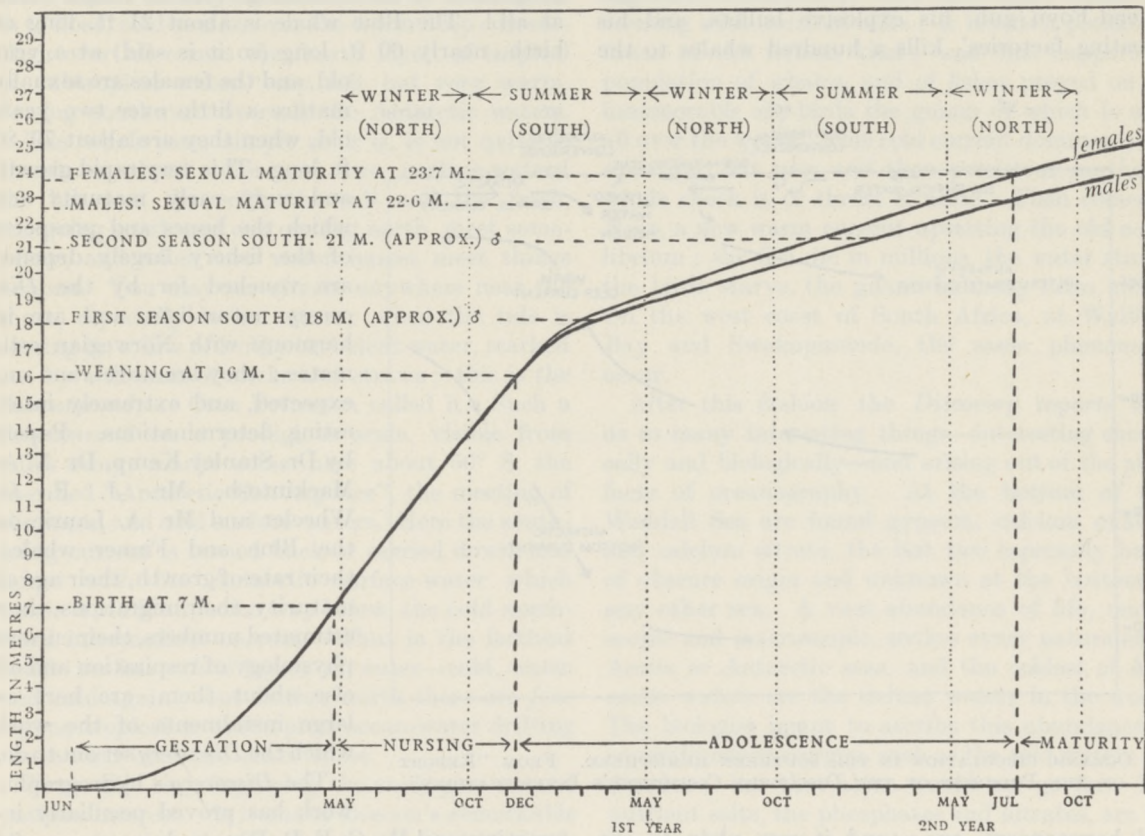


Fig. 1.

EARLY LIFE OF THE BLUE WHALE. FROM "REPORT ON THE PROGRESS OF THE DISCOVERY COMMITTEE'S INVESTIGATIONS".

strong as Stephen and his men could make them; but the old lines were not left unaltered, and when she put to sea she rolled terribly. The Hudson's Bay Co. got her later on, and the Colonial Office took her over when she was five and twenty years old and sent her on her first and last cruise to the Falklands and the South Georgian whaling-grounds. She found other Antarctic work to do under the Australian and New Zealand Governments, when our Colonial

a "whale-catcher", to study and mark the whale at close quarters; the Norwegian whaling-skippers at Walfisch Bay (when I happened once to pass thereby) thought they could have built her a great deal better; but still she has marked her whales, and done good work in other ways.

The old and new *Discovery* and their little sister-ship have been at work on and off pretty steadily for twelve years in the fierce cold and almost constant gales of Antarctic seas. Their one main object was to study, for the sake of the whale-fishery, the natural history of the several whales,

* Report on the Progress of the Discovery Committee's Investigations. Pp. 52+11 plates. (London: Colonial Office, 1937.) 3s. 6d. net.

their movements and migrations, the things on which they feed, the waters in which they live and move; physical oceanography, chemistry and all the biological sciences have their part in the story of the whale. The Basque harpooners in the Bay of Biscay killed out the Atlantic whales, one by one, until no more were seen for near a hundred years; the New Bedford men chased the Sperm whale all round the world, with ever-lessening catches; the Dundee ships in Davis Straits pursued the dwindling Greenland whale to the very verge of extinction. But the modern whaler, with his Svend-Foyn gun, his explosive bullets, and his 'floating factories', kills a hundred whales to the

most abundant whale in the Antarctic; the rarer Humpback was the first to show grave signs of depletion. Some 10,000 Blue whales are killed every year down in the Antarctic, besides a good many more (younger on the whole) on the South African coast; and, if the numbers killed do not yet become noticeably less, the mean size falls away, little by little and year by year. The whales do not live so long, their 'expectation of life' grows significantly less; worse still, the mean size over the whole catch is falling below that of first maturity—a larger and larger proportion of the remaining stock no longer breed at all! The Blue whale is about 21 ft. long at birth, nearly 60 ft. long (so it is said) at a year

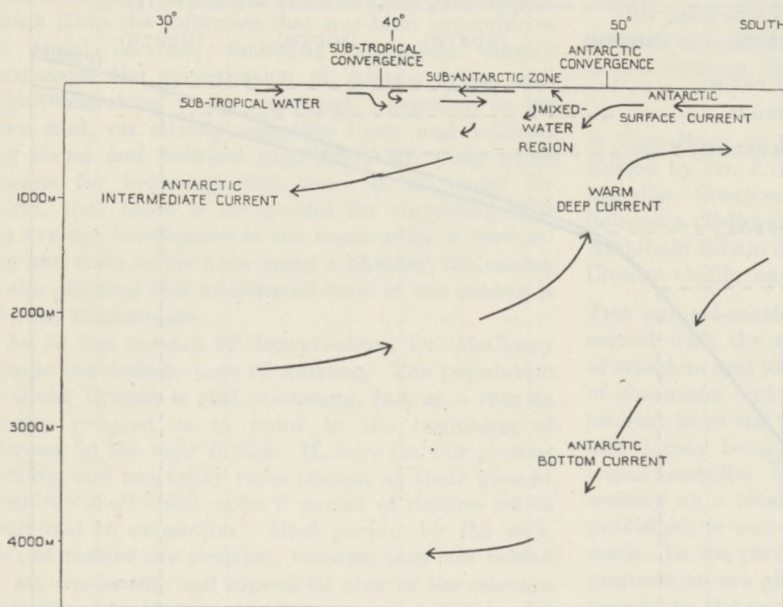


Fig. 2.

OCEANIC CIRCULATION IN THE SOUTHERN HEMISPHERE. FROM "REPORT ON THE PROGRESS OF THE DISCOVERY COMMITTEE'S INVESTIGATIONS".

old harpooners' one; and it was plain to see that, plentiful as whales were on their southern feeding-grounds, they could not outlast the insatiable pursuit for ever. The aim of the *Discovery* was "to furnish a basis for the rational regulation of whaling"; in other words, to tell the commercial world how far greed might safely go. The whale is a very different thing, say, to a codfish, which lays, year by year at random, its million eggs; the whale nurses its single child for months with all solicitude, but men of business slaughter it as the Red Men killed the buffalo, and no humanitarian considerations enter the case.

The Blue whale, or Sibbald's whale as it was until lately called (after the old Edinburgh physician of three hundred years ago), is the largest and most valuable, the Fin whale (or common rorqual) the

most abundant whale in the Antarctic; the rarer Humpback was the first to show grave signs of depletion. Some 10,000 Blue whales are killed every year down in the Antarctic, besides a good many more (younger on the whole) on the South African coast; and, if the numbers killed do not yet become noticeably less, the mean size falls away, little by little and year by year. The whales do not live so long, their 'expectation of life' grows significantly less; worse still, the mean size over the whole catch is falling below that of first maturity—a larger and larger proportion of the remaining stock no longer breed at all! The Blue whale is about 21 ft. long at birth, nearly 60 ft. long (so it is said) at a year old, and the females are sexually mature a little over two years old, when they are about 79–80 ft. long. This very rapid growth and very early maturity (on which the hopes and prospects of the fishery largely depend) are vouched for by the *Discovery* naturalists, and are in harmony with Norwegian estimates; they are novel, and unexpected, and extremely interesting determinations. Papers by Dr. Stanley Kemp, Dr. N. A. Mackintosh, Mr. J. F. G. Wheeler and Mr. A. Laurie on the Blue and Finner whales, their rate of growth, their age at maturity, their migrations, their estimated numbers, their curious physiology of respiration and all else about them, are here as large instalments of the work which the *Discovery* set out to do.

The *Discovery's* hydrographic work has proved peculiarly interesting, and Mr. G. E. R. Deacon deserves especial congratulation. Oceanography had its roots in the *Challenger* Expedition, its seeds were sown by Humboldt and Maury, but the tree only began to grow apace some thirty or forty years ago; it was then that Nansen told us something of the peculiar oceanographic interest of the polar seas. The *Challenger* had given us, as a first approximation, the simple story of a bottom-current, cold and heavy, flowing towards the equator, while a surface-current, salt and warm, streamed over it to the pole. That the great oceans show a more complex stratification than this was indicated even by the *Challenger* observations, as Merz saw long afterwards; but the Edinburgh physicists were cautious men, and had been afraid to trust to what seemed the too complicated evidence of their own thermometers.

Now the *Discovery*, following on the *Meteor's* work, gives us a new story just a little less simple than the old, telling of four water-layers in the oceanic circulation instead of two. Starting out from the Weddell Sea, toppling to begin with over the edge of the plateau, down to the bottom and away northward, goes a current of cold heavy water. Lying over this and creeping slowly southward, a mass of warm salt water lies; it rises up over the Antarctic current as this plunges down to the depths on its northward way, but it does not come to the surface, for there is other Antarctic water there with a density so far reduced by melting ice as to float, cold as it is, over the warm deep current. Then over all comes the fourth layer, of tropical or subtropical water, very salt but very warm, flowing southward over all the Antarctic waters.

The whole case, simple as it is, is not quite so simple as that! For our two surface-waters, the hot and the cold, the salt and the fresh, one going south and one coming north, meet somewhere, and when two water-masses meet things happen. You may see almost anywhere near the shore, especially in an estuary when the tide is coming in, a line of frothy turbulent water, marked out by a flotsam of sticks and straws; this is the *Schaumrand*, as Otto Petterson called it. Such a *Schaumrand* on a prodigious scale, visible from miles away, marks somewhere about 50° S. the so-called "Antarctic Convergence", the meeting of the warm and cold surface-waters. Here the south-going current is turned back or carried down, and mixes with the Antarctic surface-water which meets it, to form, some way below, the cold northward intermediate current. Thus in the farthest south we have *three* layers of water—cold, warm and cold again; but farther north there are *four* layers, tropical or subtropical ocean-water drifting southward over the other three.

From this easy beginning the story goes on and gathers interest. It is one of Deacon's remarkable discoveries that the Weddell Sea, and that alone, is the source of all the heavy bottom-water, heavy with cold and undiluted by melting ice; from the Weddell Sea the drift creeps along at the bottom of the great oceans, and is traceable even as far as the Bay of Biscay. But there are parts of the Antarctic Ocean so barred by shoals or submarine walls as to be shut off from the main current-system. Ross's Sea has a northern wall so high that the warm deep current does not enter it at all. So Ross's Sea becomes filled up with Antarctic water, extremely cold, and also extremely salt because much water has been removed to form pack-ice; and the fauna of Ross's Sea has (I believe) its consequent peculiarities.

Surface-currents coming northward from the far south hug the west coasts of the great continents,

and the most important and best-known of these, which the *William Scoresby* has specially investigated, is the Peru or Humboldt Current. It flows for more than 2000 miles along by Chile and Peru, now slow, now swift, now narrow and widening out again, even to a breadth of some 200 miles. It seems to arise about 40° S., in one of those convergences or divergences of which we have spoken, where cool and moderately saline water of Antarctic origin wells up from below the warm water of the equatorial counter-current, as indeed it continues to do for all its length along the western edge of the continent. The cold water comes up teeming with nutrient salts; it breeds a plankton-fauna of the richest kind; and this supports a population of whales, and of fishes preyed on by innumerable sea birds the guano of which is sent all over the world. This cold current dominates the situation, but now and then persistent northerly winds check it or thrust it aside. Then comes *el Niño*, a new warm current upsetting the old equilibrium; the fish die in millions, the water stinks, the birds starve, the guano industry cries aloud. On the west coast of South Africa, at Walfisch Bay and Swakopmunde, the same phenomena occur.

After this fashion the *Discovery* reports lead us to many interesting things—interesting chemically and biologically—and arising out of the plain facts of oceanography. At the bottom of the Weddell Sea are found gypsum, calcium oxalate and calcium citrate, the last two especially being of obscure origin and unknown at the bottom of any other sea. A vast abundance of life, microscopic and macroscopic, strikes every naturalist in Arctic or Antarctic seas, and the coldest of Antarctic waters are the richest waters in the world. The biologist is apt to ascribe this abundance to superabundant oxygen, such as the cold waters can dissolve; but that alone would not go far. The nutrient salts, the phosphates and nitrates, are the true limiting factors in the growth of that micro-vegetation with which the whole biological cycle begins. The tropical oceans are often very barren of these salts; in our own latitudes there is never too much, and the burst of growth in spring uses up the supply leaving little or nothing to spare; but the *Discovery* people have shown us that phosphates and nitrates are more abundant in the Antarctic Ocean than in any other seas, and that down there plant-growth is never checked for want of them. Plant-growth in the ocean is limited to a certain depth by its need of sunlight, so the water a little lower down tends to be rich in unused phosphates. In the neighbourhood of any great divergence these waters rise to the surface, and foster an unusual micro-vegetation there. At the edge of the continental shelf we meet with such

rising waters, and have again a richer growth of plants and of creatures great and small to feed on them and one another.

A hundred years ago, Johannes Müller was using the first tow-net, about the time when Edward Forbes was borrowing for the first time a fisherman's oyster-dredge; but only now do we begin to understand properly the importance of the floating life of the sea. Its distribution, its seasonal abundance, its variation with temperature, its presence in this water and absence in that, the vast variety of organisms of which it is variously and with varying importance composed, all these things are a great part of the science of the sea and of our understanding of all the fisheries. Prof. A. C. Hardy of Hull (a most ingenious student of the plankton) and Mr. E. R. Gunther have written an interesting report on the ways and means by which plankton is dispersed and distributed, and how the gathering-places of the whales may be expressed in terms of

plankton, and again of the phosphate supply. Dr. N. A. Mackintosh has demonstrated a seasonal circulation in the Antarctic plankton on a scale unrivalled elsewhere; the big Euphausias, staple food of the Blue whale, first made known by the *Challenger* and met with again by Dundee whalers who went far south unsuccessfully some forty years ago, are fully described by Dr. F. C. Fraser and Mr. Dilwyn John. But without saying more of the ship's company and their doings, let me just say that the *Discovery II*, with a great task to do and ample means to help to do it, has added largely and handsomely to natural knowledge, and given the ship's name an honourable place among voyages of exploration and discovery. There is one omission in the report before us. I have read it all through without encountering the name (save in a list of papers) of the leader and director of the Expedition, the distinguished author of the report.

D. W. T.

Tests in Common Use for the Diagnosis of Colour Defect*

By Dr. Mary Collins

TESTS for colour vision fall into two categories. In one type of test, transmitted light is used, in the other reflected light. While the former type of test is regarded as the more fundamental, the latter can be of great service for quick diagnosis of colour anomaly. Colour tests may be administered purely for theoretical purposes, or they may be applied for practical purposes, as selection tests for different vocations. This second function assumes its most important role in vocations in which lack of accurate discrimination between different coloured signals may involve human lives. This function is also of significance in other vocations in which the lack of colour discrimination, though not involving danger to the community, is highly disadvantageous to its possessor.

There seems to be no need at the present day to emphasize the importance of the recognition and detection of colour defect. It is, however, very illuminating to study some of the more recent investigations in the field, particularly those concerned with the incidence of red-green defect. The percentages given seem to be much higher than in the reports of the earlier investigations. It does not necessarily follow that the incidence of the defect is increasing; the indications are rather that detection is more accurate owing to the

improvement of the test material. Out of 360 candidates applying for acceptance as apprentice printers, the percentage of red-green colour-blinds was 7.5, this figure being exclusive of the colour-weak and the anomalous.

It seems more or less agreed that red-green colour-blindness is a reduction system of normal colour vision, one cogent argument in support of this contention being that normal colour matches are valid for any type of dichromate. The colour-blinds lack something which the normal eye has, but have nothing which the normal eye does not possess. The individual with normal colour vision sees a spectrum composed of six or seven colours. The red-green colour-blind has a spectrum composed of only two colours, these two colours being yellow and blue. The acceptance of this fact was delayed for a long time, and it is doubtful if it is yet generally accepted. Herschel, in 1845, was the first to put forward the dichromic explanation of colour-blindness. He pointed out in his article on "Light" in the "Encyclopædia Metropolitana" that certain individuals could only distinguish two colours, and that these two colours were yellow and blue. Clerk Maxwell, among others, opposed this, for he accepted the theory put forward at that time by Young and Helmholtz that colour-blinds were either red-blind, green-blind or violet-blind, and that the red-blind were blind to red,

* From the presidential address to Section J (Psychology) of the British Association, delivered at Nottingham on September 3.

but could see the remaining two colours, green and violet: the green-blind were blind to green, but could see red and violet.

In an account by Pole of his own case, we find he vigorously protests against these prevailing beliefs, and gives a careful analysis of his own colour vision as evidence. He had been pronounced red-blind by Maxwell and green-blind by Holmgren. Pole repudiated both suggestions, and claimed that the true solution was that he was blind to both colours. This conclusion was confirmed by a large number of facts. One was the evidence of the colour-blinds themselves who, whether they were classified as red-blind or green-blind, asserted that their colour sense was composed of blue and yellow. Another was a case of congenital unilateral dichromatism investigated by von Hippel in 1880. The individual tested had normal colour vision in his left eye but was colour-blind in his right eye. With the right eye he confused red and green with yellow, as tested by various standard tests. The colours which the subject could distinguish with his right eye were blue and yellow, these being confirmed when he looked at them with his normal eye. Von Hippel diagnosed the case as one of red-green blindness with spectrum of normal length. Holmgren examined the case with his wool test and proclaimed it to be one of red-blindness with shortened spectrum in accordance with the Helmholtz theory. Von Hippel retested his subject and reaffirmed his finding. This was the first case of monocular colour vision reported, and it undoubtedly strengthened the case for the acceptance of Herschel's and Pole's views. Holmgren, it is interesting to note, ultimately agreed that blue and yellow were the only colours seen. That this point is still controversial may be gathered from the statement made by Pitt in a recent investigation, that the fundamental responses of the protanope are blue and a saturated green, while those of the deutanope are blue and a mixture of red and green.

Only a few cases of unilateral colour-blindness have been recorded, and these, according to Parsons, are of "doubtful value". In these cases, however, the suggestion is always that the colours seen are blue and yellow. Miles and Beaumont, who tested the two eyes separately in an investigation into colour-blindness, found considerable difference between the two eyes in many cases, and suggest that although there is no conclusive evidence as to the frequency of unilateral colour-blindness, "possibly it amounts to three or four per cent of the colour-blind". They discovered one such case in a group of 23, and Miles and Craig found another in a group of 390 mercantile salesmen. This latter individual was a dry goods

salesman and aware of his condition, and if required to match fabrics he closed the defective eye and made the proper discrimination with his normal eye. If these cases of unilateral colour-blindness are as numerous as suggested, a field seems opened up for further investigation which may lead to definite conclusions as regards the fundamental sensations of the red-green colour-blind.

The results of investigations carried out over a number of years at Edinburgh into the colour-sensations of the red-green colour-blind seem to indicate that their colour sensations are indeed blue and yellow. The extent to which these two colours replace all the other colours in the spectrum is, however, not constant for every colour-blind. With some, yellow and blue may replace all the other colours, that is, red, orange, yellow and green may be seen as different shades of yellow, blue and violet as different shades of blue. Sometimes, instead of the green being replaced by yellow, it may appear as grey, or the blue-green may appear as grey, the extent of the neutral band varying with the gravity of the defect. A second neutral band is also found extra-spectrally in the complementary colour, in the purples. In one extreme case which came under observation, only two narrow bands of yellow and blue existed, the other colours being seen as shades of grey. Red appeared as black, orange as dark grey, yellow could be discriminated, green and blue-green were seen as grey, blue could be distinguished, but violet appeared as dark grey. In one test, out of 76 colours observed, 64 of them appeared as grey.

All cases, however, are not so extreme as the one just described, and the general finding which seems to be gradually gaining ground is that there exist different degrees of colour-blindness extending from extreme cases in which blue and yellow are the only two colours visible, to milder cases in which the blindness to red and green is not total. In these milder cases the individual can see red and green if they are bright enough or vivid enough. It is these milder forms which constitute the great practical problem, for in these cases the ability to distinguish between red and green is likely to fail when the individuals are fatigued, or when the illumination is poor, as in mist or fog. The extreme cases can be easily detected, but the milder cases, which have been described as 'dangerous colour-blinds', require very careful examination if they are to be detected.

That different degrees of colour-blindness exist has been emphasized by more than one writer. Hayes "wonders if we shall presently have to give up all classifications by types, arrange colour defectives in distribution tables and give a colour graph or profile for each subject, showing his

efficiency or deficiency for each colour in terms of a per cent of the normal or average attainment". Troland states that the original restriction of colour-blinds to protanopes, deuteranopes and tritanopes is no longer adequate, and allowances must now be made for more types of variation. Edridge-Green recognizes seven different types of colour vision, and Schjelderup states that there are at least eighteen significant species of colour-blindness. Collins reaches the conclusion that it is quite unprofitable to try to classify the colour systems of the colour-blind because there exist so many individual variations.

One group in which the colour defect is not extreme has been definitely recognized. Seebeck, in 1837, found certain cases which he was reluctant to classify as colour-blinds, who yet showed signs of colour abnormality. It was not until 1881, however, that these cases were understood. In that year, Rayleigh found that a number of individuals with otherwise normal colour vision were unequally sensitive to red and green. In equating red (lithium line $670.8 \mu\mu$) and green (thallium line $535 \mu\mu$) to match a yellow (sodium line $589 \mu\mu$), since known as the Rayleigh equation, some were found to require far more red than the normal, others required an excess of green. Von Kries, in describing an extensive series of experiments, applied the name 'anomalous trichromates' to these cases, and this designation has gained universal currency. Guttman advocated the terms red-weak and green-weak, and distinguished seven characteristics which they manifest, the chief of which are high thresholds, heightened colour contrast and a quick fatigue to colour stimuli.

It is customary to divide these anomalous trichromates into two groups corresponding to the two groups of dichromates, deuteranomalous trichromates or partial deuteranopes in which the sensitivity to green is below normal, and protanomalous trichromates or partial protanopes in which the sensitivity to red is below normal. The

green anomalous seem to be more numerous than the red anomalous, the ratio being quoted as 5 to 1.

These cases, it may be, form the connecting link between normal colour vision on one hand and colour defect on the other, and if a sufficient number of cases could be tested ranging from normality to complete red-green deficiency, a continuous series might be obtained.

It is a moot point as to whether these anomalous trichromates form 'dangerous colour-blinds'. The general finding seems to be in favour of the affirmative. Some writers, for example, Troland, actually include them in classifications of types of colour-blindness. Oblath points out that they can only recognize colours when they are saturated and of intense luminosity; "It is evident that these peculiarities render these subjects less fitted for certain services". In a report on "Colour Vision Requirements in the Royal Navy" (Med. Res. Council Report, Spec. Series No. 185; 1933), it is stated that "the mildly anomalous trichromate can be considered a safe look-out. On the other hand, the unfit anomalous trichromate is, in many ways, a greater source of danger than the dichromate". The incidence of this anomaly is estimated, in the same report, as 6 per cent, which is stated to be a very conservative estimate. Both reports emphasize very strongly the fact that the anomalous trichromate behaves as if colour-blind when conditions are unfavourable, such as when mist, fog or smoke are present, and this is all the more disastrous because the individual is rarely aware that he suffers from any colour defect. The heightened contrast and the quick fatigue characteristic of such anomaly may well make the judgment of colour and the discrimination of colour highly erroneous. The testing and discovering of these cases of anomalous trichromatic vision is not easy, and necessitates very careful procedure, and generally not the application of one test, but of a battery of tests.

(To be continued.)

Obituary Notices

Sir David Orme Masson, K.B.E., F.R.S.

PROF. SIR DAVID ORME MASSON, who died at Melbourne on August 10, was born at Hampstead, London, on January 13, 1858. He was of mixed English and Scots descent. His father, Prof. David Masson, editor of *Milton*, *Goldsmith* and *De Quincey*, and *Historiographer-Royal* for Scotland, came of Aberdeenshire stock—there is a saying in the Don valley that "Eassons, Massons an' Kessons a' cam' frae Tarlandside". His mother, Rosaline Orme, had a forbear George Rutt, the father of

Joseph Priestley's biographer, John Towill Rutt; and it may be mentioned, as throwing some light on the family, that the home of the Ormes, in Avenue Road, Hampstead, was a favourite rallying ground of the Pre-Raphaelites. In 1865 David Masson migrated from the chair of English literature at University College, London, to the Regius chair of English in the University of Edinburgh, and so it came about that his son, David Orme Masson, was educated at Edinburgh Academy and afterwards graduated M.A. and B.Sc. at Edinburgh.

In his younger days Masson was a strong walker and swimmer, and he played golf, tennis and billiards. After a short period of research with Prof. Crum Brown, he left Edinburgh for Bristol in 1880, to become Prof. W. Ramsay's first assistant (in later days, his son, Irvine Masson, was to become Sir William Ramsay's last assistant, at University College, London). Before Masson returned to Crum Brown, he and Ramsay had laid the foundations of a lifelong friendship. Meanwhile he had acquired some further research experience at the University of Göttingen. During his second period at the University of Edinburgh, Masson, with R. Fitzroy Bell, founded the first Students' Representative Council in any university, of which Masson became the first Senior President. The ensuing revolutionary improvement in the students' behaviour at graduations, etc., led Principal Sir Alexander Grant to exclaim, at the end of the tercentenary celebrations: "Gentlemen, you have saved the Republic!" Masson was also a prime mover in the foundation of the Students' Union in the University of Edinburgh—again, the first in Great Britain.

In 1886 Masson was elected to the chair of chemistry in the University of Melbourne, a key appointment which he held with high distinction until he retired in 1923, to become professor emeritus. Orme Masson, and his contemporaries Baldwin Spencer and T. R. Lyle, must be numbered among the prime creators and moulders of Australian science; to them Australia in general and the University of Melbourne in particular owe a debt beyond computation. A brilliant and inspiring teacher, Masson built up Australia's most distinctive school of chemical research at Melbourne, and exerted a steady influence upon the development of Australian science through his pupils and research students; but this was only one side of his work. His remarkable clarity of vision, combined with his organizing and administrative ability, his interest in the wider aspects of science, and his flair for public work, naturally brought him out as a leader in the foundation of national scientific institutions in Australia. Among these were the Commonwealth Advisory Council of Science and Industry, of which he was deputy chairman from 1916 until 1920, and which merged later into the Commonwealth Council for Scientific and Industrial Research; the Australian National Research Council, of which he was president in 1922-26; and the Australian Chemical Institute, of which he was the original president in 1924. Masson was also president of the Australasian Association for the Advancement of Science in 1911-13, and was largely instrumental in bringing about the visit of the British Association to Australia in 1914. In addition to all this, he was active in the interests of Antarctic exploration from Australia.

Masson's researches were concerned chiefly with physical chemistry, more particularly with the theory of solutions, ionization, and chemical dynamics. With Ramsay, at Bristol, he worked upon atomic volumes at the boiling point¹. This investigation was followed, at Edinburgh, by some work with M. Hay on the composition of nitroglycerine², and

by a series of researches on sulphine salts, carried out partly in collaboration with L. Dobbin³. The latter theme was afterwards extended at Melbourne with J. B. Kirkland⁴. A paper on molecular volumes⁵ was followed by another early research at Melbourne, in which, with N. T. M. Wilmshire, Masson came near discovering the celebrated organic synthetic reagents later associated with the name of Grignard⁶.

In 1891 Masson pointed out the analogies between solution and vaporization which are embodied in his term 'critical solution temperature'; at the same time he brought to notice certain other principles regulating the miscibilities of liquids⁷. He was a keen exponent of the ionic theory in its early days, and between 1897 and 1899 he developed the direct 'jelly-tube' method of measuring ionic velocities⁸. Later notable work emanating from the Melbourne laboratories under his inspiration included various observations on the decomposition of persulphates and of sulphine hydroxides in aqueous solution (Leila Green, Brenda Sutherland⁹), and studies on the viscosity and conductivity of some aqueous solutions (W. Heber Green¹⁰). Another interesting research (1909), dealing with the mechanism of urea-formation from cyanates, was carried out in collaboration with his son, Irvine Masson¹¹. During this period also, B. D. Steele and Kerr Grant¹² developed their quartz micro-balance in Masson's department; this was afterwards used by Ramsay and Whytlaw-Gray to measure the density of radium emanation.

It is not generally known that early in 1895 Masson evolved a modification of Mendeléeff's periodic system, which, apart from the treatment of the rare-earth metals, is practically identical with the later classification of Bohr. Masson's arrangement was printed immediately after Ramsay's discovery of helium¹³, and it contained spaces which were later filled by neon, krypton, xenon, and niton. "Helium and Argon," it is stated in an inset to the table¹⁴, "are placed in the new Group VIII, characterized by valence=0 and atomicity=1." It was probably a discussion between Masson and Ramsay in May, 1895, during a visit of Masson to Great Britain, which first gave Ramsay real confidence in the idea of this missing *group* of rare elements. Masson's arrangement was adopted by Ramsay and incorporated by him in a celebrated wall-diagram which he used in his lectures at University College, London (part of this diagram was reproduced in the well-known caricature of Ramsay by 'Spy').

Another example of Masson's prescience is provided by a paper published so early as 1921, in which he developed what was essentially a proton-electron statement of the composition of atoms and of the consequent form of the periodic classification¹⁵. This striking treatment of a fundamental problem failed to attract the attention it deserved. A similar remark applies to Masson's final contribution to physical chemistry. This work, which was summarized in a paper brought before the Australasian Association for the Advancement of Science in 1935, and afterwards printed, offered a new treatment of the facts of the electrolytic conductivity of strong

and feeble electrolytes, in strong and weak solutions, from which Masson deduced a simple general law based upon the viscosity aspect.

Masson's direct contacts with industrial chemistry were limited, but a constant stream of his students went forth into industrial careers in Australia and elsewhere. Through the close touch which he maintained with his former students and their firms, he exerted a wide influence in this field, directed particularly towards the scientific management of industrial concerns. Among his old students who entered academic chemistry may be mentioned his own successors at Melbourne, Prof. (now Sir) A. C. D. Rivett and Prof. E. J. Hartung, and elsewhere Prof. L. S. Bagster, Dr. A. C. Cumming, Prof. J. I. O. Masson, the late Prof. B. D. Steele, and Prof. N. T. M. Wilsmore.

Masson's work received early recognition in his election to the Royal Society in 1903. He became C.B.E. in 1918, K.B.E. in 1923, and LL.D.(Edin.) in 1924. He married Mary, daughter of the late Prof. Sir John Struthers, M.D., of Aberdeen and Edinburgh, who survives him; of his two daughters one survives; and his only son, Irvine Masson, is professor of chemistry in the University of Durham.

David Orme Masson was a man of great charm and urbanity, with a rare gift of lucid exposition and a lively and polished wit. Modest, versatile, and cultured as befitted his ancestry, he possessed an unusually wide range of interests and human sympathies. He was the doyen of chemistry in Australia, a great teacher in the University of Melbourne, and a much-loved citizen of his adopted country.

JOHN READ.

¹ *J. Chem. Soc.*, 39, 49 (1881).

² *Trans. Roy. Soc. Edin.*, 32, 87 (1883).

³ *J. Chem. Soc.*, 47, 56 (1885); 49, 233, 249, 846 (1886).

⁴ *J. Chem. Soc.*, 55, 126, 135 (1889).

⁵ *Phil. Mag.*, [5], 30, 412 (1890).

⁶ *Proc. Chem. Soc.*, 7, 16 (1891).

⁷ *NATURE*, 43, 345 (1891); *Z. phys. Chem.*, 7, 500 (1891).

⁸ *Phil. Trans.*, A, 192, 331 (1899).

⁹ *J. Chem. Soc.*, 97, 2083 (1910); 99, 1174 (1911).

¹⁰ *J. Chem. Soc.*, 93, 2023, 2049 (1908).

¹¹ *Z. phys. Chem.*, 70, 290 (1910).

¹² *Proc. Roy. Soc.*, A, 82, 580 (1909).

¹³ *J. Chem. Soc.*, 67, 1107 (1895).

¹⁴ Masson's table was published as a folding card by Melville, Mullen and Slade, London and Melbourne, n.d. A note states: "Atomic weights taken from the table of F. W. Clarke, revised to 1st January, 1895."

¹⁵ *Phil. Mag.*, [6], 41, 281 (1921).

Canon B. H. Streeter

CANON B. H. STREETER, provost of Queen's College, Oxford, who was killed with his wife in an aeroplane accident in Switzerland on September 10, was one of the great Biblical scholars of the world. He was a many-sided man, and his intellectual interest was wide. Psychology, modern physics, anthropology, psychical research, the relations between religion and science, were all subjects in which he had read widely and become interested. He had a large circle of friends from whom he could acquire at first hand the information on these subjects he needed. He was, in particular, profoundly alive to the difficulties raised by the relations of science to

religious truth, and some of these were discussed by him in his most popular book, "Reality: A New Correlation of Science and Religion" (1926), more briefly also in "Adventure" (1927), and in the Bampton Lectures for 1932, "The Buddha and The Christ".

By 'religion' Streeter meant religion and not, as so often in similar discussions, theology. In religion as implying a quest for God, an apprehension of things beyond the limits of ordinary experience, he was a firm believer. In "Reality" he discussed the connexion between this and science, as he conceived it, clearly and simply. He held strongly that religion, like science and art, reveals to us genuine aspects of reality. Science, he said, gives us a representation of ultimate reality diagrammatic rather than pictorial; religion the reverse—it gives us the picture, not the exact diagram. The two aspects are there; in a sense they are complementary; they are not, however, commensurable. He put it in another way. Science is concerned with the metrical aspects of existence, religion (as art) with non-metrical or qualitative aspects, with values that are mostly ethical. Science states definitely; religion suggests. One tries to explain what is observed by finding laws covering individual cases; the other isolates an individual event or circumstance and makes it symbolic of some aspect of reality. For Streeter the truth of religion lay mainly in the quality of the myths (in the Greek sense) it embraces. The values enshrined or symbolized there are inherent in reality to the extent that the religion is true.

In the eighth Bampton Lecture Streeter, discussing psychical research, gave some of his own experiences of suggestion, mass-hypnotism and telepathy. In particular he discussed the 'levitation' of D. D. Home in 1871 witnessed by the Master of Lindsay and two friends present. He suggested from his own successful repetition of this exploit that Home probably gave each of the three a 'waking suggestion' which effectively convinced them that what they attested actually occurred.

Streeter was born at Croydon in 1874 and educated at King's College School. He went to Oxford as scholar of Queen's College in 1893 and thereafter spent most of his life there. As undergraduate he obtained three first classes and many university prizes. He was fellow of Pembroke from 1899 until 1905 and of his old college, Queen's, from 1905 until his appointment as provost in 1933. He was a fellow of the British Academy and honorary doctor of several universities. He married in 1910 but had no children.

A. S. R.

WE regret to announce the following deaths:

Dr. J. R. Airey, formerly principal of the City of Leeds Training College, on September 16, aged sixty-nine years.

Prof. de Burgh Birch, C.B., emeritus professor of physiology in the University of Leeds, on September 18, aged eighty-five years.

Mr. F. A. Potts, University lecturer in zoology in the University of Cambridge, on September 15.

News and Views

Prof. G. Barger, F.R.S.

THE appointment, which is announced elsewhere (p. 556) of Prof. G. Barger, professor of chemistry in relation to medicine at the University of Edinburgh, to the Regius chair of chemistry in the University of Glasgow, will give general satisfaction. By his work during the past thirty years, Prof. Barger has exercised a considerable influence on the development of organic chemistry and biochemistry in Great Britain. In his well-known early collaboration with Dr. (now Sir Henry) Dale, in the laboratories of Messrs. Burroughs, Wellcome and Co., he was jointly responsible for one of the most fruitful applications of organic chemistry to biological problems which has ever been made; he is a distinguished worker in the field of alkaloid chemistry and by his own work and through his pupils he has made major contributions to what may be called in general terms organic biochemistry. Prof. Barger's appointment in 1919, after holding the professorship of chemistry at the Royal Holloway College, London, to the newly instituted chair of chemistry in relation to medicine at Edinburgh, was in itself a recognition of the outstanding characteristic of his work, namely, the attack of organic chemical problems related to biology not from a narrowly chemical point of view but with true appreciation of their biological implications. His Department at Edinburgh has continued to work on these lines, and has at the same time been responsible for great improvements in the teaching of chemistry to students of medicine. Prof. Barger's influence in chemistry to-day is further enhanced by the many contacts which he maintains with colleagues in other countries, aided as he is by linguistic attainments of distinction. It is encouraging to those who believe that organic chemistry has still vital contributions to make to biology that an important chair of chemistry such as that at Glasgow should be occupied by one who has shown the keenness of his biochemical interests by his own sustained efforts and through the work of his pupils.

Memorial to Samuel Smiles, LL.D.

IN the latter half of the last century a book called "Self Help" was widely read, and an indication of this is shown by its having been translated into twenty-two languages. It developed from a lecture given by Dr. Samuel Smiles in the old Cholera Hospital, Leeds, to a mutual improvement class of working men. Smiles was born in 1812 at Haddington and educated at the Burgh School and at the University of Edinburgh, where he qualified as a medical man. Not having sufficient patients, he wrote articles, and these were seen by the proprietor of the *Leeds Times* who in 1838 asked him to be editor. In 1842, having then "had enough of unquiet life of newspaper work", he set up as a surgeon in Holbeck,

South Leeds. He was partly attracted there by the activities of a school and in his autobiography he says: "On Sundays I taught young men and sometimes gave addresses in Zion School, New Wortley." Smiles married the daughter of a Leeds contractor and in 1845 became secretary of the Leeds and Thirsk Railway, which was afterwards absorbed into the Midland Railway system. This occupation brought him into contact with engineers, and he began to collect data which later appeared in his five volumes of the "Lives of the Engineers"; "Industrial Biography"; "The Lives of George and Robert Stephenson", etc. By his writings and lectures, etc., he helped to create in the West Riding a strong public opinion on such questions as the repeal of the Corn Laws; Parliamentary reform; national education and free public libraries. Zion School was one of the first to have such a library. A memorial tablet in bronze is to be fixed on the old school building, and a set of his books has been presented by Sir John Murray, whose firm published them. Sir Walter D. Smiles, M.P., is also presenting an enlarged framed portrait. The organizer of the memorial is Mr. E. Kilburn Scott, of 38 Claremont Square, London, N.1.

"Shiva's Temple", Arizona

WIDESPREAD interest has been aroused by the investigation of "Shiva's Temple", in the Grand Canyon, Arizona, U.S.A., which is being explored by the Paterson-American Museum Grand Canyon Expedition, with Dr. Harold Anthony, curator of mammalogy in the American Museum of Natural History, as its leader. Shiva's Temple, an isolated cliff of limestone, rises to a height of 1,200 feet above the floor of the Canyon, and is surmounted by a wooded plateau two hundred and seventy-five acres in extent, which is reputed never to have been visited by man since the cliff was separated from the mainland at some time about the close of the Ice Age. It was anticipated that forms of animal life, if any, surviving on the plateau after so lengthy a period of isolation might afford valuable evidence of adaptation and divergence. Dr. Anthony and Mr. Edwin McKee, chief naturalist of the Grand Canyon National Park, with six other members of the expedition, reached the plateau on September 16 after a three hours' climb. Shed antlers of deer were seen, as well as chipmunk, a rabbit and signs of coyote. The first specimens brought to the base camp were a pair of leaf-eared mice. Traps have been set for other animals by Dr. Anthony, who remained on the plateau when other members of the party returned to the base camp. Supplies were dropped from an aeroplane, including water, of which no trace has been found on the plateau. This makes it remarkable that the party should have been much troubled by mosquitoes.

It would appear that before it was isolated, the plateau was a favourable hunting ground for early man. A number of stone arrow-heads and knives have been found. Unless these are the relics of an early party of adventurous climbers, which seems unlikely, they should help in assigning a date to the period of isolation, more especially if the arrow points should conform to the highly specialized type of stone implement known as the Folsom point, which is widely distributed over the High Lands of the south-western United States from Wyoming to New Mexico, though not yet found in characteristic form in Arizona. As mentioned below, stone implements have been found recently in South America in association with the extinct horse and giant ground sloth, while Folsom points have been found embedded in the bones of an extinct bison, as well as in association with that form and with the mammoth, at Folsom and Clovis in New Mexico and elsewhere. It is now beyond question that in certain parts of North America early man was contemporary with an extinct fauna which in Europe would justify a Pleistocene dating in the later part of the Ice Age. In America, however, it is generally conceded, the characteristic Pleistocene fauna, or at least certain members of it, may have survived to a much later date than in the Old World, while conditions militated against a very early appearance of man in the New. If the implements of Shiva's Temple are of the earliest type, and belong, as appears probable, to the pre-isolation period, they indicate on a conservative estimate an upward limit for the period of isolation of approximately ten thousand years, or possibly a little but not much more.

Ancient Man in Chile

An expedition to Chile of the American Museum of Natural History, New York, extending over a period of two and a half years, is reported to have discovered a succession of stone age industries claimed to be of greater antiquity than any previously known in South America. More than four thousand stone implements, it is stated by Science Service, Washington, D.C., have been collected by Mr. and Mrs. Junius Bird, on behalf of the Museum, from two cave sites, Fell's Cave and Palli Aike Cave on the banks of the Rio Chico in southern Chile, near the Straits of Magellan. In the former of the two caves was a stratified succession of five cultures, of which the earliest included tanged spear-points, unique in South America, associated with the bones of the extinct horse and giant ground sloth. This culture was covered by a rockfall, while at Palli Aike, twenty miles away, the oldest culture period closes with a deposit of volcanic ash. Some considerable time after the fall of rock, Fell's Cave was again occupied by man. With the artefacts of this period are associated at first bones of the horse and ground sloth, and later of foxes, of which one form is extinct, and birds. The implements are cruder than those of the early stage. In this and the preceding period the animal bones have been split for the extraction of marrow and show the effects of fire.

The succeeding culture introduces the bola, of which the carefully grooved weights have been found with the stone gravers used to make the grooves. Arrow points and knives appear with the bola in the fourth culture, which is dated tentatively at 2000 B.C. on comparative evidence. The last occupants of the cave, who show no affinity with their predecessors, were the possessors of a culture in many ways comparable with that of the Ona of Tierra del Fuego, who, up to a few years ago, used stone arrow-points similar to those found in the cave. The cave seems to have been abandoned before the Spanish conquest, as no bones of the horse then introduced into America have been found in it.

University Development at Birmingham

It is reported that the University of Birmingham is selling the Mason College site, and the price is said to be £400,000. If the negotiations are satisfactorily completed, the long-desired transfer of the whole of the University to the Edgbaston site will soon be an accomplished fact, and the uneconomical and very inconvenient separation of the faculties will be a thing of the past. Already the building of the new medical school (between the great new hospital and the University at Edgbaston) is nearing completion, and it is hoped that the school will be ready for opening next year. Such an event would be a fitting crown to the work of the Vice-Chancellor (Sir Charles Grant Robertson) who has expressed his intention of retiring at the end of the coming session and who has taken a leading part in the establishment of both hospital and medical school. The money resulting from the sale of the Mason College site will also make possible the expansion, and improvement of the equipment, of some of the departments already at Edgbaston, the Physics Department in particular, which is at present partly housed in old Army huts, inconvenient and unsightly.

Health and the Community

In the account of the discussion in Section I (Physiology) of the British Association on "Health and the Community", which appeared in NATURE of September 18, p. 493, it is stated on p. 494 that the safest rate of reproduction for both mother and offspring is the modal rate. The author of the article has asked us to point out that this statement holds for any size of family, but the example of modal rate actually given was for a family of seven. This does not bear the implication that seven is the ideal number per family. Actually the lowest mortality was found in families of three, produced at the modal rate. The author has also sent the following supplementary note. "One point in the discussion of immense importance for the future not only of the race but also threatening civilization itself, was not sufficiently stressed in the article, namely, the differential birth rate. It follows from the facts that the modal rate is, on the whole, observed only in the lowest paid members of the community, and that they start reproduction early (less than twenty years of age), that the number of the population

below the poverty line, that is, those being maintained by the tax-payers, will steadily increase. In 1930, round about 10 per cent of the families had more than 40 per cent of the pregnancies, 45 per cent of the still-births, 53 per cent of the infant plus child mortalities and 63 per cent of the miscarriages. In 1950, the 10 per cent will have become at least 30 per cent. Nothing short of massacre can alter that now. Births cannot be retrospective. If nothing is done and the process goes on, in 1970, the submerged tenth will be multiplied by seven. This means that, apart altogether from the increasing load of old people, some 30 per cent of the population will have to face the problem of supporting the rest of the community."

The Short-Mayo Composite Aircraft

EXPERIMENTAL flights of the two units of this combination are proceeding successfully at Rochester. *Mercury*, a four-engined monoplane seaplane, which is to be attached to the top of, and launched from, *Maia*, a four-engined monoplane flying boat of a modified Empire type, have both flown separately, and have now to carry out trials, taking off, flying and landing as a combined unit. These will be followed by tests involving releasing in the air and landing as separate units, their normal functions. This experiment is one of fundamental importance in the problem of high-speed long-range flight, as it represents one of several possible methods of getting an aircraft into the air with a load which would make taking-off unsafe or even impossible for a machine under its own power. Heavy loads are not only economical from the transport point of view, but also high wing loading is essential for economical power consumption in high-speed flight. Reduction in engine power used not only reduces costs, but also increases the machine's range on a given fuel tank capacity. When this problem is successfully overcome, it will also help in the case of land aircraft, allowing the use of smaller aerodromes for large heavily loaded commercial machines.

ANOTHER point of the composite type of aircraft is that it will allow the engines of the launched machine to be of the supercharged type necessary for high altitude flying, without their having to carry the complications necessary to allow them to function efficiently at ground level, for the purpose of taking off, as well. Other methods of attaining the same object at present being developed are (1) the use of various wing attachments such as slots or flaps, wing surface and contour changing devices, variable pitch propellers, to increase the speed range of the aircraft, and (2) catapulting the machine into the air, giving it the speed necessary for flight with its high loading, from a momentum applied to it from an external source of power, usually either explosive or hydraulic.

Progress of Marine Engineering

ON September 14, Mr. S. J. Pigott, director-in-charge of the Clydebank Works of John Brown and

Co., Ltd., where the *Queen Mary* was built, delivered the presidential address to the Institute of Marine Engineers. In the main it was a review of the development in marine engineering during the last sixty years. The era 1877-87, he said, might be designated "The Advent of Steel in Engineering". In that decade it was possible to raise the pressure in cylindrical boilers to 160 lb. per sq. in., and at the same time forced draught was introduced. The next decade, 1887-97, saw the development of the quadruple-expansion engine, which in the period 1897-1907 attained its maximum size. The year 1897 was also marked by the use by Sir Charles Parsons of the marine steam turbine, and in 1904 the Cunard Steamship Company equipped the *Carmania* with a high-pressure turbine driving a centre-line shaft and exhausting to a low-pressure turbine on each wing-shaft. The Diesel engine first made its appearance on shipboard in 1903 in the small Russian tanker *Vandal*. Another landmark was the fitting of geared turbines in the *Vespasian* in 1909. In 1910 impulse turbines as opposed to the earlier reaction turbines were fitted in H.M.S. *Bristol*, and to-day, the most highly powered British naval vessel, H.M.S. *Hood*, is propelled by impulse turbines with gearing. If the era 1927-37 has seen no epoch-making development, it has produced progressive designs as is seen in the cross-channel motor-ship *Prince Baudouin*, the turbo-electric P. and O. liner *Viceroy of India*, and last but not least the *Queen Mary* and *Normandie*.

Miniature Ball Bearings

AN invention which, apart from its intrinsic merits as a mechanical development, promises to be of especial interest in a scientific sense, is the introduction by a Swiss manufacturer of a range of miniature ball bearings. Ordinary bearings of this class have been made in sizes varying from half an inch to five feet in diameter overall; but nothing small enough has been available to satisfy the requirements of small and sensitive instruments. The bearings now obtainable as a result of this invention are of several different types and vary in size from 1 to 22 millimetres in diameter overall. They are thus of suitable size for use in such devices as small motors, recorders, meters, clockwork, tachometers and scientific instruments of many kinds in which measured movements are produced by infinitesimal forces, and friction must be eliminated as far as possible. Comparative tests on these bearings and the jewelled bearings they are intended to replace show advantages under three different modes of operation. The time to damp down a rotary motion was in some cases so high as eight times that when plain pivots were used and twenty times that when tapered pivots were used, though there is a good deal of variation in the results. In an oscillatory test the corresponding figures were about 4 and 15, while in the deviation test the results claimed are also favourable. As these new bearings are obtainable at moderate prices, it is probable that, after adequate trials, they will play an important part in the

future construction of scientific instruments. They are being marketed by International Technical Developments, Ltd., Thames House, Millbank, London, S.W.1.

The Wettest Place in the British Isles

DR. J. GLASSPOOLE, in an article entitled "The Wettest Place in the British Isles", which appears in the *Meteorological Magazine* of July, seeks to end the false idea so commonly held that Seathwaite, in Borrowdale, is the wettest place in Great Britain. He points out that there are several small areas nearly twice as wet as Seathwaite, and suggests that the common error has lasted so long because meteorological literature has not provided definite figures to disprove it. This lack of precise information has been due to the lack of rain gauges near the summits of the highest mountains in the four wettest areas over which the average annual rainfall exceeds 150 inches—areas in Snowdonia, the English Lake District, on Ben Nevis, and at the head of the River Garry in the western highlands of Scotland. Dr. Glasspoole considers that in the light of records now available and a study of the relationship between average rainfall and the configuration of the land, estimates can be made of the maximum rainfall in each of the four areas. In Snowdonia we have Glaslyn, at 2,500 feet, with 198 inches, which is probably a little less than the figure for the summit, only about 500 yards away. In the Lake District it is thought that 185 inches is not exceeded in the wettest area, which includes Scafell and Scafell Pikes, while Ben Nevis, in spite of its greater elevation, is more isolated and in consequence offers less obstruction to the moisture-bearing winds, and its summit has a rainfall estimated at only about 165 inches. At the head of the River Garry, however, the fall on Sgurr na Ciche is thought to be comparable with that of the summit of Snowdon over a small area, namely, about 200 inches, compared with the 129 inches of Seathwaite Farm, which last is not even the wettest habitation in Great Britain.

Fortified Hill-top Site in Sussex

A FORTIFIED hill-top site on Mount Caburn, one mile north of Glynde, near Lewes, has been partially excavated by Dr. A. E. Wilson of Brighton Grammar School with the assistance of Dr. E. Cecil Curwen. Since July, it is reported in *The Times* of September 14, portions of the outer and inner ramparts and a length of Iron Age road, with three gateways, have been uncovered. Of the gateways, one on the north side of the town, where the slope is comparatively easy, is of considerable size and is provided with re-entrant ramparts on either side for purposes of defence. A number of sling stones were found. The steep slope of the south side was defended by ramparts and a deep ditch. There are indications in the ceramic evidence that the site was first occupied about 500 B.C., and was fortified about two hundred years later. Stratification revealed by trenching suggests two periods of reconstruction, one about 50 B.C., when the main gate was moved a few feet forward, and a second about one hundred years

later, when a second gate, forming a sort of barbican, was added. Piles of ash near this gate may be, it is conjectured, either a relic of the process of hardening the ends of oak stakes to be driven into the ground, or evidence that the town was destroyed by fire. Flint kerbs mark the edges of the Iron Age roadway, of which the surface is reinforced by flints at a distance of four feet six inches apart, indicating that the gauge of the prehistoric cart was approximately the same as that of the modern cart. One of the ramparts shows what appears to be an early attempt to mix a concrete, powdered chalk apparently being mixed with water and rubble. A grant of £20 made by the Sussex Archaeological Society has made it possible to continue the work of excavation until the end of October.

Prehistoric Finds at Glasgow

EVIDENCE, it is claimed, indicating the site of a wooden circle, or temple, the largest of its kind yet known, has been found at Knappers, on the Dumtoter Boulevard, Glasgow. The site has been under investigation for some weeks by Mr. Ludovic McLellan Mann and Capt. Robert Bush Black, the proprietor of the land. The circle, it is reported in *The Times* of September 15, has a radius of 86 ft., the ground plan being revealed by the socket-holes which held the wooden posts and showing a symmetrical arrangement, "involving circles, ellipses and a large number of serpentine figures". A cemetery adjoins the circle containing fifty-three burials, both cremated and inhumed, with grave furniture and stone settings, many of which are said to be of an unusual nature. The associated funerary vessels fall into four classes and indicate both stone and bronze age datings. For the further exploration of the site financial assistance is required. Should this be adequate the site will be preserved and the monument reconstructed. Donations should be addressed to Mr. J. Eric Fergusson, 166 Buchanan Street, Glasgow.

Educational Films

FROM the British Film Institute we have received three lists, intended for the use of teachers, of about a thousand 16 mm. films: "Geography Teaching and Travel" (about 600), "Science" (400) and "History" (30). Against the title of each is shown its length, whether silent or sound, reference to report, if any, in the Institute's monthly film bulletin, and name and address of distributor. A large majority of the films are silent. Among the sound films are thirty "road-shows" obtainable through Sound-Services, Ltd., which provides a complete projection service in combination with the hire of films. The other sources of supply are very various: camera makers (Kodak, etc.), trade publicity organizations (Australian and Canadian), railway and other travel agencies (L.M.S., Scottish, German, Dutch), firms specializing in educational films such as British Instructional Films, Ltd., Educational Films Bureau, Educational and General Services, Ltd., Gaumont-British Equipment, Ltd., Visual Education, Ltd., and Dance-Kaufmann Technical Films; also the Empire Film Library,

G.P.O. Film Library and the National Film Library of the British Film Institute. Of the science films more than half are classified as zoology; others as physics and meteorology (72), botany (40), mathematics, astronomy, chemistry, geology, physiology and applied science. The prices, exclusive of postage, are: geography, 6*d.*; science, 4*d.*; history, nil. The Institute also issues lists of films dealing with agriculture and industry and catalogues of British medical films. The lists should prove useful to teachers, especially those who do not have access to the National Encyclopaedia of Educational Films. The Institute co-operated with the Educational Handwork Association in organizing a Film School, held in the University of London Institute of Education on July 26-August 6, at which there were lectures on the use of the film in school, film making for teachers, technique and manipulation, etc.

The Carnegie United Kingdom Trust

THE Carnegie United Kingdom Trust's annual reports are always worth reading, not only for the intrinsic interest of the Trust's achievements but also as revealing the latest developments of the administrative policies gradually evolved by the trustees. Co-operation with other trusts and relation to Government services are two aspects of the Trust administration that tend to call increasingly for careful study, owing to recent creations of other and comparable trusts and the ever-increasing liberality of the statutory services, notably since the inauguration of the Government's national health and youth programme. In this connexion, the report for 1936 notes that the Trust's playing fields policy, which has been completely successful, has now been discontinued, the future fulfilment of its objects having been sufficiently secured. Of the various land-settlement schemes which the Trust has been helping to finance, very encouraging accounts are given. "One of the most striking features of the new full-time holdings is the brightness of spirits of the whole community", although most of the men (about 110) had been unemployed for several years. Part-time subsistence holdings (about 1,000 in all) have been an immediate success in nearly every district where they have been established. Of the village halls the Trust has helped to finance, the report says their existence "has given new life to the community. Other recipients of the Trust's help during the year were: young farmers' clubs, the National Council of Social Service, new estates' community centres, amateur music societies, conductors' schools, adult education (inquiry into social and educational needs of the 18 + age-group), museums and libraries.

University or Polytechnic

In the current issue of *Queen's Quarterly*, a Canadian review, "The Higher Learning" is discussed by Dr. R. C. Wallace, formerly president of the University of Alberta and now principal of Queen's University, Ontario. He refers to a recent assessment by R. M. Hutchins, president of the University of Chicago, of "The Higher Learning in America" (Yale

University Press) which confirms Abraham Flexner's estimate of the modern university. Admitting that there is a tendency for the university to become a mere congeries of professional schools deserving rather the name of polytechnic, Dr. Wallace rejects the suggested remedy—the severance of professional schools from the university and the restriction of the university's field to the fundamental sciences and mental discipline, such as metaphysics. He argues that the aim of liberalizing university education may be realized by invigorating and revitalizing the arts school, establishing a system of organic connexions and interchange of thought between it and other parts of the university so that its influence may permeate them all, and selecting for key positions in the professional schools persons of wide sympathies and philosophic outlook capable of using professional courses as instruments of mental culture as well as of vocational training. So confident is he of the potential liberalizing influence of the arts school that he declares its actual impotence to be the gravest fault of the existing university system.

Economic Position and Outlook in Germany

AN admirable review of the economic outlook of Germany, contributed by Alwyn Parker to *Lloyds Bank, Ltd., Monthly Review* of July, deserves attention not only for its sympathetic but dispassionate analysis of the present economic situation in Germany but also for its discerning attempt to understand and interpret the motives and aims of the German system. It is pointed out that the serious cleavage of outlook between the Anglo-Saxon and the German owing to the clash of strong and irreconcilable historical traditions need not be incompatible with broad and real community of aim, sentiment and policy abroad. The author traces the factors which have rendered Germany a peculiarly receptive and fertile soil for the idea of self-sufficiency. Scientific workers will be interested in his critical review of the development of synthetic processes in Germany, notably his assessment of the petrol and synthetic rubber position, as well as in his discussion of the raw materials situation. In regard to rubber, he ventures the opinion that the large-scale substitution of a costly State-subsidized synthetic product for a cheap imported material must cause some abrasion of Germany's capital resources. The greatest interest of this survey lies not in its technical details but in its attempt to understand the German mind, its plea for fair-mindedness and its attempt to forecast the lines of understanding. The author indicates certain steps that the German Government could well take of itself, but while he obviously is unimpressed with Germany's legal or economic case for the return of her colonies, he emphasizes the value of some moderate colonial settlement and the opportunity for the best qualities of philosophic statesmanship and vision. This plea for impartial investigation and goodwill should not be overlooked by any who are concerned with re-establishing an international order in which Anglo-German friendship must find its place.

American Museum Meteorite Collections

DR. CHESTER A. REEDS gives in *Bull. Amer. Mus. Nat. Hist.* (1937) a detailed catalogue of the meteorites contained in this collection, which in 1935 was transferred from the Department of Geology to that of Astronomy, and is now housed in the new planetarium building. The previous catalogue, by Dr. E. O. Hovey in 1896, showed 45 specimens representing twenty-six falls. The collection now contains 3,744 specimens, representing 546 of the 1,073 falls known to the end of the year 1935. The large number of specimens is partly accounted for by 2,129 stones, ranging in weight from 0.2 to 6,650 grams, from the Holbrook, Arizona, shower of 1912. Notable masses are the three Cape York, Greenland, siderites, the largest of which weighs $36\frac{1}{2}$ tons, that is, short tons of 2,000 lb., and is by far the largest meteorite preserved in a museum; and the Willemette, Oregon, siderite of 14.2 metric tons. Much of the general information in the catalogue, even that relating to American meteorites, is reproduced word for word from the late Dr. G. T. Prior's British Museum catalogue.

Mining Industry of Canada

THE Department of Mines of the Dominion of Canada has issued as usual its report for the Fiscal Year ending March 31, 1936 (Ottawa: King's Printer, 1936. 25 cents). This is a valuable paper and deserves careful study, especially the opening pages signed by Charles Camsell, Deputy Minister of Mines, which give a brief review of the whole mining industry of Canada; of course, the record of the gold industry is exceptionally important owing to the increased price of gold, but the base metals, copper, lead and zinc, also improved and played an important part in the increased value of the exports of base metals. This opening chapter is followed by fuller accounts of the various divisions included under mines, such as mineral resources, ore dressing and metallurgical, fuels and fuel testing, etc.

Centenary of Van der Waals

IN commemoration of the birth of J. D. v. d. Waals on November 23, 1837, an international conference on interaction between molecules will be organized by the "van der Waals Fonds" and the "Nederlandsche Natuurkundige Vereeniging". The ordinary sessions will be held in the van der Waals Laboratorium at Amsterdam on November 25 and 26, and an official celebration will take place on November 27. The object of the conference is to give a survey of some of the recent work connected with the idea of van der Waals forces. The programme will be published later. Sufficient time will be left for general discussion. A special number of *Physica* will appear during the conference; it is hoped to be able to publish in this issue a number of papers on a variety of questions having some relation to the work of van der Waals. Physicists willing to contribute to it should send in their manuscripts before October 15, and though it will be impossible to read all these papers during the conference, it is hoped

that they will play an important part in the discussions. The organizing committee, comprising Prof. J. D. v. d. Waals, Dr. A. Michels, Prof. Dr. J. A. Prins and Dr. H. B. G. Casimir, van der Waals Laboratorium, Nieuwe Achtergracht 129, Amsterdam (C), will be glad to give further information.

Solvay Conference

THE Institut International de Chimie Solvay has issued personal invitations to its sixth chemical conference, which is to take place in Brussels on October 4-9, the chosen subjects for discussion being vitamins and hormones. Eight main papers have been promised, namely: P. Karrer, a general report on vitamins; H. von Euler, carotenoid and B₂ vitamins; Ad. Windaus, vitamins D and B₁; W. N. Haworth, ascorbic acid; A. Szent-Györgyi, physiological and therapeutic properties of the vitamins; L. Ruzicka, a general report on hormones; E. Laqueur, sex hormones; T. Kögl, vegetable hormones. Including those named, some twenty-five of the leading workers in these subjects have accepted invitations, so that very valuable discussions should take place during the eight sessions.

Announcements

THE Harben Lectures for 1937 will be delivered in the Lecture Hall of the Institute of Hygiene, London, on October 11, 12 and 13 at 4.30 p.m. by Prof. E. C. Dodds, Courtauld professor of biochemistry in the University of London, on "The Theoretical and Practical Significance of Endocrinology".

THE third National Coal Convention will be held at Harrogate on October 6-7, when the speakers will include Lord Horder and Sir Frederick Sykes, chairman of the Miners' Welfare Committee.

THE Lilienthal Society of Aviation, founded in 1936, will hold its annual congress at Munich on October 12-14, when there will be an exhibition relating to aviation. Further information can be obtained from the general secretary of the Society, Wilhelmstrasse 148, Berlin, S.W.68.

THE ninth International Congress on Psychotherapy will be held in Copenhagen on October 2-4. Prof. C. G. Jung of Zurich and Dr. Paul Bjerre will give the inaugural addresses. The chief subjects for discussion will be psychotherapy in general practice and "Can Psychotherapy be Taught?" Further information can be obtained from the general secretary, Dr. Olaf Brüel, 2 Amagertorv, Copenhagen K.

A SESSIONAL meeting of the Royal Sanitary Institute will be held on October 1 in the Town Hall, Llandudno, when Dr. D. A. Powell, principal medical officer of the King Edward VII Welsh National Memorial Association, will open a discussion on "Tuberculosis in Wales—a Stock taking", and Dr. R. W. Dodgson, director of the Ministry of Agriculture and Fisheries Shellfish Services, will speak on the Conway mussel purification tanks. On October 2 a visit will be paid to the Conway Station for a demonstration and inspection of the tanks. Further information can be obtained from the Secretary, Royal Sanitary Institute, 90 Buckingham Palace Road, S.W.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He 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.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 550.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Investigation of Equilibrium Diagrams of Ternary Alloys by X-Rays

It is the purpose of this note to point out how rapidly and efficiently ternary equilibrium diagrams may be elucidated by means of X-ray analysis. In a recent paper, Jette¹ described a partial analysis of the chromium-iron-silicon system by X-rays. We have carried out the analysis of several ternary diagrams which will be published shortly. As an example, we give the diagram for the copper-nickel-aluminium system, the compositions being represented in the usual way by points within an equilateral triangle. Any one such diagram shows the phases at a given temperature, and a series of such diagrams is required to represent the state of affairs at different temperatures. The present diagram actually shows the phases present after a uniform heat treatment of slow cooling at 10° C. per hour. No claim is made that equilibrium has been established, our main object being to show the exploratory power of X-ray analysis. It will be supposed that the binary equilibrium diagrams, represented by the three sides of the triangle, have previously been established by metallurgical or X-ray methods. It is our experience that the investigation of the whole interior of the ternary diagram is, in general, easier than that of a single complicated binary system, since for the most part the phases are the same as those of the binaries. In other words, the appearance of quite a new phase is comparatively rare; we merely have to determine how far the two-component phases extend into areas of the ternary diagram.

The power and rapidity of the X-ray methods are due to the large amount of information which can be obtained from each powder-photograph of an alloy. The extent of this information makes it possible to explore the whole area by making up a relatively small number of alloys, judiciously chosen so as to fix the important feature of the boundaries. An X-ray photograph tells us:

- (a) The number of phases present, which may be one, two, or three in a ternary diagram.
- (b) The type of each phase, that is, face-centred cubic, body-centred cubic, 'γ' structure, etc.
- (c) The lattice spacing of each phase, which in most cases makes it possible to deduce the compositions of the separate phases in a two-phase or three-phase area.
- (d) The relative amounts of the phases present, deduced from the relative intensities of their lines

in the photograph. In addition, the presence of superlattice lines can be detected.

The ternary diagram CuNiAl is shown in Fig. 1. It is divided into single-phase, two-phase and three-phase areas. The single-phase areas have curved

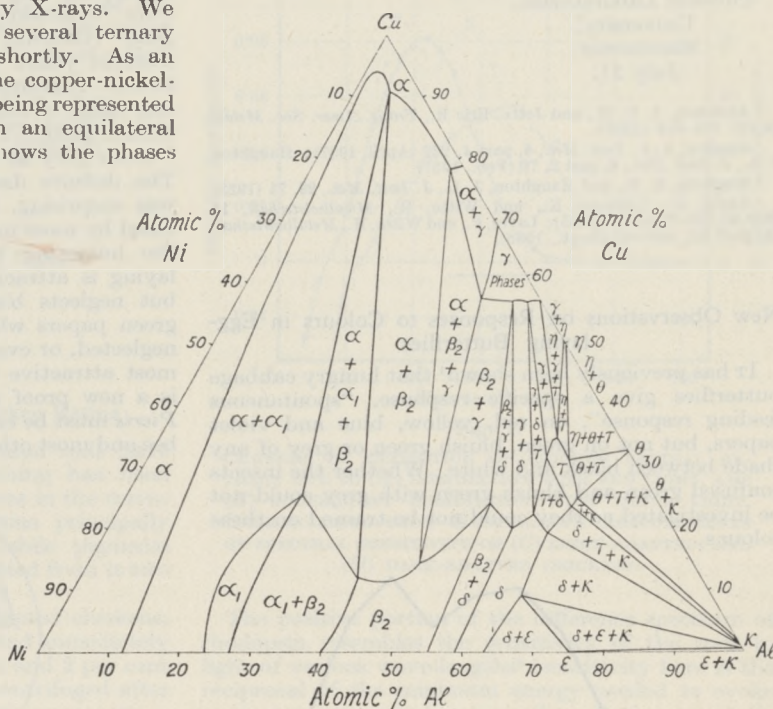


FIG. 1

boundaries. The two-phase areas are covered by 'tie lines' (not shown in the diagram though their general direction can be guessed from the straight-line boundaries of the areas). An alloy of composition represented by a point in a two-phase area breaks up into two phases of compositions represented by the ends of the tie-line running through the point from one single phase area to another. The three-phase areas are triangles, the vertices of which are at cusps on single-phase areas. An alloy anywhere within a three-phase area breaks up into three phases of the compositions represented by the vertices. The diagram exemplifies these points.

Nomenclature presents some difficulties². We have tentatively called all face-centred cubic phases 'α', body-centred 'β' and γ-type 'γ'. Superlattices are denoted by suffixes, for example, α₁, β₁. Phases only appearing with three components are denoted by Greek letters from the end of the alphabet, for example, τ, which checks with the phase found by

Bingham and Haughton³. The γ phases in the CuAl system are of several types, which cannot be shown separately on the present diagram.

We have made such investigations of the FeNiAl, CuNiAl and CuFeAl systems, and are investigating the FeCuNi system. These form ternaries from the four faces of a *quaternary tetrahedron*, and it is already possible to see the general nature of the equilibrium diagram for the quaternary system FeNiAlCu. There are indications of very interesting general features of these diagrams, in particular the effects of electron-atom ratio⁴.

We are indebted to Prof. W. L. Bragg for his kind interest in this work.

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July 31.

¹ Andersen, A. G. H., and Jette, Eric R., *Trans. Amer. Soc. Metals*, 24 (2), 375-419 (1936).

² Bradley, A. J., *Inst. Met.*, 4, part 4, 222 (April, 1937); Haughton, J. L., *J. Inst. Met.*, 4, part 2, 79 (Feb., 1937).

³ Bingham, K. E., and Haughton, J. L., *J. Inst. Met.*, 29, 71 (1923).

⁴ Laves, F., Löhberg, K., and Witte, H., *Metallwirtschaft*, 14, Heft 40, 793-794 (Oct., 1935); Laves, F., and Witte, H., *Metallwirtschaft*, 15, Heft 36, 840-842 (Sept., 1936).

New Observations on Responses to Colours in Egg-laying Butterflies

It has previously been shown¹ that hungry cabbage butterflies give a specific response, "spontaneous feeding response", on red, yellow, blue and violet papers, but not on green, bluish green or grey of any shade between black and white. Whether the insects confused green and bluish green with grey could not be investigated as they could not be trained on these colours.

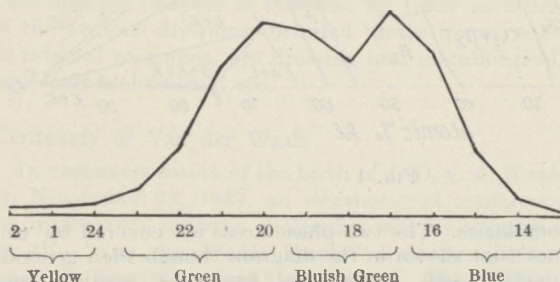


Fig. 1.

I have now found another specific response to colours which makes it possible to investigate this point. As in several other species of butterflies² the female cabbage white, *Pieris brassicae* L., during egg laying will fly to leaves of various plants and on their surface perform what I have called a "drumming reaction". This reaction consists in a very quick alternating movement of the first pair of legs. It can be elicited by any object which shows certain colours. As it cannot be confused with the feeding response, it has been used as a basis for a new series of experiments on colour vision.

In every experiment, fifteen small models, cut out of grey papers of several different shades, and of coloured papers belonging to the twenty-four

Standard Ostwald papers, were offered simultaneously. All the grey papers were entirely neglected. The results for the coloured papers are shown in two curves (Figs. 1 and 2). In Fig. 1, the colours from yellow to blue, according to their position in the spectrum, are plotted against the relative number of drumming reactions on each colour.

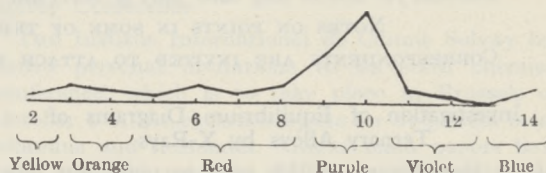


Fig. 2.

It can be seen that the butterflies in the stage of egg laying very distinctly select a continuous range from "Emerald Green" (Ostwald No. 22) to "Oxide Blue" (Ostwald No. 16) which is slightly greenish; whereas yellow and pure blue are practically neglected. This shows that they were able to distinguish this range of colours—the greater part of which had been neglected by the same insect when seeking food—from grey as well as from yellow and pure blue. The definite distinction between yellow and green was surprising, because these two colours are confused by most insects, especially the hive bee³. Thus the humming bird hawkmoth, which during egg laying is attracted by green, visits yellow as well, but neglects bluish green⁴. Exactly those bluish green papers which by most insects are constantly neglected, or even confused with grey⁵, proved to be most attractive to the female cabbage white. This is a new proof that the system of colour vision in *Pieris* must be entirely different from that in the hive bee and most other insects, and nearer to that of man.

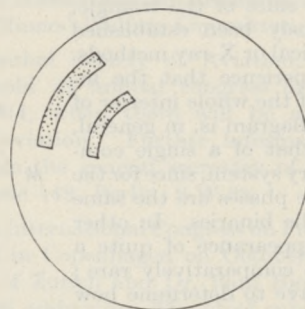


Fig. 3.

COLOURED DISKS WITH GREY STRIPES (STIPPLED) OFFERED TO INSECTS

Another observation also supports this suggestion. Fig. 2 shows the relative number of drumming reactions on the Ostwald papers beyond yellow and blue. It was surprising to find among these colours a distinct though comparatively small peak in purple (Nos. 9 and 10). A more careful observation of the drumming on purple, however, showed that about half the reactions were performed on the adjacent background, which never happened when the insects drummed on green or bluish green. This raised the suggestion that for the eyes of the cabbage white, as for those of man, the purple colours might induce a greenish colour in their surroundings by a simultaneous colour contrast. (For the eyes of the hive bee, purple seems to induce a yellowish colour³.)

To decide this question, in a second series of experiments much bigger models were used, which made it easier to see the exact place of the drumming. Moreover, these models had been furnished with a few small colourless stripes (see Fig. 3) which for our eyes showed an especially strong contrasting colour. In an experiment where two green disks (No. 22 and 21) and two purple disks (No. 9 and 10), each of six inches diameter, were offered simultaneously, the result was as follows :

	Number of drumming reactions on : Coloured disk	Adjacent background	Colourless stripes	Total
Green	48	2	0	50
Purple	0	6	9	15

This provides very suggestive, if not conclusive evidence, that, for the eye of the cabbage white, on the colourless areas adjacent to purple, one of the greenish colours which elicits a distinct drumming reaction had been induced by a simultaneous colour contrast.

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¹ Ilse, D., *Z. vergl. Physiol.*, 8 (1928).
² Ilse, D., *Sitzungsber. d. dtsh. Entomol. Ges.*, 7 (1937).
³ Kühn, A., *Z. vergl. Physiol.*, 5 (1927).
⁴ Knoll, F., *Abh. d. zool.-bot. Ges.*, 12 (1923).
⁵ Hertz, M., *Naturwiss.*, 25 (1937).

Photo-labile Pigments of the Chicken Retina

THOUGH visual purples of the retinal rods have been known for sixty years^{1,2}, nothing has been learned directly of analogous substances in the cones. In the chicken retina, which contains principally cones, attempts to identify photo-labile pigments heretofore have failed³. I have extracted from it two such pigments.

Retinas of ten 8-week old dark-adapted chickens, prepared in very dim red light, are ground immediately in 4 c.c. of 3 per cent sodium chloride and 2 per cent digitonin in water. This mixture is centrifuged after about eight hours in the dark at room temperature. Spectra of a 1 cm. layer of the extract are recorded photo-electrically.

The extract is light orange in colour and possesses a complicated spectrum. On irradiation with deep red light (above 650 mμ), its extinction falls between about 470 and 700 mμ, maximally at about 575 mμ, and rises below about 460 mμ. Sufficiently long irradiation completes these changes. The final difference in extinction between the unbleached and bleached preparations ('difference spectrum') is shown in Fig. 1 A. I believe it to represent the photo-labile pigment of the cones.

When red light produces no further effect, the residue is exposed to bright white light. The extinction now falls between about 435 and 620 mμ, maximally at about 508 mμ, and rises below about 430 mμ. The difference spectrum of this change is shown in Fig. 1 B. It is characteristic of rhodopsin^{3,4}.

If retinas are soaked in 4 per cent alum for several hours following dissection, their digitonin extracts yield the difference spectrum of rhodopsin alone. The alum treatment apparently renders the cone pigment

insoluble. An extract of chicken retinas with 2 per cent disodium phosphate, freezing and thawing several times during extraction, displayed no measurable trace of either pigment.

The rise in absorption below 460 mμ on irradiation shows the cone pigment, like rhodopsin⁴ and porphyropsin—the visual purple of certain freshwater fishes⁵—to bleach to coloured products. Its difference spectrum, therefore, may partly resemble, but obviously is not, its true absorption spectrum.

Rhodopsin, porphyropsin and the cone photopigment form a graded series, in which functions and properties run closely parallel. Their colours are respectively red, purple and apparently violet. I propose to call the cone pigment *iodopsin* (lov = violet).

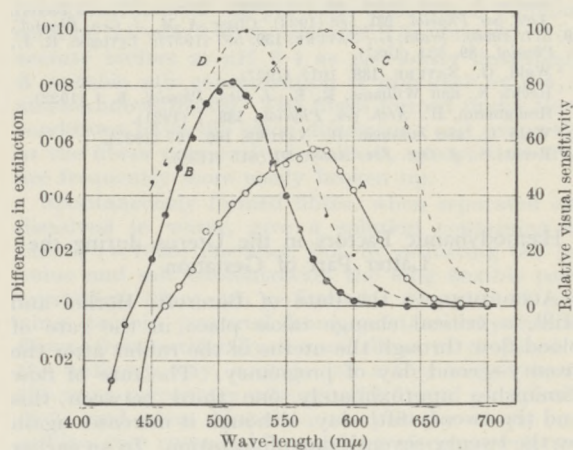


Fig. 1.
CHANGES IN EXTINCTION OF CHICKEN RETINAL EXTRACT DUE TO (A) IRRADIATION WITH RED LIGHT, AND (B) SUBSEQUENT IRRADIATION WITH WHITE LIGHT. BROKEN LINES SHOW HONIGMANN'S MEASUREMENTS OF SPECTRAL SENSITIVITY OF (C) LIGHT-ADAPTED, AND (D) DARK-ADAPTED CHICKENS.

The positive portion of the difference spectrum of rhodopsin resembles the sensitivity of the rods to light of various wave-lengths⁶ (sensitivity here is the reciprocal of the minimum energy needed to evoke a constant response). A similar relation has been inferred to exist between known spectral sensitivities of cones and the spectra of hypothetical cone photopigments^{6,9}. Honigmann⁷ has measured the spectral sensitivity of light- and dark-adapted chickens. His data, plotted as percentages of their maxima, are shown in Fig. 1 C (light adapted—cone function) and Fig. 1 D (dark adapted—rod function). Light adaptation shifts the maximal sensitivity from about 520 to about 580 mμ. This is the familiar Purkinje effect, for which clearly the extracted photo-pigments form an adequate chemical basis.

The difference spectra of rhodopsin and porphyropsin are nearly symmetrical in form³, while that of iodopsin is decidedly skew, due to stronger absorption on the short wave-length side of its maximum. In this spectral region the visual sensitivity might be expected to be correspondingly high. However, this is also the region in which the effectiveness of light entering the chicken cones is decreased through absorption by carotenoid filters⁸. The net result is the nearly symmetrical sensitivity function shown in Fig. 1 C.

Trichromatic vision in man may depend upon the presence in the cones of three distinct photo-labile pigments, differing in absorption characteristics¹. In the chicken retina three groups of colour filters provide a possible basis for hue differentiation. It is unnecessary, therefore, to assume more than a single cone photo-pigment in this animal.

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¹ Boll, F., *Arch. Physiol.*, 1, 4 (1877).

² Kühne, W., *Unters. physiol. Inst. Heidelberg*, 1, 15 (1877).

³ Kottgen, E., and Abelsdorff, G., *Z. Psych. u. Physiol. Sinnesorg.*, 12, 161 (1896).

⁴ Garten, S., *Arch. Ophth.*, 63, 112 (1906); Hosoya, Y., and Bayerl, V., *Arch. ges. Physiol.*, 231, 563 (1933); Chase, A. M., *J. Gen. Physiol.*, 19, 577 (1936); Wald, G., *NATURE*, 139, 587 (1937); Lythgoe, R. J., *J. Physiol.*, 89, 331 (1937).

⁵ Wald, G., *NATURE*, 139, 1017 (1937).

⁶ Hecht, S., and Williams, R. E., *J. Gen. Physiol.*, 5, 1 (1922).

⁷ Honigsmann, H., *Arch. ges. Physiol.*, 189, 1 (1921).

⁸ Wald, G., and Zusman, H., *NATURE*, 140, 197 (1937).

⁹ Hecht, S., *J. Opt. Soc. Amer.*, 21, 615 (1931).

Hæmodynamic Factors in the Uterus during the Latter Part of Gestation

ACCORDING to the data of Barcroft, Herkel and Hill¹, a critical change takes place in the rate of blood flow through the uterus of the rabbit after the twenty-second day of pregnancy. The rate of flow diminishes approximately one third between this and the twenty-fifth day, although it increases again by the twenty-seventh day of gestation. In an earlier paper by Barcroft and Rothschild², measurements were made of the volume of blood contained within the maternal vessels of the uterus on different days of pregnancy. The data of this study show that the volume of blood increases to a maximum by the twenty-eighth day and diminishes by fifty per cent during the next two days. The volume of the placental tissues during this time follows a parallel curve, so leading these investigators to the reasonable conclusion that the volume of blood in the uterus increases as the extent of the placental vascular bed increases. The cause of the changes in the rate of blood flow through these vessels has not, however, been described. When the foregoing data were used to estimate the efficiency of the uterine circulation during the latter part of gestation as certain growth changes take place, an insight was gained into some of the hæmodynamic factors operating at this time, providing a basis for interpreting the effects which Barcroft and his associates have reported.

The percentage of the blood volume which changes each minute (that is, the efficiency of the maternal circulation in the uterus) has been calculated from the data cited above with the result shown in the accompanying table:

Day of pregnancy	Blood volume of uterus	Minute-volume of blood	Efficiency (% turn-over)
14	8.0 c.c.	5.0 c.c./min.	62.5
18	12.3 "	13.5 "	109.7
20	14.5 "	20.0 "	137.1
22	16.2 "	29.0 "	179.0
25	21.5 "	19.0 "	88.3
27	29.0 "	27.5 "	94.8
28	32.0 "	28.5 "	89.0

Here, it will be seen, a marked increase takes place in the turn-over of the blood each minute until the twenty-second day, as the blood volume increases coincidentally. By the twenty-fifth day a marked decrease occurs in the efficiency of the local circulation. This fall parallels that which takes place in the circulation rate. From this point on, so far as the data go, this level of efficiency in the uterine circulation is maintained. The level at this time equals that found on the seventeenth day of pregnancy when the embryos are almost inappreciable in size, whereas by the twenty-fifth day they are comparatively large and are growing at a nearly maximum rate³. The oxygen requirement of the embryos is met by greater oxygen unsaturation of the blood as it flows through the uterus⁴.

The significance of these considerations is shown by the recent discovery that a critical change occurs in the relationship between the rate of growth of the uterus and the growth of the products of conception about the twenty-second day of gestation. Between the twenty-second and the twenty-fourth days the uterus commences to grow less rapidly, from causes already described^{3,4}. At the same time, the products of conception grow at a rate almost as rapid as at any time during pregnancy^{3,4}. The foetuses and their associated structures must act, therefore, as an impeding influence to the maternal circulation and so serve as a factor which diminishes the quantity of blood flowing through the maternal vessels of the uterus at this time. This resistance to the local flow of blood in the maternal circulation of the uterus is transient, however, as shown by the data of Barcroft, Herkel and Hill.

It is therefore clear that the rate and efficiency of the blood flow in the maternal circulation of the uterus are adversely affected as the influence of distention first becomes manifest, but with increasing degrees of distention as pregnancy nears term, some compensating adjustment takes place which maintains the efficiency of this local circulation of blood. The pumping action of the increasing muscular movements which are known to take place at this time⁵ would serve such a purpose. The efficiency and forcefulness of these contractions would likewise be enhanced by the increasing distention resulting from the disproportion in the rates of uterine and foetal growth respectively.

These considerations suggest, therefore, that the increasing distention which the uterus undergoes in the latter part of gestation first brings about a diminution in the efficiency of the maternal circulation through the uterus. As the degree of distention becomes greater, however, it becomes *pari passu* the means by which the efficiency of this circulation is maintained, mainly by virtue of the influence which distention has upon the contractility of the myometrium.

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¹ Barcroft, J., Herkel, W., and Hill, S., *J. Physiol.*, 77, 194 (1935).

² Barcroft, J., and Rothschild, P., *J. Physiol.*, 76, 447 (1932).

³ Reynolds, S. R. M., *Amer. J. Obst. Gynecol.*, 33, 968 (1937).

⁴ Reynolds, S. R. M., Symposium on Quantitative Biology, The Biological Laboratory, Cold Spring Harbor, Long Island, N.Y., volume 5 (1937).

⁵ Wijsenbeck, I. A., and Grevenstuck, A., *Nederl. Tijdschr. v. Geneesk.*, 2, 2155 (1922).

Devernalization of Spring Rye by Anaerobic Conditions and Revernalization by Low Temperature

A PREVIOUS letter in NATURE¹ presented evidence to show that in winter rye (var. Petkus) anaerobic conditions at normal temperatures (20° C.) when alternated with aerobic conditions at 1° C. quantitatively annul the vernalizing effect of low temperature. It appeared possible, therefore, that spring rye of the same variety might be devernalized by the application of anaerobic treatment at 20° C. Previous work^{2,3} has shown that the process of vernalization in winter rye decreases the number of leaves produced on the main axis before flower initiation, as well as decreasing the period of time required to reach anthesis. An increase in these characteristics in spring rye after anaerobic treatment would thus indicate a process of devernalization.

The experiment was performed by sealing the grains in tubes, with sufficient water to imbibe them fully, in an atmosphere of pure nitrogen, leaving for varying periods at 20° C., and then sowing in sand culture. Periods up to three weeks alone could be used, as longer exposures to anaerobic conditions led to death of the seeds.

The results of this experiment are given in Table 1.

Table 1.
DEVERNALIZATION OF SPRING RYE BY ANAEROBIC TREATMENT.

Preliminary period in nitrogen	No. of leaves on main axis	Days to anthesis	No. of replicates
Control (none)	6.80 ± 0.20	50.3 ± 0.49	10
1 week	7.52 ± 0.11	52.6 ± 0.45	23
2 weeks	7.67 ± 0.13	54.4 ± 0.73	24
3 weeks	8.29 ± 0.36	57.4 ± 1.7	7

A significant increase in leaf number and time to anthesis follows anaerobic treatment, thus establishing the possibility of devernalization at normal temperature.

The process of vernalization is held by us to be a specific effect of low temperature, and in confirmation of this view it has been established that spring rye partially devernalized by anaerobic conditions may again be vernalized by subsequent exposure in air to 1° C. The data are given in Table 2.

Table 2.
REVERNALIZATION OF SPRING RYE AFTER ANAEROBIC TREATMENT
All variants, except controls, received 3 weeks' chilling at 1° C. in air after removal from anaerobic conditions.

Preliminary anaerobic treatment	No. of leaves on main axis	Days to anthesis	No. of replicates
Control (none)	6.80 ± 0.20	50.3 ± 0.49	10
1 week	—	47.3 ± 0.34	14
2 weeks	7.10 ± 0.23	50.5 ± 0.79	10
3 weeks	All plants failed		

It will be noted that both leaf number and time to anthesis have been reduced to the level of the controls which were untreated.

These results thus add further evidence for the reversible nature of the vernalization process.

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Artificially Prepared Visible Paracrystalline Fibres of Tobacco Mosaic Virus Nucleoprotein

A RECENT letter in these columns¹ contained photomicrographs of mesomorphic or paracrystalline fibres of tobacco mosaic virus which had formed spontaneously in clarified juice expressed from diseased tobacco leaves. Similar fibres have now been prepared from solutions of the pure virus protein by suitably adjusting the pH value of the medium and the salt and virus concentrations. Although the fibres may be produced over a relatively wide range of pH values, the best results are obtained at a pH value of about 5 (near to the point where, in the comparative absence of salts, virus solutions are most viscous or gel-like).

The pure virus was obtained by a combination of precipitation with 15 per cent ammonium sulphate solution at pH 7 with isoelectric precipitation from acetate buffers at pH 3.4 as previously described². A suitable salt concentration is provided by 0.4 M ammonium sulphate. The fibres formed under these conditions have the same dimensions and properties as the fibres previously described¹, except that they are frequently more easily broken up.

Spontaneously formed fibres, when separated and dissolved in water, give a solution containing no visible (×1000) particles, but by adjusting the pH value and salt concentration the long flexible paracrystalline fibres are re-formed. Samples of pure virus protein prepared from spontaneously formed fibres, from artificially formed fibres or prepared in the ordinary way, contain (on a dry weight basis) the same percentage nitrogen (16.6) and phosphorus (0.5), and when diluted to one part by weight in a million give comparable numbers of primary lesions on *Nicotiana glutinosa* leaves.

The temperature at which artificially formed fibres disrupt is the same as for the spontaneously formed ones. Taken in conjunction with the evidence presented in the previous letter¹, there can be no doubt of the identity of the fibres with the virus.

Bernal and Fankuchen³, by means of X-ray analysis, deduced the arrangement of the virus molecules within the paracrystalline aggregates. They point out that in view of this structure, homogeneity of the aggregates is less certain. I assume that by this they mean that viruses like yellow tobacco mosaic, a closely related mutant strain of ordinary mosaic virus, may form a part of such aggregates without altering the general arrangement. This is a possibility which cannot be overlooked. However, my preparations were derived from plants which had been artificially infected with virus separated at its iso-electric point of pH 3.4, and which had been raised in an isolated compartment of an insect-proof glasshouse and showed no symptoms other than those of ordinary mosaic.

The finding of Bawden and Pirie⁴ that the virus contains nucleic acid has been confirmed, and my preparations contain 0.52 per cent phosphorus. There is evidence to associate the acid prosthetic groups deduced by me⁵ on the basis of the pH activity curve for this virus, with the nucleic acid demonstrated by Bawden and Pirie. The circumstance that Stanley's⁶ earlier preparations contained no demonstrable amounts of phosphorus, and the presence of small but variable amounts in his later preparations⁷ are understandable when it is realized that during the purification processes his preparations were exposed to pH values which are known to

¹ Gregory, F. G., and Purvis, O. N., NATURE, 138, 1013 (Dec. 12, 1936).

² Purvis, O. N., Ann. Bot., 48, 919-955 (1934).

³ Purvis, O. N., and Gregory, F. G., Ann. Bot., N. S. [i] (in the Press).

inactivate a large percentage of the virus, and that this action must have been more pronounced in his earlier methods. The test for active virus is much more sensitive than the test for phosphorus.

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Aug. 12.

¹ Best, Rupert J., *NATURE*, **139**, 628 (1937).

² Best, Rupert J., *Austral. J. Exp. Biol.*, **14**, 1 (1936).

³ Bernal, J. D., and Fankuchen, I., *NATURE*, **139**, 923 (1937).

⁴ Bawden, F. C., Pirie, N. W., Bernal, J. D. and Fankuchen, I., *NATURE*, **138**, 1051 (1936).

⁵ Best, Rupert J., *Austral. J. Exp. Biol.*, **14**, 323 (1936).

⁶ Stanley, W. M., *Phytopath.*, **28**, 305 (1936).

⁷ Stanley, W. M., *J. Biol. Chem.*, **117**, 325 (1937).

Blood-groups of Veddahs

BLOOD-GROUPING in the field in Ceylon presents almost insurmountable difficulties, so that no records of blood-grouping of the Veddahs have been hitherto published. Until recently I had only one record—that of a Veddah whom I had persuaded to come down to Colombo for treatment in hospital. Recently, however, I had the opportunity of making observations on a series of four more Veddahs. These were brought to Colombo, with two others, who refused to give blood, by an enterprising showman, for exhibition at a fair held on the occasion of the Coronation celebrations. All the Veddahs were tolerably good specimens of their race. The blood samples were examined independently by myself and by the staff of the Pathology Department, General Hospital, Colombo, with identical results. I used imported standard sera (Burroughs and Wellcome's) that had been kept in the refrigerator. The hospital authorities make their own standard sera. Although the numbers examined are too few for any definite conclusions to be drawn, I consider they are worthy of record in so far as no previous information is available relative to this important race.

TABLE I. BLOOD-GROUPS OF VEDDAHs.

Veddah No.	Name	Sex	Locality	Blood-group
1.	Davitha	♂	Bulugahadena Bintenne	B
2.	Kaira	♂	Dambane Bintenne	O
3.	Burunda	♂		B
4.	Kanda	♂		O
5.	Dematha (son of No. 4)	♂		O

These results give a proportion of 60 per cent Veddahs with the O group and 40 per cent with the B group. The proportion of O is thus practically the same as in the Australian aboriginal, but the B group differs considerably in the two races. On the contrary, the Paniyans of South India agree with the Australians in the low proportion of B, but differ from both Australians and Veddahs in the low proportion of O. The difference is made up by a high proportion of group A (see Aiyappan, 1936¹).

With regard to the other inhabitants of Ceylon, I give below the results of a series of blood-groupings which have been taken in the General Hospital, Colombo, for routine blood-transfusion purposes, and for which I am indebted to Dr. S. Thiagarajah, the pathologist to that institution. It will be noted that, in all the communities studied, group O takes the

highest place, except in the Moors, where groups O and B are in equal proportion. Group B is also high in the Tamils, so that the high value of that group in the Moors is to be explained by the amount of Tamil blood present—a fact which is corroborated by their physical characters. The Sinhalese, on the contrary, have an almost equal proportion of individuals with groups A and B blood. The Veddahs, therefore, so far as the meagre numbers examined throw any light upon the question, do not resemble either of the predominant local populations, but fall into a category of their own. Examination of larger numbers would most probably bring them into line with the Australian aboriginals, a supposition which would be expected on the grounds of their physical characteristics.

TABLE II. BLOOD-GROUPINGS OF OTHER CEYLONESE PEOPLES.

People	Numbers examined	Group O	Group A	Group B	Group AB
Sinhalese	712	335	187	176	14
Tamils	136	69	19	42	6
Burghers	61	35	17	8	1
Moors	29	10	7	10	2

TABLE III. PERCENTAGE REPRESENTATION OF BLOOD-GROUPS IN THE PEOPLES DISCUSSED HEREIN.

People	Group O	Group A	Group B	Group AB
Veddahs ..	60	—	40	—
Paniyans ..	20	60	7	10
Australians ..	57	38.5	3	1.5
Sinhalese ..	47	24.7	23.1	2.0
Tamils ..	50.7	14	30.9	4.4
Burghers ..	57.4	27.7	13.1	1.6
Moors ..	34.4	24.1	34.4	6.8

In conclusion, I have to acknowledge my indebtedness to Prof. F. O'B. Ellison of the Physiology Department, Ceylon Medical College, and his laboratory staff for the use of apparatus in his department.

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¹ Aiyappan, A., *Man*, **36**, 255 (1936).

Modes in Modern Egyptian Music

WE have been engaged on determining the frequency ratios involved in the principal musical scales or modes in current use in Egypt to-day. Those scales were the subject of a controversial discussion at an international congress held in Cairo in March 1932.¹

In the present investigation, three expert tuners (appointed by the Royal Institute of Oriental Music) tuned a Qanun, an instrument consisting of strings stretched on a sounding board, to the different modes, and the frequencies were then measured by means of an audio-frequency valve oscillator to which a calibration curve was plotted by means of a set of standard tuning forks. The actual determination of each frequency was carried out using the method of beats. The notes constituting each scale were taken in ascending and then in descending order, so as to

correct for possible variation in temperature. The experimental error is of the order of 0.1 per cent.

The results for each of the three tuners were recorded separately and an average was then taken. The following table gives the fourteen recognizable intervals into which an octave was found to be subdivided compared with the diatonic and equitempered scales.

The four principal modes correspond to the following groups of notes (quoted by their numbers): (1, 3, 5, 7, 9, 11, 13), (3, 4, 8, 9, 11, 13, 1'), (3, 5, 7, 8, 11, 12, 1'), (1, 3, 4, 7, 9, 10, 14). Of these the last is the same as the minor scale in European music.

No. and Name of Note	Frequency ratios		Equitempered scale	Diatonic scale	Symbol
	Our results	Conf'nce results			
1 Rast	1	1	1	1	C
2 Shahnaz	1.057	..	1.057	1.042	C#
3 Doka	1.123	1.123	1.120	1.080	Db
4 Kurd	1.200	..	1.187	1.125	D
5 Sika	1.228	1.227	..	1.171	D#
6 Nim Busalik	1.274	..	1.257	1.200	Eb
7 Girka	1.330	1.337	1.330	1.250	E $\frac{1}{2}$ b
8 Higaz or Saba	1.417	..	1.411	1.250	E
9 Nawa	1.498	1.503	1.496	1.257	E
10 Hisar	1.590	..	1.583	1.279	Fb
11 Huseini	1.685	1.685	1.677	1.302	E#
12 Agam	1.779	..	1.778	1.333	F
13 Irak	1.831	1.838	1.822	1.333	F#
14 Nim Mahur	1.880	..	1.882	1.390	G
1' gawab el Rast	2.000	2.000	2.000	1.440	Gb
				1.500	G
				1.562	G#
				1.600	Ab
				1.667	A
				1.738	A#
				1.800	Bb
				1.875	B $\frac{1}{2}$ b
				1.920	B
				1.955	Bb
				2.000	C

Other modes are obtained by changing the first note (key-note) in a group. The most characteristic feature of the scheme is the appearance of neutral thirds and neutral sevenths.

A fuller account will appear elsewhere.

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¹ "Oriental Music Conference," p. 559 (Cairo, 1932).

Magnetic Anisotropy of Rare Earth Sulphates and the Asymmetry of their Crystalline Fields

In an important paper in the *Physical Review* for 1932 Penney and Schlapp¹ have discussed theoretically the Stark-splitting of the energy levels of the rare earth ions in crystals under the influence of the crystalline electric fields, and its influence on the magnetic behaviour of the ions. Experimentally, Spedding and his co-workers² have studied the absorption spectra of rare earth salts of the type $M_2(SO_4)_3 \cdot 8H_2O$, where $M = Pr, Nd, Er$ at different temperatures, and thence deduced the low-lying energy levels of the M^{+++} ions in the crystals. They find that (1) the number of low-lying energy levels and their relative separations are the same as predicted by the theory for a field of cubic symmetry

acting on the M^{+++} ions; (2) the intensity of the cubic field required to produce the observed separations is the same in all the three crystals, as should be expected from their isomorphism; (3) the observed separation of the levels is not inconsistent with the available magnetic data for the mean susceptibilities of the crystals. From these and other results, it has been concluded that the fields acting on the M^{+++} ions in these crystals should be almost rigorously cubic in symmetry.

One direct result of such a cubic symmetry in the field would be a magnetic isotropy for the crystal, and any observed deviation from isotropy will give us some idea of the deviation of the field from cubic symmetry. We have recently measured the principal magnetic susceptibilities of single crystals of several rare earth salts, and we give below the values for the anisotropy of the sulphates; $\Delta\chi$ denotes the difference between the maximum and the minimum principal susceptibilities of the crystal, and χ the mean of the three principal susceptibilities.

Crystal	$\Delta\chi/\chi$
$M_2(SO_4)_3 \cdot 8H_2O$	
$M = Pr$	0.20
Nd	0.11
Sm	0.21
Er	0.12

$\Delta\chi/\chi$ is not small, and when we remember that the group of atoms associated with each M^{+++} ion in the crystal should have at least this anisotropy, and has very probably more (as the different groups present in the unit cell of the crystal—probably eight in number—will not, in general, be oriented parallel to one another) and that it is the anisotropy of the above group (and not that of the crystal) which corresponds to the asymmetry of the field under consideration, it is easy to realize that the deviation from cubic symmetry should be quite marked. From an inspection of the table it becomes clear, as pointed out by Penney and Kynch³, that the non-cubic part of the field has produced separations in levels, degenerate in the cubic field, comparable in size with those of the cubic field pattern itself.

A rediscussion of the valuable results on the absorption spectra of these crystals obtained by Spedding and his co-workers, taking into account the non-cubic nature of the crystalline fields as evidenced by the magnetic anisotropy of the crystals, is very desirable.

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¹ *Phys. Rev.*, **41**, 194 (1932).

² *J. Chem. Phys.*, **5**, 191, 316, 416 (1937).

³ *NATURE*, **140**, 109 (1937).

Variations of Cosmic Ray Intensity during Magnetic Storms

In a paper¹ on trajectories of electric particles with applications to cosmic rays, published January 4, 1937, I directed attention to possible effects of magnetic storms in the following words:

"As to other electromagnetic fields which may modify this supposition (regarding simplifying

hypotheses for the mathematical treatment), the only case of interest may be *the outer magnetic field during magnetic storms*. It would be very interesting to make a careful inspection of the cosmic ray registrations during such a storm (for instance of the order of magnitude of the storm of February 4th, 1872, when auroras were seen almost over the whole earth) in order to discover possible actions due to this field."

It is most interesting that such an effect has just been observed during the recent magnetic storms in April this year, both by Mr. S. E. Forbush in America² and by Prof. Victor F. Hess and A. Demmelmair in Europe³.

We have here an effect analogous to the effect of magnetic storms on auroras, driving the aurora zones away from their usual situations and towards the magnetic equator as the intensity of the storm increases.

The mathematical theory of the motion of electric particles in the earth's magnetic field, which I developed⁴ so long ago as 1904, and which Mr. Forbush attributes to Lemaître and Vallarta, receives by these new facts renewed interest and suggests continual observations of cosmic rays both in high and low magnetic latitudes, because the solar activity and magnetic storms both approach their maximum intensity.

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¹ "On the Trajectories of Electric Particles in the Field of a Magnetic Dipole with Application to the Theory of Cosmic Radiation, Sixth Communication", *Astrophysica Norvegica*, [ii] 4, 195 (1937).

² *Phys. Rev.*, 51, 1108 (1937).

³ *NATURE*, 140, 316 (1937).

⁴ For details see Oslo University Observatory Publications No. 10, Oslo 1934, and *Phys. Rev.*, 45, 835 (1934).

Points from Foregoing Letters

As an example of the ease with which equilibrium diagrams of alloys containing three elements can be obtained, by means of X-ray analysis, A. J. Bradley, H. J. Goldschmidt, H. Lipson and A. Taylor submit a diagram for the copper-nickel-aluminium system. It shows the phases present at different percentage composition, after a uniform heat treatment (slow cooling at 10° per hour; equilibrium not necessarily established). The X-ray method gives at the same time the number, nature and relative amount of phases present and the lattice space of each phase.

Dora Ilse describes experiments on the response of egg-laying butterflies to coloured papers; these indicate that colour vision in the cabbage butterfly, *Pieris*, is different from that in the hive bee and most other insects and nearer to that of man. The cabbage butterfly in the stage of egg-laying reacted to a range of colours from 'emerald green' to 'oxide blue' and responded also to simultaneous colour contrast (green induced on white background adjacent to purple).

Dr. G. Wald has extracted from chicken retinas rhodopsin and the photo-labile pigment of the cones, heretofore unknown. The shift in visual sensitivity toward the red on light adaptation (Purkinje effect) in the chicken appears to depend upon the spectral characteristics of these pigments. The cone pigment, for which the name iodopsin is proposed, is apparently violet in colour and bleaches to coloured products.

From the data of Barcroft and his associates, Dr. S. R. M. Reynolds has estimated the efficiency of the maternal circulation of the uterus of the rabbit between the fourteenth and twenty-eighth days of gestation. It is found that the minute-volume turnover of blood in the uterus increases until the twenty-second day, after which it decreases sharply. This decrease in the efficiency of the uterine circulation is coincident with a period of diminished uterine growth and accelerating foetal growth. It is suggested that with the onset of increasing distention the uterine circulation is impeded, but as the influence of distention becomes more marked, the circulation through the uterus is aided, chiefly by the increasingly effective contractions of the myometrium which occur as gestation nears term.

Cold-treated ('vernalized') wheat grains, imbibed in water and kept in an atmosphere of nitrogen at 20° C., will survive, according to Prof. F. G. Gregory

and O. N. Purvis, for three weeks, and will become devernalized, as shown by a significant increase in the leaf-number and in the time of flowering. Partially devernalized spring rye may again be vernalized by subsequent exposure in air to 1° C.

The artificial preparation, from pure virus protein, of paracrystalline fibres of tobacco mosaic virus is described by R. J. Best. The properties of these fibres are similar in all respects to the spontaneously formed ones previously described in *NATURE*. Bawden and Pirie's demonstration of the presence of nucleic acid in the virus molecule has been confirmed.

Blood examination of five Veddahs from Ceylon, reported by Prof. W. C. O. Hill, showed two of them to belong to the blood-group *B* and three to blood-group *O*. The author believes that examination of a larger number of individuals will probably show that they are similar to the Australian aborigines. He also gives tables showing the blood-groupings of peoples from the island and the percentage blood-groups in each. In all communities of Ceylon which have been studied, group *O* takes the highest place, except in the Moors, where group *O* and *B* are in equal proportion.

A table is given by M. Mokhtar and Dr. A. M. Mosharrafa showing fourteen recognizable intervals into which an octave, in modern Egyptian music, could be subdivided, compared with the diatonic and the equitempered scales. The notes were obtained by means of a Qanun, an instrument consisting of strings on a sounding board, and the frequencies were measured by means of an audio-frequency valve oscillator calibrated with a set of standard tuning forks.

From extensive studies on the absorption spectra of crystals of hydrated sulphates of the rare earths at different temperatures, Spedding and his co-workers have concluded that the crystalline electric fields acting on the rare earth ions in these crystals should have cubic symmetry. Prof. K. S. Krishnan and A. Mookherji now report marked magnetic anisotropy of these crystals, which does not support this conclusion.

Prof. C. Störmer quotes a statement which he published last January, indicating on theoretical grounds the possibility of an interrelation between magnetic storms and the intensity of cosmic rays, which has since been observed by Forbush in America and by Hess and Demmelmair in Europe.

Research Items

Problems of the New Stone Age

SOME problems in the changed outlook of the last twenty years on the introduction and spread of the neolithic civilization into Europe have been discussed by Mr. H. J. E. Peake (*Mem. and Proc. Manchester Lit. and Phil. Soc.*, 1936-7). By 1925 it had been shown that the neolithic culture had reached Switzerland from western Asia by way of the Ægean and Danube Valley early in the third millennium B.C. The problem remained whether it reached the west in the same way or had come by sea from the eastern Mediterranean. This question must be viewed from the wider standpoint, in time and space, of when man first began to cultivate grain and domesticate animals, and how such knowledge reached our islands. Cultivation of wheat apparently began in south Syria or northern Palestine. Early grain growers are, with certain exceptions, always possessed of domesticated animals, and the precise origins of agriculture are obscure. Its progress, however, can be traced from Asia, through the Ægean to Switzerland, via the Danube. West of the Rhine, however, is a rude pottery, which has been filiated with the leather bag, derived, it is now suggested, from animal *scrota*. This 'bag-ware' is found widely distributed in western Europe, appearing in Switzerland and Germany from the west, and having as its starting point Lusitania. Important elements in this Lusitanian culture are shown to derive from the eastern Mediterranean—the tombs and the pottery. The megalithic tomb is traced back to Tell Arpachiyā and thus related to the Tell Halaf culture of the fourth or fifth millennium, while it descends to the stone cist of the early Bronze Age. The evidence of the pottery depends on a number of decorative and other details traced from the eastern Mediterranean and ultimately Tell Halaf, beginning not later than the end of the fourth millennium, and appearing in the Iberian peninsula about 2800 B.C. Cattle, which could scarcely have been brought from the Ægean, were probably acquired by contact with Danubian peasants of Switzerland. This culture passing through France reaches Britain by a land bridge from Artois, and appears as the early neolithic culture of Windmill Hill. The red "bag ware" found at Maiden Castle, on the other hand, may have reached Britain from Brittany.

South African Native Cattle

LITTLE has been attempted by Europeans in the way of improving the cattle of Africa by selection within native breeds, the practice being to intergrade with European breeds. H. H. Curzon and R. W. Thornton, realizing the potentialities of the native cattle, have laid a foundation for further investigations by outlining the cattle types of Africa and their approximate distribution (*Onderstepoort J. Vet. Sci. Anim. Ind.*, 7, 613; 1936). Probably all the breeds, except the Hamitic longhorn of Egypt, came originally from Asia, and all reached their destination through north-east Africa except the shorthorned zebu which was introduced along the east coast north of the Zambezi River. Three parent stocks are involved—Hamitic longhorn, brachyceros

and lateral-horned zebu; and from these three other types have been derived—short-horned zebu, sanga, and lyre-horned zebu. In West Africa there are possibly two other types derived from admixture of brachyceros and Hamitic longhorn in one case, and in the other from brachyceros and thoracic humped zebu. The paper is illustrated by perhaps the most complete set of photographs of African cattle breeds yet published.

Stomatopoda of the Bingham Oceanographic Collection

G. ROBERT LUNZ has reported on the Stomatopoda from various localities collected by the *Paunee* and from coastal trawlings by members of the Bingham Oceanographic Laboratory (*Bull. Bingham Oceanographic Collection. Peabody Museum of Natural History, Yale University*, 5, Art. 5; Jan. 1937). There is also included valuable material collected on the west coast of Florida by Miss M. Storey of Stanford University and a few specimens from Tahiti obtained by Mr. Henry Sears. 157 specimens are recorded, referable to five genera and thirteen species. A new variety is described from Tahiti of *Gonodactylus chiragra*, a species well known throughout the tropical portions of the Pacific and Indian Oceans but not before recorded from Tahiti, also a new variety of *Chloridella rugosa*, and there is one new species, *Chloridella edentata*, described from a single specimen, its nearest relative being *C. mantoïdea*.

Cytology of *Gagea spathacea*

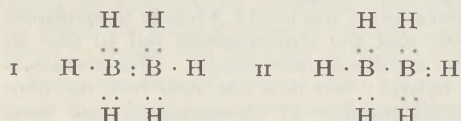
Gagea spathacea is a member of the Liliaceae occurring from southern Sweden through Denmark to Holland and Belgium. It apparently produces no seeds, its pollen is sterile and it reproduces vegetatively by numerous small bulbs. Dr. M. Westergård (*C. R. Lab. Carlsberg, Série Physiologique*, 21, No. 18), who has investigated its cytology, finds that while *G. lutea*, *G. minima* and *G. pratensis* undergo their pollen meiosis in Denmark in January, in *G. spathacea* this is delayed until April. *G. minima*, the most nearly related species, has $n=12$, while in *G. spathacea* $2n=circa\ 102$ and the chromosomes fail to pair in meiosis, with resulting micro-nuclei. This species is probably a hybrid; but it is not clear how its more than octoploid number of chromosomes has been reached. Its vegetative spread to Sweden must have occurred when the Baltic sea was a lake, unless it arose independently through crossing in the northern area. The embryo-sacs of *G. minima* and *G. lutea* ($n=36$) were examined, and stages were found indicating that the sac is of the type now known in *Lilium*, *Fritillaria* and *Tulipa*, that is, the four megaspore nuclei function, three passing to the chalazal end of the sac and one to the micropylar end. Here they all divide again, the chalazal spindles fusing so that two triploid nuclei result. One of the latter degenerates while the other divides. The mature sac thus contains an egg apparatus composed of three haploid nuclei and two triploid antipodal cells. In double fertilization a pentaploid endosperm arises from the fusion of a haploid and a triploid nucleus with the male nucleus.

Magnetostriction

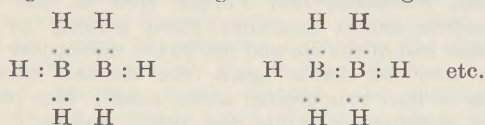
THE June issue of the *Science Reports* of the University of Sendai, Japan, contains two reports of the Research Institute of Iron, Steel and other Metals by Dr. Y. Masiyama, which deal with his recent work on magnetostriction of iron, nickel, cobalt, single crystals of iron and binary alloys of the three metals. The specimens were ovoids placed in the centre of a magnetizing coil, the field of which could be varied from 0 to 400 gauss. The changes of length of each ovoid were determined by fixing it between two quartz tubes coaxial with it, one of which projected out of the coil and ended in a small brass block. To compensate for temperature changes of length of the ovoid, a brass bar of suitable length was placed within the coil parallel to the axis of the ovoid and between two similar quartz tubes. Between the brass blocks a thin spindle carrying a mirror was placed in such a way that differential changes of length of ovoid and brass rod produced a rolling of the spindle and rotation of the mirror. The changes of length observed are generally less than 30 millionths at the maximum field, and are shown by curves in terms of the field and of the magnetization. They are independent of the sign of the field and at low fields are different for increasing and decreasing fields. For cobalt and nickel and alloys of the two the length decreases; for iron and alloys containing iron the length decreases at first, then increases as the field is increased. Each material tested showed hysteresis in its magnetostriction, and the effect will have an important bearing on the theory of magnetization.

Structure of Diborane

AN outstanding difficulty for the valency theory is the molecule B_2H_6 and the non-existence of the molecule BH_3 , since boron is a trivalent element in numerous other compounds. Some light is thrown on the problem by determinations of the interatomic distances by S. H. Bauer (*J. Amer. Chem. Soc.*, 59, 1096; 1937), by means of the electron diffraction method. The values for the B—B (1.86 Å.) and B—H (1.27 Å.) distances are considerably larger than the single-bond separations expected from other diatomic hydrides. This is interpreted as meaning that the bonds in the molecule have to some extent a character weaker than single bonds. This would be expected for the B—H bonds on the basis of structure I:



which gives each B—H two thirds single-bond and one third one-electron-bond character. A slight extension considering resonance to structures such as II would further account for the increased B—B distance. The distances are also compatible with a structure representing resonance among the seven arrangements:



giving each bond 6/7 single-bond and 1/7 no-bond character. Theoretical arguments support the view that the molecule resonates among all the above structures, the B—B and B—H bonds having single-bond, one-electron-bond and no-bond characters.

Shortening of the B—B distance below the single-bond value is not observed; this is regarded as eliminating all structures such as Wiberg's, which attribute some double-bond character to the B—B link. The stability of B_2H_6 relative to BH_3 is explained as due to the resonance energy made available by the full use of the four orbitals of boron.

High Intensity Light Sources

AN article by Dr. J. A. V. Fairbrother in the *Electrical Review* of August 6 discusses the light source required to project a beam within a fairly small angle. Practical considerations permit only a small source, as otherwise a large paraboloidal reflector would be required. The lower limit to the size of the light source is fixed by its brightness (intrinsic brilliancy) and the quantity of light obtainable from it. The intrinsic brilliancy is measured by the candle power divided by the projected area of the source on a plane perpendicular to the direction of view. It is convenient to measure it in candles per square millimetre. For bodies which emit full radiation the intrinsic brilliancy increases rapidly as the temperature approaches the melting point. As carbon and tungsten have the highest melting points, the carbon arc and the hot tungsten filament are the two high-intensity light sources usually employed for projection purposes. But owing to the fact that much of the spectral emission from a hot surface is not in the visible region, it is an inefficient converter of heat into light. One of the earliest light sources was the Welsbach mantle, which made use of the selected radiation from cerium and thorium. At the present time the most promising of all is the selected light emission from gases and vapours the molecules of which are excited by the passage of an electric current. By exciting mercury vapour in a quartz envelope at a high pressure, a light source is attained which has a higher efficiency and greater intrinsic brilliancy than over-run tungsten. The author has obtained with a carbon arc a maximum brilliancy of 330 candles per sq. mm. which is about eighteen times the average intrinsic brilliancy of the 5-kw. tungsten filament spot lamp. Mercury vapour quartz lamps are now being made the length of the arc of which is only about 10 mm. and which when the temperature is kept low by cooling water in contact with the outer wall of the envelope can take an input of 700 watts. This lamp approaches the carbon arc in intrinsic brilliancy and is more than twice as efficient.

Sunspot Photography with a Small Visual Refractor

THIS is the title of a paper by Mr. Cecil Maby (*J. Brit. Astro. Assoc.*, 47, 9, July 1937), in which the author gives the results of his experiments with different filters and photographic plates. He made use of his telescope and its Huygenian eyepiece as projection lenses, and those who are interested in the photography of sunspots will find much useful information in this paper on the employment of visual refractors for this purpose. The paper should be studied by amateur astronomers, who will find a full description of the equipment, which is both efficient and inexpensive.

ERRATUM. The paper referred to under the heading "Petrofabric Study of Moine Schists" in *NATURE* of September 4 (p. 429) was by Dr. F. C. Phillips, Department of Mineralogy and Petrology, Cambridge, and not by F. C. Cole as stated.

Engineering and Marine Exhibition at Olympia

AT this Exhibition, which will remain open until October 2, there is so much of scientific interest that it is possible only to select a few representative items as indicative of the extent to which the results of research are being utilized with the aid of mechanical ingenuity. One gets, for example, a definite impression of a universal effort being made to deal with the problem of noise both by improvements in design and workmanship and by the adoption of new types. At one stand a noiseless sliding door is exhibited, and of silently operating machinery a notable example is the Mirreles-Imo pump for oils and other liquids. This has only three moving parts—a central screw which is the actual pumping unit, and two side screws which act as seals and are rotated merely by their engagement with the central screw. In high-speed Diesel engines vibration is destructive of the exhaust pyrometers which, by the close relationship between exhaust temperature and horse power, are necessary to ensure that an even and efficient balance is maintained between the several cylinders. Messrs. Negretti and Zambra are exhibiting pyrometers in which a few inches of the tube immediately below the instrument have been replaced by a helical spring, and instruments so constructed are to be seen mounted on a vibrating table yet relatively unaffected.

The hygienic importance of the reduction of dust lends interest to means for its measurement, and the Tyndallometer shown by E. Leitz (London) provides a new and rapid means of its measurement. It consists of a dust chamber, a photometer head, an observation telescope and the necessary means of illumination. In the field of view is a beam of the scattered light and a comparison beam and, when these are equalized, the scale reading and the calibration curve give an instantaneous value for the dust content. On the same stand is shown a simple profile projector for the metal industry with several other optical aids. Messrs. Kelvin, Bottomley and Baird, Ltd., have on view the colour vision lantern developed by Dr. L. C. Martin in collaboration with the Medical Research Council, and also the K.B.B. Cabinet for ultra-violet fluorescence. The latter can be seen in operation with a very representative group of samples which illustrate its value in scientific testing and research, and also in industrial, medical, police and other investigations. In Messrs. Avery's recent design of Brinell and diamond impression testing machine the arrangement is such as to enable results to be obtained very rapidly, and in this respect alone this exhibit marks an advance on the usual design.

Under modern conditions, metals are frequently required to conform to very severe specifications, and Barronia Metals, Ltd., are exhibiting examples of many such problems which they have solved. One of these was the preparation of a non-ferrous alloy with a coefficient of expansion greater than steel for use with a hydrocarbon gas containing sulphur at a pressure of 200 lb. per sq. inch and a temperature of 1150° F. Other instances of new developments in manufacture of materials are the glass cloth now being made by Chance Bros. and Co., Ltd., to replace asbestos cloth in low-temperature services and likely also to develop in decorative and other directions,

and the method of electric forging which has been brought to a fine art by Messrs. Omes, Ltd. The samples of forgings exhibited indicate the wide application of the process and the high quality both of material and of surface which is obtainable. In conjunction with H. A. Brassert and Co., Ltd., Messrs. Imperial Chemical Industries Ltd. illustrate the Brassert process for acid burdening the blast furnace. By regulating the flux so as to form slag of the lowest possible melting point and viscosity, iron production is increased while less coke is used and low-grade ores can be dealt with. As a result also of the sodium carbonate treatment there is a reduction of sulphur and, due to oxidation, of silicon content. The Macrome treatment of tool steel by an electric process, applied after the usual heat treatments have been given, is claimed by Messrs. Macrome Ltd. to increase the working life of tools by 50–300 per cent according to the steel treated and the work performed. An electric process exhibited by the O.C.P. Company is that for conditioning water and preventing scale in boilers. The water is made to pass through tubes each containing an electrode, and this process effects a physical change in the mineral salts which, on being heated, appear as crystals and do not build up scale. The elimination of chemical treatment is an obvious advantage of the method.

The Marconi Company has arranged a series of historical exhibits illustrating the development of wireless apparatus. Another exhibit of this firm shows how one type of echometer can indicate to a trawler the depth of the sea-bed and also that at which a shoal of fish may be passing. The Accurato Recording Instrument Co. has working models of a liquidmeter which will very soon be manufactured. This, although very sensitive and carefully compensated, is of a robust construction and is not likely to get out of order. It operates by means of two pairs of opposed hydraulic bellows so that the displacements made in the tank are exactly reproduced at the dial. Among other recording instruments, Messrs. Radiovisor show the counting unit such as is used in the Mersey Tunnel to give a record of vehicles entering and also in factories for counting sacks, tins, etc., by the interception of a beam of light.

Of the many Diesel engines on view, that of the Brush Electrical Engineering Co. Ltd. will be of considerable interest to engineers. It is a horizontal type and has four cylinders arranged in pairs on opposite sides of the crankshaft. An independent test by Mr. W. A. Tookey showed the fuel consumption to be 0.357 lb. per B.H.P. hour when developing 250 B.H.P. at a speed of 250 r.p.m.

The exhibit, however, which takes the highest place in scientific importance and which at the same time appeals to all who are mechanically minded is that of the Department of Scientific and Industrial Research and associated bodies. It illustrates researches carried out in engineering and metallurgy, showing how the tests are made on models of ships' hulls and propellers, on coal, on the transport and storage of food and on fire resistance of structures. By the use of short films the visitor sees more than the mere instruments and materials of the test; he is enabled to follow the course and operations of the investigation.

Origin of the Red Rocks

THE subject for discussion in Section C (Geology) at the British Association on the morning of September 2 was the "Origin of the Red Beds of the Northern Midlands". Speakers, however, did not confine themselves to local conditions, and other parts of England were also considered.

In opening, Dr. R. L. Sherlock remarked that the region discussed forms an indefinite area but may be supposed to include the Cheshire Basin, the synclines between the fanning-out ridges of the Pennine Range and the easterly dipping beds of Nottinghamshire.

It is agreed that the British Permo-Trias is of Continental origin and that the climate became progressively drier from the beginning to the end of the period. This fact seems to be of almost world-wide application, for it is also true for the United States, South Africa and other countries.

Late in Carboniferous time, earth-movements on a great scale probably raised Great Britain into mountains, but rapid erosion of the soft Coal Measures soon reduced the elevation, and the detritus filled the hollows and formed red beds. This indicates oxidation of grey strata in a dry climate. There is a relation between colour and texture; the finer the grain the richer the red tint, owing no doubt to ease of oxidation. The green colour found at times appears to indicate wetter periods. Although there is no doubt that secondary changes of colour have occurred, it is highly probable that both red and green strata are primary. Evidence for the primary origin of red beds is that the colour is constant in depth. It is noteworthy that green marls occur at the top of the Keuper, just before the Rhætic Sea burst in, when base-levelling of the land had presumably allowed wet oceanic winds to bring in a damper climate.

Although the saline deposits were no doubt deposited in drying up inland seas and lakes, the source of supply offers difficulties. Ordinary sea water, if evaporated, would deposit only 0.7 ft. of gypsum or anhydrite for each 1,000 ft. of depth, yet beds 10 ft. or more in thickness were deposited from shallow seas. Evidently there was local concentration.

Gypsum often shows swirl-like structures, and so does rock-salt. In Cheshire, stratification and cross-bedding are also present in the salt, indicating a possible explanation of the thickness of saline deposits. If evaporation caused supersaturation of the water, the salt would be deposited very rapidly and the granular precipitate might be concentrated by currents. It sometimes happens that, if two bore-records are compared, one containing thick salt and the other none, the records agree roughly if the salt is ignored, suggesting that the time of formation of the salt was negligible.

While the rest of our salt deposits were formed in desert lakes, the Middlesbrough deposits represent a dried-up sea.

Mr. F. W. Shotton communicated the results obtained by the Lapworth Club of the University of Birmingham in an investigation, lasting several years,

of the outcrops of Lower Bunter in Worcestershire and East Shropshire between Oakengates, Bewdley and Stourbridge. Every accessible outcrop was examined and careful measurements made of dip and false bedding; more than a thousand readings being taken and examined statistically. In addition, numerous rock specimens were collected and examined for variation in the size of the sand-grains. Conclusions arrived at were that, throughout the area, the Lower Bunter is false-bedded and that it was deposited on land by easterly winds coming from the Mercian Highlands. The sand is remarkably well-graded and free from clay or silt-bands, and 90 per cent lies between the ranges of 0.50 mm. and 0.10 mm.

Mr. A. N. Thomas then described the Trias of north-west Somerset between Porlock and Williton. The Triassic subsurface is highly irregular and the earliest deposits fill in isolated depressions, the later ones being increasingly widespread so that the areas tend to coalesce.

Dr. S. E. Hollingworth gave an account of some results of recent borings in the Vale of Eden. These borings have proved the presence of three horizons of anhydrite in the 'Permian' Hilton Plant Beds at Kirkby Thore, although only two horizons are known elsewhere in the area. As these chemical precipitates indicate periods of desiccation, they are probably due to regional climatic changes, and it is reasonable to suppose that sequences of such deposits in adjacent areas may be correlated. This does not necessarily mean that two areas of deposition were united. Dr. Hollingworth correlates the lowest anhydrite bed (base of Hilton Plant Beds) with the lower salt (and anhydrite) at the base of the 'Permian Middle Marl' of the region east of the Pennines. The two higher horizons of the Vale of Eden he correlates with the upper salt and anhydrite and the upper anhydrite respectively of Yorkshire. Correlations between Cumberland and Furness indicate the probability of a lateral passage from 'Permian' Hilton Plant Beds to 'Triassic' St. Bees Shales. Dr. Hollingworth's conclusion is in accordance with the evidence from the east of the Pennines of a lateral passage of 'Permian' into 'Trias' brought forward in 1911 by Dr. R. L. Sherlock.

No time was left for discussion, but inquiries were made as to where the formation of red beds in Continental areas is at present in progress. This difficulty is analogous to that felt by students of coal formation—the origin of which by swamp-growth is generally agreed upon, although the exact conditions for it do not seem to exist anywhere at the present day. Nevertheless, in various parts of the world certain kinds of Triassic-like rocks are being formed, for example, in Turkestan, although nowhere can all the types be found now forming.

As was pointed out by Dr. Rudolf Richter on another occasion, when describing conditions of sedimentation off the German coast, we must not carry uniformitarianism too far; special conditions existing at certain periods have never been repeated.

R. L. S.

The Teaching of Mathematics

THE mathematical subsection (A*) of the British Association departed this year from its usual policy of presenting papers on specialized branches of research, and its sessions at Nottingham were devoted chiefly to two discussions on the teaching of mathematics. On Saturday, September 4, Prof. E. H. Neville opened a discussion on the unification of algebra in schools. Mr. T. A. A. Broadbent condemned the older school text-books as a collection of watertight compartments, and pointed out the need for the course to be systematized and unified. Mr. G. L. Parsons contrasted the older method of putting all the emphasis on technique with the newer methods of bringing out the ideas of the subject. He favoured the approach by means of the formula or the equation rather than by tedious drill in elementary algebraic processes. Mr. M. H. A. Newman gave the university point of view, particularly as regards the importance of linear transformations and matrices. Mr. W. J. Langford pointed out that changes in the school course could not be made unless such examinations as that for the School Certificate were modified correspondingly. He suggested that teachers should agree upon a policy, and then submit alternative syllabuses to the examination authorities.

The papers attracted a large audience, including many from other sections, and the lively discussion that ensued proved that the subject was felt to be of great interest and importance.

On Tuesday, September 7, Prof. H. T. H. Piaggio opened a discussion on the bearing of higher geometry on the school course. Prof. E. H. Neville protested against the policy of drill in the application of devices of which no rational explanation had been given. Mr. H. G. Green showed how to give this explanation in the case of the 'line at infinity', and Prof. W. H. McCrea in the case of the 'circular points at infinity'. Prof. H. S. Ruse pleaded for an extended treatment of differential geometry, including vector methods. A general discussion followed.

At the end of this discussion Mr. C. H. H. Franklin exhibited a most interesting collection of models representing four- and five-dimensional solids, by a principle analogous to that employed to represent three-dimensional solids by a sketch on two-dimensional paper.

The secretary of the subsection, Dr. Dorothy M. Wrinch, is to be congratulated on the success of the policy of replacing isolated papers by discussions on topics of wider interest. H. T. H. P.

Biological Standards*

THE proceedings of the meeting of the Permanent Commission on Biological Standardization held at Geneva in the autumn of 1935 have been published, together with the reports of the technical experts to whom a number of different questions dealing with biological standards had been referred.

Six standards were adopted or redefined by the Commission. The pituitary (posterior lobe) powder and the *Digitalis purpurea* leaf powder, at present in use as standards in Great Britain, stocks of which are held at the National Institute for Medical Research, Hampstead, were adopted as international standards, and the Institute was asked to distribute them on behalf of the Health Organisation. The original international standard pituitary powder was prepared by Prof. Voegtlin and was available for issue to authorities desirous of testing their national standards, but up to that time no laboratory had been entrusted by the Commission with its general distribution: the two preparations are of the same activity. The original international digitalis standard powder is nearly exhausted; but the stock of the British Standard is sufficient for international requirements for some time: its potency is, however, greater than that of the previous standard, so that one unit is represented by 0.08 gm. of the new standard, as compared with 0.1 gm. of the previous preparation. A crystalline sample of insulin was adopted as standard and defined as containing 22 units per mgm. The previous standard was amorphous

and contained 8 units in one milligram. Two standards for substances for which standards had not been previously available were recommended for adoption: one for *B. histolyticus* antitoxin, and the other for diphtheria antitoxin for use in the flocculation test. The question of the standards for asphenamine and its derivatives was left for further consideration by a small technical committee.

It was further agreed that work should be carried out on tetanus antitoxin, poliomyelitis convalescent serum, staphylococcus antitoxin and antityphoid serum. The recommendations adopted by the inter-governmental conference on biological standardization were considered and certain subjects recommended for further examination, including the standardization of anti-anthrax serum, anti-swine erysipelas serum, anti-venom serum and the preparation of a standard *Digitalis lanata* leaf powder.

The bulk of the report is devoted to the reports of the experts who have been examining proposed new standards, and gives the evidence on which the Commission has based certain of its recommendations: for the details of these experiments the original report must be consulted. The separate sections deal with insulin, histolyticus antitoxin, diphtheria antitoxin, tetanus antitoxin and antipoliomyelitis convalescent serum. The bulletin also includes reports of the Standards Departments of the National Institute for Medical Research, Hampstead, and the Statens Serum Institute, Copenhagen, and concludes with a useful description of a simple laboratory method for the desiccation of serum and other protein solutions.

* *Quarterly Bulletin of the Health Organisation*. Special Number, November: Biological Standardisation (2). (Geneva: League of Nations; London: George Allen and Unwin, Ltd., 1936.) Pp. 571-745

University Events

GLASGOW.—Prof. George Barger, professor of chemistry in relation to medicine in the University of Edinburgh, has been appointed Regius professor of chemistry in the University in succession to Prof. George Henderson, who has resigned.

Dr. Noah Morris, lecturer in biochemistry, has been appointed professor of materia medica and therapeutics.

Science News a Century Ago

The Iron Ship *Sirius*

THE first iron ship to be classed by Lloyd's Register of Shipping was the steamer *Sirius*, the records of Lloyd's Register stating she was built under the inspection of the Society's London surveyors, and intended for service on the River Rhone, her port of registry being Marseilles. The *Sirius* was built by William (afterwards Sir William) Fairbairn at his yard at Millwall, which afterwards formed a part of the yard at which the *Great Eastern* was constructed. According to the *Railway Magazine*, she was launched on September 26, 1837, and she was the longest vessel so far built of iron. She measured about 164 ft. in the keel and 176 ft. on deck. Her beam was 17 feet. She was intended to be worked by two high-pressure engines of 35 horse-power each having a 24-in. cylinder with a stroke of 3½ ft. She was to have three boilers with copper tubes. "The iron planks of which she is made", said the *Railway Magazine*, "are about 7 ft. long, 14 in. wide and a quarter of an inch thick, and her ribs are of double angle iron with diagonal stays. Her mould is handsome, but rather narrow; and when she has her machinery and water, it is calculated she will not draw above two feet of water. She is besides, divided into four compartments by three iron water-tight bulkheads; so that if a fracture should happen in any one part she will still float safely."

Fossil Discoveries in France

IN its column of Miscellanea, the *Athenæum* of September 30, 1837, under the title "More Fossils", said: "M. Azéma has found some fossil bones of mastodons and the rhinoceros, reptiles, and some well-preserved fruits in the parish of Sauveterre, near the district explored by M. Lartet, whose discoveries we announced some time back. We should like to ascertain whether the skeleton of the new and remarkable rhinoceros brought from behind the Cape by the expedition under Dr. Andrew Smith, presents more affinity to the recent or to the fossil species. It seems that the new fact concerning fossil quadrumana has been succeeded by a similar discovery in the Himalaya mountains, but which is not so curious as the circumstance of finding these animals in Europe; and what is still more extraordinary, the comparative anatomists have determined the European species to be similar to those Gibbons which inhabit the remotest parts of Asia. M. Lartet's discoveries have given rise to much discussion in the French Academy of Sciences. . . ."

Reforms in the Hospitals

A CORRESPONDENT signing himself "Spectator" in a letter to the *Lancet* of September 30, 1837, mentions the following improvements which had taken place

at the London hospitals during the previous ten years:

"1. The introduction of clinical lectures, a department of instruction which was before shamefully neglected in this country, and is even yet but imperfectly taught. 2. The publishing of hospital reports, a measure forced upon the medical officers by *The Lancet*. 3. The annual distribution of prizes to the students (which did not become general until after 1826). 4. The withholding of certificates unless a few lectures have been attended; for I remember the time when it was not an uncommon occurrence for a student to boast that he had received a certificate without having attended a single lecture. Lastly, I may mention the posting of post-mortem examinations; the absence of hole and corner operations; the opening of the libraries and museums; the establishment of clerical clerkships, the greater punctuality in the visits of the medical officers (although, I confess, there is much yet to reform in this respect) and the frequency of periodical examinations by some of the teachers may also be added to the list of benefits on the part of the students which have reluctantly been obtained from the 'Dubs and Pures.'"

Medal Striking

THE *Gentleman's Magazine* of September 1837 contains the following announcement: "M. Pistrucchi, chief medallist in the Royal Mint, has discovered a method by which he can stamp a matrix or a punch from a die which has never been touched by an engraver, and yet still make the medal identically the same with the original model in wax; an operation by which the beauty and perfection of the master's design are at once transferred to any metal, whether gold, silver or copper, by striking it according to the usual process. The model being made in any substance, wax, clay or wood or other fit material, a mould of it is taken in plaster, from which mould when dried and oiled to harden it, an impression is taken in sand, or other similar substance which may be preferred, and from this again a cast is obtained in iron as thin as possible, that the work may come out sharply, and the iron attain the hardness almost of a steel die hardened."

Spirit Drinking in India

AN editorial in the *Indian Journal of Medical and Physical Science* of October 1, 1837, contains the following warning to the Government: "The lives of European soldiers in this country are unhappily passed in a state of imprisonment in their barracks from 10 o'clock in the morning to 4 o'clock in the evening. There is nothing of that change of scene and agreeable occupation of time as experienced by British soldiers in their own congenial and delightful country. Their indolence and want of amusement tend to a despondency of mind, and to depression of the whole animal functions, to arouse which spirits are had recourse to, and which is in fact looked upon as a necessary and luxurious pastime, sanctioned as a ration, and approved of as a custom. Canteens are rooms appointed by military rule as a place of refuge to gratify the appetite, by adding the indulgence in liquor to social conviviality. But is the Government of the country aware that all this breaks up the physical energies both bodily and mental of their brave troops?"

Societies and Academies

Paris

Academy of Sciences, July 19 (C.R., 205, 185-264).

MARCEL DELÉPINE and CHARLES HANEGRAAFF: The catalytic hydrogenation of cinnamic aldehyde and of citronellal. Study of the order of attack of the aldehyde group and the double bond, using Raney nickel with and without platinizing.

RICHARD FOSSE and ROGER DE LARAMBERGUE: The mechanism of the synthesis of cyanamide in the oxidation of glucose in the presence of ammonia.

HENRI COLIN and HENRI BELVAL: Chemical affinities and classification in the *Hordeæ*.

PIERRE LEJAY: New determinations of the acceleration of gravity in Europe and in the Levant.

JACQUES DE LAPPARENT: Ancient phenomena of rubefaction in the central Sahara.

LUCIEN DANIEL: New observations on grafting.

FOLKE ODQVIST: Equations of compatibility for any system of orthogonal triple co-ordinates.

LUCIEN GODEAUX: Algebraic varieties of genus unity containing cyclic involutions.

M. EIDELHEIT: Systems of linear equations with an infinity of unknowns.

J. KUNTZMANN: Homomorphy between multiform systems.

ROBERT WAGNER: Multivalent functions in space of matrices.

FLORIN VASILESCO: An application of normal families of distributions of mass.

NICOLAS CIORANESCO: The deformation of elastic plates in the case of analytical data.

JEAN GALIBOURG and PIERRE LAURENT: Sub-permanent deformations (reactivity phenomena).

JEAN MALFITANO: The constitution of the photon considered as a dipole.

MME. ZINA SOUBAREW-CHÂTELAIN: The variations of conductivity undergone by dilute solutions of molybdic acid in the course of their neutralization. The experiments described support the theory of the existence of the acid $H_2Mo_2O_7$.

O. DONY-HÉNAULT and A. DE JAER: Study of electrolytic vessels with mercury cathode.

MAURICE FALLOT: The magnetic properties of the alloys of iron with ruthenium and osmium.

ROGER SERVANT: The double refraction of quartz in the extreme ultra-violet and the Schumann region.

LUCIEN MAILLET: The emission of X-rays by vacuum tubes of very small dimensions, submitted to a high-frequency current. The tubes described were 2-6 cm. long and 3-5 mm. in diameter, fitted with a single wire anode. Some applications in the field of radiotherapeutics are indicated.

MORDECHAI BOBTELSKY and MME. MÉLANIE RAPPOPORT: The decomposition of hydrogen peroxide in the presence of a cobaltictric complex compound as catalyst.

PIERRE TRUNEL: The electric moments of some fatty dinitriles.

RAYMOND QUELET and JEAN ALLARD: The chlor-methylation of anisic aldehyde. Passage to 1-methoxy-2-methylol-4-methylalbenzene.

LUCIEN DAUTREBANDE, PIERRE ANGENOT and EDMOND DUMOULIN: Study of anti-aerosol esparto grass filters. The influence of the hygrometric state on the penetration of anti-aerosol filters. The influence of the time of passage of the moist atmosphere.

R. RUSSO: The Kimmeridgian age of the terminal layers of the western Beni Snassen (Morocco).

CHARLES CHABROLIN: The germination of the seeds of *Orobancha speciosa*.

ROBERT ECHEVIN and ROGER ULRICH: The nature of the intravacuolar inclusions in the fruit of the ivy (*Hedera Helix*).

PIERRE DRACH: Generalities on the development of the crystalline textures in the tegumentary skeleton of the brachyurous Decapods.

JEAN RÉGNIER and ANDRÉ QUEVAUVILLER: The influence of the nature of the acid on the action exercised on the motor nerve by different salts of novocaine and morphine: different qualitative behaviour according to the concentrations.

PAUL FORTIN: Very clear entoptic vision of the retina in the orange red.

MARCEL AVEL: Experimental analysis of the determination of the dorso-ventral axis in the regeneration of the head in worms.

ETIENNE WOLFF: Egg laying anomaly in an inter-sexed fowl, after the action of androsterone, on the Müller ducts of the embryo.

AUGUSTIN BOUTARIC and MME. MADELEINE ROY: Spectrophotometric researches on aqueous solutions of bile.

JEAN LOISELEUR and MME. RENÉE COLLIARD: The adsorption of polypeptides by the proteins of the blood serum.

CHARLES CHAMPY, MAURICE HEITZ-BOYER and ROGER COUJARD: The mechanism of the hormonal actions on the dysuria of prostatitis.

Moscow

Academy of Sciences (C.R., 15, No. 5, 1937).

S. BERGMANN: A theory of functions satisfying a linear partial differential equation (1).

V. S. IGNATOVSKIJ: The Laplace transformation (8).

L. LUSTERNIK: A generalization of the equation of the Sturm-Liouville type.

A. BOBROV: The relative stability of sums of positive quantities.

V. FOCK: The Bose amplitudes in the neutrino theory of light.

A. TOPOREC: The mechanism of the formation of atomic and colloidal centres of silver in alkali phosphorus halide.

L. I. BELAJEV: The problem of the electrophoresis of lamellæ at the interface of liquid phases.

P. J. SCHMIDT and G. P. PLATONOV: Anabiosis and fish transport without water. Experiments are described showing the possibility of preserving chilled fishes alive for more than twenty-four hours, while smaller fishes can be revived after chilling for ten days.

J. N. GOLUBINSKIJ: A tetraploid form of *Ocimum canum* Sinis produced experimentally.

D. J. VAKULIN: Reaction of reversibility in *Perilla ocymoides* L. under natural conditions.

T. T. DEMIDENKO: Iron in the nutrition of higher plants.

V. L. VAGIN: The position of the Ascothoracida ord. nov. (Cirripedia Ascothoracica Gravel 1905) in the system of Entomostraca.

P. J. SCHMIDT: The Pacific genera *Eurymen* Gilbert and Burke and *Gilbertidia* C. Berg (Pisces, Cottidæ).

G. V. LOPASHOV: (i) The formation of organs in organisms deprived of the nervous system. (ii) The specificity of inductive influences.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Wednesday, September 29

SOCIETY FOR THE STUDY OF ALCHEMY AND EARLY CHEMISTRY, at 8—(at University College, Gower Street, W.C.1).—Dr. D. McKie: "Some Early Work on Combustion, Respiration and Calcination".*

NATIONAL SMOKE ABATEMENT SOCIETY, October 1-2.—Ninth Annual Conference to be held at Leeds. Dr. H. A. Des Voeux: President.

Appointments Vacant

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

CIVIL ENGINEERING ASSISTANTS in the Headquarters and Divisional Road Engineer's Offices of the Road Department of the Ministry of Transport—Establishment Officer of the Ministry, Metropole Buildings, Northumberland Avenue, W.C.2 (September 27).

ASSISTANT IN THE DEPARTMENT OF CIVIL ENGINEERING, Queen's University, Belfast—Prof. Hummel (September 28).

ENGINEER in the Directorate of Factories, War Department—Chief Superintendent, Ordnance Factories, Royal Arsenal, Woolwich (September 28).

ASSISTANT MASTER FOR ELECTRICAL ENGINEERING in the Llanelly Mining and Technical Institute—Clerk of the Education Committee, County Education Offices, 24 King Street, Carmarthen (September 28).

A DESIGNER (Ref. No. 542 B) and AN ASSISTANT (Grade II) (Ref. No. 550 B) for work in the Stress Section of the drawing office, and a TECHNICAL OFFICER (Ref. No. 574 B) and ASSISTANTS (Grade III) (Ref. No. 589/590 B) for work on electrical equipment of aircraft, at the Royal Aircraft Establishment, South Farnborough, Hants—Chief Superintendent (October 1).

ASSISTANT LECTURER IN THE CHEMISTRY DEPARTMENT at Robert Gordon's Technical College, Aberdeen—Secretary and Registrar (October 2).

JUNIOR ASSISTANT in the Science Museum Library—Director (October 4).

LECTURER IN PHYSICS in the South-East Essex Technical College, Dagenham—Clerk to the Governors (October 4).

OFFICER-IN-CHARGE OF POULTRY RESEARCH SECTION, Imperial Veterinary Research Institute, Iznagar, United Provinces, India—High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (October 8).

CHIEF LECTURER IN ELECTRICAL ENGINEERING at the West Ham Municipal College, Stratford, E.15—Principal (October 9).

TWO ASSISTANT KEEPERS (Second Class) on the Higher Technical Staff of the Science Museum—Director, envelopes marked "Assistant Keeper" (October 11).

SECOND ASSISTANT PETROLEUM TECHNOLOGIST for the Government of Trinidad and Tobago—Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, London, S.W.1 (October 15).

WM. HUDSON PROFESSOR OF ECONOMICS in Natal University College, Pietermaritzburg and Durban, South Africa—Registrar, Natal University College, Pietermaritzburg, Natal (November 9).

ASSISTANT IN ZOOLOGY in the University of Glasgow—Secretary, University Court.

MASTER FOR MECHANICAL ENGINEERING at the Technical Institute, Ashford—Principal.

RAILWAY ENGINEER (temporary) for H.M. Office of Works—Chief Architect, Room 65A/3rd. H.M. Office of Works, Storey's Gate, S.W.1.

Official Publications Received

Great Britain and Ireland

Department of Scientific and Industrial Research. Forest Products Research Records, No. 21: The Growth and Structure of Wood. By B. J. Rendle. Pp. iii+24+1 plate. (London: H.M. Stationery Office.) 6d. net. [39]

Ordnance Survey. The Magneto-Theodolite. Pp. 12+4 plates. (London: H.M. Stationery Office.) 2s. 6d. net. [39]

Mines Department. Fifteenth Annual Report of the Safety in Mines Research Board, including a Report of Matters dealt with by the Health Advisory Committee, 1936. Pp. 130+14 plates. (London: H.M. Stationery Office.) 2s. net. [39]

Board of Trade. Survey of Industrial Development, 1936: Particulars of Factories opened, extended and closed in 1936; with some figures for 1935. Pp. iv+38. (London: H.M. Stationery Office.) 9d. net. [39]

University of Manchester: Faculty of Technology. Prospectus of University Courses in the Municipal College of Technology, Manchester, Session 1937-38. Pp. 414. (Manchester: College of Technology.) [69]

City of Birmingham. Annual Report of the Mental Hospitals Committee. April 1st, 1936, to March 31st, 1937. Pp. 30. (Birmingham.) [69]

Record of the Royal Institution of Great Britain, 1937. Pp. 180. (London: Royal Institution.) 5s. [69]

Proceedings of the Physical Society. Vol. 49, Extra Part, No. 274: Report of Conference on the Conduction of Electricity in Solids, held at Bristol, July 1937. Pp. vii+154. (London: Physical Society.) 7s. net. [79]

Department of Scientific and Industrial Research. Forest Products Research Records, No. 20 (Timber Series, No. 6): The Properties of British Honduras Pitch Pine (Slash Pine)—*Pinus caribaea* Mor. Pp. ii+9+2 plates. (London: H.M. Stationery Office.) 6d. net. [79]

Birkbeck College (University of London). The Calendar for the Year 1937-38. Pp. 272. (London: Birkbeck College.) [89]

Battersea Polytechnic. Technical College for Day Students: Calendar for the Session 1937-1938. Pp. 47. 3d. Domestic Science Department and Training College: Calendar for the Session 1937-1938. Pp. 34. 3d. Department of Hygiene and Public Health: Calendar for the Session 1937-1938. Pp. 20. 3d. Evening and Afternoon Courses and Classes: Calendar for the Session 1937-1938. Pp. 36. Free. (London: Battersea Polytechnic.) [89]

Other Countries

Canada: Department of Mines and Resources. The Canadian Mineral Industry in 1936. Reviews by the Staff of the Bureau of Mines. (No. 786.) Pp. iii+78. 25 cents. Analyses of Coals and other Solid Fuels, 1934 to 1936. Appendices: 1: Analyses of Coals and Peats, 1918 to 1925, hitherto Unpublished; 2: Analyses of Ash from Coals, Cokes, Peat and Woods. Compiled by J. H. H. Nicolls and C. B. Mohr. (No. 779.) Pp. iii+139. 25 cents. (Ottawa: King's Printer.) [69]

Royal Observatory, Hong Kong. Magnetic Results, 1936. Prepared under the direction of C. W. Jeffries. Pp. 49. (Hong Kong: Royal Observatory.) 1 dollar. [69]

Det Kgl. Danske Videnskaberne Selskab. Biologiske Meddelelser 13, 7: Rhythmic Diurnal Variations in the Oestrous Phenomena of the Rat and their Susceptibility to Light and Dark. By Axel M. Hemmingsen and Niels B. Krarup. Pp. 61+4 plates. 3.00 kr. Biologiske Meddelelser 13, 8: The Production of Mating Instincts in the Rat with Chemically Well-defined Oestrogenic Compounds. By Axel M. Hemmingsen and Niels B. Krarup. Pp. 10. 0.50 kr. (Copenhagen: Levin and Munksgaard.) [69]

Department of Agriculture, Straits Settlements and Federated Malay States. Insects, Fungi and Bacteria associated with Copra in Malaya. 1: Insects associated with Copra in Malaya; 2: Deterioration of Copra caused by Bacteria and Moulds. By G. H. Corbett, Mohamed Yusope, Abu Hassan and F. S. Ward. Pp. iii+108+11 plates. (Kuala Lumpur: Department of Agriculture.) 50 cents. [69]

Memoirs of the Geological Survey of India. Paleontologia Indica. New Series, Vol. 24, Memoir No. 1: The Eocene Beds of the Punjab Salt Range. By Lieut.-Col. L. M. Davies and E. S. Pinfold. Pp. iii+79+77 plates. (Calcutta: Geological Survey of India.) 6.2 rupees; 10s. [69]

The Genus *Youngia*. By Ernest B. Babcock and G. Ledyard Stebbins, Jr. (Publication 484.) Pp. iii+106+5 plates. (Washington, D.C.: Carnegie Institution of Washington.) [79]

Southern Rhodesia. Meteorological Report for the Year ended 30th June 1936. Pp. 45. (Salisbury: Government Stationery Office.) [79]

Bulletin of the Bingham Oceanographic Collection, Peabody Museum of Natural History, Yale University. Vol. 3, Art. 7: Concluding Report on Fishes, with Species Index for Articles 1-7 (Fishes of the Third Oceanographic Expedition of the *Panicee*). By Albert Eide Parr. Pp. 79. Vol. 6, Art. 1: A Contribution to the Chemistry of the Caribbean and Cayman Seas. By Norris W. Rakestraw and Homer P. Smith. Pp. 41. Vol. 6, Art. 2: On the Longitudinal Variations in the Dynamic Elevation of the Surface of the Caribbean Current. By Albert Eide Parr. Pp. 20. (New Haven, Conn.: Peabody Museum of Natural History.) [79]

South Australia: Department of Mines. Mining Review for the Half-Year ended 31st December 1936. (No. 65.) Pp. 105+6 plates. (Adelaide: Government Printer.) [89]

South Australia: Department of Mines: Geological Survey of South Australia. Bulletin No. 16: Geology of the Northern Part, Hundred of Macclesfield, with Special Reference to its Economic Aspects. By Ralph W. Segnit. Pp. 63+3 plates. (Adelaide: Government Printer.) [89]

Catalogues, etc.

A Pamphlet on Cambridge CO, Apparatus for the Steam Raiser (Folder No. 60.) Pp. 6. (London: Cambridge Instrument Co., Ltd.) Priced Catalogue of B.D.H. Laboratory Chemicals. Pp. iv+204. Plant Hormones: Substances promoting and controlling Cell Growth and Root Formation in Plants. Pp. 4. (London: The British Drug Houses, Ltd.)

Catalogue of Books on Natural History: including Anthropology, Botany, Entomology, Evolution, Zoology, Ornithology, etc. Pp. 44. (London: W. and G. Foyle, Ltd.)

Natural History. List No. 1. Pp. 6. (Den Haag: Antiquariaat W. Junk.)

Conti-Glo Luminescent Products. Pp. 4. (Cleveland, Ohio: Continental Lithograph Corporation.)

A Catalogue of Books and Periodicals on all Classes of Zoology. (No. 540.) Pp. 120. (London: Bernard Quaritch, Ltd.)

Photomicrography with the Vickers Projection Microscope. (Publication No. 872.) Pp. 64. (York: Cooke, Troughton and Simms, Ltd.)

Recent Scientific and Technical Books

Volumes marked with an asterisk (*) have been received at "NATURE" Office

Mathematics : Mechanics : Physics

- Bergmann, L.** Der Ultraschall und seine Anwendung in Wissenschaft und Technik. 8vo. Pp. 230. (Berlin: V.D.I.-Verlag, G.m.b.H., 1937.) 18.50 gold marks.
- Demmig, R.** Repetitorium der Vektorenrechnung. Teil 1: Einführung. Sup. Roy. 8vo. Pp. 26. (Darmstadt: Demmig Verlag, 1937.) 3 gold marks.
- Föppl, O.** Dämpfungsfähigkeit der Werkstoffe, Oberflächenrücken, Resonanz-Schwingungsdämpfer für Kurbelwellen. 8vo. Pp. 61. (Braunschweig: Friedr. Vieweg und Sohn, 1937.) 4 gold marks.
- Fulford, R. J.** Junior Revision and Mental Tests in Arithmetic and Algebra. Cr. 8vo. Pp. iv + 108. (London: University Tutorial Press, Ltd., 1937.) Without Answers, 1s.; with Answers, 1s. 6d.
- Hanford, Hart.** Practical and Geometrical Drawing. (Practical Workroom Series.) Book 3. Cr. 8vo. Pp. 48. (London, Toronto, Melbourne and Sydney: Cassell and Co., Ltd., 1937.) 1s. 3d.
- Hasse, H.** Höhere Algebra. (Sammlung Göschen, Band 932.) Zweite vermehrte Auflage. Pott 8vo. Pp. 158. (Berlin und Leipzig: Walter de Gruyter und Co., 1937.) 1.62 gold marks.
- Hellmann, H.** Einführung in die Quantenchemie. Sup. Roy. 8vo. Pp. 350. (Wien und Leipzig: Franz Deuticke, 1937.) 20 gold marks.
- Kestelman, H.** Modern Theories of Integration. Sup. Roy. 8vo. Pp. viii + 252. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 17s. 6d. net.*
- Kettle, Frederick.** A New Approach to Mathematics: Graduated and Educative Problems in Mathematics for use in Schools. Cr. 8vo. Pp. viii + 107. (London: Frederick Muller, Ltd., 1937.) 1s. 9d. net.
- Lenard, Ph.** Deutsche Physik. In 4 Bänden. Sup. Roy. 8vo. Band 4: Magnetismus, Elektrodynamik, Register zum Gesamtwerk. Pp. 317. (München: J. F. Lehmann, 1937.) 8.80 gold marks.
- McKelvey, Joseph Vance.** Calculus. Ex. Cr. 8vo. Pp. ix + 420. (New York: The Macmillan Co., 1937.) 12s. 6d.*
- Nentwig, K.** Die Kathodenstrahl-Röhre. 8vo. Pp. 175. (Berlin-Tempelhof: J. Schneider, 1937.) 5 gold marks.
- Neuber, H.** Kerbspannungslehre. Roy. 8vo. Pp. 160. (Berlin: Julius Springer, 1937.) 15 gold marks.
- Pidduck, F. B.** Lectures on the Mathematical Theory of Electricity. Demy 8vo. Pp. viii + 110. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 7s. 6d. net.*
- Rietz, H. L.; Reilly, J. F., and Woods, Roscoe.** Plane and Spherical Trigonometry. Revised edition. Demy 8vo. Pp. xi + 168 + 72 + xiii. (New York: The Macmillan Co., 1936.) 10s.
- Sauer, R.** Projektive Liniengeometrie. (Goschens Lehrbücherei, Gruppe 1, Band 23.) Roy. 8vo. Pp. 194. (Berlin und Leipzig: Walter de Gruyter und Co., 1937.) 9 gold marks.
- Schulz, Günther.** Formelsammlung zur praktischen Mathematik. (Sammlung Göschen, Band 1110.) Pott 8vo. Pp. 147. (Berlin und Leipzig: Walter de Gruyter und Co., 1937.) 1.62 gold marks.
- Warrell, Charles.** Sane Arithmetic: for Seniors. Demy 8vo. Book 1. Pp. 64. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1937.) Paper, 10d.; limp cloth, 1s. 3d.
- Webb, H., and Hill, J. C.** Arithmetic of Daily Life. A New Series for Senior Schools, in three books. Cr. 8vo. Book 1. Pp. ii + 98. (Cambridge: At the University Press, 1937.) Manilla, 1s.; cloth boards, 1s. 3d.; Teachers' edition, 2s. 6d.

Weiss, J. Der Kathodenstrahloszillograph im neuzeitlichen Unterricht. 8vo. Pp. 78. (Berlin: Nauck Verlag, 1937.) 3 gold marks.

Wendehorst, R. Bautechnische Zahlentafeln. Zweite erweiterte Auflage. (Teubners Tabellenbücher.) 8vo. Pp. 185. (Leipzig und Berlin: B. G. Teubner, 1937.)

Yule, G. Udny, and Kendall, M. G. An Introduction to the Theory of Statistics. (Griffin's Scientific Text-Books.) Eleventh edition, revised throughout and re-set. Med. 8vo. Pp. xiii + 570. (London: Charles Griffin and Co., Ltd., 1937.) 21s. net.*

Engineering

- Anger, G.** Zehnteilige Einflusslinien für durchlaufende Träger. Zweite erweiterte Auflage. 8vo. Pp. 118. (Berlin: Wilhelm Ernst und Sohn, 1937.) 10 gold marks.
- Ardenne, M. von; Fehr, W., u. a.,** Bearbeitet und herausgegeben von. Handbuch der Funktechnik und ihrer Grenzgebiete. 3 Bände. Sup. Roy. 8vo. Band 2: Bauelemente für Empfänger und Verstärker. Pp. 217. (Stuttgart: Franckh'sche Verlagsbuchhandlung, 1937.) 15 gold marks.
- Benzel, M.** Grundbau. (Teubners H.T.L.-Bücherei, Band 18.) Sechste neubearbeitete Auflage. Roy. 8vo. Pp. 172. (Leipzig und Berlin: B. G. Teubner, 1937.) 6.80 gold marks.
- Cocking, W. T.** Wireless Servicing Manual. Third (revised) edition. Cr. 8vo. Pp. x + 241. (London: Iliffe and Sons, Ltd., 1937.) 5s. net.*
- Friedrich, E.** Die Tragfähigkeit von auf Biegung beanspruchten Eisenbetonbauteilen. (Dt. Ausschuss für Eisenbeton, Heft 85.) Sup. Roy. 8vo. Pp. 44 + 15 plates. (Berlin: Wilhelm Ernst und Sohn, 1937.) 5.60 gold marks.
- Göbel, A., und Henkel, O.** Grundzüge des Stahlbaues, Teil 1. (Teubners H.T.L.-Bücherei, Band 31.) Neunte Auflage, bearbeitet von H. Buchenau. Roy. 8vo. Pp. 129. (Leipzig und Berlin: B. G. Teubner, 1937.) 3.20 gold marks.
- Grein, K.** Über die Berechnung von Pilzdecken. Sup. Roy. 8vo. Pp. 48. (Berlin: Wilhelm Ernst und Sohn, 1937.) 6.60 gold marks.
- Hentze, J.** Wasserbau. Fünfte neubearbeitete Auflage. Roy. 8vo. Pp. 244. (Leipzig und Berlin: B. G. Teubner, 1937.) 9.60 gold marks.
- Hering, W.** Einführung in die elektrische Nachrichtentechnik für Betrieb und Verwaltung. 8vo. Pp. 160. (Berlin: Heidecker Verlag, 1937.) 4.80 gold marks.
- Hyland, P. H., and Kommers, J. B.** Machine Design. Med. 8vo. Pp. x + 578. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 36s.
- Ibbetson, W. S.** Electrical Installation Rules and Tables: for Rapid Reference. Pp. 120. (London: E. and F. N. Spon, Ltd., 1937.) 2s. 6d. net.
- Langsdorf, Alexander S.** Theory of Alternating-Current Machinery. (Electrical Engineering Texts.) Med. 8vo. Pp. xviii + 788. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 36s.*
- Riedl, C.** Konstruktion und Berechnung moderner Automobil- und Kraffradmotoren. Dritte neubearbeitete Auflage. Roy. 8vo. Pp. 776. (Berlin: Schmidt und Co., 1937.) 32 gold marks.
- Schoklitsch, Armin.** Kostenberechnungen im Wasserbau und Grundbau. Roy. 8vo. Pp. viii + 619. (Wien und Berlin: Julius Springer, 1937.) 66 gold marks.
- Schroeder, Gerhard.** Landwirtschaftlicher Wasserbau. (Handbibliothek für Bauingenieure, herausgegeben von R. Otzen, Teil 3, Band 7.) Roy. 8vo. Pp. ix + 397. (Berlin: Julius Springer, 1937.) 36 gold marks.

Sellar, W. The Geometry of Conical Pipes, Bends and Joints. Demy 8vo. Pp. 46. (London: Draughtsman Publishing Co., Ltd., 1937.) 2s. net.*

Shih, Tsonge. Das Rauschen der Elektronenröhren bei selbsterregung. 8vo. Pp. 45. (Dresden: Dittert Verlag, 1937.) 2.40 gold marks.

Terzaghi, K. von, und Frohlich, O. K. Erdbaumechanik und Baupraxis: eine Klarstellung. Roy. 8vo. Pp. 33. (Wien und Leipzig: Franz Deuticke, 1937.) 2 gold marks.

Weichart, Fr. Die Grundlagen der Funktechnik. Pott 8vo. Teil 4. Fünfte verbesserte Auflage. Pp. 147. (Berlin: Weidmann Verlag, 1937.) 3 gold marks.

Chemistry: Chemical Industry

Beilsteins Handbuch der organischen Chemie. Vierte Auflage. Die Literatur bis 1 Januar 1910 umfassend. Herausgegeben von der Deutschen Chemischen Gesellschaft. Band 26: Heterocyclische Reihe; Verbindungen mit 3 und mehr cyclisch gebundenen Stickstoffatomen. Roy. 8vo. Pp. 656. (Berlin: Julius Springer, 1937.) 138 gold marks.

Eggert, John. Lehrbuch der physikalischen Chemie in elementarer Darstellung. Vierte, verbesserte Auflage. Sup. Roy. 8vo. Pp. xii + 681. (Leipzig: S. Hirzel, 1937.) 25.50 gold marks.*

Findlay, Alexander. A Hundred Years of Chemistry. (The Hundred Years Series.) Demy 8vo. Pp. 352. (London: Gerald Duckworth and Co., Ltd., 1937.) 15s. net.*

Jost, Wilhelm. Diffusion und chemische Reaktion in festen Stoffen. (Die chemische Reaktion, herausgegeben von K. F. Bonhoeffer und H. Mark, Band 2.) Med. 8vo. Pp. viii + 231. (Dresden und Leipzig: Theodor Steinkopff, 1937.) 20 gold marks.*

Lange, Norbert Adolph, Compiled and edited by, assisted by **Forker, Gordon M.** Handbook of Chemistry: a Reference Volume for all requiring Ready Access to Chemical and Physical Data used in Laboratory Work and Manufacturing. With an Appendix of Mathematical Tables and Formulas, by Richard Stevens Burington. Second edition, revised and enlarged. Cr. 8vo. Pp. xvi + 1501 + 249 + 30. (Sandusky, Ohio: Handbook Publishers, Inc., 1937.) 6 dollars.*

Langhans Wehrchemie als Dezimalklassifikation der Feuer-, Explosions-, Nebel-, Rauch-, Giftkampff-Momente. Roy. 8vo. Pp. 474. (Berlin: "Offene Worte", 1937.) 35 gold marks.

Lebbin, G. Die Färbung der Lebensmittel und sonstige Farbveränderungen. (Chemisch-technische Bibliothek, Band 409.) 8vo. Pp. 173. (Wien: A. Hartleben, 1937.) 5 gold marks.

Leberle, H. Abriss der Bierbrauerei. Roy. 8vo. Pp. 248. (Stuttgart: Ferdinand Enke, 1937.) 9.60 gold marks.

Olberg, A. J. Der vollkommene Brau- und Malzmeister. (Chemisch-technische Bibliothek, Band 407.) 8vo. Pp. 179. (Wien: A. Hartleben, 1937.) 5 gold marks.

Prakash, Satya. Agnihotra: or An Ancient Process of Fumigation (A Study from the Chemical Standpoint). Cr. 8vo. Pp. 199. (Delhi: The Sarvadeshik Arya Pratinidhi Sabha, 1937.) 2.8 rupees; 5s.*

Prodinger, W. Organische Fällungsmittel in der quantitativen Analyse. (Die chemische Analyse, Band 37.) Roy. 8vo. Pp. 163. (Stuttgart: Ferdinand Enke, 1937.) 15 gold marks.

Robertson, G. Ross. Laboratory Practice of Organic Chemistry. Demy 8vo. Pp. xii + 326. (New York: The Macmillan Co., 1937.) 10s. net.*

Technology

Bodenbender, H. G. Zellwolle—Kunstspinnfasern: Vistra, Flox, Cuprama, Zehlawa . . . , ihre Herstellung, Verarbeitung, Verwendung und Wirtschaft. Zweite vermehrte und neubearbeitete Auflage. 8vo. Pp. 680. (Berlin: Bodenbender Verlag, 1937.) 18 gold marks.

Elfein, M. Die thermische und elektrische Leitfähigkeit von Aluminium-Gusslegierungen unter besonderer Berücksichtigung selbstveredelnder Legierungen. (Forschungsarbeiten über Metallkunde und Röntgenmetallographie, Folge 23.) Roy. 8vo. Pp. 63. (München: Hanser Verlag, 1937.) 4.50 gold marks.

Forbes, Raymond S. A Three Year Course in Handicraft in Wood. Med. 8vo. Teachers' Book 1. Pp. 94. 2s. 6d. Book 2: Second Year. Pp. 94. 1s. 6d. (London and Glasgow: Collins Clear-Type Press, 1937.)

Jänecke, E. Kurzgefasstes Handbuch aller Legierungen. Roy. 8vo. Pp. 493 + 80 plates. (Leipzig: Otto Spamer, 1937.) 52 gold marks.

Schwarz, H. Die Tiefenwirkung bei der elektrolitischen Metallabscheidung. 8vo. Pp. 47. (Borna: Noske Verlag, 1937.) 2.25 gold marks.

Thurstan, Violetta. Weaving Patterns of Yesterday and To-day. Oblong 8vo. Pp. 44. (Leicester: The Dryad Press, 1937.) 2s. 6d. net.

Völkel, E. Kunstseiden- und Zellwollarten. (Bibliothek der gesamten Technik, Band 436.) 8vo. Pp. 74. (Leipzig: Max Jänecke, 1937.) 1.80 gold marks.

Watt, Alexander. Electro-plating. Based on "Electro-Metallurgy Practically Treated". Cr. 8vo. Pp. 184. (London: The Technical Press, Ltd., 1937.) 6s. net.

Meteorology: Geophysics

Hann, J., und Süring, R. Lehrbuch der Meteorologie. Fünfte vollständig neubearbeitete Auflage. Herausgegeben von R. Süring. Sup. Roy. 8vo. Lieferung 1. Pp. 96. (Leipzig: Willibald Keller, 1937.) 6.60 gold marks.

Polynov, B. B. The Cycle of Weathering. Translated from the Russian by Alexander Muir. Demy 8vo. Pp. xii + 220. (London: Thomas Murby and Co., 1937.) 10s. 6d. net.*

Geology: Mineralogy

Bureau d'études géologiques et minières coloniales. Les ressources minérales de la France d'outre-mer. 5: Le pétrole. Roy. 8vo. Pp. iii + 263. (Paris: Société d'Éditions Géographiques, Maritimes et Coloniales, 1937.) 45 francs.*

Geological Survey and Museum. British Regional Geology: East Anglia and adjoining Areas. By C. P. Chatwin. Roy. 8vo. Pp. vi + 91 + 8 plates. (London: H.M. Stationery Office, 1937.) 1s. 6d. net.*

Geological Survey of Great Britain: England and Wales, Memoirs of the. Gosforth District (One-inch Geological Sheet 37, New Series). By F. M. Trotter, S. E. Hollingworth, T. Eastwood and W. C. C. Rose. Roy. 8vo. Pp. vii + 136 + 6 plates. (London: H.M. Stationery Office, 1937.) 3s. 6d. net.*

Mines Department: Safety in Mines Research Board. Paper No. 98: Coal Measure Rocks. Part 1: Classification, Nomenclature and Relative Strengths. By H. M. Hudspeth and D. W. Phillips. Roy. 8vo. Pp. ii + 22 + 10 plates. (London: H.M. Stationery Office, 1937.) 1s. net.*

Wooldridge, S. W., and Morgan, R. S. The Physical Basis of Geography: an Outline of Geomorphology. Demy 8vo. Pp. xxi + 445. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 12s. 6d. net.

Geography: Travel

Bartholomew, J., and Alnwick, H., Edited by. Harrap's Modern School Atlas. Cr. 4to. Pp. iii + 64 + 16. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1937.) 4s. 6d.

Brunner, Th. Ägypten: Schweizer fahren in das Pharaonenland. 8vo. Pp. 296. (Bern: Hallwag Verlag, 1937.) 8.50 francs.

Carter, C. C., and Simpson, C. A. The World of Man. Book 1: First Studies from Great Britain. Cr. 8vo. Pp. xv + 201. (London: Christophers, 1937.) 2s. 9d.*

Coysh, A. W., and Hunt, D. M. Exercises in Modern Geography. Demy 4to. Book 4: Europe. Pp. 36. (London: University Tutorial Press, Ltd., 1937.) 1s.

Etherton, P. T., and Barlow, V. Auf den Spuren der Eroberer (bes. Südamerika). Übersetzung von D. von Mikusch. 8vo. Pp. 263. (Berlin: S. Fischer Verlag A.-G., 1937.) 3.80 gold marks.

Fleming, P. Tartaren-Nachrichten: eine Reise von Peking nach Kaschmir. 8vo. Pp. 418. (Berlin: E. Rowohlt, 1937.) 6.50 gold marks.

Illion, Theodore. In Secret Tibet. Cr. 8vo. Pp. 190. (London: Rider and Co., 1937.) 5s. net.

Jones, John. The British World. (Collins New Scheme Geographies, Vol. 9.) Cr. 8vo. Pp. viii+280. (London and Glasgow: Collins Clear-Type Press, 1937.) 2s. 9d.

Kretschmer, K., Nussbaum, Fr., u. a. Allgemeine Geographie. Teil 1: Physikalischen Geographie. Sup. Roy. 8vo. Pp. 556+23 plates. (Potsdam: Athenaion Verlag, 1937.) 45.30 gold marks.

Lockhart, R. H. Br. Wieder in Malaya. Aus dem Englischen übertragen von R. v. Scholtz und W. E. Süskind. 8vo. Pp. 423. (Stuttgart: Deutsche Verlags-Anstalt, 1937.) 6.75 gold marks.

Maillart, Ella K. Forbidden Journey: From Peking to Kashmir. Translated by Thomas McGreevy. Demy 8vo. Pp. 320+32 plates. (London: William Heinemann, Ltd., 1937.) 12s. 6d. net.

Marshall, A. J. The Black Musketeers: the Work and Adventures of a Scientist on a South Sea Island at War and in Peace. Demy 8vo. Pp. xiii+329+35 plates. (London: William Heinemann, Ltd., 1937.) 15s. net.*

Mikhaylov, N. Soviet Geography: the New Industrial and Economic Distributions of the U.S.S.R. Translated from the Russian by Natalie Rothstein. Second edition revised by the Author. Demy 8vo. Pp. xviii+229. (London: Methuen and Co., Ltd., 1937.) 10s. 6d. net.*

Murdoch, Nina. Vagrant in Summer. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1937.) 8s. 6d. net.

O'Brien, Kate. Farewell Spain. Cr. 8vo. Pp. 256. (London: William Heinemann, Ltd., 1937.) 7s. 6d. net.

Schäfer, E. Unbekanntes Tibet. Roy. 8vo. Pp. 295. (Berlin: Paul Parey, 1937.) 6.50 gold marks.

Skawran, P. Das Südafrika-Buch. Roy. 8vo. Pp. 160. (Berlin: Freiheitsverlag, 1937.) 6.80 gold marks.

Smythe, F. S. The Mountain Scene. Ex. Cr. 4to. Pp. x+153 (78 plates). (London: Adam and Charles Black, Ltd., 1937.) 12s. 6d. net.*

Snaitch, Stanley. At Grips with Everest. Imp. 16mo. Pp. xv+240+8 plates. (London: The Percy Press, 1937.) 3s. 6d. net.

Willis, Margaret S. Systematic Geography. Part 1: World Relations. Demy 8vo. Pp. xiv+300. (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd., 1937.) 5s. 6d.

Wöller, J. Von Jütland bis Java. 8vo. Pp. 271. (Frankfurt a.M.: Societäts-Verlag, 1937.) 5.40 gold marks.

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