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A Scientific Approach to Peace

A GROWING volume of uneasiness is evident among men of science as to their responsibilities regarding association with preparations for war. Many scientific workers are conscious of their duties to mankind as a whole as well as their responsibilities to their own nation, and the virulence of economic nationalism in some parts of the world has tended to accentuate their sense of the wider responsibilities; but so far there has been no well-defined professional attitude on the question. The suggestion put before the Technical Committee of the Disarmament Conference that the chemists of the world should include in their code of ethics an undertaking not to work knowingly on the development and production of any prohibited method of warfare, and to expose publicly anyone who was detected in such work, might indeed make secret preparations impossible and render a nation unable to use prohibited methods, because its chemists refused to be associated with the work, but it is chiefly a significant pointer of the growth of scientific opinion on this matter. The matter was also raised at the meeting last summer in Brussels of the International Council of Scientific Unions (see *NATURE*, July 21, p. 89).

The Bishop of Carlisle, in his British Association sermon at Aberdeen, suggested that the time has come when science should abandon something of that severe spirit of isolation which keeps it aloof from moral inquiries and confines it to the austere analysis of natural events. "Is it," he asked, "to remain content with the provision of antidotes for poisons which it has itself created, or to meet the menace from the air by even more skilfully constructed weapons of defence? Or is it to come down into the arena where men strive and groan to free themselves from perils which are not natural but perversions of the authentic human spirit?"

Beyond this there are indeed others such as Dr. W. A. Noyes, whose part in the reconciliation of German and French chemists after the War is well known, who are seeking to enlist the scientific men of the world in a definite campaign to prevent another and more terrible war.

The suggestion that chemists should combine in refusing to work knowingly on prohibited methods of warfare was, however, commended for consideration by Mr. J. Davidson Pratt in a recent address before the Glasgow Section of the

Society of Chemical Industry. The ethical codes of the medical and legal professions show that it is not impossible for a profession to set up and maintain high ideals of professional conduct, and there is no doubt that a right attitude on the part of the profession of science would be a small but definite help in preventing war.

If the extent of that help can easily be over-rated, it is none the less worth having. At present even chemists, the most numerous class of scientific worker, are not sufficiently organised in any country for a definite professional standard to be adopted. The organisation of scientific workers in effective professional associations, and possibly even the legal closure of the profession, may be required before the profession of chemistry or other branch of science could insist that every chemist should give such an undertaking of non-participation under pain of exclusion from the profession.

The first step, however, is the clarification of the conflicting issues and the formulation of a definite opinion and policy. The time is opportune for much wider and freer discussion of the whole question by the professional associations representing every branch of science, and the chapter on "Science and War" contained in Prof. Julian Huxley's recent book "Science and Social Needs" provides an excellent starting point for such a discussion. Most scientific workers would probably accept the realistic attitude which Prof. Huxley adopts regarding the use of science in preparations for war. So long as there is real risk of war, or so long as the possibility remains of nations, through the League of Nations or other institution, being compelled to use armed force against an aggressor nation and violator of international law and order, the fullest resources of science should be used to make warfare as efficient as possible from the military or naval point of view at the lowest possible cost.

This attitude does not, however, as so many are apt to assume at once, give the unqualified support of science to all preparations for war. If we regard research work in connexion with general war needs as legitimate, the general code of the man of science may equally hold that it is illegitimate to undertake research in agencies prohibited by international agreement, or to help in the large-scale production of armaments in peace-time. The acceptance and maintenance of such standards may well become a very important factor, more especially in view of the extent to which industry is passing

under the management of those whose outlook is being increasingly influenced by professional standards and ideals.

Discussions on this aspect of the relations between science and war are commonly confused by inability or reluctance to regard the problem of preparation for warfare, and conversely of disarmament, as a whole. The sectional treatment of chemical warfare has dissipated a vast amount of energy that might well have been fruitful had it been applied to the scientific study of disarmament as a single problem. Similarly, no scientific man, any more than any industrialist, however sincere his desire for peace and however firm his belief in world co-operation, can lend his countenance to policies which deliberately encourage inefficiency and the waste of public money, whether on preparations for war or in any other way.

Accepting the view that, while the need for preparations for war remains, these preparations whatever their scale must be as efficient as possible, the scientific worker need find little difficulty in the way in which the general advance of science yields facts and ideas which can be applied to purposes of warfare, any more than in the advantages which industry and society in general have sometimes reaped from research instigated primarily in the service of national defence. He may, however, at times be called upon to point out that the same and much greater results might equally have been achieved by the expenditure of the same effort on deliberate social or industrial investigations. Indeed it is difficult to assess, for example, the advantages which would accrue from the expenditure on investigations on public health of a fraction of our expenditure on war research.

The discussions on the relations between science and war rarely reach this point, and both Prof. Huxley's book and the Bishop of Carlisle's sermon direct attention to the greater possibilities which attend the application of science to the wider field which we here touch. The application of science in the interest of efficiency for war is only the first aspect of the realistic attitude. The application of science to make war as unlikely as possible is equally important, and yet the application of science to the general problem of disarmament has scarcely begun.

The technical aspect of this question has been explained to some extent by Major Lefebure in his book "Scientific Disarmament", but few if any of his suggestions have been taken up, whether by

scientific opinion or the Disarmament Conference itself, a situation which powerfully demonstrates the need for a professional attitude of science on this question. At present, it remains a reproach to the scientific community that it has made no real attempt to secure a real step towards the problem of disarmament by a scientific analysis of the process of armament.

Besides this technical aspect of the study of disarmament, there is a wide field in which the application of scientific methods and of the scientific spirit might do much to eliminate the causes of international friction. The outbreak of national passions which have at the moment largely paralysed disarmament is the natural sequence to our neglect to undertake the scientific study of international relations, and to provide for the impartial and authoritative study of many of the complex international economic and racial problems of to-day. Scientific research on any considerable scale into the causes of war in general, the risks of war in the modern world and the measures to be adopted for reducing those risks, if prosecuted with any vigour on an adequate scale, could not fail to have fostered an atmosphere in which the discussions on technical disarmament would have been much more fruitfully carried on. In its absence, however, the disarmament discussions have necessarily been largely futile.

The very extent of national passions at the present time enhances the need for unprejudiced study of the economic, political and psychological factors making for war. It is only out of such a study that there can emerge the lines of a solution which will command general assent, or influence sufficiently the political outlook and practice to ensure its execution. When, however, Prof. Huxley presents the case for this dispassionate survey, he is only putting into other words the Bishop of Carlisle's plea that science should take the whole of life for its operations, or General Smuts's plea for more of the cool serious spirit of science in human affairs. Already science has largely delineated the external world, and the leading workers in each field know well within what lines the next advance in that field will take place. The plea that science may win even more striking victories for the human spirit, if it regards not only truth but also justice and liberty as equally relevant to its vast concerns, and takes for its subject matter in addition the inner tragedies of the human spirit, cannot lightly be dismissed.

An English Dictionary of Organic Compounds

Dictionary of Organic Compounds: the Constitution and Physical and Chemical Properties of the Principal Carbon Compounds and their Derivatives, together with the Relevant Literature References. Vol. 1: *Abietic Acid—Dyprone.* Editor-in-Chief: Prof. I. M. Heilbron. Pp. xix+706. (London: Eyre and Spottiswoode (Publishers), Ltd., 1934.) 105s. net.

EARLY in the present century, it was a comparatively simple matter to ascertain whether a specific organic compound had been described in the literature, and, if so, to determine what was known about it. Time, however, has afflicted operations of this kind with an ever-increasing locomotor ataxy, similar to that which impresses the occasional patron of the London taxi. Indeed, organic chemist and motorist are faced at present with fundamentally similar problems, due to excessive multiplication of the species.

The 1910 edition of Richter's "Lexikon der Kohlenstoff-Verbindungen" contains a systematic record of 144,150 carbon compounds; but organic chemistry has travelled a long way, with continuous acceleration, since 1910. Richter's arrangement is based upon molecular formulæ, and it is a common experience to find a list of thirty or forty isomeric substances arrayed under a particular formula. In his quest of the organic Grail, the modern Galahad who has penetrated the outer defences of Richter is still confronted by numerous sandbagged fortifications in the shape of stout volumes of Stelzner's continuation and the succeeding annual indexes of one or other of the standard series of chemical abstracts; an alternative route leads him into the formidable fastnesses of Beilstein's "Handbuch der organischen Chemie". Issued originally in 1881 in two modest volumes, this encyclopædia of organic compounds—still ironically termed a handbook—has grown into a colossal and excessively costly work, the fourth and unfinished edition of which already embraces nineteen volumes and sixteen supplementary volumes. Even so, this Charlie's Aunt of organic chemistry, in its latest supplements, covers the literature only to 1919.

The perils that do environ the man who meddles with the siren of organic chemistry need no further elaboration. Prof. Heilbron and his collaborators have done much to minimise them, and to conserve the time and energy of the many whose work demands frequent and rapid reference to specific organic compounds. The new work is arranged upon an alphabetical basis, and this method should meet with general approval. In the absence of a universally recognised system of organic nomenclature, the compilers have usually

adopted the most reasonable and obvious names, and there are generous cross-references. Naturally, the dictionary aims neither at the completeness of Richter nor the fullness of Beilstein: by so doing it would sacrifice its chief advantages. It is safe to say, however, that the proportion of organic substances of real importance which has been omitted is remarkably small; the omission of dyestuffs as a class is justified by the existence of the "Colour Index" and other publications.

The full structural formula, when known, is given for each substance: this is a particularly valuable feature. The literature references, which have been selected with judicious restraint, usually guide the inquirer to a description of the best method of preparing the substance. The data for each compound, occupying ordinarily from a couple to a dozen lines, include the molecular formula, molecular weight and common physical constants, besides frequent allusions to functional derivatives. Users of the existing works of reference will welcome most of all the up-to-date character of the dictionary: many of the references in the first volume are so late as 1933, while an addendum (pp. 689-706) refers in certain instances to the literature of 1934, for example, in the entries relating to astacene (a pigment of the Crustacea) and capsanthin (contained in *Capsicum annuum*).

A rough calculation, made on an assumed average of about ten entries per page, indicates that the first volume contains references to nearly 7,000 compounds, excluding the numerous functional derivatives. The dictionary is to be completed in three volumes, the last of which is due in 1936, at an inclusive price of fifteen guineas. It will be a remarkable achievement to cover the whole field of organic chemistry in this short period and at so moderate a cost. The format and production of the work are all that can be desired, the type being particularly easy to read. The publication of this first dictionary of organic compounds in the English language is an event of prime importance to chemists and workers in allied fields of science. Prof. Heilbron, his collaborators, and the publishers have earned the lasting gratitude of all concerned by attacking their monumental task with such enthusiasm, skill and success.

One last thought. In the world of organic chemistry each day is literally 'a bringer of new things'; and now a small cloud of 'heavy hydrogen', no bigger than a man's hand, is taking shape upon the horizon. Could not Prof. Heilbron and his colleagues provide us with some new and ingenious device, modelled perhaps on the card-index, which would guide us in the teeming years to come in our further explorations of 'that untravell'd world, whose margin fades for ever and for ever when we move'?

JOHN READ.

Bacteriology and Immunology

- (1) *An Outline of Immunity*. By Prof. W. W. C. Topley. Pp. vii+415. (London: Edward Arnold and Co., 1933.) 18s. net.
- (2) *Streptococci in relation to Man in Health and Disease*. By Dr. Anna W. Williams. Pp. xi+260+8 plates. (London: Baillière, Tindall and Cox, 1932.) 29s.
- (3) *Bacteriology and Sanitary Science: for Students in Pharmacy, Chemistry and Applied Sciences*. By Prof. Louis Gershenfeld. Second edition, thoroughly revised. Pp. xx+17-493+3 plates. (London: Henry Kimpton, 1934.) 21s. net.
- (4) *Bacteriology: for Medical Students and Practitioners*. By A. D. Gardner. (Oxford Medical Publications.) Pp. v+276. (London: Oxford University Press, 1933.) 6s. net.

(1) **T**HE unassuming title which Prof. Topley has chosen for this new and important addition he has made to the bacteriologist's reference library does less than justice to its scope and the concise yet carefully reasoned treatment devoted to its twenty-one chapters. Though ostensibly for the student, and let us hope, the more advanced student, this individual effort of more than 400 closely printed pages will find a place on the expert's bookshelf alongside another still young arrival of composite authorship, the "Immunity" volume of the "System of Bacteriology" published by the Medical Research Council. Four years ago, Prof. Topley and his colleague, Prof. G. S. Wilson, of the London School of Hygiene, published their "Principles of Bacteriology and Immunity" in two volumes. The pages there given over to immunity problems have been entirely rewritten for incorporation in the "Outline", and these with the addition of much new matter make up the substantial volume now before us.

In recent years there has been considerable activity in many fields of immunology, particularly perhaps in connexion with the constitution of bacterial antigen, the ultimate nature of antigen-antibody reactions and the phenomena associated with local immunity processes. These and many other keenly debated questions of the day are very thoroughly ventilated and expounded in the easy and attractive style which the author commands. He is rarely laboured, his judgments following detailed argument are clear and precise, and when the occasion demands he is not ashamed to say "we do not know".

A most valuable feature of the book is the introduction of summaries at the conclusion of each chapter. These at any rate will be eagerly seized upon by the unfortunate overburdened student seeking a short cut to knowledge in this

field. Moreover, each chapter is provided with ample references to authorities cited. The book does the author great credit, and his colleagues in the bacteriological world are grateful to him for an authoritative exposition of a difficult subject.

(2) Few people are better qualified to write about that vast group of bacteria, the streptococci, than Dr. Anna Williams, for many years the assistant director of the Department of Health Laboratories, New York City, and the colleague of Dr. W. H. Park, who contributes an interesting introduction to her monograph.

The streptococci have always attracted investigators, with the result that the literature on the subject, whether in the current scientific journals or summarised in volumes such as those issued by the Thomsons, is now enormous. Few can spare the time required to study either the papers or the volumes, consequently this monograph, while it cannot pretend to cover the entire field, is most welcome, for it allows one to become reasonably familiar with the problems presented by streptococci in their relation to man, in a reasonable time.

Systematic classification is dealt with, but not unduly stressed. The rôle of streptococci in scarlet fever, rheumatism, erysipelas, puerperal fever and the problems of milk-borne infection are treated with adequate detail. There is even a short chapter on the possible rôle of streptococci in virus diseases.

It is in the last chapter dealing with general considerations concerning our knowledge of streptococci that one realises the difficulties of the task undertaken by the author, for the truth is that from the point of view of the research worker, the streptococci constitute perhaps the most perplexing group of organisms to tackle. On the whole, Miss Williams has given us an admirable presentation of a subject on which the last word will not be said for many days to come. There is an excellent bibliography.

(3) This, the second edition of Gershenfeld's "Bacteriology and Sanitary Science", is designed primarily for the instruction of pharmacists, chemists, nurses, welfare workers and all whose occupation demands for its intelligent performance some knowledge of microbiology in some one or other of its many spheres of practical application. The author, who is professor of bacteriology and hygiene in the Philadelphia College of Pharmacy and Science, gives a succinct but very readable account of bacteria and bacterial economics in a great variety of fields. The scope of the book is, however, much wider than this, and in the 32 chapters into which its 500 pages are divided will be found useful information on a host of topics such as disinfection, fumigation, standardisation of biological products, insect extermination, water

purification, sewage disposal, milk hygiene, etc. Immunity also is not forgotten. The book, for the purpose its author has in view, should prove of great value.

(4) There is too little time during the medical course for students to deal adequately with all the subjects of the curriculum. Later on, in practice, this fight against time is even more in evidence. Dr. Gardner's small compendium has been written in an attempt to remedy this state of matters. In addition to providing what all books of the kind hope to do, a short cut, it also aims at lifting the study of bacteriology from the dull subject the student often holds it to be, to the highly intriguing one it really is.

How far students' aids succeed, in the long run, is an open question. If we assume them to have a definitely useful place in the medical student's library, this one should do very well, provided it is adequately supplemented by a sound practical course and a comprehensive set of lectures. It is really doubtful whether any short work on so vast a subject as bacteriology can hope to make the subject alive and interesting.

A James Johnstone Memorial

Lancashire Sea-Fisheries Laboratory. *James Johnstone Memorial Volume*. Pp. x+348. (Liverpool: University Press of Liverpool, 1934.) 21s. net.

JOHNSTONE regarded a *Festschrift* as the ideal honour to a scholar, and it is therefore appropriate that this volume of contributions by his friends should be issued in his memory. A biographical note by Prof. F. J. Cole tells us that Johnstone was born in Ayrshire in 1870, became an apprentice woodcarver and a qualified craftsman, and then went with a National scholarship to the Royal College of Science, London, where he came under the influence of Howes. Soon after finishing the course, he was appointed, in 1898, assistant in the Fisheries Laboratory, Liverpool, under Herdman, whom he succeeded in 1920 as professor of oceanography, a post he held until his death in 1932.

The volume is a tribute to Johnstone's many-sided outlook—in zoology, philosophy, fisheries problems, parasitology, oceanography—and to the regard in which he was held at home and abroad, for the contributions are by British, Canadian, American, German, Norwegian, Danish, Russian and Italian writers. It is possible to notice only a few of the twenty-two papers.

Dr. E. S. Russell writes in appreciation of Johnstone's philosophic outlook on biology, basing his remarks on two subjects considered in

Johnstone's last book, "The Essentials of Biology"—the psychobiological unity of the organism, and hence the importance of the study of behaviour and ecology, and the entropy law which he called "the fundamental generalisation of science". H. A. Marmer (U.S. Coast Survey) points out that in English-speaking countries oceanography was until recently focused primarily on biology, but Johnstone in "An Introduction to Oceanography" stressed the geophysical aspects of the subject which may be considered as more or less separate from biology though the marine biologist "will continue to be a powerful ally to the oceanographer".

Prof. W. M. Tattersall and Miss Sheppard contribute an admirable account of the bipinnaria larva of the starfishes *Luidia sarsi* and *L. ciliaris* based on observations of numerous living examples collected in Lough Ine, Cork. The authors state clearly the characters of the respective larvæ; that of *L. sarsi* bears a five-rayed starfish-rudiment and undergoes metamorphosis by shedding the larval ciliated arms, that of *L. ciliaris* has a seven-rayed starfish-rudiment which finally absorbs the larval arms. These larvæ were observed to move, not by ciliary action, but by the rhythmic contraction and extension of the pre-oral lobe. The ciliated grooves of the arms carry food particles close to the mouth into which, when the particles are aggregated into pellets, they are driven. The authors have overlooked Gemmill's short account (1915) of the larvæ of both species from the plankton material of the Irish Fisheries Department.

Prof. F. B. Sumner describes experiments on colour change in fishes. By covering the eyes of *Fundulus* with 'goggles' made of a transparent yellow colour filter, the fish was caused to assume a distinctly yellowish tint identical with that of specimens which had been kept for some hours or days in aquaria with yellow walls and bottom. Writing of the astonishing conformity of the pigment pattern of some flat-fishes to mixed bottoms, Prof. Sumner holds that the only possible interpretation is in terms of concealment.

In a short article, Prof. E. Linton records observations on the helminths of fishes of the Woods Hole region. Prof. W. J. Dakin states that a striking feature of the plankton of the continental shelf of the Pacific coast of Australia is the presence not only of the same genera of plants and animals but also often of the same species as in British seas. Further, the plankton curve of production is strikingly similar to that found for the Irish Sea, but the diatom production does not present such high peaks in spring or autumn.

Prof. A. C. Redfield discusses the proportions of organic derivatives in sea-water and their relation

to the composition of the plankton, and Dr. E. Kreps of Leningrad writes of organic catalysts or enzymes in sea-water; he states that in *filtered* water-samples, chemical processes are going on which are generally attributed to micro-organisms, and suggests that a study of the enzymes in sea-water would add greatly to our understanding of the chemical changes in the sea.

Other papers on chemical and physical oceanography include a consideration of the salinity of the surface waters of the ocean, the significance of bottom temperature measurements in relation to the investigation of the deep sea, observations of water movements in the North Sea and in the Straits of Gibraltar and the development of computational methods in relation to the detailed dynamical explanation of the tides in areas of certain defined limits.

The editor, Dr. R. J. Daniel, and publishers deserve commendation for their share in the production of this interesting memorial to one who throughout his life was a keen and independent searcher for truth.

Science and the Modern Highway

- (1) *Road Making and Administration*. By Dr. P. E. Spielmann and E. J. Elford. (The Road Makers' Library, Vol. 1.) Pp. x+441. (London: Edward Arnold and Co., 1934.) 25s. net.
- (2) *Highway Engineering: a Textbook for Students of Civil Engineering*. By John H. Bateman. Second edition. Pp. x+441. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 25s. net.

IT is no mere figure of speech to describe this work as one which has been long looked for by municipal and county engineers and their technical staffs, as well as by many members of the general public. Although it is stated that some knowledge of the principles of road construction is desirable in the reader, the ground covered, the clarity of writing and the happy style of phrasing are such as to make the book eminently suited to all those who are interested in this rapidly developing feature of our modern civilisation.

Very little criticism of main outlines need be offered; among minor points, the following were noted:—The section dealing with the planning of highways would have been improved by the addition of a few diagrams; the obviating of slipperiness in asphalt surfacings by the new heat treatment method is only briefly referred to, possibly owing to the fact that it is still more or less in embryo, or on account of Dr. Spielmann's well-founded objections to the application of

excessive heat to bitumens, owing to the risk of damaging them. A misprint seems to have crept in in the last line of page 138; it is thought that the line refers to the new British standard specifications for asphalt surfacings now in course of preparation. The Building Research Station pat test for clinker is not included, while the notes on the slump test for concrete could have been amplified with advantage. The impression obtained from the matter on silicate of soda methods of hardening concrete surfaces does not coincide with the conclusions reached by the Building Research Station thereon. The troubles caused by creeping in rubber blocks, although becoming of historical interest, are not included; the advantages of section 146 of the Public Health Act, 1875, whereby a local authority can get estate roads made up by developers before building takes place, in place of the cumbrous procedure under other Acts, would perhaps have been worth mention.

One of the best sections is that dealing with traffic control, while that on road emulsions is exceptionally clear and complete. It is significant that slag chippings are shown to have almost entirely disappeared under traffic conditions which have left granite chippings still *in situ*.

The photographs are well reproduced, those by the authors being superior to those supplied by firms. Altogether, the work can be described as being by far the best on this important subject yet known to the writer.

(2) Several aspects of road practice peculiar to the United States, such as the construction of earth, shell and sand-clay roads, are dealt with in considerable detail in this treatise, which essays the difficult task of covering the whole field of highway construction in just over 400 pages. One of the distinctive features is the portion dealing with the assessment of benefit derived from road widenings, new arterial roads, etc.; on the other hand, the section on location is disappointingly brief, while that on bridges and culverts, short as it is, would seem to fall within the purview of a complete work thereon.

There is a certain amount of duplication under the heading of superelevation, a well-known formula being stated twice, and the factor of skidding being omitted altogether. The important subject of road intersections is dismissed in a single page, while slipperiness is apparently considered of much less importance in the United States than in Great Britain.

It is not stated whether the book is intended for the use of students, although the sets of problems (answers to which are not given) suggest that its purport is that of a textbook. This being the case, definitions of such terms as water-cement ratio, etc., would have been an advantage, while

a fuller explanation of the diagrams would have been helpful.

Tests for aggregates and stone setts are given, but not for such important materials as tar and bitumen; the details of highway plant are fully set out, probably owing to their more extended use in America.

B. H. K.

Lions and their Cubs

(1) *Lions, Wild and Friendly: presenting the King of Beasts as a Companion and an Interesting Subject for Photography in his Natural Habitat; the Anecdotes of one who has reared Lions as a Hobby.* By Eric F. V. Wells. Pp. xi + 112 + 32 plates. (London, Toronto, Melbourne and Sydney: Cassell and Co., Ltd., 1933.) 8s. 6d. net.

(2) *Engato the Lion Cub.* By J. H. Driberg. Pp. 151 + 2 plates. (London: George Routledge and Sons, Ltd., 1933.) 3s. 6d. net.

(1) **T**HE psychology of our pets is our constant study, and the extent of our understanding of the same represents the measure of the success we attain with them. Mammals, being more nearly related to ourselves, particularly attract us, most reacting well to patient endeavour. An occasional person is successful with birds, and now and again we have seen in the East even lizards and snakes made to show affection and go through primitive tricks. Castrated lions and tigers are sometimes seen in Eastern villages wandering about, quite harmless, so long as they are fed. Here we have Mr. and Mrs. Wells visiting the lions in their homes, stealing occasional cubs and rearing them in large enclosures on their veld-farm.

At first the cubs are fed from a bottle, then given a little meat with their milk and finally meat alone, the ration for an adult being about 4,000 lb. a year; not much for a beast weighing about 500 lb. In all, thirty-three lions have been thus reared in nine years, having been taught to take up much the same position in the household as cats and dogs, coming to tea, rolling over and demanding the usual playful attentions and finally expressing their thanks in the usual licks. Regular grooming and cleanliness seem all-important. Always the cub is given a dog as a companion, the two romping together, and the dog, often a terrier, quite safe even when his friend has grown up. "The two amuse each other and the lion is happy" and, when the dog comes to the whistle and is taken for a walk, the cub follows and soon learns.

Of course lions, like Alsations, are somewhat temperamental, but with owners such as these, who have learnt to read their very expressive faces, they appear to be safe enough. This understanding and an absence of fear has enabled the wild lion packs to be approached, watched and

photographed with great success. We learn much that is unexpected of the intimate habits of very noble beasts, who train their children for their first two or three years in all that pertains to their wild-craft. They are creatures of habit and ordinarily only hunt their legitimate hoofed prey, never learning except by chance that man may be an easier victim. The latter is safe enough in his tree, for the lion is not a climber. It is claimed that he hunts not by scent but by a very acute hearing, while the kill is a highly scientific affair, following a short charge at incredible speed.

(2) In contrast, Mr. Driberg's story is that of the cub he reared with a goat as foster-mother; this was in Kenya, mostly in the Lango country. It is described as kittenish but it soon joined the dogs, obeyed the whistle and even slept under his master's bed. 'Engato' was always a companion on his duty-treks, and we doubt not but that he added to his master's prestige in many a village palaver. The two became inseparable, so that, when one underwent manhood initiation into a Lango society, it was proposed that his associate, 'Engato', should be admitted to "The Lions"; both initiations are described, but, while the master was starved, Engato was allowed to draw upon a private store of meat. Okeng and Lungamoi also tell us some human lore and another story is of a voyage over Kioga, but these good tales must be read in the original.

Origin of Man in America

The American Aborigines: their Origin and Antiquity. A Collection of Papers by Ten Authors assembled and edited by Diamond Jenness. (Published for presentation at the Fifth Pacific Science Congress, Canada, 1933.) Pp. 396. (Toronto: University of Toronto Press; London: Oxford University Press, 1933.) 10s. 6d. net.

THIS book, sponsored by the National Research Council of Canada, was prepared for presentation to the Fifth Pacific Science Congress, which was to be held in Canada in June 1932, but actually did not meet until June 1933. The editor's preface is dated February 1932, and it must be assumed that these papers were written before that date. The point is not without consequence. The papers are focused on the problem of the antiquity of man and his culture on the American continent, which is considered in the light of the evidence of geology, palæontology, archaeology, physical anthropology, linguistics and cultural anthropology. In view of the numerous accessions to archaeological knowledge now being made in the United States and Central America,

it is important to know precisely what evidence was accessible to the authors when arriving at the conclusions which they have here set down.

On the whole, the views put forward are in agreement that the arrival of man in America was late. As Dr. N. C. Nelson puts it in writing on the archaeological evidence, it was "some time after, but probably incidental to the general disruption caused by the last ice retreat". Man is thus made to arrive as "the bearer of the partially developed Neolithic culture somewhere between 5,000 and 10,000 years ago". At most it is conceded that the Folsom stone 'points' from New Mexico may show faint traces of the Solutrean cultural stage. This, it is admitted, is difficult to reconcile with the palæontological evidence, unless the very late survival of extinct fauna be accepted; for notwithstanding much doubtful evidence, the contemporaneity of man and varieties of extinct fauna, especially in the south-western United States, seems well on the way to being established.

On the other hand, the evidence of physical characters is difficult to interpret. Prof. E. A. Hooton, who deals with this topic, shows considerably more caution than some of his colleagues, especially in Europe, in assigning to American Indian strains their Old World affinities. He suggests, very tentatively, that the three dolichocephalic types which he distinguishes point to Mediterranean, negroid and 'archaic white' elements, "subsequently glossed over with mongoloid traits due to mixture with other migrants", and that his three brachycephalic types are derivative from Asiatic Mongoloids. His final view, however, is that the evidence from physical anthropology provides a scheme of research rather than any present contribution to the solution of the problem.

The temptation to follow up the argument as it is set forth in the remaining papers must be resisted. In addition to the topics already mentioned, the geological evidence is discussed by Mr. W. A. Johnston of the Geological Survey of Canada; Dr. Alfred S. Romer of Chicago deals with that of the Pleistocene vertebrates; Dr. Clark Wissler discusses ethnological diversity in America and its significance, and Mr. H. J. Spinden the origin of the civilisation of Central America and Mexico. The late Baron Erland Nordenskiöld deals with the origin of South American civilisation in a thorough manner, which once more emphasises the loss to science through his untimely death. Prof. Franz Boas and Dr. Roland B. Dixon deal with Old World contacts, the former with north-east Asia and the latter across the Pacific. The final contribution is from the editor, who brings his intimate knowledge of the north-west to bear on the difficult problem of the Eskimo.

Short Notices

Traité de Géodésie. Par Capt. P. Tardi. Fasc. 1 : *Généralités sur la géodésie, géodésie mathématique, triangulations.* Pp. xxx+422. 80 francs. Fasc. 2 : *Astronomie géodésique de position, géodésie dynamique, la figure de la terre.* Pp. xi+425-732. 70 francs. (Paris : Gauthier-Villars et Cie, 1934.)

VOL. 1 of this important treatise opens with a succinct historical account as to attempts made to determine the figure of the earth, and goes on to detail the mathematical formulæ on which the more elementary part of the work is based. Methods of calculation of geodetic co-ordinates and of the commoner map projections used in large-scale survey maps are set out in detail. Under the former heading, Roussilhe's method of calculating co-ordinates, developed in recent years, is fully set out, but the Bonne projection, important in France, is but briefly dealt with.

As might be expected, the method of least squares receives full attention, and the value of the volume is very much enhanced by the clearly arranged correction sheets for a primary triangulation.

VOL. 2 deals in greater detail with the determination of the figure of the earth, and gives a full consideration to the mathematical aspect of the finding of latitude, longitude and azimuth, the field work being only treated as incidental thereto. Modern tendencies in the direction of gravity surveys, and a résumé of the geodetic side of isostasy and of theories as to the rigidity of the terrestrial globe conclude the work, which is of a high order. The reviewer does not know any British or American work on geodesy which covers so wide a field in so short a space. It will prove of immense interest to geodesists and to those connected with the mathematical side of Ordnance Survey work. B. H. K.

Modern Home Laundrywork. By E. Henney and J. D. Byett. Pp. x+171. (London : J. M. Dent and Sons, Ltd., 1934.) 3s. 6d. net.

OUR educational systems have failed to impart the desire on the part of many boys and girls to know about the ordinary things around them; they are content to drive a motor-car, but not to understand it, to do laundry work and complain of the results equally without understanding. It is true that an increasing number of girls pass through a course of domestic science, and it would be all to the good if a much larger number could be induced to do so, for which purpose much greater facilities for part-time study are required.

This little handbook includes instruction in every process of laundry work from the practical point of view, with just enough science to give a clue to the basis of the treatment advised. Fibres, water, cleansers, are explained; there is a very practical chapter on stain removal.

We would advocate the presenting of such a book to all girls on leaving school, confident that if they took the trouble to master it, their subsequent path through life would be materially smoothed.

L'Électron magnétique (théorie de Dirac). Par Prof. Louis de Broglie. Pp. viii+315+2 plates. (Paris : Hermann et Cie, 1934.) 100 francs.

IN this book Prof. Louis de Broglie gives an admirable historical introduction to the theory of the spinning electron, starting from the early theories of Bohr and Sommerfeld and exposing all the difficulties which were encountered in connexion with the fine structure and Zeeman effect. He then develops in great detail the theory of the linear wave equation due to Dirac. Dirac's theory is then applied to obtain the fine structure of hydrogen-like atoms and Landé's formula. Finally, the book concludes with a discussion of the problems raised by the existence of states of negative energy.

The mathematical treatment is almost entirely in terms of wave functions and wave operators, the spin operators introduced by Dirac being always taken to have that particular matrix representation which he himself used.

As a result, some of the analysis is rather lengthy, and could have been considerably simplified by the use of operational methods. However, there are many workers in this field who will find it extremely convenient to have a book which sets out in full the wave mechanical aspect of Dirac's theory. There are certain omissions from the book, notably Mott's theory of scattering and the recent theoretical speculations of Eddington. G. T.

The Subject Index to Periodicals, 1933. Issued by the Library Association. Pp. x+273. (London : Library Association, 1934.) 70s.

GREAT credit is due to the editor, Mr. T. Rowland Powel, his staff and the voluntary contributors for a further speeding up of the publication of the annual volumes of this subject index. This year, the volume for 1933 appeared only eight months after the end of that year. Although these subject indexes have a permanent value as a record of published work, it is obvious that those who are engaged in investigations will wish to have the work of others in the same field brought to their notice as soon as possible.

The present volume comprises entries of more than 25,000 articles, selected from periodicals of which a list is given. Of these periodicals, no less than 539 are English and American, but 41 are French, Belgian, Swiss, German and Italian publications. It should, however, be noted that the indexing of English and American periodicals is not complete, because, with few exceptions, no attempt has been made to index periodicals covered by the following publications : *Agricultural Index, Engineering Abstracts, Engineering Index, Index Medicus, Journal of the Society of Dyers and Colorists, Photographic Abstracts, Revue de Géologie, Minéralogie et Crystallographie, Royal Meteorological Society's Bibliography, Science Abstracts and Journal of the Textile Institute.* A wide range of subjects has been selected for indexing, but verse and fiction are excluded.

Recent Progress in the Chemistry of the Sex Hormones

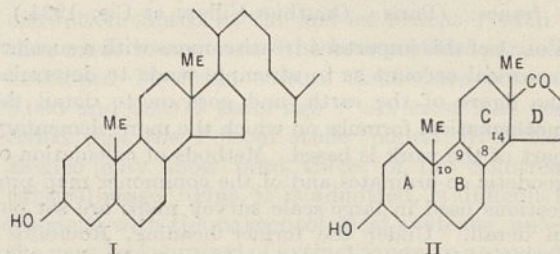
By DR. J. W. COOK

THE conversion of cholesterol into the male sex hormone (androsterone)¹, already noted in these columns², with its attendant elucidation of the complete chemical structure of this hormone, provides a convenient point at which to review the present state of chemical knowledge of the sex hormones.

Stimulated by secretions of the anterior lobe of the pituitary, the gonads (testis, ovary) secrete substances which control the growth and development of the organs of reproduction, and excite the secondary sexual characteristics. There are many biological tests with castrated male mammals, birds and fishes by which the presence of such substances in testicular extracts may be recognised, as has long been known. Similar active extracts may be prepared from the urine of males, and in 1931 Butenandt and Tscherning³ isolated four crystalline substances from oily extracts prepared from 100,000 litres of such urine. One of these, when injected in minute doses, produced growth of the undeveloped comb of the capon. The measurement of the extent of such growth, resulting from injections made under exactly defined conditions, gives a quantitative test for the male hormone⁴, and is the only biological test which had hitherto been applied to the pure crystalline active substance (now known as androsterone). Thus it has not been possible to ascertain if the manifold effects of testicular extracts on male organs are due to one or to several substances. Now that Ruzicka¹ has achieved the artificial preparation of androsterone, it will be available in sufficient quantity to make a complete biological study of its effects, and such questions will doubtless soon be answered. Indeed, it is reported already that the artificial hormone had very definite regenerative action on the accessory male organs (seminal vesicles, prostate and penis) of castrated male rats.

The immense difficulty of isolation of appreciable amounts of androsterone from urine, due not only to the very small concentration, but also to the presence of chemically related inactive substances, has precluded any attempt to study the molecular structure by means of degradative reactions. Nevertheless, Butenandt was able to characterise the substance as a saturated hydroxy-ketone of the probable formula $C_{19}H_{30}O_2$, and to prepare a number of functional derivatives such as the oxime, acetate, etc. On the assumption of a relationship to the sterols and to oestrin, the structure (II) was suggested for androsterone. This structure has been completely verified by

Ruzicka's isolation of androsterone from the neutral products of the chromic acid oxidation of the acetate of *epidihydrocholesterol* (I) :—



Of the 128 stereoisomerides of (II) which are theoretically possible, four were prepared by Ruzicka. The configurations of these are naturally those of the sterols from which they were formed by oxidation. These sterols were dihydrocholesterol, *epidihydrocholesterol* (both have *trans* configurations of rings A and B, but differ in the spatial positions of the hydroxyl group), *coprosterol* and *epicoprosterol* (both of these have *cis* configurations of rings A and B).*

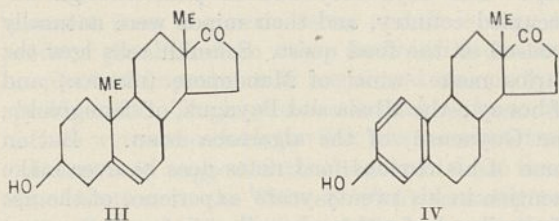
The remarkably specific action of the hormone was shown by the fact that the two *cis* hydroxy-ketones (II) were without action on comb growth in doses about fifteen times as large as that of androsterone which sufficed for a 20 per cent increase in area of the comb. By contrast, it may be recalled that the biological activities of oestrin may be reproduced by a whole series of artificial compounds differing appreciably in structure from the natural hormone⁵.

Great interest attaches to the biogenetic implications of Ruzicka's experiments. The hypothesis that androsterone is an ultimate product of biological degradation of the side chain of cholesterol, passing through the intermediate phases of lithocholic acid and pregnandiol, is no longer tenable, for lithocholic acid and pregnandiol both belong to the coprostane (*allocholestane*) series, whereas androsterone is shown to be related stereochemically to *epidihydrocholesterol*. In this connexion, Ruzicka records in a footnote an experiment with lithocholic acid which shows that the bile acids belong to the *epicoprosterol* series. Ruzicka suggests that the biological conversion of cholesterol into androsterone proceeds through the same stages as the transformation *in vitro*, that is, reduction to dihydrocholesterol, epimerisation of

* The formulations used by Ruzicka to represent the configurations of these sterols and their derivatives are open to criticism on the ground that they assign definite configurations to rings A and C with respect to carbon atoms C₉ and C₁₀, and to rings B and D with respect to C₈ and C₁₄. No information bearing on these questions is at present available.

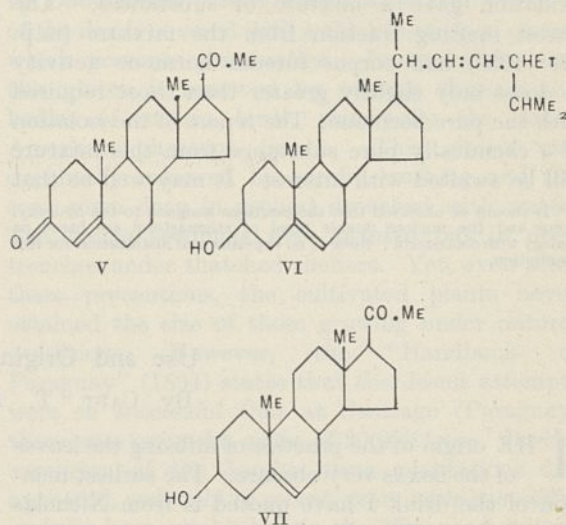
the hydroxyl group, and then oxidative fission of the side chain. It seems to the present writer that the dehydroandrosterone isolated from urine by Butenandt⁶ should be considered in this connexion. This is an unsaturated hydroxyketone which can be hydrogenated catalytically to androsterone. If the double bond of dehydroandrosterone is in the position suggested by Butenandt (III), then this substance rather than dihydrocholesterol may be the intermediate in the natural formation of androsterone. The fact that the configurations of rings *B*, *C* and *D* of androsterone are identical with those of the corresponding rings of the sterols and bile acids is a strong argument against the view that the hormone is synthesised by the body independently of cholesterol.

Dehydrogenation of ring *A* of androsterone, with loss of the methyl group at C_{10} , would lead to structure (IV), which is the formula at present favoured for the principal oestrus-producing hormone, oestrone. Developments in the chemistry of this hormone are too well known to require more than a passing reference here⁷. The demonstration of the presence of the phenanthrene ring system⁸ and the proof that the complete ring system is that of cholesterol with the hydroxyl group in the same position⁹ lend strong support to structure (IV) for oestrone, but it must be emphasised that experimental proof of the position of the carbonyl group is lacking, except that it is known to be in the five-membered ring. Also, nothing is known concerning the configuration of the ring system of oestrone (sixteen stereoisomerides of (IV) are theoretically possible).



Together with its other physiological effects, oestrin is responsible for the oestrous phenomena of the lower mammals, and probably also for the reparative changes of the uterine endometrium during the first half of the post-menstrual period in primates. Closely bound up with oestrin in its action is the hormone secreted by the corpus luteum, an organ formed normally by development of the ruptured follicle after expulsion of the ovum. The corpus luteum hormone (also known as progestin) exerts a specific proliferative action on the uterine endometrium, and prepares the uterus for implantation of the fertilised ovum. Moreover, actively secreting corpora lutea (or suitable extracts) must be present during the phenomenon

of pseudo-pregnancy which occurs in the lower animals (mouse, rat, rabbit, dog); in some species (for example, the rabbit, but not the primates) the presence of progestin is necessary for the maintenance of pregnancy. It is believed that oestrin and the corpus luteum hormone, acting in conjunction, are responsible for the menstrual cycle in the human species.



The pure corpus luteum hormone has recently been isolated from corpus luteum extracts by three groups of workers^{10, 11, 12}. As with the male hormone, isolation of the active principle is complicated by the accompanying inactive substances of similar chemical nature, and there was at first some difference of opinion regarding the physical characteristics of the pure hormone. All three groups of workers are now agreed that the principal hormone is an unsaturated diketone of m.p. 128° , and they have also isolated a second substance of m.p. 118° – 120° , which Slotta and his collaborators find also to have the biological activity of the hormone. The second substance is converted by heat into the hormone, m.p. 128° , and the two active substances are regarded by Slotta as stereoisomerides (the suggested stereoisomeric forms are, in fact, identical if his postulated formula is correct). On the assumption that this hormone also is derived from the sterols, its composition and properties suggest that it is an unsaturated derivative of pregnandione, that is, of the diketone arising from the oxidation of pregnandiol, a physiologically inactive substance first isolated by Marrian¹³ from urine of pregnancy, and shown by Butenandt¹⁴ to belong to the cholane series. Slotta, Ruschig and Fels attribute structure (V) to the corpus luteum hormone, the position assigned to the double bond depending on spectroscopic evidence, which suggests an $\alpha\beta$ -unsaturated ketone. Evidence in favour of this view is afforded by the

degradation of the side chain of stigmaterol (VI)* to a substance having corpus luteum hormone activity¹⁵. Adopting the technique of Fernholz¹⁶, Butenandt and his collaborators converted stigmaterol into a hydroxy-bisnorcholeonic acid (VI); but with side chain degraded to $-\text{CHMe.CO}_2\text{H}$). By a further series of changes this acid was converted into the hydroxyketone (VII), which on mild oxidation gave a mixture of substances. The lowest melting fraction from the mixture (m.p. $129^\circ\text{--}135^\circ$) had corpus luteum hormone activity in doses only slightly greater than those required with the pure hormone. The report of the isolation of a chemically pure substance from this mixture will be awaited with interest. It may well be that

* It should be observed that the positions assigned to the hydroxyl group and the nuclear double bond of stigmaterol are based on analogy with cholesterol; there is no experimental justification for this assumption.

the day is not far distant when the three sex hormones (androsterone and progesterin as well as oestrin) will be available for clinical use in chemically pure crystalline form.

¹ Ruzicka, Goldberg, Meyer, Brünnger and Eichenberger, *Helv. Chim. Acta*, **17**, 1389, 1395; 1934.

² NATURE, **134**, 563, Oct. 13, 1934.

³ Butenandt and Tscherning, *Z. angew. Chem.*, 905; 1931. A review of investigations on the testicular hormone is given by Tscherning, *Ergebnisse der Physiologie*, **35**, 301; 1933. See also reference (6).

⁴ Schoeller and Gehrke, *Wien. Arch. inn. Med.*, **21**, 329; 1931.

⁵ Cook, Dodds, Hewett and Lawson, *Proc. Roy. Soc.*, B, **114**, 272; 1934.

⁶ Butenandt, *Wien. Klin. Wochschr.*, **47**, 936; 1934. *Forschungen und Fortschritte*, **10**, 266, 276; 1934.

⁷ A review, with bibliography, is given by Störmer and Westphal, *Ergebnisse der Physiologie*, **35**, 318; 1933.

⁸ Butenandt, Weidlich and Thompson, *Ber.*, **66**, 601; 1933.

⁹ Cohen, Cook, Hewett and Girard, *J. Chem. Soc.*, 653; 1934.

¹⁰ Butenandt, Westphal and Hohlweg, *Z. physiol. Chem.*, **227**, 84; 1934.

¹¹ Slotta, Ruschig and Fels, *Ber.*, **67**, 1270, 1624; 1934.

¹² Hartmann and Wettstein, *Helv. Chim. Acta.*, **17**, 878, 1365; 1934.

¹³ Marrian, *Biochem. J.*, **23**, 1090; 1929.

¹⁴ Butenandt, *Ber.*, **63**, 659; 1930. **64**, 2529; 1931.

¹⁵ Butenandt, Westphal and Cobler, *Ber.*, **67**, 1611; 1934.

¹⁶ Fernholz, *Annalen*, **507**, 128; 1933.

Use and Origin of Yerba Maté*

By CAPT. T. A. JOYCE, O.B.E.

THE origin of the practice of infusing the leaves of the ilex is very obscure. The earliest mention of the drink I have quoted is from Nicolás Durán (1626–27). By that time, as the extract shows, the beverage had spread far and wide through South America. But there is no account of its discovery. Pinelo, writing in 1636, refers to an author, Robles Cornejo, where he says a full account of the herb is given. Cornejo's work, "Examen de los Simples Medicinales", dated 1617, must contain the first reference to the drink. But the book existed only in manuscript and, though mentioned in Cejador y Franca's "Historia de la Lengua y Literatura Castellana", has absolutely disappeared.

So far, evidence would seem to show that the drink was a native discovery, developed by the Jesuits; but a study of the early history of the country provides another aspect. The Rio de la Plata was discovered by Juan Diaz de Solis in 1516. In 1534, an expedition was sent from Spain under Pedro de Mendoza to make permanent occupation of the country to the north. With him sailed Ulrich Schmidt, or Schmiedel, as he was called by the Spaniards, a Bavarian agent of merchants in Seville. He ascended the Paraná and Paraguay with the pioneer expeditions and made many journeys of exploration through the heart of the Guaraní country, finally making a cross-country journey of some hundred and thirty miles from the upper Paraná to São Vicente; then he returned to Europe after an absence of nearly twenty years.

Schmidt's reminiscences are remarkable from several points of view, and perhaps especially for

the accuracy of his memory and the almost incredible vileness of his orthography in dealing with Spanish and Indian words. His narrative is of great importance to anthropology, because it is the report of a pioneer and an observer. Whatever he may have forgotten, his mind is extraordinarily clear on the food question. He writes in detail what he had to drink and eat and where, day by day. Naturally, food was very important, and these European expeditions, living on the country, were often on the verge of starvation. For days they had to pass through unoccupied country, and their minds were naturally focused on the food quest. Schmidt tells how the Carios make 'wine' of Mandepore (manioc) and of honey; the Mbaia and Payagua, of 'fenugreek'; the Guyacurú, of the algarroba bean. But in none of his copious food notes does he ever make mention in his twenty years' experience of the use of the ilex leaf either chewed or infused.

During the period of Schmidt's residence in Paraguay, Cabeza de Vaca was sent to the country as Adelantado. From São Francisco, in the far south of Brazil, where he landed, he made a remarkable overland journey to the newly founded settlement of Asunción, passing through the heart of the country where the ilex grew naturally. In the course of his three years' residence he made several journeys northward. His narrative (1555) is full of details of considerable ethnographical importance and, though he pays less attention to local foodstuffs than Schmidt, the precarious nature of his supplies led him to record much useful information on this subject. Yet in his account there is no mention of the ilex.

* Continued from p. 724.

Between 1569 and 1574, Nicholas Monardes published a work entitled "Las cosas que se traen de nuestras Indias occidentales", translated into English in 1580 under the far more attractive title "Joyfull Newes of the New-found World". He gives an extended and delightful description of the properties of coca, tobacco and many other American products, but there is no mention of *yerba maté*.

Diaz de Guzman (1612) gives a descriptive account of practically the whole region occupied by the Spanish east of the Andes in his "Historia Argentina" (Paraguay did not become a separate province until 1620), but there is no mention in his pages of the 'herb of Paraguay'. Thus the first reference to the use of the *ilex* leaf does not occur in literature until more than ninety years after Schmidt entered the country, eighty-five years after Cabeza de Vaca passed through the forests which later became the principal source of supply, and more than half a century after Monardes had published his series of monographs on the economic contribution made by the newly discovered Americas to the Old World. The lost MS. of Cornejo might supply the information as to the origin of the commercial use of the 'herb'. But the inference is, on the evidence, that the leaf was not in general use by the natives prior to the establishment of the Jesuit missions, except, perhaps, for chewing.

The native name of the dried leaf gives little help. In the Guaraní dialect the principal varieties were known as *Caamini* and *Caaguazú* (in Brazil, *Congonha*).

The tree itself was known as 'caa', which simply means a tree, a generic term, and it is easy to produce parallels from other native dialects that no plant of importance is mentioned except by a specific name. The implication is that, as far as the natives were concerned, the *ilex* was merely a tree.

It has been suggested that the word 'caa' bears some relation to the Chinese 'c'ha', meaning tea in the Pekinese, Mandarin and Cantonese dialects. Tea was first brought to Europe by the Dutch in the early seventeenth century from Bantam, whither it had been imported by Chinese merchants from Amoy, where it was called 'té'. The Portuguese found it in Macao, under the name 'c'ha', a little later. The first mention of tea in Western literature is in Maffei's "Historica Indica", published in 1558. It is not inconceivable that the Jesuits of the period, looking for a substitute for tea, by then introduced into southern Europe, also introduced the Chinese word, which was mispronounced by the natives.

The subsequent development of the *yerbales*, or *ilex* plantations, is a matter of history. The economic importance of the leaf, combined with

the fact that it grew in the less accessible regions (swampy mountain valleys), soon led to the inception of attempts to bring it under cultivation. Rodero gives the account of the first attempt.

Young trees were brought from Maracayu to the mission communities along the Paraná river, but did not flourish. Experiments in raising seedlings were also a failure. The eventual success is recorded by Dobrizhoffer (1749), who reports that the seed of the *ilex* is covered with a thick coating of gluten which prevents germination. In the wild state, this gluten is removed by passage through the bodies of certain birds, principally the South American pheasant (*jacu*). This gluten was eventually removed by careful washing and the seed sown deep in ground drenched with water. The young seedlings were planted out in deep trenches under thatched shelters. Yet, even after these precautions, the cultivated plants never attained the size of those growing under natural conditions. However, the "Handbook of Paraguay" (1894) states that the Jesuit attempts were so successful that at Santiago (Paraguay) there once existed a grove of 20,000 trees. On the expulsion of the Jesuits, these plantations disappeared, and only in recent years have successful *yerbales* been established in the Misiones territory of north-eastern Argentina.

The *ilex* tree remained without any name assigned by international botanists until the nineteenth century; and it was by a curious piece of bad luck that the famous French botanist, Dr. Bonpland, was prevented from having the honour of classifying *yerba maté*. Bonpland went, in the year 1820, up-river from Buenos Ayres to Paraguay, with the object of obtaining specimens of the plant; but Paraguay, always isolated, was under the dictatorship of that extraordinary individual José Gaspar Francia, whose policy put a fence round the little country. Bonpland was placed under a kind of arrest, detained for many years, and while he was still practically a prisoner of Francia's, *yerba maté* had been seen by Saint Hilaire in South Brazil, in the Curityba region, identified as a member of the *ilex* family, and named by him *Ilex paraguayensis*. Saint Hilaire afterwards changed the name to *Ilex maté*; but meanwhile, in 1824, A. B. Lambert, the distinguished English botanist, described the tree, illustrated it, and gave it the name *Ilex paraguayensis*, by which it is now usually known.

The subject with which I have been dealing may seem, at first sight, to be a little removed from anthropological studies; but I would suggest that the study of ethno-botany is of the highest importance. The rapid spread of stimulants, narcotics and food plants throughout the world has a direct bearing on culture-diffusion. But trouble arises

from the fact that valuable food plants spread so rapidly that their origin becomes obscured—especially cereals. Maize, to give one example, indigenous to America and unknown in the Old World before Columbus, became the staple food of half Africa within a century of the discovery, spreading from tribe to tribe, far beyond European exploration. In Europe it penetrated to the Levant, and became known in France as *blé de Turquie*. In Germany it was called *türkische Weisen*. In England it was called guinea corn, because it came

to us from West Africa. I suggest that there is a splendid opportunity for a young man, trained in botany, to undertake the revision of that fine work "The Origin of Cultivated Plants" written by Alphonse de Candolle. The last edition of this was published in 1909, but the preface, written in 1882, is a model of sympathetic guidance to those who follow. Much has been discovered since de Candolle's day, and a new edition is badly needed. I hope that some of the younger men may take up the task.

A Marsupial Sabre-toothed Tiger from South America*

THE marsupial or pouched mammals of Australia are well known to include groups which are parallel in form and habits to many groups of the higher mammals living in the rest of the world. The pouched mammals of South America, both past and present, are less varied and represent only insect-eaters and flesh-eaters. Among the latter, however, Dr. Elmer S. Riggs has just described perhaps the most remarkable mimic of a higher mammal hitherto discovered. In a Pliocene deposit in Catamarca, northern

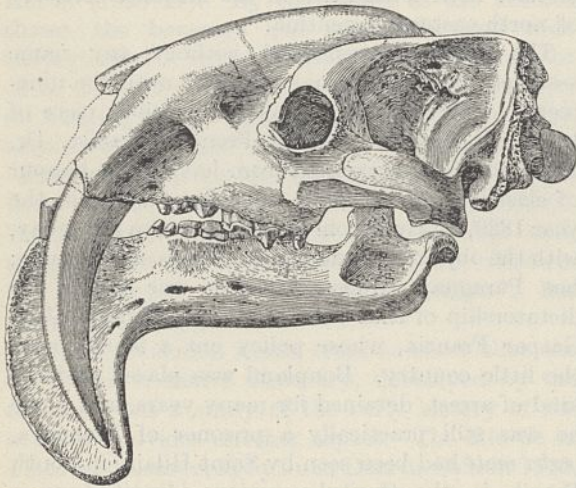


FIG. 1. Side view of skull of *Thylacosmilus atrox*. Holotype No. P 14531 Field Museum. Reproduced from *Field Mus. Geol. Ser.*, 6, 61, Dec. 11, 1933.

Argentina, he has found the remains of a pouched mammal which nearly resembles the familiar Machærodonts or 'sabre-toothed tigers', but is clearly inferior in the less efficient adaptations of its skeleton to its mode of life.

Of *Thylacosmilus*, as Dr. Riggs names the new mammal, most parts of the skeleton are now in the Field Museum of Natural History, Chicago. The skull, which is shown in side view in Fig. 1, measures from 8 to 10 inches in length, according

to the species; and the head and trunk would have about the same relative proportions as in a leopard. The great canine tusks differ from those of the ordinary sabre-tooths in having an open pulp-cavity enabling them to grow throughout life; and the maxillary bones which enclose their roots grow upwards and backwards over the forehead to accommodate them. These tusks are not quite sabre-shaped, being flattened triangular in section, and the enamel which only incompletely covers them is very thin. They are very feebly and finely serrated on the edge. There are no incisor teeth, and the molars and premolars are as small and inefficient for cutting flesh as those of their contemporary relatives, the Borhyænidae—very different from the powerful corresponding teeth of the true sabre-tooths. There is a bony post-orbital bar, evidently to strengthen the side of the skull; and the back of the head is shaped for the insertion of strong neck-muscles. The lower jaw is remarkable for the large size of the pair of bony flanges which protect the tips of the canine tusks. They are larger than those in any of the sabre-tooths.

The hinge of the lower jaw on the skull, however, is almost exactly as in the sabre-tooths, and the mouth could be opened as widely as in them to allow the tips of the tusks to be used. The neck vertebrae are large and strong for the origin of the powerful neck muscles which would be needed for the thrusting of the tusks. The feet, however, are astonishingly different from those of the sabre-tooths, for they bear only pointed toes, not grasping claws.

As Dr. Riggs points out, the discovery of *Thylacosmilus* is all the more remarkable because among the numerous fossil mammals known from the older Tertiary rocks of Argentina there are no recognisable ancestors in which the canines are gradually enlarging. It shows that the deposits hitherto explored contain only an imperfect record of the extinct mammal fauna, and that much may be expected from future discoveries. A. S. W.

* Elmer S. Riggs, "A new Marsupial Saber-tooth from the Pliocene of Argentina, and its Relationships to other South American Predacious Marsupials" (*Trans. Amer. Phil. Soc.*, n.s., 24, pt. 1; 1934).

Meteorology in India

THE report on the Administration of the Meteorological Department of the Government of India in 1932-33 (Delhi: Manager of Publications, 1933. 12 annas; 1s. 3d.) includes an account of internal adjustments made, in the face of a cut of more than twenty-five per cent in the Department's budget, with the view of providing meteorological information for aviation. The Administration had to meet, so far as was practicable, increasing demands for forecasts and warnings due to extensions of the aerial passenger and mail services. The situation revealed by the report is such that it can only be hoped that less difficult financial times will very soon lead to its improvement; about 4,000 miles of the main international air route has to be dealt with by the meteorological centres at Karachi and Calcutta, now that the offices at Delhi and Rangoon have been abolished, and with the staff available only two daily forecasts have been possible, one at noon and one at 8 p.m., and the preparation of special weather charts during disturbed weather has been greatly curtailed.

Partially to compensate for this, auxiliary centres have been established at landing places on the main route, in charge of meteorological assistants, and a scheme for increasing the frequency of weather reports throughout the whole weather report system has been drawn up with a view to its early introduction. It is satisfactory to note that other branches of applied meteorology have not been neglected, the services rendered to the public and to public bodies having actually increased. Valuable assistance was rendered to the Everest flight and expedition; the exploration of the upper atmosphere by sounding balloons carrying meteorological instruments has been continued, a large number of records having been obtained which extend into the stratosphere; the section for agricultural meteorology organised a model observatory at an agricultural college with the view of providing facilities for agricultural workers requiring training in the study of weather in relation to crops, and in addition a number of special pieces of research work have been carried out and the results published.

The Meteorological Office at Poona is situated between two rivers. Katabatic winds develop in the river valleys at night under certain conditions and may overcome the normal wind drift due to the general pressure gradient over the west of India. A study of the dust haze and fogs that develop at night over the city in the cold season and of these conflicting winds—that have an important bearing on fog formation—has been attempted recently, the upper limit of the obscurity

being determined either photographically—on moonlight nights—or with the aid of a searchlight and theodolite. The observations were made by L. A. Ramdas and S. Atmanathan and are discussed and illustrated in some detail in *Scientific Notes*, vol. 5, No. 54, of the India Meteorological Department. The establishment of inversions of temperature after sunset and their break-up after sunrise is demonstrated by readings of temperature made on the tower of the Meteorological Office with an Assmann ventilated thermometer between ground level and a height of 34.5 metres.

The visual and photographic studies towards the end of the paper on the behaviour of the top of the haze or fog at the time of its dispersal are perhaps the most valuable portion, especially those showing the effect of a katabatic wind from the south-west, which may be to remove the top part of the haze so as to leave a sloping upper surface at the same time that the whole area of haze is displaced towards the north-east. At an early stage of the dispersal of fog by sunshine, distinct cumulus clouds were sometimes observed to result from the breaking up of the top layers, but at a later stage the fog boundary became very blurred at the same time that it extended upwards, under the action of turbulence, the distant hills eventually showing through the fog, as turbulent diurnal winds began to complete its dispersal.

In the memoir entitled "The Indian Southwest Monsoon and the Structure of Depressions associated with It" by K. R. Ramanathan and K. P. Ramakrishnan (*Mem. India Met. Dept.*, vol. 26, part 2) an attempt is made to gain a clearer insight into the nature of the depressions accompanying the cyclonic rains that occur in the Indian rainy season, making use on one hand of the more complete information about upper winds furnished in recent years by pilot balloon ascents, not only in India but also in Arabia and Burma, and on the other hand the method of analysis by fronts developed by the Norwegians. The wind data have been used to obtain normal lines of air-flow over this area at heights of 1, 2, 3, 4, 6 and 8 kilometres in the months of May, June and July, the latter month being the one during which the monsoon is normally at its height, and these have been supplemented by mean isotherms at 2, 3 and 4 kilometres calculated from the figures obtained with sounding balloons.

Information of this kind has, of course, great value apart from its application to particular theories of the nature of depressions, while attempts at relating rainfall to the normal conditions of the upper atmosphere, such as the one made in the second part of this paper, are very desirable and

may lead to increased accuracy of weather forecasting. Two depressions during the monsoon of 1930 are examined in considerable detail. The conclusion is reached that the main fronts were formed between 'fresh' monsoon air, resulting from an accelerated advance of this damp air from the far side of the equator, and 'old' monsoon air, that is, air that had a similar origin but had been modified since its first advance, having become the warmer of the two; that fronts also formed between monsoon air and heated continental air that was part of the westerlies of middle latitudes and was the warmer up to about 3 kilometres. It is concluded that depressions retain their strength so long as plenty of fresh and old monsoon air is available.

Another paper dealing with the same subject on the same lines forms the next in this series of memoirs. It is by N. K. Sur, and is entitled "On the Physical Characteristics of Fronts during the Indian Southwest Monsoon" (*Mem. India Met. Dept.*, vol. 26, part 3). Both these papers appear to have been inspired by an earlier paper by Wagner "On the Aerology of the Indian Monsoon" (*Gerlands Bei. Geophys.*, 30, 196-236, 1931). The Indian authors appear to question the truth

of Wagner's picture of cold dry westerlies extending right across the north of India, so as to form the cold sector of a vast stationary depression in which the ascending warm current is drawn primarily from the seas to the south and west of India, and has been deflected westwards by the mountains of Burma and Assam.

In Sur's paper stress is laid on the difficulty of determining the lines of flow in the upper air during times of increased activity of the southwest monsoon, owing to the fact that the amount of cloud generally makes it impossible to follow pilot balloons to high levels. It is shown that at times, in the most active stages of the monsoon, a wedge of dry continental air separates the south-westerly winds from the Arabian Sea from the easterlies of the Gangetic valleys, and the characteristics of some of the fronts occurring with these three air streams are discussed with the aid of sounding-balloon data; cases of cyclonic rains in Central India are described in which continental air played, apparently, no part, the easterlies ascending directly over deflected south-westerlies from the Arabian Sea, moving towards the east. It is these studies that make the author doubt the reality of Wagner's conception.

News and Views

Science and Human Values

IN the course of a recent address to the Ripon Diocesan Conference at Harrogate, the Archbishop of York, Dr. Temple, remarked that "there has sprung up an immense multitude of new schools which are predominantly scientific in type", and that "while education until lately had been unduly literary in its emphasis, there is a risk now of its becoming unduly scientific". Leaving out of consideration for a moment the inferences drawn by Dr. Temple from these suggested developments, it would be interesting to know what group of schools he particularly had in mind. The largest group in which science occupies a place in the curriculum is the 1765 secondary schools recognised by the Board of Education as efficient. There are more than half a million pupils in these schools, and the attention given to the various subjects of instruction may be estimated from the subjects taken by candidates in School Certificate examinations. Of the 68,406 candidates who presented themselves in the First School examination last year, more than ninety per cent took English, history, French and mathematics. Latin, chemistry and art each attracted about forty per cent. In the Second School examination, the highest percentage of entrants was in mathematics (44.6), and succeeding percentages were French (38.3), English (37.5), history (33.1), physics (31.6), chemistry (31.0), Latin (21.5). This examination leads up to university scholarship standards, and

the number of open scholarships and exhibitions awarded by the universities of Oxford and Cambridge last year were in classics, 148; history, 115; science, 104; mathematics, 70; modern languages, 53; and others, 99.

THESE figures may be taken to represent fairly what are the chief subjects taught in our secondary schools; and they give little support to the view that an immense number of schools is giving predominant attention to science. There is indeed not even a remote possibility that our secondary schools will become unduly scientific instead of unduly literary; and very few men of science would wish them to be. What Dr. Temple fears is that, as science is concerned with observation and measurement instead of human values, "there is great danger in it if the proportion between scientific and humanistic training is seriously distorted". Why, because "All the things that matter most in life, such as friendship, fellowship, and loyalty, are not capable of measurement, nor can they be submitted to any laboratory test", it should be assumed that students of science are necessarily unfamiliar with these intangible attributes is difficult to understand. The purpose of a scientific training should be to observe or investigate evidence before arriving at judgments; and the world would be all the better if this method were followed in political and other social spheres.

The Loch Ness 'Monster'

At a general meeting of the Linnean Society of London, held on November 8, the Loch Ness 'monster' was for the first time discussed by a scientific society. Sir Edward Mountain gave an account of his endeavours to settle the creature's identity by employing twenty watchers distributed around the Loch under the supervision of Capt. Fraser. These watchers were supplied with cameras on loan from the Kodak Co. Ltd., and also with field glasses. During the first two weeks of last July, the creature was seen by the watchers twenty-one times. In September a film was taken by Capt. Fraser with a telephoto lens at a distance of about a mile from the creature; it was stated that the portion of the creature visible in the film had been estimated by the Kodak Co. to be about eight feet in length. The film was run through the projector several times and a discussion followed. The first impression of most members of the audience was probably that the movements of the creature shown on the film suggested those of a seal, but some of the speakers pointed out difficulties in the way. Commander R. T. Gould did not believe that the creature was a seal; he felt sure that the watchers would have readily recognised it as such. Further, he considered that it could not be a killer whale. Sir Sidney Harmer thought that until further evidence had been produced the verdict should be 'not proven'. He thought that the creature was not a cetacean, but would probably prove to be a seal. Mr. M. A. C. Hinton and Mr. F. C. Fraser felt certain that the creature was a seal, with which opinion Dr. Stanley Kemp disagreed; nor did he believe it to be a cetacean. Sir Arthur Smith Woodward, referring to the popular belief, said that it was hopeless to compare the creature with a Mesozoic reptile as no traces of these reptiles had been found in Tertiary rocks in any part of the world. Capt. J. G. Dollman was firmly convinced that the creature was an otter. The president (Dr. W. T. Calman) and Mr. A. J. Wilmott expressed doubts as to the size of the creature as estimated by the Kodak Company. Enlargements of some of the 'still' photographs taken by the watchers were also exhibited at the meeting.

Electrical Disturbance of Radio Reception

It is well known that broadcast reception is often seriously interfered with by outside electrical disturbances over which the receiver has no control. A special committee was appointed by the Institution of Electrical Engineers a year ago to consider this problem, and evidence and assistance has been given to it by several official and unofficial organisations. At this early stage, it is clear that radio interference is widespread and constitutes a serious annoyance to the public. The committee finds that listeners and those who advise them have not yet done all that is possible on their receiving sets to mitigate some of the effects of interference. A memorandum has been prepared for the committee by the B.B.C. on the features of design and installation of radio sets which, when attended to, help to

lessen, sometimes very appreciably, this trouble. The attention of those who supply radio sets is directed to this memorandum. On the Continent, where State regulations are favoured, little assistance is given to those listeners who do not take reasonable precautions against interference. Still, when the listener has done all he can, there is left a large amount of interference which can only be effectively corrected by suppression at the source. Interfering apparatus generally has a commutator motor, but mercury arc rectifiers and high-tension lines under certain conditions may cause trouble. As a first step towards assisting those manufacturers who desire to produce interference-free appliances, the committee has taken the initiative in the preparation of a specification with this end in view, and it is hoped with the co-operation of the British Standards Institution to issue a complete specification early next year.

THE committee is reluctant to be dogmatic on the subject of compulsory versus voluntary suppression of radio interference. It is not the tradition in England to make regulations until it is certain, first, that they are needed, and secondly, that they can be carried out effectively when made. There is at present much goodwill amongst all concerned, and readiness to help to rectify trouble when it is serious, but the committee believes that a threat, at the present time, to impose compulsory regulations might have the effect of retarding instead of forwarding progress. But when co-operation and goodwill have done their best, there may be a residuum of recalcitrant cases in which some form of compulsion will probably be desirable. Manufacturers are unwilling at the moment to express themselves definitely on the subject of compulsion. The extent of increase of price of appliances depends largely on the level of interference which is permissible. At a special international conference held in Paris last June, an approximate permissible level was suggested, but it was more tolerant than most countries would like to prescribe. It is agreed that, if hard and fast regulations are to be laid down immediately, a tolerant figure is inevitable.

Beilby Memorial Awards

THE administrators of the Beilby Memorial Fund, consisting of the officers of the Institute of Chemistry, the Society of Chemical Industry and the Institute of Metals, have awarded one hundred guineas each to Dr. W. Hume-Rothery, Royal Society Warren research fellow, and to Dr. E. A. Rudge. Dr. Hume-Rothery, who is thirty-five years of age, took first class honours in chemistry at Oxford, and then worked at metallography for three years at the Royal School of Mines under the direction of Sir Harold Carpenter, after which he returned to Oxford for independent research work. His published work includes a book on the electrical properties and theories of metals and alloys, papers on valency relations in alloy structures, and determinations of equilibrium diagrams of metallic systems. Dr. Hume-Rothery has introduced new conceptions and generalisations into the study of alloys, and has

provided much new information as to the general laws and relations which determine the nature and properties of alloys. Dr. E. A. Rudge, who is forty years of age, graduated B.Sc. (London) with first class honours in chemistry in 1915, and thereafter was engaged as an analytical chemist first at Messrs. Johnson and Sons, at their smelting works, and then as an analytical and research chemist in the Osram Robertson Lamp Works. Since 1930, Dr. Rudge has made a special study of the uses and behaviour of timbers in South Wales industries, and of the causes and circumstances of decay in industrial timbers, and he has now in the press "The Decay of Wood in Relation to Humification", and "Wood Decay and Coal Formation".

Palaeolithic Pottery

NOTWITHSTANDING the number of claims for the discovery of pottery of palaeolithic age made hitherto, none has been substantiated. Such claims, owing to defects in the evidence, have usually had to be rejected or at best to be held 'not proven'. It would indeed be remarkable, if palaeolithic man really had been a potter, that among the very numerous relics of his cultural activities which have survived, there should be no trace of his pottery. There are, however, certain fragments recently discovered in East Anglia and the Lower Thames Valley, for which the evidence for a palaeolithic origin is unusually well attested. The fragments in question were discovered in stratified deposits at Ipswich and at Swanscombe, and they were associated in both localities with flint implements which are regarded by Mr. J. Reid Moir and Mr. J. P. T. Burchell as of Upper Palaeolithic type. A description of six of the fragments of pottery and of the conditions of their discovery are given by Messrs. Moir and Burchell in *Man* of November. The floor from which they were obtained lies at a depth of about twelve feet beneath three distinct strata in Ingress Vale; but deposits of about ten feet depth had been removed before the site was first visited, so that the possibility of intrusion, though unlikely, is not entirely eliminated. One of the fragments obtained is ornamented and certain authorities, it is said, have adjudged it thereby to be of Bronze (Beaker) Age date. Mr. Stuart Piggott, writing in the same issue of *Man*, while hesitating, on account of the size of the sherd, to be more precise in his verdict than "prehistoric", thinks that the Bronze Age beaker is suggested as the immediate parallel among the prehistoric wares of Britain. An influential committee, including among others Prof. P. H. G. Boswell, Mr. M. C. Burkitt, Mr. A. S. Kennard, Dr. L. S. B. Leakey, Dr. K. S. Sandford, and Mr. Reginald Smith, as well as Mr. Reid Moir, is to examine and report on the deposits and their contents.

Respiration of Fruits

IN his Friday evening discourse on November 9 at the Royal Institution, Dr. Franklin Kidd discussed the respiration of fruits. The lecture opened with a number of demonstrations illustrating the way in

which oxygen enters fruits and carbon dioxide escapes from them in the process of respiration. Failure of the mechanism for the escape of carbon dioxide is considered as the possible cause of bitter pit, a disease which is responsible for great losses to orchardists. The changes in respiratory activity throughout the life of a typical fruit such as the apple were then described and corresponding changes in chemical constitution of the fruit considered. The conclusion arrived at is that the primary sugar which forms the basis of respiratory oxidations is the active or gamma form of fructose. Attention was then given to the sudden rise in respiratory activity which occurs at maturity and upon which ripening depends. This change, called the climacteric, probably occurs when the acidity of the fruit falls to a certain point, and can be delayed by keeping the fruit in the presence of carbon dioxide. Oxygen is also necessary for the change. After the climacteric, the fruits begin to produce odours, and if these are not allowed to escape freely, fruits become injured. The injuries due to this cause are responsible for the large amount of wastage in fruit storage. The recent discovery that ripening fruits produce a toxic substance which is probably ethylene was discussed. Unripe fruits exposed to the vapour of ripe fruits are stimulated to begin ripening at once. The intermediate stages in the oxidation of sugars in respiration were discussed. In the absence of oxygen the climacteric change which initiates ripening does not occur. The storage life of fruits can be lengthened by treatments which reduce their respiratory activity, such, for example, as certain manurial treatments in the orchard and the storage of fruit in atmospheres rich in carbon dioxide and poor in oxygen.

A Famous Dutch Pumping Engine

IN a paper read to the Newcomen Society on October 17 by Eng.-Lieut. J. J. Bootsgezel, late of the Dutch Navy, an account was given of the pumping engines erected about ninety years ago for draining the Haarlemmermeer, or "The Meer", a tract of flooded land stretching from Haarlem and Amsterdam to Leyden. The task of draining this area was entrusted to the two Dutch engineers A. Lipkens (1782-1847) and G. Simons (1802-68). Three large pumping stations were erected and in them were installed Cornish pumping engines made in Cornwall. The three stations were named after three individuals associated with the draining of the Meer: J. A. Leeghwater, F. G. van Lijnden and N. Cruquius. The engines were put into commission in 1848, and on July 1, 1852, the *State Gazette* announced: "The Meer is dry." The area drained was more than 44,000 acres. Two of the engines have been dismantled, but through the action of the Koninklijk Instituut van Ingenieurs, the Cruquius engine, which last worked on June 10, 1933, has been put in a state of preservation, and the boiler house will be maintained as a museum. Lieut. Bootsgezel was able to give many interesting particulars of the engines. The main features of the Cruquius engine included a single vertical high-pressure cylinder of 7 ft. diameter within a low-pressure cylinder of 12 ft. diameter.

The stroke was 10 ft. There were five piston rods in all, carrying an overhead weight of more than 80 tons and connected to eight great beams disposed radially about the cylinder. From the outer ends of the beams hung the pump rods and pump buckets. Each pump barrel was 6 ft. in diameter and had a stroke of 10 ft. The engine is installed in a fine round castellated building surrounded by a platform with a parapet, and the whole undoubtedly forms the most imposing historical example of pumping machinery in the world, and one which we are sure will attract the attention of many visitors to Holland.

German Sterilisation Laws

RECENT German legislation on eugenic sterilisation is described by Dr. Aubrey Lewis in the *Eugenics Review* (Oct. 1934, p. 183), especially as regards the ordinances issued by the Ministers for Home Affairs and for Justice, and the semi-official commentary of Rüdin, Gütt and Ruttke. Voluntary sterilisation is precluded except for the diseases for which sterilisation is compulsory, and carriers of a hereditary disease may not be sterilised voluntarily. If an appeal is lodged against a sterilisation order, the patient must be detained until his case is disposed of. The physician must report every relevant case encountered in his professional work, but all information collected by the Psychiatric Research Institute is strictly confidential. Overcrowding of the mental hospitals is resulting from the administrative delays. The total population of mental institutions in Germany is reckoned at 160,000, of which 36,000 will probably undergo sterilisation. However, Roemer, an influential psychiatrist, estimates that 400,000 people in Germany are envisaged for sterilisation, 360,000 of which are psychiatric cases. In the same journal (p. 211) Dr. F. Tietze gives an account of the Austrian sterilisation trial at Graz, in which the supreme court reversed the decision of the provincial court and condemned the defendants to imprisonment for practising or advocating eugenic sterilisation, on the ground that the consent of the individual did not exclude 'hostile intention' or change the character of a sterilising operation.

U.S. Petroleum Industry

THE review of the petroleum industry in the United States by Hale B. Soyster and members of the U.S. Geological Survey, Bureau of Mines and Petroleum Administrative Board, recently published by the U.S. Department of the Interior (Circular 11), gives an authoritative, unbiased survey of the American petroleum industry to-day, besides supplying up-to-date statistics of production, stocks, imports and exports. A vital fact is that petroleum reserves, both proved and unproved, are limited and irreplaceable. Wastage, whether physical or economic, is to be deplored and must be combatted with carefully planned and controlled development of all supplies. Latterly, knowledge of methods of preventing waste of both oil and gas and conserving natural energy necessary for recovery of these substances, has rapidly increased, but there are still varied forms of economic

waste, to some of which it is difficult to find a solution. Competitive development and premature extraction of petroleum still characterise a majority of new fields and will continue to do so as long as the theory of 'capture and reduction to possession' holds sway.

WITH petroleum increasingly incident in the industrial life of the nation, particularly as motor fuel, and with the knowledge that reserves are limited, it is natural that extensive researches should be prosecuted to find substitutes in the event of shortage. After consideration of possibilities of high- and low-temperature carbonisation, hydrogenation and complete gasification of coal, the most feasible method for large-scale production of gasoline, should petroleum resources decline rapidly in the future, is that of hydrogenation and liquefaction. During this process, however, more original fuel energy is lost than in making gasoline from petroleum, and the cost of gasoline produced is higher. The reassuring fact that processes are available for producing motor fuel substitutes from coal is no excuse for wasteful exploitation of present oil reserves. Coal should be used wherever possible for ordinary heating and stationary power generation, and petroleum strictly conserved in all phases of its production and refinement to avoid the necessity of producing gasoline from coal by an elaborate and expensive process.

Bulk Supply of Electric Power for Manufacturers

SHEFFIELD CORPORATION has now connected up what is probably the largest individual user of electricity in Great Britain to its supply mains, increasing the supply by more than thirty per cent. Messrs. Thomas Firth and John Brown, Ltd., of Sheffield, have works covering 140 acres, and formerly had two generating stations of their own having a capacity of 20,000 kilowatts. Now they have abandoned these, and obtain energy from the public supply mains. Generally speaking, there are many reasons for taking this course. They will be able, for example, to concentrate on their own particular processes of production, leaving the generation of electricity to experts. The space formerly occupied by the boilers and turbines of the private plants can now be utilised for extensions. The basis of the manufacturing processes carried out by the firm are in the melting house, where there are installed furnaces ranging from a capacity of 2 tons to 40 tons. The largest furnace, when melting at its peak load, requires 5,000 kilovolt amperes. The electric furnaces alone melt 1,000 tons per week. This is much greater than the output of any other electric furnace plant in Great Britain. All the supply problems are now dealt with by the Corporation engineers, who have the Grid behind them as a reserve. The bulk supply is given to the works at 33,000 volts, and the distribution is so operated that the lowest possible simultaneous demand is made. The decision reached by this firm to take the public supply will carry great weight with other companies which are considering the problem of continuing to manufacture their own electric power or not.

The 200-inch Telescope

ACCORDING to Science Service, of Washington, D.C., it is now definite that the two hundred-inch telescope will be erected on Palomar Mountain, 45 miles north-east of San Diego, California. Astronomers have never felt completely satisfied with the 'seeing' at Mount Wilson. Bad 'seeing' arises from local irregularities in the atmospheric refraction which have the effect of distorting the stellar image, especially when a very large aperture telescope is being used; and since it was supposed that convection currents of air running up the steep sides of Mount Wilson contributed materially to the imperfections in the seeing at that observatory, a search for better seeing has been conducted on many plateaux and flat-topped peaks in southern California. The tests of seeing were made by observing Polaris through a standard telescope and noting the character of the image from night to night. The flat-topped Palomar has excellent seeing qualities; it is further advantageous in that it is remote from any great city. Scattered light from Los Angeles and its environs finds its way into the 100-inch reflector on Mount Wilson, and imposes a limit on the length of exposure which one can give to a photographic plate. It may be added that the 200-inch mirror is to be cast at Corning, N.Y., the scene of a previous 200-inch cast, now kept as a 'spare', while the mirror will be ground and the telescope itself constructed in Pasadena, at the California Institute of Technology. This institution will be responsible for the administration of the telescope when completed.

A Portable Sundial

WE have received a small portable sundial of ingenious construction, made of aluminium ("Kosmos-Sonnenuhr". Stuttgart: Franckh'sche Verlags-handlung). The workmanship is neat and attractive, and the instrument should be of value in giving instruction to schoolchildren. Some features call for comment. The sundial can be adapted to work in any latitude by rotating one of its members about an axis, the latitude being read off by a pointer against a scale marked from 0° to 90° by steps of 5° . This device, of course, helps the manufacturer to bring out sundials for various latitudes by mass production, and it may conceivably assist a teacher demonstrating fundamental principles to students; but we cannot imagine any real use for a sundial which is to be carried from one latitude to another. A further comment should be made on the method of adjustment in azimuth. A small magnetic compass is embodied in the instrument, and values of the magnetic variation for a number of places are given in the instructions. But if the instrument is to be set up permanently, one had better look up the equation of time in an almanac and set the instrument by adjusting it to give the right time, known independently. It will then, of course, work correctly; and this method of adjustment is easier to effect as well as being more accurate than the use of a tiny compass, liable to gross error through stray magnetic field.

Leaflets of the Astronomical Society of the Pacific

FOR some nine years past, the Astronomical Society of the Pacific (Merchants' Exchange Building, San Francisco, California, U.S.A.) has issued—at first irregularly, then bi-monthly, and later, in response to growing demand, once every month—a series of leaflets explaining, in simple but authoritative terms, astronomical matters of general interest. These leaflets have become widely known and appreciated, not only by the general astronomically-minded public for whom they were primarily designed and whose interests have been given first consideration throughout, but also by working astronomers as a convenient and trustworthy source of information on certain facts to which reference is frequently required. For example, in Leaflet 30, Dr. F. C. Leonard, of the University of California, gives an account of the newly-discovered planet, Pluto, with the most accurate data available at the time and a useful diagram showing the relation of the orbit to the orbits of the other planets of the solar system; while the distance-velocity relation characterising the extra-galactic nebulae is explained with a table, diagram and photograph in Leaflet 37 by Mr. Humason himself. The first fifty of these leaflets, each bearing the date of writing, have now been bound together and re-issued as a small volume, and it is satisfactory to note that, since the monthly publication of the leaflets is to be continued, further volumes may be expected in due time. The collection, which it is impossible to praise too highly, unfortunately bears no indication of its cost, but we feel confident in saying that no one interested in astronomy, whatever his degree of knowledge of the subject, will regret the purchase of a copy.

White and Coloured Headlight Beams in Fog

EXPERIMENTS, made at the National Physical Laboratory, comparing the revealing power of white and coloured headlight beams in fog, are described by Dr. W. S. Stiles in the *Illuminating Engineer* of October. Two headlights of known candle-power distribution were mounted at the height and spacing employed on the average car. They were arranged to throw their beams parallel to and in the direction of the road. The observer stood behind the offside headlight and viewed a disc painted grey with its centre lying on the axis of the light. Test discs of different reflecting powers were used in the experiments. The discs were moved up and down the road, and the distances at which the discs first became invisible were measured. The experiments were repeated with both coloured and neutral light filters held in a frame at a suitable height. Taken as a whole, the results point definitely to the conclusion that the sole effect of the colour filters is due to the reduction in light intensity. This was proved by showing that the range of observations for neutral and colour filters, when plotted against filter transmission, lay on the same curve. The effects that occurred always showed a reduction in the range when compared with the unmodified beam. So far as the experiments went, the revealing power of a

coloured beam is the same as that of a white beam of the same intensity. This conclusion was quite definite for the winter fogs in Surrey, near the National Physical Laboratory. There is a possibility that the conclusions may not hold good for other kinds of fog.

Earth-Sounds in the East Indies

CAPT. P. JANSEN, St. Helens Court, London, E.C.3, has sent us an interesting account of sounds heard by him near the mouths of rivers in the Dutch East Indies. Except in their higher pitch, they seem to resemble the barisal guns of the Ganges delta and the brontides of certain districts in Italy. On the roads of Sourabaya in Java, he says, two or three noises, as of foghorns of different notes, were heard at irregular intervals of a few seconds, each lasting for one or two seconds. In the hold of an empty ship, the noise was deafening. After continuing for one or two hours, the noises ceased as suddenly as they began. Capt. Jansen has heard the same noises, but less frequently, at the mouth of the Palembang River in Sumatra. At the mouths of some of the rivers of the Malay Peninsula, other noises were heard, like that of plucking the strings of a musical instrument, all on the same note and at irregular intervals. Although barisal guns and brontides have for a long time been carefully studied, their origin is still obscure. They are heard frequently in seismic districts and also in countries free from earthquakes. Possibly they have more than one origin, but their frequent occurrence near the mouths of great rivers seems to connect them with the settling of the delta or of the underlying crust.

International Scientific Management

It is now ten years since the first international conference was held in Prague at which papers dealing with various aspects of scientific management were read. That the intervening period has not been barren of results is the opinion of numerous European and American engineers and men of science who have contributed to the volume, "After Ten Years" ("Po desíti letech"), which has just been issued by the Masaryk Academy of Work under the editorship of Dr. S. Spaček, the Czechoslovak engineer who presided at the inaugural meeting in 1924. The next conference is to be held in London during July 1935, and will be under the auspices of the Federation of British Industries. In view of the many remarkable changes in outlook concerning industrial management, this conference should prove of considerable interest. One authority refers to the fact that scientific management was originally concerned exclusively with output by employees, whereas to-day attention is being focused upon wasteful administrative methods. It is considered that there is scope for much improvement in this direction.

Princeton Institute for Advanced Study

AN interesting account of the origin of this institute is given in *Scripta Mathematica* (1, No. 2) and reproduced in the Indian journal, the *Mathematics Student* (2, No. 2). Mr. Bamurger and Mrs.

Felix Fuld were much impressed by Dr. Flexner's well-known book, "Universities: American, English, German", and they asked the author what centre of learning he would organise if adequate funds were placed at his disposal. Dr. Flexner, after consultation with scholars throughout the world, replied that he regarded mathematics as the most fundamental of all disciplines, and suggested setting up a School of Mathematics. Mr. Bamurger and Mrs. Fuld accepted Dr. Flexner's ideas and gave five million dollars to have them put into effect. Prof. Einstein is director of the institute, which includes also Profs. Veblen and Weyl. Scholarships and fellowships are available for suitably qualified students. These are under the supervision of the professors, but there are no hard-and-fast rules, and each professor is at liberty to adopt whatever methods, formal or informal, he considers best calculated to promote research. This is an important point, since many consider that research institutes have a fatal tendency to become over-organised, to the detriment of original thought.

Positions in the Tristan d'Acunha Group

It has recently been discovered that certain positions in the Tristan d'Acunha group are incorrectly quoted in vol. 1, Part 1 of the "Report of Scientific Results of the Exploring Voyage of H.M.S. *Challenger* 1873-76". The principal effect of these errors is to place Inaccessible and Nightingale Island in incorrect positions relative to Tristan Island. A full account of the origin of these errors, with a description of the sequence of events which led to their discovery, has been published in the *Empire Surveyors Review* (vol. 2, No. 13, July 1934).

Exhibition of Kinematography

THE Royal Photographic Society, at its house at 35 Russell Square, is holding an exhibition of kinematography until November 30. The exhibition will be open from 10 a.m. to 6 p.m. daily, and a number of public lectures has been arranged. Admission is free. Particulars may be obtained from the Secretary of the Society. The opening lecture was given on November 6 by Mr. F. F. Renwick who described the Dufay colour process. As already mentioned in *NATURE* (133, 678; 1934), this process was to be made available to users of 16 mm. kine film during the summer of this year. When the film was issued it was found to be extremely successful. In his lecture, Mr. Renwick stated that a very large amount of research work had been carried out relating to the application of the process to the full-size kine film. In making copies, much progress had been made, and he was able to exhibit samples made both by projection and contact printing. This accomplishment has already been followed by prominent film-producing companies, and soon Dufay colour films will, no doubt, be included in screen programmes.

A Photographic Centenary

THE year 1834 is famous for the production of the earliest recorded photograph on paper. This was the work of Henry Fox Talbot, who used paper

sensitised by means of silver chloride. Fox Talbot's extensive investigations may be said to have laid the foundations of modern photography. The inventor and his work are briefly described in the *Photographic Journal* (August 1934, pp. 427-435). An exhibition celebrating this centenary of photography is now to be seen at the Gallery of Messrs. Elliott and Fry, Ltd., 63 Baker Street, London. The collection includes a copy of Talbot's book, "The Pencil of Nature", written in 1843, the first book to be illustrated with photographs. Several original prints, including one of Trafalgar Square without the Nelson Monument, and one original paper negative are shown. Talbot was a very close friend of Sir William Herschel, and the early progress of photographic inventions owed much to the suggestions of the latter—notably one made on January 30, 1839, that 'hypo' should be used to fix the photographic records.

Biochemical Society, Calcutta

WITH the object of the promotion of biochemical studies and research, a Biochemical Society has recently been formed at Calcutta. The Society was formally inaugurated on July 6, 1934, at the All-India Institute of Hygiene. The first committee of the Society is constituted as follows: Prof. N. M. Basu, Lieut.-Col. T. C. Boyd, Prof. S. Ghosh, Prof. J. N. Mukherjee, Dr. B. B. Sen, Prof. H. K. Sen, Prof. H. E. C. Wilson, with Dr. B. C. Guha as honorary secretary and Dr. B. Ahmad as honorary treasurer. It has been arranged to hold monthly meetings for biochemical discussions and reading of original papers, reviews, etc. Four meetings have already been held.

Vitamin B₁ Potency of Marmite

THE Marmite Food Extract Co., Ltd., writes, with reference to Mr. A. R. Keast's comments on the vitamin B₁ potency of its yeast extract (*NATURE*, Nov. 3, p. 696), that the first estimation which showed a content of 840 international units per oz. has been confirmed in a later test on a mixture of eight different samples. The tests were carried out on pigeons by the method described by Coward, Burn, Ling and Morgan (*Biochem. J.*, 27, p. 1719; 1933). Their letter has been referred to Mr. Keast, who points out that Marmite deteriorates with age, and that the pigeon cure method does not always give the same result as the rat growth method of assaying vitamin B₁ in terms of the international standard. Coward *et al.* (*loc. cit.*) found, for samples of dried yeast, that the pigeon method (cure of head retraction in birds given a diet of polished rice) gave a higher value for the vitamin B₁ potency than the rat method (growth of rats on a diet deficient solely in vitamin B₁): the same results were, however, obtained by both methods in the case of a soft yeast extract. They also point out that although the probable error of the pigeon test is much greater than that of the rat test, yet the former has the great advantage of being specific for the factor it is used to estimate.

Announcements

AT the annual dinner of the Institute of Fuel held on November 12, H.R.H. the Duke of Kent presented the Melchett Medal to Dr. Friedrich Bergius, the distinguished German chemist and pioneer in the manufacture of oil from coal. In Germany, Dr. Bergius's hydrogenation process has for several years been used for the production of petrol from brown coal. Methods based on Dr. Bergius's discovery are now being developed in the United States and in Great Britain. At present, Dr. Bergius is working on the production of sugar from wood.

SIR JOHN CADMAN has been elected president of the Institution of Petroleum Technologists for the session 1935-36, and will take office immediately after the annual general meeting on March 12, 1935.

THE following officers were elected at the anniversary meeting of the Mineralogical Society on November 1: *President*, Sir Thomas Holland; *Vice-Presidents*, Mr. Arthur Russell, Sir William Bragg; *Treasurer*, Mr. F. N. Ashcroft; *General Secretary*, Mr. W. Campbell Smith; *Foreign Secretary*, Prof. A. Hutchinson; *Editor of the Journal*, Dr. L. J. Spencer.

PROF. J. B. S. HALDANE, professor of genetics in the University of London, will deliver the tenth annual Norman Lockyer Lecture of the British Science Guild on November 28 at 4.30 p.m. in the Goldsmiths' Hall, London, E.C.2 (by permission of the Goldsmiths' Company), taking as his subject "Human Biology and Its Applications". Tickets, for which there is no charge, are obtainable on application to the Secretary, the British Science Guild, 6, John Street, Adelphi, London, W.C.2.

THE eighth edition of their catalogue of collecting apparatus has been issued by Messrs. Flatters and Garnett, Ltd., 309 Oxford Road, Manchester. The list, which contains a number of new items, includes collecting apparatus for botany, entomology, pond life and geology, besides miscellaneous aquaria, glass top boxes, cabinets and collectors' books.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: An assistant lecturer and demonstrator in chemistry at University College, Leicester—The Registrar (Nov. 23). An assistant lecturer in mining at the North Staffordshire Technical College, Stoke-on-Trent—The Clerk to the Governors, Town Hall, Hanley, Stoke-on-Trent (Nov. 26). An assistant inspector of scientific supplies—The Director-General, India Store Department, Belvedere Road, S.E.1 (Nov. 26). A Pender professor of electrical engineering in the University of London (University College)—The Academic Registrar, University of London, S.W.7 (Jan. 18). A chemical engineer for research in waxes—The Secretary, Industrial Research Council, Department of Industry and Commerce, Lord Edward Street, Dublin.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

The Velocity of Light

F. K. EDMONDSON¹ has recently stated that the observed values of the velocity of light are well represented by the equation

$$c = 299,885 + 115 \sin(2\pi/40)(t - 1901),$$

and de Bray² has given a plot of this equation, together with certain experimental points. By comparing these points with the complete table of values published earlier by de Bray³, I find that they include *each* one of the seven final declared values of c , from 1875 to the present time, as well as the preliminary value of Pease and Pearson⁴. The agreement with Edmondson's equation is so remarkable that it seems desirable to tabulate the actual figures. The first eight items in the accompanying table comprise this information⁵.

Date	Investigator	Obs. Velocity km./sec.	Obs.-Calc. km./sec.
1874.8	Cornu-Helmert	299,990 ± 200	+ 10
1879.5	Michelson	299,910 ± 50	- 2
1882.7	Newcomb	299,860 ± 30	+ 5
1882.8	Michelson	299,853 ± 60	± 0
1902.4	Perrotin	299,901 ± 84	- 9
1926.5	Michelson	299,796 ± 4	- 1.6
1928.0	Mittelstaedt	299,778 ± 10	- 4.5
1932.5	Pease and Pearson	299,774	+ 0.8
1923.0	Mercier	299,782 ± 30	- 67
1906.0	Rosa and Dorsey	299,781 ± 10	- 185

In addition to Edmondson's 40-year period, Pease and Pearson⁴ have found evidences of two shorter periods, one of $14\frac{2}{3}$ days, and the other of one year. Each had an amplitude of about 20 km./sec., although the shorter period fluctuation nearly vanished during December 1932 and January 1933, reappearing again in February 1933. The origin of these short period fluctuations is still obscure, but if we admit their reality, it is not improbable that a large fluctuation of the type postulated by Edmondson *may* also exist. On the other hand, it is important to notice that these apparent variations occurred only in the direct measurements of c , for which the apparatus extended over one to twenty-five miles. When we turn to the indirect methods, for which a very compact apparatus is used, there is no evidence of a variation.

One of these indirect methods is the measurement of the velocity of electric waves guided by wires (standing waves). J. Mercier⁶ has carried out the latest and by far the most accurate work by this method. His result is $299,700 \pm 30$ km./sec., and I quoted this value in my 1929 discussion⁷ of the general physical constants. N. E. Dorsey⁸ has, however, recently noted that this value is for air, and when reduced to vacuum becomes 299,782, as given in the table. This revised figure agrees surprisingly well with Mittelstaedt's⁵ result, which was obtained with a Kerr cell and with a base line of only 41.4 metres, and with Pease and Pearson's final *average* result. It disagrees, however, by 67 km./sec. with Edmondson's predicted value for the epoch 1923.

The second indirect method for determining c is by means of the ratio of the electrostatic to the

electromagnetic unit of electricity. The best experimental value of this ratio, by E. B. Rosa and N. E. Dorsey⁹, was obtained at the mean epoch 1906.0. Their direct result is $299,710 \pm 10$, but this is in terms of international electric units. Using $p = 1.00051$ (one int. ohm. = p abs. ohm), I obtained⁷ $299,790 \pm 10$ km./sec. The best value of p is, however, now¹⁰ 1.00046 , giving $299,781 \pm 10$ km./sec. This last value, which appears in the table, is in complete agreement with the results obtained with other relatively compact apparatus (Mercier and Mittelstaedt). On the other hand, it disagrees violently with Edmondson's calculated value for 1906.

To this last conclusion the objection may properly be raised that it is the value of p that should vary with time, rather than the experimental result in terms of international units, and that the 299,781 value properly applies to 1932, the epoch at which $p = 1.00046$ was observed, and for which the calculated value of c is 299,773. But the experimental values of p do not show the predicted variation with time. Thus F. E. Smith¹¹, in 1914, obtained 1.00052, and E. Grüneiser and E. Giebe¹², in 1920, obtained 1.00051. In order to satisfy Edmondson's equation, the value of p , from 1914 to 1932, should vary by 0.00144, an amount twenty-four times the observed variation.

It is thus probable that the fluctuations observed in the directly measured value of c are related in some way to the long base-line employed in the apparatus. That such fluctuations are instrumental, rather than real, is indicated also by the evidence listed by O. C. Wilson¹³ and by R. J. Kennedy¹⁴, although the general situation outlined by them is not so clean-cut as their letters might indicate. In brief, this situation is as follows.

The apparent observed change in c is in terms of the standard metre and the mean solar day. Now if we assume the wave theory of light, and if we assume further that there is no dispersion in empty space, so that the group (that is, the measured) velocity is identical with the wave velocity, then we can write the fundamental equation $c = \lambda\nu$, where ν is the frequency of the atomic oscillator producing the light of wave-length λ . It has, however, been shown experimentally, as Wilson points out, that the length of the standard metre, in terms of λ , did not change by a measurable amount from 1892 to 1906. Furthermore, the short-period fluctuations observed by Pease and Pearson should have produced as much as one entire fringe shift per day in Kennedy's apparatus, whereas his observed shifts were always less than 10^{-4} fringe per day.

Hence if the value of c , in terms of the standard metre and mean solar day, is actually changing with time, but the value of λ in terms of the standard metre shows no corresponding change, then it necessarily follows that the value of every atomic frequency, in terms of the mean solar day, must be changing. Such a variation is obviously most improbable, but unfortunately it is not possible to make a direct test, since one cannot compare directly an atomic frequency with any macroscopic standard of time. A real variation in the measured group velocity c , if such variation exists, might then be interpreted as due to a real variation in ν , or as due to a failure of the measured c to equal the *wave* velocity $\lambda\nu$. Parenthetically, it may be noted that any such general variation in ν would not affect the value of the *non-dimensional* quantity, index of refraction, contrary to Wilson's statement.

The last four values of c given in the table represent respectively the best result by each of four quite different methods, and agree remarkably well. As a final weighted average of these results, I suggest $299,776 \pm 4$ km./sec.

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Oct. 18.

- ¹ NATURE, 133, 759, May 19, 1934.
² NATURE, 133, 948, June 23, 1934.
³ NATURE, 120, 602, Oct. 22, 1927. This table has been checked and republished by Mittelstaedt (*Phys. Z.*, 30, 165; 1929).
⁴ Annual Report of Director, Mount Wilson Observatory, 1930-31, p. 218; 1931-32, p. 170; 1932-33, p. 164. See also NATURE, 133, 169, Feb. 3, 1934.
⁵ The first three columns of this table differ from the data already published by de Bray³ and by Mittelstaedt³ only in the use of 10 in place of 20 km./sec., for the probable error of Mittelstaedt's own work (*Ann. Phys.*, 2, 285; 1929). He states explicitly on p. 310 of his paper that 20 km./sec. is his limit of error.
⁶ *J. Phys. Radium*, 5, 168; 1924. In this case, also, the published ± 30 km./sec. appears to be an estimated limit of error, rather than a probable error.
⁷ *Rev. Mod. Physics*, 1, 1; 1929.
⁸ Congrès International d'Electricité (Paris, 1932), 3, p. 202.
⁹ U.S. Bur. Standards, *Bull.*, 3, 433; 1907.
¹⁰ Nat. Research Council, *Bull.*, 93, 92; 1933.
¹¹ *Phil. Trans.*, 214, 27; 1914.
¹² *Ann. Phys.*, 63, 179; 1920.
¹³ NATURE, 130, 25, July 2, 1932.
¹⁴ NATURE, 130, 277, Aug. 20, 1932.

β -Rays of Radium D

THERE has been much uncertainty as to the energies of the nuclear β -rays of radium D. All the expansion chamber investigations^{1,2,3,4} showed, in addition to the known secondary β -rays, numerous rays of ranges around 6 mm. in oxygen at s.t.p. and therefore of energies of about 20 kilovolts. These were interpreted by Feather⁵ and one of us⁴ (H. O. W. R.) as due to the nuclear electrons.

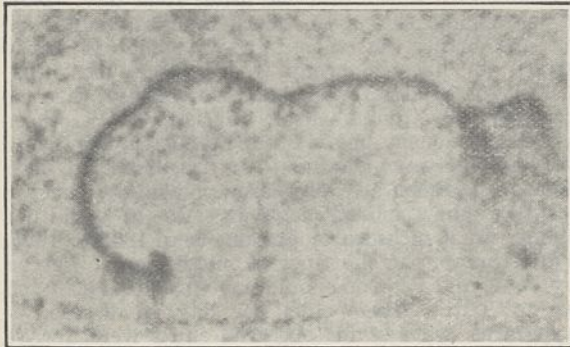


FIG. 1.

On the other hand, (1) Kikuchi¹ had failed to find pairs of secondary + nuclear tracks starting from the same atom on a weakly activated silk fibre; and (2) Stahel², using a counter, had failed to count more than 0.83 β -rays per disintegration through a collodion film of small stopping power, though there is evidence that the secondary electrons amount to at least 0.6 per disintegration^{4,6,7}.

We have obtained new evidence by photographing in the expansion chamber β -tracks coming from radium D tetramethyl. This is a vapour, and the minute quantity used is handled and introduced into the chamber by using lead-tetramethyl as a carrier. It is thus possible to observe the β -disintegration of individual radioactive atoms in the gas.

From measurements of about a hundred dis-

integrations, we find that the typical disintegration of radium D consists in a 47,200 volt γ -transition accompanied by the emission of a nuclear electron of small range, 0-3 mm. in air. The estimation of the high energy limit of the nuclear spectrum is complicated by the presence of occasional tertiary electrons due to the Auger effect with ranges similar to those of the fastest nuclear electrons. The limit is probably near 10 or 12 kilovolts.

The β -rays between 10 and 30 kilovolts found in previous experiments are absent, so that they must be identified as secondary electrons which had lost energy in the solid material on which the radio element has previously been mounted.

The appearance of a disintegration can be judged from Fig. 1, which is reproduced from a photograph showing three tracks coming from the same atom in air in a field of 650 gauss. They are interpreted as a nuclear ray of about 1 mm. range, a tertiary of 3 mm. and an L secondary of 2.35 cm.

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- ¹ Kikuchi, *Jap. J. Phys.*, 4, 143; 1927.
² Petrova, *Z. Phys.*, 55, 628; 1929.
³ Feather, *Proc. Camb. Phil. Soc.*, 25, 522; 1929.
⁴ Richardson, *Roy. Soc. Proc.*, A, 133, 367; 1931.
⁵ Stahel, *Z. Phys.*, 68, 1; 1931.
⁶ Gray, NATURE, 130, 738, Nov. 12, 1932.
⁷ v. Droste, *Z. Phys.*, 84, 17; 1933.

Effects of Cosmic Radiation in a Wilson Chamber at the Hafelekar Observatory (2,300 m.) near Innsbruck

A MAGNETIC field of 1,500 gauss was produced in a Philipp-Dörffel Wilson chamber of 12 cm. diameter and 3 cm. depth, and the effects of cosmic radiation at a height of 2,300 m. above sea-level were investigated. We obtained the following results:

On 1,200 exposures, 160 electron-tracks are visible. Those which are nearly vertical can be interpreted as 31 positive and 34 negative, if we assume that the particles have been moving downwards. The charge of the others cannot be determined, since nothing is known about the direction of their motion. On 25 exposures several simultaneous tracks are visible. A distinct shower with about seven tracks (they are not all equally distinct) was photographed. The radius of curvature could be determined for 98 tracks. The statistics show that a considerable number of soft rays is present. Half the tracks have a radius of curvature of less than 3 cm., corresponding to an energy of 500,000 e.v. 34 have a radius of more than 30 cm., corresponding to 10^7 e.v. Taking the statistics for positive and negative rays separately, we get about the same distribution. Using a strip of lead (0.6 cm. thick), laid horizontally across the chamber, only one particle penetrating it was detected. It did not show any noticeable curvature even after passing through the lead.

Beside the tracks of electrons, tracks of heavy particles were also found. We cannot assume that these rays were due to a contamination of polonium or radium (actually only polonium has to be seriously considered), as three of them had a range of 5 cm. or more (exceeding the range of polonium considerably). One ray of 4 cm. range had both ends in the chamber, which is not likely to occur with polonium. Moreover, 9 out of 15 tracks were vertical, while only 14 out of

94 were vertical in the case of a weak polonium activity *ceteris paribus*. Thus the cosmic radiation is to be regarded as the cause of these rays.

Two thicker but very short tracks (0.6 cm. range) were observed, horizontal, but with both ends in the chamber, very similar to N-atoms set in motion by neutrons. They too must be due to cosmic radiation.

As to the nature and process of origination (whether directly or indirectly due to cosmic radiation) nothing can be said so far.

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Oct. 27.

Rock Salt Absorption of Cosmic Rays

COSMIC ray absorption measurements have until recently been carried out with relatively few light elements and compounds. Rock salt mines being very often used in the determination of the residual ionisation, it seemed especially interesting to measure the absorption of cosmic rays by this mineral.

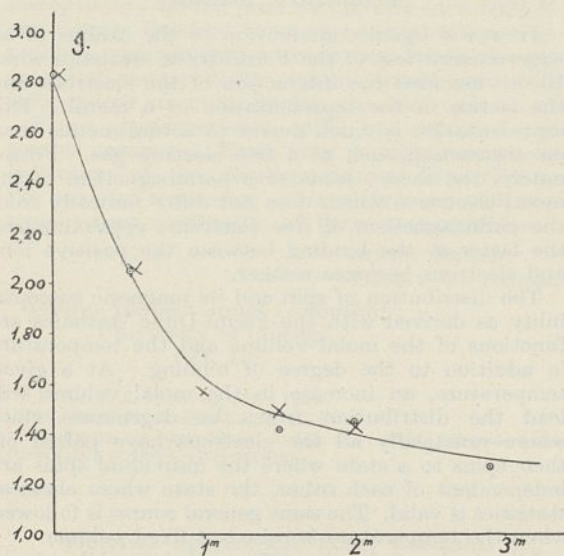


FIG. 1.

Powdered rock salt was used for this research. In one set of experiments, about 40 tons of this material was heaped above the apparatus, which was contained in a wooden box. Care was taken to create conditions analogous to those existing for experiments in water; hence great extension of the external surface was aimed at. In a second set of experiments a kind of salt hill or mound was available to the author. The results of the measurements are shown in Fig. 1, where the observations made within the mound are marked by circles. A Kolhörster apparatus made by Messrs. Günther and Tegetmeyer, of Braunschweig, was used.

On computing the results by means of the $e^{-\mu x}$ function, I find for the coefficient μ/ρ at the depth of 1-3 metres a value of $0.7 \times 10^{-4} \text{ cm.}^2 \text{ gm.}^{-1}$, which is many times lower than the corresponding value, namely, $3.6 \times 10^{-4} \text{ cm.}^2 \text{ gm.}^{-1}$, for water. Thus, rock salt seems to be the most transparent substance for cosmic rays yet examined. The detailed data concerning this work will be published in the *Acta Physica Polonica*.

I take this occasion to express my thanks to the management of the Solvay Industrial Establishments in Poland, which provided the best conditions for the realisation of this investigation at the rock salt mines of Wapno (Province of Poznań).

ST. ZIEMECKI.

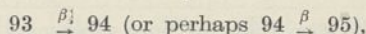
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Oct. 11.

Fermi's Element 93

WE have recently pointed out¹ that element 93 should have, according to the Periodic Law, other properties than those displayed by Fermi's element 93², and we found, on repeating his experiments with protactinium, that his 13-minute product from uranium is chemically identical with element 91.

The Italian workers, in continuation of their interesting work on neutron bombardment, have just described³ a new reaction of their element with an atomic number above 92 (co-precipitation with rhenium sulphide), and also found that their product with a period of 90-100 minutes is isotopic with the 13-minute body.

We have studied the rhenium sulphide reaction with protactinium as an indicator, and found that element 91 is precipitated to the extent of 40-60 per cent together with rhenium sulphide from 15 per cent hydrochloric acid solution, exactly like Fermi's products. Our conclusion is therefore that, instead of Fermi's assumption of



the products with 13- and 90-100-minute periods are isotopes of ekatantalum, changing by β -emission into isotopes of uranium.

Fermi's proof of the non-identity of his products with element 91, based on experiments with brevium, is not conclusive, because we have to expect the freshly formed brevium atoms to be, at least to some extent, in a chemically different state (for example, trivalent ions) than the bulk of the much longer-lived atoms of 'element 93'.

Details of our experiments will be published elsewhere.

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Oct. 12.

¹ A. V. Grosse and M. S. Agruss, *Phys. Rev.*, **46**, 241; 1934.
² E. Fermi, *NATURE*, **133**, 898, May 17, 1934.
³ E. Fermi, E. Amaldi, O. d'Agostino, F. Rasetti and E. Segré, *Proc. Roy. Soc., A.*, **146**, 495; 1934.

Experiments on Superconductors

IN a previous letter¹ it was reported that the magnetic induction in tin spheres, which were cooled in an external magnetic field until they became superconductive, did not vanish entirely, but that part of the magnetic flux remained in the body. This 'freezing in' of lines of force was observed, when superconductivity was attained either by cooling the specimen in a constant magnetic field or by decreasing the external field at constant temperature. Since then, this result has been confirmed by magnetic experiments by Rjabinin and Shubnikow² and by calorimetric measurements by Keesom and Kok³.

Meanwhile, two of us (T. C. K. and K. M.) have

extended these investigations to different supraconducting substances. For these experiments we used long cylindrical rods in which, on account of the shape (according to Gorter⁴), no magnetic flux should be 'frozen in'. The rods, round the middle part of which a single layer of insulated copper wire was coiled, were cooled below their normal transition point without an external field. Then an external field, parallel to the axis of the rod, was switched on and switched off again. While switching off the field the induction in the coil was measured by the ballistic throw of a galvanometer. At a constant temperature the induction was determined for field strengths varying from zero to far above the threshold value. Such curves showing the induction as a function of the field strength were taken at several temperatures for every specimen. Hence the amount of magnetic flux 'frozen in' could be evaluated by comparing the measurement above and below the transition point.

The results showed that the percentage of 'frozen in' lines of force varied greatly with the material, but that for any individual specimen it was approximately the same at different temperatures. The following data show for different substances the percentage of the flux of induction at the threshold value, which remains in the specimen, when the external field is reduced to zero.

	Per cent		Per cent
Hg	0	Pb + 4 per cent Bi	80-100
Sn (single-crystals)	6-10	Pb + 10 per cent Bi	100
Sn (polycrystalline)	8-12	Sn + 28 per cent Cd (not annealed)	100
Pb	15	Sn + 28 per cent Cd (annealed)	100
Pb + 1 per cent Bi	40-80	Sn + 58 per cent Bi	100

It can be seen that, for pure substances, this percentage is small. In the case of mercury, the purest substance investigated, the 'frozen in' flux was zero within the limits of error. Evidently this fulfils the ideal conditions which correspond to the case treated by Gorter. The experiments on tin, which were all carried out on rods of the same material (tin 'Kahlbaum'), show that there is no considerable difference between single crystals and the polycrystalline metal. But a marked increase in the number of 'frozen in' lines of force occurs as soon as a second component is added. Even comparatively small additions of another substance have the effect of 'freezing in' the entire flux which the rod contains at the threshold value, when the external field is switched off.

Further, it was observed in most cases that the change of induction did not seem to take place at a definite field strength but, at a constant temperature, extended over a field interval, amounting to 10-20 per cent of the threshold value field. For tin we could compare these field values with the threshold values measured in Leyden, and we found that the range in which the induction changed always lay above the threshold value. With respect to the magneto-caloric effect observed by two of us⁵ the fact that the induction changes in such a range would mean that the heat of transition too does not appear at a definite field strength but is liberated over a certain range. Whether this phenomenon is common to all supraconductors is of course still an open question.

The magnetic behaviour of alloys mentioned above seems to be in agreement with measurements of the specific heat of a supraconducting alloy (PbTi₂) which have recently been carried out by two of us (K. M. and J. R. M.). According to Gorter's⁴ thermo-

dynamical treatment of supraconductivity, a large jump in the specific heat at the normal transition point is to be expected for alloys with a steep threshold value curve. No anomaly of the predicted order of magnitude was found.

These results will be discussed in greater detail in a future publication.

T. C. KEELEY.
K. MENDELSSOHN.
J. R. MOORE.

Clarendon Laboratory,
Oxford.
Oct. 26.

¹ K. Mendelssohn and J. D. Babbitt, *NATURE*, **133**, 459, March 24, 1934.

² G. N. Rjabinin and L. W. Shubnikow, *NATURE*, **134**, 286, August 25, 1934.

³ W. H. Keesom and J. A. Kok, *Physica*, **1**, 503; 1934.

⁴ C. J. Gorter, *Arch. Teyler*, **7**, 378; 1933. *NATURE*, **132**, 931, Dec. 16, 1933. C. J. Gorter and H. Casimir, *Physica*, **1**, 306; 1934.

⁵ K. Mendelssohn and J. R. Moore, *NATURE*, **133**, 413, March 17, 1934.

A Magnetic Study of the Metallic State and the Fermi-Dirac Statistics

It was a signal contribution to the chance of an experimental test of the Fermi-Dirac statistics when Bloch¹ included the interaction of the electrons and the lattice in the representation of a metal. This representation is much nearer to actual metals than an abstraction such as a free electron gas. Fortunately, the theory leads to a paramagnetism of the metal electrons, which does not differ radically from the paramagnetism of free electrons, approximating the latter as the binding between the positive ions and electrons becomes weaker.

The distribution of spin and its magnetic susceptibility as derived with the Fermi-Dirac statistics are functions of the molal volume and the temperature in addition to the degree of binding. At a given temperature, an increase in the molal volume will lead the distribution from the degenerate state where practically all the electrons have paired off their spins to a state where the individual spins are independent of each other, the state where classical statistics is valid. The same general course is followed when the temperature is raised at fixed volume.

In actual metals, the differences in molal volume are too slight to make much difference in the distribution of energy or of spin among the electrons, and any change in distribution with temperature would become marked only above the boiling points of the metals.

Our research consisted in diluting a metal with a non-metal, the non-metal having its electrons so tightly bound and magnetically neutralised that in the first approximation the paramagnetism can be ascribed to the electrons of the metal. In this way, a great variation in molal volume can be studied, and the temperature where considerable changes in the distribution of spin occur is brought within range for experiment. Various combinations of metal and non-metal appear to be miscible in each other, such, for example, as the alkali metals in salts and in hydroxides. We have been measuring first the magnetic susceptibilities of metals dissolved in liquid ammonia, although this precise situation was not treated by Bloch. However, it was hoped that the data would parallel the results of the theories of Pauli and of Bloch. As a guide in the selection of substances, we depended upon the well-known fact

that alkali and alkaline earth metals conduct electrolytically in dilute solutions and conduct metallically in concentrated solutions. The concentrated solutions have every appearance of liquid metals. Indeed, a saturated solution of sodium, for example, has a greater electrical conductivity than solid iron³. We have here, it seems, the gradation in metallic properties we desire.

A rough computation on the basis of a free electron gas shows that metallic sodium would reach the critical temperature at about 40,000° A.; that is, its electrons would begin to uncouple in marked degree and pass into the state where they act as independent elementary magnets. At 0.1 *N* (0.1 mol. per litre), the critical temperature is about 600° A. At 0.02 *N* the corresponding temperature is about 225° A., which happens to be within the temperature range of liquid ammonia. At 0.01 *N* the temperature is about 140° A. and at 0.001 *N* about 30° A. Our preliminary measurements at 230° A. show that at about 0.5 *N* the atomic susceptibility of sodium has the same order of magnitude as pure metallic sodium. At 0.017 *N* it has about thirty times the atomic susceptibility of the pure metal, and at 0.0022 *N* it has about a hundred times the susceptibility of pure sodium, now possessing about two thirds the paramagnetic susceptibility which would arise from independent magnets having one half unit of spin.

These measurements will be repeated with greater accuracy. There may possibly emerge some indication of the diamagnetism of free electrons. We are also measuring other metals, as well as the temperature coefficients of their susceptibilities.

SIMON FREED.
HARRY G. THODE.

George Herbert Jones Laboratory,
University of Chicago.
Oct. 10.

¹ F. Bloch, *Z. Phys.*, **53**, 216; 1929.

² W. Pauli, Jr., *Z. Phys.*, **41**, 81; 1927.

³ L. Farkas (*Z. phys. Chem.*, **A**, **161**, 355; 1932) has made a theoretical study of these conductivities.

Vibration Spectra and Force Constants of 'Heavy' Acetylene

RECENTLY several workers^{1,2,3,4} have published short accounts of observations on the infra-red and Raman spectra of the 'heavy' types of acetylene, namely, HCCD and DCCD. These observations are of considerable importance in helping one to arrive at a more complete understanding of the exact nature of the potential function which defines the force field within the acetylene molecule. Although the observations are not yet sufficiently extensive to enable one to solve this problem completely, it seems desirable at this stage to point out what appear to be serious errors in the present interpretations of these observations, and to show that most of the present data can be satisfactorily correlated on the basis of two quite simple assumptions.

The first is that, for displacements along the axis of the C₂H₂ molecule, only two force constants are required to determine the motions of the atoms, namely, *k*₁ between the C and H atoms, and *k*₂ between the two C atoms. The second is that *k*₁ and *k*₂ remain unchanged when either or each of the H atoms is replaced by a D atom.

The first assumption is well known to be justified,

since it implies a relation⁵ between the three parallel frequencies of ordinary acetylene of the form

$$\nu_2^2 (\nu_1^2 - (1 + m/M)\nu_3^2) = (\nu_2^2 - \nu_3^2) \nu_3^2;$$

and since on substituting $\nu_1 = 1,974 \text{ cm.}^{-1}$, $\nu_2 = 3,372 \text{ cm.}^{-1}$, and $\nu_3 = 3,288 \text{ cm.}^{-1}$ (the well-established values of these frequencies) one finds excellent agreement between the two sides of the identity. The use of a similar assumption in the calculation of the parallel frequencies of diacetylene by Bartholomé⁶ provides an independent confirmation.

If we now compute the values of the frequencies ν_1 , ν_2 , and ν_3 for the isotopic molecules HCCD and DCCD, using the second assumption and taking $k_1 = 5.9 \times 10^5 \text{ dynes./cm.}$, $k_2 = 15.9 \times 10^5 \text{ dynes./cm.}$ (the values deduced from HCCH) we obtain the values given in Table 1. So far the only direct observation reported of a fundamental (parallel) frequency in the isotopic acetylenes is that of ν_1 for DCCD by Glockler and Davis⁴. It is seen that the agreement of the calculated and observed values is as good as could be desired. The value of $1,901 \text{ cm.}^{-1}$ calculated by Glockler and Davis for this frequency is obviously wrong since it depends on a single force constant between the two C atoms.

Table 1.

	HCCH	DCCD		HCCD		
	Observed	Calculated	Observed	Calculated	Infra-red (Herzberg <i>et al.</i>)	Infra-red (New interpretation)
ν_1	1974	1758	1761	1858	~1900	~1860
ν_2	3372	2679	—	3343	~2650	~3350
ν_3	3288	2413	—	2543	~3300	~2550

As regards the fundamental frequencies of the HCCD molecule, we have only the observations on the overtone bands in the photographic region^{2,3} from which to deduce them. Herzberg, Patat and Spinks have interpreted the bands observed by them in the way shown in Table 2, and have consequently deduced that for HCCD $\nu_2 = 2,650 \text{ cm.}^{-1}$ and $\nu_3 = 3,300 \text{ cm.}^{-1}$. Such an interpretation is very suspect in that it makes ν_3 a higher frequency in HCCD than in HCCH. It is just possible that ν_2 might be higher in the isotopic molecule, but it is difficult to see how ν_3 could ever be so. The new interpretation proposed in Table 2 seems more likely to be the correct one, in that it has been based on the newly calculated fundamentals and gives very reasonable assignments for all of the observed bands. The fact that Dennison's selection rules⁷ for the overtone bands of HCCH are not valid for those of HCCD naturally makes a unique interpretation of the present data impossible, but further work in the infra-red on the fundamentals and lower overtones ought very soon to decide between alternative explanations of particular bands.

Table 2.

Observed Band in cm.^{-1}	9706	9139	8550	8410
Interpretation of Herzberg and others	$3\nu_2$	$2\nu_2 + \nu_3$	$\nu_2 + 2\nu_3$	$2\nu_2 + \nu_1$
New interpretation	$4\nu_2$	$\begin{cases} \nu_2 + 2\nu_2 \\ 3\nu_2 + \nu_1 \end{cases}$	$\begin{cases} 2\nu_2 + 2\nu_1 \\ 3\nu_2 + \nu_1 + \nu_2 \end{cases}$	$2\nu_2 + \nu_2$

Unfortunately, the perpendicular bands observed by Randall and Barker¹ cannot be correlated so

simply, since the potential function for displacements perpendicular to the axis of the C_2H_2 molecule is rather more complicated, and in fact the bands found by Randall and Barker will have to be employed in order to determine it.

G. B. B. M. SUTHERLAND.

Laboratory of Physical Chemistry,
Cambridge.
Oct. 20.

- ¹ H. M. Randall and E. F. Barker, *Phys. Rev.*, **45**, 124; 1934.
² G. Herzberg, F. Patat, and J. W. T. Spinks, *NATURE*, **133**, 951, June 23, 1934.
³ C. A. Bradley and A. McKellar, *Phys. Rev.*, **46**, 236; 1934.
⁴ G. Gloeckler and H. M. Davis, *Phys. Rev.*, **46**, 535; 1934.
⁵ R. Mecke, *Z. phys. Chem.*, **B**, **17**, 1; 1932.
⁶ E. Bartholomé, *Z. phys. Chem.*, **B**, **23**, 152; 1934.
⁷ D. M. Dennison, *Rev. Mod. Phys.*, **3**, 280; 1931.

Diffusion of Heavy into Light Water

WE have made measurements of the diffusion coefficient of heavy water (0.5–3.0 mol per cent) in aqueous solutions. The value provisionally obtained is about 9×10^{-4} cm.²/sec. at 15° C. Since this is appreciably greater than is to be expected from the mass diffusion of water molecules (the largest recorded diffusion coefficient, namely, that of H_2 in H_2O , is about 4×10^{-5} cm.²/sec.), it appears that an atomic interchange, such as has been suggested by Bernal and Fowler¹ to account for the abnormal electrolytic mobility of the hydrogen and hydroxyl ions, is involved.

We hope to improve the accuracy of the method, and to determine the temperature coefficient.

W. J. C. ORR.

D. W. THOMSON.

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¹ *J. Chem. Phys.*, **1**, 515; 1933.

Dielectric Potentials of Physiologically Active Substances

SOME physiologically active substances change the surface tension very little and are probably adsorbed at tissue interfaces as they exhibit an action. It seems possible to explain their adsorption and action by supposing that they change the electrical potential on the interface of different dielectrics, influencing but little the surface tension, which is taken into consideration by W. Gibbs in his well-known equation.

Measurements made in this laboratory on the potential at the interface active substance solution – air with the aid of a Lindemann electrometer and a special modification of Kenrick's method gave the following preliminary results:

Substance	Solution	Potential
Quinine	M/100 quinine sulphate	430 mv.
	M/100 quinine bilydrochloride	300 "
Cinchonine	Saturated solution of the base	140 "
Cinchonidine	Saturated solution of the base	10 "
Morphine	1.49 gm. hydrochloride to one litre of solution	0 "

Only a few of the measurements are given here. A full account will be published elsewhere in the near future. The potentials exhibited are very great at low concentrations compared with the known potentials of other substances measured by Kenrick and Frumkin. The potential changes with the hydrogen ion concentration. This may be explained by the influence of the ions on the structure and dissociation of the alkaloids. The dextro- and levorotatory isomers of the same substance show different potentials.

Some physiologically active substances give no potential on the interface solution – air (*in vivo*, for example, the lung), but they give potentials on the interface water solution – solution of greater dielectric constant. Such dielectric constants are known in the living organism; for example, substance of the brain, nerves and the surrounding solution.

The potentials seem to explain a vast field of physiological action and they deserve a special name. I propose the name 'dielectric potential' in distinction from the potentials met with on the interface conductor – solution, as in the elements of electrochemical cells.

B. KAMIENSKI.

Institute of Physical Chemistry
and Electrochemistry,
Jagellonian University,
Cracow.
Oct. 14.

Pit-Head Generation of Electric Power

THE analysis of my address at the Aberdeen meeting of the British Association contributed by a correspondent to *NATURE* of October 13 emphasises too strongly the part dealing with pit-head stations. My main theme was that the selling price of electricity was approaching a figure below which the demand would greatly increase, and only by this increase could the heavy cost of distribution be materially reduced. In order to start this increase in the demand the use of pit-head stations and the adaptation of industrial steam were advocated, and it was claimed that the existence of the Grid afforded facilities for bringing in these sources of supply, which formerly were difficult to use. A reduction in local rates was put forward as an additional help to this end, not as an argument in favour of pit-head stations.

The condensing water difficulty is always brought up against pit-head stations, and is usually overstated. Nor is your correspondent an exception. He quotes the Battersea station as having a thermal efficiency of above 26 per cent, using river water, against Hams Hall at Birmingham with 23.3 per cent using cooling towers; but he fails to take into account the facts that the Hams Hall machines are 30,000 kw. and work at 350 lb. steam pressure, while the Battersea machines are 67,000 kw. working at 600 lb. These two conditions alone would account for nearly all the difference in efficiency. Moreover, Hams Hall works at the low load factor of 0.32, which lowers its efficiency. My statement that "the gain in efficiency due to the high vacuum is often exaggerated by failure to apply comparable conditions", was not unjustified.

Your correspondent also gives alarmist figures about the enormous loss of cooling water by evaporation. This is now slightly less than the amount of steam condensed, and in a 100,000 kw. station, working at a load factor of 0.4, it amounts, on the average, to a stream of water one foot wide and one foot deep flowing at the slow rate of a little more than one mile an hour. Few mines are so fortunate as to have less water to pump than this.

Increased distance of distribution is another objection, but this is now a very small matter if the distance is moderate. It is much cheaper to transmit electricity than coal. Moreover, the presence of a very large station in an urban area is becoming recognised as undesirable, and the concentration of industry in a few large centres no less so. It is hoped

that the wide distribution of electric power will reduce this tendency, and for such supply the more numerous stations will be advantageous.

The proper price for this low grade coal must be controlled by a joint board of some kind, but it will not be fixed at 5s. per ton, any more than the price of steam coal is fixed at its present price. But for the various reasons given in the paper, the fair price will always be a low one.

Your correspondent agrees that there may be individual cases where pit-head production can be economically undertaken. That is exactly my plea. Let the most advantageous places be undertaken first, and then consider the extension of the scheme as opportunity arises. An important asset in the plan is that it can be carried out gradually, and can be developed to any degree of completeness, without detriment to its successful operation at any stage. It may merely supplement the present stations, or it may ultimately replace them, but there is no commitment to a large scheme which once begun must be completed to obtain success. Although the potentialities are very large, the initial risk is small and each step can be proved before a further advance is made.

FRANCIS G. BAILY.

Juniper Green,
Midlothian. Oct. 18.

Inland Water Survey

AFTER reading the valuable leading article in NATURE of October 27 on "Inland Water Survey", with most of which I am in full sympathy, I should like to comment on the view therein expressed that: "Until a survey has been instituted and in a large measure completed, it cannot be known with any degree of certainty and reliability to what extent supplies are actually available for distribution", and that such schemes as the creation of a statutory central water authority, or regional committees are "not ripe for consideration at the present juncture".

It is evident that a survey of the water resources of Great Britain, which many of us hope will be supervised by the Department of Scientific and Industrial Research, will necessarily be a slow and laborious investigation, lasting for an indefinite period. But in the meantime, urgent schemes for the allocation and distribution of water will arise and have to be dealt with in the light of existing knowledge of the water resources in the areas relative to such schemes. It may well be that an *ad hoc* investigation of the resources of the district in question would have to be carried out promptly, possibly with the aid of the central water survey organisation.

As I see the whole problem, the establishment of a central water authority, with its subordinate statutory regional water committees, which in the opinion of our leading water engineers is urgently required at the present time, for many sound reasons which need not be stated here, is not inconsistent with the simultaneous institution of a national water survey. The former would function in the administration, allocation and distribution of water supplies, while the latter would organise the purely scientific and technical survey of our resources. The ideal no doubt would be to have available the results of a completed survey before attempting to allocate resources, but in the meantime we must be content to absorb and utilise the new knowledge as and when it becomes available. I think that if this dual aspect

of the question is kept in mind, it might help the Government to arrive more readily at a decision.

40 Oakfield Road, W. S. BOULTON.
Selly Park, Birmingham.
Oct. 29.

WE can readily concur with Prof. Boulton in his view that "the establishment of a central water authority . . . is not inconsistent with the simultaneous institution of a national water survey". Both matters are alike important, but while there appears to be no valid obstacle to the immediate inauguration of a survey, we see much of a highly contentious nature in the various proposals put forward for the constitution of a central water authority. Our view is that the survey, which is a primary necessity, should not be held up pending a settlement of these purely administrative details, which cannot in the least affect the operations of a survey. In the practical vernacular of the engineering profession, we are anxious to see the Department of Scientific and Industrial Research given authority to "get on with the job".—Editor, NATURE.

The Theory of Colour-Vision

In 1889 I put forward the theory that light perception and colour perception were quite distinct and were distinguished by different cells in the brain, and that colour-blindness was a defect in the evolution of colour perception. This theory enabled me to predict a large number of new facts, and with my experience as special examiner and adviser to the Board of Trade on colour vision and eyesight for fourteen years, with the very fine apparatus in my laboratory, no fact has been discovered which is not in agreement with the theory.

Henschen has shown that there are different cells in the visual centre for the perception of light and colour. Colour-blindness cannot be explained on the old theories and any classification on them is erroneous. Let us consider two examples of the 50 per cent of dangerous cases which pass the old wool test with ease. One has shortening of the red end of the spectrum; he will look at a blazing red light of long wave-length and declare there is nothing there, but will recognise red of shorter wave-length to the lowest degree of luminosity perceptible to the normal sighted. Then take a trichromic (one who sees only three colours in a bright spectrum, red, green and violet); his chief defect is that he has no yellow sensation and therefore is in difficulty over so-called white lights which are really yellow. A trichromic must not be confused with an anomalous trichromat. 90 per cent of the dangerously colour-blind agree with the normal equation, an anomalous trichromat does not.

There are innumerable varieties of dichromic vision, not two main varieties as stated in many books. The dichromic sees two colours in the spectrum, red and violet, with a white interval. This white interval may be so large as to include yellow, green and blue and the luminosity curve may be normal. Very many dichromics pass the wool test with ease. A man may through disease become totally colour-blind whilst retaining his light perception and normal visual acuity.

F. W. EDRIDGE-GREEN.

Board of Trade,
London, S.W.1. Oct. 27.

Peculiar Behaviour in a Female Rat

It is not uncommon for the female rat to exhibit disapproval of a male rat introduced into her premises and to allow her hostile attitude to include any other female sharing her cage. Her attitude towards the male, at such times, is merely defensive—if he approaches her, she rises on her hind legs and utters cries of distress, repelling him with her forepaws. The circumstances seem to have demanded stronger measures from a female rat recently observed. At the same time as her litter was removed, a male was placed in her cage. Immediately she drove him to a corner in the forefront of the cage, where he was obliged to stand on his hind-legs and to remain so standing, while she excitedly brought pieces of hay and, literally, walled him in. Her actions were accompanied frequently by protesting cries which became vehement if he tried to fall on all-fours. The hay was patted in place, to the full height of the cage, so that she might not see him. She herself was totally without bedding ultimately. The state of siege lasted for some six or seven hours, when a truce was apparently arranged.

It is unlikely that the removal of her litter had anything to do with the attitude that this female exhibited, as her youngsters were thirty-four days old at this time.

The intruder made no protest, manifesting a gallantry which is almost invariable in the male rat.

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Oct. 25.

British Association Mathematical Tables

THE appreciation in NATURE of September 13, p. 414, of the work of the Committee responsible for the British Association Mathematical Tables is very gratifying, but the inevitable inference from the note is that financial help is no longer required, and I shall be glad if I may be allowed to correct this impression: the need is still urgent. It is true that the Committee reported at Aberdeen that the publication of the tables of Bessel Functions is now assured. But the grants mentioned in the Committee's report and in the note in NATURE are precisely those which were mentioned in these columns on March 17, and the appeal made then for further support, far from being successful, has elicited as yet only the most meagre response.

The explanation of the change of tone is in the new proposals for publishing. The Cambridge University Press is prepared to handle the Bessel Function volumes not as a business proposition but as a subsidised undertaking on which some loss is to be expected. Considered in relation to a capital cost of about £1,000 for producing the two volumes, the sum of £150 available was properly described in March as "little more than an earnest of belief in the Committee's plan". Regarded as a contribution to a subsidy, the same sum has a very different value. Despair has, therefore, given place to hope. The Committee's assurance that the volumes will appear is, however, not a statement of account but an expression of confidence. It is just possible to pay the subsidy on the first volume now, and that volume need not be delayed to some indefinitely remote future. The Committee is encouraged to proceed

steadily with the preparation of the second volume, but the work cannot be completed until further grants or donations are made: to readers of NATURE a word should be sufficient.

E. H. NEVILLE
Chairman, British Association
Mathematical Tables Committee.

University,
Reading.
Oct. 27.

Oxygen Preparation from Sodium Peroxide: A Dangerous Experiment

A FEW days ago oxygen was prepared in the course of a lecture experiment by allowing water from a drop funnel to fall upon some ordinary sodium peroxide (not specially purified) in a flask. On applying a glowing splint there was an immediate and terrific explosion, which was heard throughout the Department and was regarded by those in the more remote rooms as a student's reminder that November 5 was not far distant. The flask was entirely pulverised and the demonstrator was badly cut with flying glass. Fortunately, no students were injured.

It appears probable that the peroxide contained some unoxidised metallic sodium so that in contact with water an explosive mixture of hydrogen and oxygen was evolved. We have never heard of this happening before although the experiment has been carried out as a routine lecture demonstration scores of times during the last fourteen years. We should be interested to hear if any other lecturers have had a like experience.

J. NEWTON FRIEND.
S. MARKS.

Chemistry Department,
Technical College,
Birmingham.
Oct. 22.

Mechanism of the Liesegang Phenomenon

IN order to throw light on the mechanism of the Liesegang phenomenon, I decided to investigate this under the simplified conditions obtained by causing ions to migrate into gels under a fixed external potential gradient.

Preliminary results obtained from the migration of Ag^+ ions into gelatine gels containing sodium chloride (approximately $N/100$) showed that, under these conditions, sets of rings were obtained spaced approximately equidistant from one another along the direction of the current, one experiment giving eleven rings so arranged.

These results are of interest from the point of view of the theory advanced by Michaleff, Nihiforoff and Schemjakin¹, and supported by some experiments in which the rings obtained from free diffusion were observed, and again by Christiansen and Wulff², that the phenomenon is due to the de Broglie wavelength of the diffusing molecular species, in that on this theory equal spacing of the rings under a potential gradient would be expected; while the actual spacing obtained was of the order of magnitude predicted by this theory.

These experiments will be continued.

E. C. BAUGHAN.

Balliol College,
Oxford. Oct. 20.

¹ *Kolloid Z.*, **66**, 197; 1934.

² *Z. phys. Chem.*, **26**, B, 187; 1934.

Research Items

Archæology in North-East Greenland. In the course of a hunting expedition to north-east Greenland in 1929-31, and a further expedition in 1932-33, the remains of ancient Eskimo settlements extending from Cape Borlase Warren to the south of Antarctic Harbour were examined by Dr. Soren Richter, whose report is published under the title "A Contribution to the Archæology of North-East Greenland" (*Skriften om Svalbard og Ishaveg*, No. 63). The Eskimo evidently chose the sites of their permanent habitations, their winter huts, with an eye to the factors of light, hunting and facility for movement afforded by the state of the ground. They were always near the coast, as watching for marine animals was then their most constant occupation. Small game was also hunted; but reindeer hunting apparently took place only in the late summer and autumn. About 270 Eskimo huts, distributed in 58 settlements in the region of the north-east, are now known to the author, and about 150 to the north and south belonging to the abandoned north-east district. Probably most of the settlements were occupied only for a very short time, and the population was small and readily migratory. Two settlements only had more than ten huts. The huts are fundamentally of the same type, characterised by being built into a slope, with the roof practically flush with the terrain. The walls were built of single broad stones or narwhal skulls, placed edgewise, serving mainly to prevent the sides from falling in. Curiously enough, narwhal skulls were preferred, even when stone was available. The culture throughout is remarkable for its versatility, but shows no sign of a very high antiquity, a date of about five hundred years ago being suggested.

Social Grades in Mangaia. While acting as a temporary High Commissioner of the Cook's Islands Administration in Mangaia, in 1929-30, Dr. P. Buck (Te Rangi Hiroa) was enabled through his official relations to collect certain material towards an ethnological survey (Bull. 122, Bernice P. Bishop Museum, Honolulu). The Mangaiaians have long been in contact with Europeans, and owing to the attitude towards their previous customs encouraged in the early days of contact, information is not now readily to be obtained. Within the tribes, social grades were the high chiefs, lesser chiefs and the commoners. The highest title (*ariki*) is vested in the first-born son of a first-born son, and cannot be held by a female, even though she be the elder, nor can her children displace their cousins, who are born of her younger brother. The *ariki* is senior to all other chiefs in the tribe. The junior members of the chiefly line were termed *rangatira*. If they established strong families they had to be considered in the politics of the tribe and were consulted by the *ariki*. The *ariki* was often a figure-head. The younger members of the families, who in course of time were pushed further and further away from the chiefly line of succession, became the commoners. They were free men, but the higher positions in the tribe were occupied by their seniors in birth. In the course of history, the prestige of the successful warrior (*toa*) began to overshadow that of the *rangatira*. Successful leadership in war determined whether a tribe kept its own land and acquired other lands, for after a battle the victors seized and divided among them-

selves the taro lands of the vanquished. The war leader of the successful tribe became the temporal lord of Mangaia, holding more power than any hereditary official. Thus the hereditary chief could not rely on his seniority alone, but had to be a warrior as well. In one instance, in which the descendants of the chief displayed no military ability, the leadership passed to a junior branch.

Bilingual Problem in Education. Dr. M. E. Bickersteth read a paper before Section J (Psychology) of the British Association meeting at Aberdeen on the bilingual problem in the Gaelic-speaking districts of Scotland. Psychological tests were given in eighty very isolated schools in the highlands and islands, and the results showed that the children scored higher when tested in Gaelic or by means of performance tests, but were behind English-speaking children of the same age in the development of logical thinking. Dr. Bickersteth thinks the results were influenced by the very isolated lives of the children, and by the fact that in the schools not Gaelic but English became the medium of instruction before the junior school stage was reached, causing emotional confusion and retardation in the development of thinking.

Atlantic Syngnathi. In a very interesting paper, Mr. C. M. Breder, Jr. (New York Aquarium) discusses the habits and development of certain belonids and their relatives (Papers from the Tortugas Laboratory and Carnegie Institution of Washington, 28, 1934). The fishes were studied in the field and in the laboratory in various places including New Jersey, Panama, Florida and Nassau. Marked differences in behaviour, swimming attitudes and habitat are shown in the live fishes, especially those belonging to the Belonidæ, which, when adult, are all surface or near-surface feeders, pursuing and eating great numbers of small fishes and invertebrates. The young, until the beak is developed, are of necessity more delicate feeders, but *Tylosurus raphidoma*, having no half-beak stage, is predaceous at all stages studied. The development of *Tylosurus* is distinctly different from that of *Strongylura* and apparently much closer to the line leading to the *Hemirhamphidæ* than is *Strongylura*, which may be looked upon as a more specialised side branch. All have many enemies. The Belonidæ are preyed upon by the larger fishes, including sharks; the Exocetidæ, although capable of leaping high into the air, are devoured in enormous quantities by birds and also by fishes, and form the bulk of the food of huge colonies of terns and noddies. The paper is well illustrated by line drawings and photographs.

Clearing and Dyeing Fish for Bone Study. Miss Gloria Hollister has been singularly successful in treating the bodies of fishes so that the bony skeleton, deeply dyed, can be plainly examined *in situ* through the soft tissues, rendered transparent by a process of clearing. She gives an account of her technique in *Zoologica*, 12, No. 10. The staining medium is the well-known one of alizarin dye, and advice is given on the precautions needed to ensure satisfactory results. The more important part of the technique, however, is the means by which the flesh is depigmented and rendered transparent. After specimens are removed from the alizarin bath, they are placed

in a weak solution of potassium hydroxide and then submitted to ultra-violet light from an alpine sun-lamp. Miss Hollister finds that this is the only treatment which, without damaging the specimens, will extract the black pigment from deep-sea fishes and render the tissues crystal-clear with every detail of bone visible. Preparations made in this way can be preserved permanently if they are kept in chemically pure white glycerine to which a small crystal of thymol has been added, and glass or rubber stoppers are used instead of cork. The thymol is needed to prevent the formation of mould, while the use of cork is to be discouraged because it discolours the glycerine and causes the tissues of the fish to turn dark brown. The efficacy of Miss Hollister's technique is shown by the fact that she has made successful preparations of approximately three thousand of the shallow-water and deep-sea fishes found off Bermuda.

Parasites of the Codling Moth. In the July issue of the *Bulletin of Entomological Research* (25, Pt. 2, 1934), Mr. H. T. Rosenberg of the Parasite Laboratory of the Imperial Institute of Entomology contributes a study on the above subject. The codling moth (*Cydia pomonella*) is a widespread pest of the apple, and a study of its parasites is a necessary preliminary to the adoption of measures of biological control. In the present instance, extensive collections of the host larvæ were made in various parts of France and the parasites bred out in England. The total percentage of parasitism was found to be very low, not exceeding 25.7 per cent in any region of France from which the material came. Of individual parasites, the ichneumonid *Pristomerus vulnerator* had the highest parasitism (14.3 per cent). There is insufficient evidence to show that the codling moth is appreciably controlled by parasites of the larva in France. Other controlling factors were also studied, and it is concluded that predaceous birds and the removal of the larvæ during the gathering of the crop are of more importance than parasitism of the larva.

Meiotic Chromosomes of *Allium*. A view of chromosome structure and division containing several new features is contained in a paper by Prof. T. K. Koshy (*J. Roy. Micro. Soc.*, 54, p. 104). He has studied the meiotic chromosomes in twelve species of *Allium*, as complementary to a previous investigation (see NATURE, May 26, 1934, p. 800) of the somatic chromosomes. He finds that the telophase split of the chromosomes is not suppressed in the last pre-meiotic division as has been suggested. He also finds continuous chromonemata in all stages of the meiotic chromosomes, the leptoneuma of early prophase in meiosis consisting of two closely intertwined threads. These undergo pairing in the zygotene stages, thus giving four more or less intertwined strands. The double coiled threads frequently give a false appearance of chromomeres. The pairing of threads appears to begin at the ends simultaneously and proceed towards the median constriction. The four-strand structures thus formed undergo contraction to form the bivalent chromosomes. As regards the relation between meiosis and mitosis, it is concluded that the split which occurs in prometaphase of somatic mitosis is completely suppressed in the heterotypic prophase owing to the pairing of homologous chromosomes. The univalent chromosomes in heterotypic anaphase and telophase have two coiled chromonemata, and each chromonema divides in late prophase of the second division. The

meiotic are thus similar to the somatic chromosomes, with the difference that synapsis accompanied by suppression of the late prophase split in the threads effects the reduction in chromosome number.

Growth of Roots. The annual report of East Malling Research Station for 1933 includes a paper by Mr. W. S. Rogers on "Root Studies, (4). A Method of observing Root Growth in the Field, illustrated by Observations in an Irrigated Apple Orchard in British Columbia" (The Kent Incorporated Society for Promoting Experiments in Horticulture. Annual Report, Twenty-first Year, 1933. Pp. 268+14 plates. East Malling: East Malling Research Station, 1934. Free to Associate Members; to non-Members, 4s.). Trenches were dug in the ground, about 2 ft. 6 in. away from an apple tree. A piece of plate glass was erected in each trench, at the end nearest the tree, and the soil was dried and replaced. Wooden linings and a roof rendered the trench convenient and light-tight. Roots from the tree grew against the glass, and could be observed and photographed as in the usual 'observation box'. It has been shown that there is a close correlation between the rate of root growth and the temperature of the soil, though lack of sufficient moisture quickly checks root growth. Soil moisture is measured by an ingenious device, the construction of which is briefly described. This method of estimating root activity has several disadvantages, but has the great merit that it allows living roots to be studied under natural conditions.

Occurrence of Sulphides on the Sea Bottom. In the Walvis Bay area, South-West Africa, periodical outbursts of sulphuretted hydrogen occur under the sea, accompanied by widespread destruction of fish and the appearance of floating islands of mud. These are popularly ascribed to submarine volcanic action. Careful examination of the conditions has, however, shown that the gas in all probability owes its origin to bacterial action (Investigational Report No. 3. Department of Commerce and Industries, Fisheries and Marine Biological Survey Division. By W. J. Copenhagen. Pretoria: Government Printer, 1934). The dark green mud of the sea bottom in this area, a sample of which contained 0.12 per cent H_2S , consists largely (60 per cent of the dry residue) of diatoms, the growth of phytoplankton being greatly favoured in this region by the upwelling of water rich in phosphates from the Benguella current which flows northwards from the Antarctic Ocean. The decay of the accumulated debris of these organisms gives rise to sulphuretted hydrogen, part of which is oxidised by the oxygen present in solution in the sea-water, so that anaerobic conditions are established which are favourable to the growth of sulphate-reducing bacteria. These in their turn reduce the sulphates of the sea-water, forming sulphuretted hydrogen. The gas accumulates in the mud during the winter and some of it is given off in summer causing the outbreaks described above. Sulphate-reducing bacteria could readily be detected in the mud by the use of Van Delden's medium under anaerobic conditions. Black mud also occurs in Cape Town harbour, and this likewise contains sulphate-reducing bacteria; but in this case sufficient iron compounds are present to react with the sulphuretted hydrogen forming ferrous sulphide, so that no accumulation of gas takes place and no outbreaks occur.

Excluding Noise by Means of Double Windows. A very old-fashioned method of excluding street noises is to use double windows. Experiments on the acoustical insulation of rooms and buildings by this method have been made at the National Physical Laboratory. It has been proved that the insulation afforded by a partition of simple construction—a solid brick wall, for example—is determined almost entirely by its weight per square foot of surface. The greater the density of the wall, other things remaining the same, the more effective is the screening. If a room is fitted with single windows, practically all the sound entering it from the street passes through the window-panes. To overcome this drawback, a special investigation has been made at the Laboratory of the acoustical insulation of double partitions and in particular of double windows. The researches show that large changes in the insulation are caused by varying the distance between the windows. It was found that if the separation between the panes of 21 oz. window glass in a double window is only $\frac{1}{4}$ in., it is possible for a conversation to be carried on between two persons standing on opposite sides of the window. When the separation between the panes was increased to six inches, speech is impossible. The insulation does not always diminish as the space between the windows is increased. In some cases, a little increase was shown at first. This is attributed to a resonance effect, particularly in the lower notes transmitted. The conclusion arrived at is that, if the double window is properly designed, its sound insulation can be even better than that of the wall in which it is built.

Rotary Wing Aircraft. There are many conceivable types of aircraft. In addition to the orthodox aeroplane, we have the helicopter (air screw), the autogiro and the paddle wheel or flapping wing machine. Any combination of two or more of these simple types would be a conceivable machine. In the Year Book of the Cambridge University Engineers' Association, a thoughtful discussion of the subject is given by J. De La Cierva. He points out that there are three types of living creatures that fly. Big soaring birds during most of their flying illustrate the first type, deriving their lift from the translational motion only. Amongst man-made aircraft, aeroplanes and most flapping wing machines belong to this class. In the second type, there are the smaller birds which derive their lift partly from the translational motion and partly from a relative motion between wings and body. Autogiros, certain helicopters and paddle machines illustrate this class. The third type includes insects, which derive their lift mostly from a relative motion between wings and body. A comparison is given of the relative merits of aeroplanes on one side and autogiros, helicopters and paddle machines on the other, taking into account their efficiency, the use to which they can be put, piloting, safety, simplicity and cost. For speeds greater than some 250 miles per hour, the speed of sound will be approached by points of the rotary wings of autogiros and helicopters, and it is likely that some drop in efficiency will occur. The author considers it likely that the rocket aeroplane will be the fastest of flying machines which can ever be built, since tractor air-screws will suffer from the same limitations as autogiros at high speed. In his opinion, the best all-round flying machine in practice is the autogiro.

Electrical Properties of Soil at very High Frequencies. R. L. Smith-Rose and J. S. McPetrie have recently described in two papers some measurements made on the electrical properties of soil which affect the propagation of wireless waves of lengths 1.5 metres and less (*Proc. Phys. Soc.*, Sept.). Field tests were made with a transmitter and receiver mounted on a post vertically above one another. As the transmitter and receiver are moved up and down, the distance between them being kept constant, the receiver current varies periodically on account of the interference between the direct waves and those reflected from the ground. The reflection coefficient may be estimated from the maximum and minimum current readings, and the phase change on reflection may be found by observing the change in the position of the interference pattern when the ground is covered by a 'perfect conductor' of copper gauze. The dielectric constant of the soil lies between 7 and 16 at 1.5 m. and the conductivity is less than 10×10^8 E.S.U. Measurements were also made at 0.46 m. wave-length. Laboratory tests were made by packing soil round a Lecher wire system excited by a magnetron oscillator at 1.5 m. The position of the nodes on the wires outside the box was followed continuously as the soil was added and the wave-length in the soil could be deduced. It is difficult to separate the conductivity and dielectric constant in these experiments, but useful limits can be obtained for the quantities, and their variation with moisture content was investigated. The results are in satisfactory accord with the experiments made in the field.

Potassium Nitrate. Miscellaneous Publication 192 of the United States Department of Agriculture (Washington, D.C. Government Printer, 5 cents) is entitled "A Review of the Patents and Literature on the Manufacture of Potassium Nitrate with Notes on its Occurrence and Uses", by C. W. Whittaker and F. O. Lundstrom. It contains a historical sketch and statistics of the saltpetre industry, the various methods of production of potassium nitrate and its uses as a fertiliser and also a bibliography of literature and patents. The literature on this subject is rather scattered and the publication gives a brief and useful review of the information.

Disulphur Decafluoride. The main product of the action of gaseous fluorine on sulphur is the hexafluoride, SF_6 , which is a very stable gas. Other fluorides of sulphur which have been described are S_2F_2 and SF_4 . By the fractionation of a large quantity of the hexafluoride prepared by passing fluorine over sulphur, K. G. Denbigh and R. W. Whytlaw-Gray (*J. Chem. Soc.*, 1347; 1934) have obtained a new compound, disulphur decafluoride, S_2F_{10} , melting at -92° and boiling at $+29^\circ$. It is stable, but not so inert as SF_6 . Only small quantities are produced, although the yield is somewhat improved by using plastic instead of rhombic sulphur. The vapour density and some physical properties were measured and they are in agreement with the simple formula in which sulphur is sexavalent, the two sulphur atoms being linked together and each with five atoms of fluorine, all by single bonds. Some difficulty was experienced in the preparation owing to the presence of carbon fluorides in the fluorine, derived from the carbon anode of the cell containing potassium hydrogen fluoride. These were removed by passing the fluorine through a tube cooled in liquid oxygen.

Geology in Great Britain

PART I of the "Summary of Progress of the Geological Survey of Great Britain" for 1931¹ contains the usual annual reports of the Geological Survey Board and of the Director and gives particulars of routine work carried out during the year under review. Fifty-four maps were issued, together with four English and two Scottish memoirs, all of which have already been noticed in our columns (NATURE, 131, 370-372; 1933). Part 2² contains a series of papers on subjects of special interest. The Carboniferous system receives particular attention, D. A. Wray dealing with the Yorkshire Coal Measures and S. W. Hester with the Millstone Grits of North Staffordshire, while Stanley Smith, R. Crookall and W. S. Bisat discuss palaeontological problems. C. B. Wedd contributes notes on the Ordovician of Montgomeryshire and an important study of Palaeozoic and later tectonic structures between the Longmynd and the Berwyns. Three new species of Old Red Sandstone fishes are described by D. M. S. Watson. Petrology is represented by two highly interesting papers: one by Sir John Flett on the Stankards Sill, a teschenite-picrite intrusion in which differentiation was accomplished either before or during intrusion; the other by A. G. MacGregor and W. Q. Kennedy on the Morvern-Strontian 'granite', a complex of the appinite-lamprophyre suite followed by tonalites, granodiorites and biotite-granite.

Part I of the "Summary" for 1932³, in addition to the usual information, records the plans for displaying exhibits in the New Museum of Practical Geology at South Kensington, plans that are now being actively put into operation. New models have been constructed to show the relation of geological structure to surface features in several characteristic British regions, and panoramic displays designed to illustrate geological processes and mining geology. Maps issued in 1932 numbered 59 and there were published five English and three Scottish memoirs some of which have been noticed already (*loc. cit.*) while others, together with some that have since appeared, are briefly reviewed below.

In Part 2⁴ Sir John Flett describes the important changes in the interpretation of the geology of Meneage rendered necessary by critical discoveries made in recent years. Three important contributions to the geology of the Kent Coalfield are made by H. G. Dines (sequence and structure), R. Crookall (fossil flora) and C. J. Stubblefield (fossil fauna). Other palaeontological papers are by Gertrude L. Elles on the Lower Ordovician graptolites with special reference to the Skiddaw Slates and by S. H. Straw on a Palaeozoic fauna revealed by the Little Missenden boring; Sir Arthur Smith Woodward reports on the fish remains of this fauna. E. E. L. Dixon describes the Gault of Cambridgeshire. An example of composite auto-intrusion in a Lower Carboniferous lava-flow (mugearite and trachyandesite) provides W. Q. Kennedy with a petrological problem of a new type.

The memoir on the Cheviot Hills⁵ (Sheets 3 and 5) replaces two smaller ones issued in 1888 and 1895, and deals with an area of special interest since it includes a deeply dissected volcano of Old Red Sandstone age, laid open by long exposure to erosion. Violent eruptions broke through a land-area of intensely folded Silurian sediments and these were followed by the outpouring of andesitic lavas. After

a pause, activity was resumed with the intrusion of granite. The rock is normally a pink granophyric type, but varieties produced by the absorption of earlier and more basic rocks are not uncommon. There was much tourmalinisation towards the north and west, and ramifying strings of felsite were injected as the granite consolidated. Two well-marked dyke-swarms followed, this final episode also closing with felsitic veins. After long denudation, Carboniferous rocks overlapped against the Cheviots and with them was associated a renewal of volcanic activity. Later igneous action is represented by late-Carboniferous dykes and by the Acklington dyke of Tertiary age. The Jurassic and Cretaceous periods have left no trace. The glaciology of the region, rich in phenomena connected with the retreat of the last great ice-sheet, receives full treatment.

Under the general title of "Economic Geology of the Ayrshire Coalfields" a series of four memoirs has now been issued. The first two dealt with north Ayrshire and appeared in 1925. The third is devoted to the Mauchline Basin and the coalfields to the west and east, and was published in 1930. The present volume⁶ is the last of the series and is concerned with the southern portion of the field, which includes the Carboniferous Limestone Coals of Dailly and Patna and the important seams in the Coal Measures of Dalmellington and New Cumnock. Extensive outcrops of Ordovician, Silurian and Old Red Sandstone rocks border the area everywhere save along the northern margin. The Calciferous Sandstone, Carboniferous Limestone, and Coal Measure Series follow in upward succession. Preliminary correlations of the Coal Measures by means of 'mussel' zones are made with the English equivalents. A striking feature is the series of powerful faults crossing the country in a north-east direction, probably determined by the strike of the axes of the compressed folds in the older Palaeozoic rocks that underlie the district. Igneous activity is represented by Permian sills, dykes and vents and by Tertiary dykes.

The Central Coalfield of Scotland has been divided into nine areas, to each of which a separate memoir has been assigned. Area III⁷, dealing with the country around Bo'ness and Linlithgow, is the eighth in order of issue, and the series will be completed by the memoir on Area I now in preparation. The region now described drains entirely to the Firth of Forth. Calciferous Sandstone sediments occur in the south-east and are followed in regular succession to the west by the Carboniferous Limestone Series (including the Limestone Coal Group), the Millstone Grit, and the Productive Coal Measures. The main complications as regards structure arise from the great thicknesses of volcanic rocks that occur locally, most of these falling within the limits of the Carboniferous Limestone. Sills, dykes and vents represent related intrusions, the later quartz-dolerites being assigned to a Permo-Carboniferous age. Mining of coal from the Limestone Coal Group has been carried on in the Bo'ness field for several centuries, and the landward coal is now nearly exhausted. Special sections deal with recent mining developments underneath the Forth and with the concealed coalfield below the Millstone Grit and Coal Measures to the west. Glaciation and the superficial deposits receive detailed attention and also such economic

materials as building stone, fireclay, limestone and road metal.

Leaving the north, we turn to a memoir⁸ describing the country to the south and south-east of Cambridge (Sheet 205), a district almost wholly devoted to agriculture and most of it but thinly inhabited. The solid rocks exposed are of Cretaceous age, from the Gault to the Upper Chalk, but the Lower Greensand, which yields good supplies of water, has been reached in many well-borings in the north-west. The greater part of the memoir deals with the Pleistocene and other superficial drifts. In addition to glacial gravels and boulder clays and fluvial terrace gravels and alluvium, a series of deposits termed 'Taele Gravels' is distinguished. The word 'Taele' is used in Denmark and Norway to signify deeply frozen ground, and by the melting of this, coupled with heavy precipitation, the mud-flows and washed and bedded gravels of these deposits have probably been formed. The glacial history is of great complexity and as final conclusions cannot as yet be reached, the alternative views are fairly presented. Records of several new wells are included and contoured maps are given showing the water-table in the Chalk in 1928 and 1929.

The memoir describing the well-known country around Reigate and Dorking⁹ (Sheet 286) is likely to make a wide appeal since it extends from Epsom across the North Downs to Leith Hill and is a picturesque and favourite residential district within easy reach of London. The geological structures epitomise those found throughout the Wealden area. Though the regional dip corresponds to the gentle flexure of the Weald dome, the structure is locally complicated by subsidiary folds, generally monoclinical, in which steeper dips, sometimes nearly vertical, occur. Details of these are clearly described. The solid formations range from the Lower Cretaceous Tunbridge Wells Sand to the Eocene Bracklesham Beds, and due attention is given to the scanty Pliocene remains and to the Pleistocene and Recent superficial deposits. Economic aspects are dealt with somewhat fully, especially water supply and fullers' earth. The latter, as prepared at Nutfield, excels in quality to such a degree that it forms a standard by which other varieties are gauged. A noteworthy chapter is devoted to the scenery and drainage systems of this attractive countryside.

The Cirencester memoir¹⁰ is descriptive of Sheet 235 and is a notable contribution to the geology and geography of the Cotswolds by an author distinguished for his researches on these classic hills. Apart from the superficial deposits, which do not make extensive spreads, the formations are wholly Jurassic, ranging from the Lower Lias to the Oxford Clay. Just off the map the Palaeozoic floor was reached in a boring near Burford Signet. A valuable part of the memoir is that on agriculture by Prof. J. A. Hanley. Not only is this a contribution of interest to agriculturists and soil investigators, but also to botanists, since it contains many references to the connexion between the flora and the parent rocks. Questions of water supply are discussed but briefly, as this topic has already received detailed treatment in the "Wells and Springs of Gloucestershire" issued by the Survey in 1930.

The memoir on the Holmfirth and Glossop district¹¹ (Sheet 86) covers part of the high moorland (north of the Derbyshire Dome) of the Southern Pennines, everywhere formed by the Millstone Grits, and the adjoining portions of the coalfields of Yorkshire and

Lancashire-Cheshire. Full use has been made of recent advances in our knowledge of the palaeontology of the Millstone Grits and, as a result, the structure of the area has been worked out in great detail. It is of interest to find that the structural disturbance which divides the Yorkshire Coalfield into two parts, the West and South Yorkshire fields respectively, can be traced far back into Millstone Grit times. The beds thicken both north and south from the neighbourhood of Hepworth and Denby Dale, showing that movement was taking place contemporaneously with their deposition. Much new information is also given of the non-marine lamellibranchs of the Coal Measures. During Glacial times, this part of the Pennines lay between the great ice sheets of the east and west and was practically unglaciated, and in consequence it is a region of special interest to botanists and archaeologists.

The Torquay memoir¹², which is a second edition, revised after thirty years, embraces such well-known South Devon localities as Paignton, Totnes and Dartmouth, as well as Torquay itself (Sheet 350). The area includes a diversified stretch of picturesque coastline, famous for its fine sections of Devonian and New Red rocks, and many of these are effectively illustrated by photographs and line-drawings. The general correlation of the sub-divisions of the Devonian with those of the Continent may now be regarded as established, correspondence with the German type being closer than with the Franco-Belgian type. Igneous rocks have a wide distribution, particularly in the Ashprington district. Spilitic lavas are common and most of the intrusions are albitised dolerite; quartz-keratophyres occur, but are relatively infrequent and have their chief development in the Lower Devonian. Pleistocene phenomena are well represented by bone caverns, including the famous Kent's Cavern, raised beaches, and the submerged forest bordering the shores of Tor Bay. Notable new features are the petrology of the igneous rocks, the palaeontology of the Lower Devonian and the treatment of the soils and agriculture of the area. This memoir, like some of the others described above, should be of special value to students and others taking part in geological excursions.

¹ "Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1931." Part 1. Pp. iv+81. 1s. 6d. net.

² *Ibid.* Part 2. Pp. vi+166+4 plates. 3s. net.

³ *Ibid.* for the year 1932. Part 1. Pp. iv+98. 2s. net.

⁴ *Ibid.* Part 2. Pp. iv+142+10 plates. 3s. net.

⁵ "The Geology of the Cheviot Hills". By R. G. Carruthers, G. A. Burnett and W. Anderson, with Petrological Notes by H. H. Thomas. Pp. xi+174+7 plates. 4s. net.

⁶ "Economic Geology of the Ayrshire Coalfields, Area IV (Dailly, Patna, Rankinston, Dalmellington and New Cumnock)". By J. B. Simpson and A. G. MacGregor, with contributions from J. E. Richey and V. A. Eyles. Pp. viii+167+3 plates. 3s. 6d. net.

⁷ "Economic Geology of the Central Coalfield, Area III (Bo'ness and Linlithgow)". By M. Macgregor and D. Haldane. Pp. vi+128+1 plate. 3s. net.

⁸ "The Geology of the Country near Saffron Walden". By H. J. Osborne White, with contributions by F. H. Edmunds. Pp. xii+126+5 plates. 3s. net.

⁹ "The Geology of the Country around Reigate and Dorking". By H. G. Dines and F. H. Edmunds, with notes by H. Dewey and C. J. Stubblefield, and a chapter on palaeontology by C. P. Chatwin. Pp. vii+194+5 plates. 4s. net.

¹⁰ "The Country around Cirencester." By Linsdall Richardson, with contributions by J. A. Hanley and H. G. Dines. Pp. xi+119+7 plates. 3s. net.

¹¹ "The Geology of the Country around Holmfirth and Glossop." By C. E. N. Bromehead, Wilfrid Edwards, D. A. Wray and J. V. Stephens, with notes by G. V. Wilson and W. Lloyd. Pp. xii+194+5 plates. 4s. net.

¹² "The Geology of the Country around Torquay." By W. A. E. Ussher. Second edition (revised). By W. Lloyd, with palaeontology by C. P. Chatwin, and a chapter on the petrography of the Igneous Rocks by W. G. Shannon. Pp. xiii+169+7 plates. 4s. net. London: H.M. Stationery Office, 1932-34.

Scientific Research and New Uses for Coal*

IT is frequently stated that the lessened demand for coal is due partly to its more economical use, partly to the great extension in the use of gas and electricity, and partly to the harnessing of water-power. Nothing could be more erroneous. The more economical use of a commodity, as Prof. Jevons has shown, does not, as is commonly supposed, lead to a restriction in its consumption. Every economy in the production and consumption of an essential commodity, if duly reflected in its selling price, will increase the public demand. That is emphatically so in the case of fuel. People do not keep windows closed in Great Britain because they prefer stuffiness to air, but for warmth. Our climatic conditions are such that for two thirds of the year there is a large unsatisfied demand for fuel in Great Britain.

As with fuel, cheapening the cost of power leads to its more extensive consumption. Take the case of Italy. It was stated when Italy set about developing her considerable latent resources of water-power, owing to the high price of coal in 1918-20 (coal was sold in Genoa at £7 10s. 0d. per ton after the Armistice), that the importation of coal would decrease materially.

The reverse has proved to be the case, as the following figures show :

Year	Imports of Coal and Coke : tons	Home production : tons
1913	10,659,890	266,552
1919	6,093,776	2,368,068
1929	14,272,147	945,000
1931	10,911,657	590,701

It is fifteen years since Sir George Beilby, Sir Charles Parsons, myself, and Mr.—later Sir—Richard Thelfall signed the Report on Gas Standards, in which we stated that "The national interests will best be served by that policy which will promote the widest adoption of scientific methods for the preparation and use of fuel". There are prospective developments—what are commonly termed 'new uses' for coal—which are under constant and intensive examination, though it cannot yet be said positively—with one possible exception—that they are able to stand on their own feet. The prospective developments I have in mind are :

- (1) The hydrogenation process.
- (2) Low-temperature carbonisation of coal.
- (3) The use of gas in transport in place of petrol.

I refer, in particular, to the turning of coal into oil, namely, the wider application of the low-temperature carbonisation of coal, with the consequent production of tar suitable for burning under boilers, or the hydrogenation of this resultant tar in order to secure a home supply of petrol of the first quality ; or, alternatively, the treatment of the tar so as to render it available for use in Diesel engines. I prefer to regard the hydrogenation process as, at present, applicable rather to the treatment of tar than to the direct treatment of coal.

In view of the increasing use of smokeless semi-coke resulting from the low-temperature distillation of suitable coals, it is worth while to pause for a few minutes and consider what would be the result of its substitution on the grand scale for raw coal in

our homes. Great Britain is at present practically dependent upon foreign countries for its supply of fuel-oil and of petrol, and from this point of view alone it would appear that the development of a home source is of great importance. There is also the fact that were the low-temperature carbonisation of coal to become established, it would undoubtedly contribute to an increase in the production of coal and to greater employment in many directions.

As indicative of the possible bearing that the application of these methods may have upon the coal industry, I would point to the domestic consumption of raw coal, which amounts to about 35 million tons per annum. If the whole of this demand were met by the semi-coke produced by low-temperature carbonisation, there would result :

- (1) An augmentation in the national output of coal amounting to about 12 million tons per annum.
- (2) The production annually of the following alternative products : (a) 2 million tons of tar-oil for fuel purposes ; (b) 1½ million tons of Diesel engine oil ; (c) 358 million gallons of petrol.
- (3) The production annually of 100 million gallons of petrol by stripping the gas.
- (4) An increase in the employment of miners of 35,000-45,000 men, with a consequent annual saving in unemployment benefit.
- (5) Increased employment at low-temperature carbonisation works.

The quantity of fuel-oil obtained would be more than sufficient to meet the peace requirements of the Royal Navy ; or, if subjected to full hydrogenation, 358 million gallons of petrol would be produced which, with the 100 million gallons obtained from the gas, would amount to about half the quantity imported during 1932.

Even if it were not found practicable to carbonise the whole of the 35 million tons of domestic fuel for the above purposes, owing possibly to the competition that would arise due to the increasing use of electricity and gas for domestic purposes, it is useful to record that there should still be forthcoming the following advantages :—(1) A considerable augmentation in the output of coal due to the increased demand for semi-coke, electricity and gas. (2) The production of at least enough tar for fuel purposes, or, alternatively, of Diesel oil or petrol for power purposes, to enable Great Britain to have a reasonable home source of these products, and one capable of expansion in times of national emergency. (3) An increase in employment of workers.

The semi-coke, as is well known, produces a more efficient open fire than raw coal, with the definite added advantage that it is smokeless. In the words of Sir Frank Smith in his Norman Lockyer lecture of last year, "It should not be forgotten that the damage done by smoke to the nation's health and to our buildings must be reckoned in tens of millions of pounds per annum ; smokeless fuels, including gas and electric power, show us the way out."

The low-temperature distillation process seems to be in a fair way to becoming a stable industry, for the year 1929 saw the establishment in England of the first distillation plant in the world devoted solely to the distillation and fractionisation of low-temperature coal-oil. In 1930 occurred the first full-scale experiments with aeroplanes flying on coal-petrol, and in 1932, for the first time, vessels of the British Navy

* From the presidential address to the Institution of Civil Engineers, delivered by Sir Richard Redmayne on November 6.

put to sea fuelled only with oil made from British coal. 1933 saw a number of home-defence aircraft, flying daily, actuated by coal-petrol alone, and also, for the first time, large cargoes of low-temperature coal-oil distillates were shipped to foreign countries.

Another possible method of increasing the consumption of coal is in the larger production of gas owing to its use in the compressed form for motor transport. A committee which has been considering this matter for many months past recently published the results of the experimental work so far completed. From those results it is quite evident that the technical problems involved in the substitution of gas for liquid fuel have been solved. For more than a year, such vehicles have been running continuously and successfully upon compressed gas. It has been found that 250 cubic feet of gas of a calorific value of 500 B.Th.U. per cubic foot (that is, $1\frac{1}{4}$ therm) is equivalent to a gallon of motor spirit.

In a report of a series of exhaustive tests made with a lorry owned by the Whitwood Chemical Company, Ltd., of Normanton, and extending to about 670 miles, it is stated that the consumption of fuel was 9,400 cubic feet of gas and 27 gallons of low-grade oil. Based on the data obtained from this trial, it is possible to give the comparative costs of petrol, oil and enriched gas, as follows:—

Total All-in Costs per Mile for Varying Mileages per Annum

Miles per annum	Petrol (pence)	Oil (pence)	Gas (pence)
5,000	19.54	19.54	18.41
10,000	12.18	11.62	11.05
15,000	9.73	8.98	8.60
20,000	8.50	7.66	7.37
30,000	7.27	6.34	6.14
40,000	6.66	5.68	5.53
50,000	6.29	5.28	5.16

Developments in the use of producer gas, electricity, and steam for motor transport have also made great strides. A strong case could be made out for the sole use in our large towns of electric taxis, with the beneficial results of cessation of noise and deleterious fumes, for it is possible now to run a Morrison electric car for 40 miles without recharging, doing $2\frac{1}{2}$ miles per unit of electricity. Each such vehicle daily at work means in electricity consumption alone 3 days' work per annum to a miner. For long-distance, heavy-goods transport, the steam-driven lorry, year in year out, is probably the cheapest motor for the purpose on the road.

University and Educational Intelligence

CAMBRIDGE.—At the Congregation of the Senate on November 17, a grace will be submitted approving the conferment of M.A. *honoris causa* upon Prof. William P. Wynne, emeritus professor of chemistry in the University of Sheffield, who is engaged on research work at Cambridge.

The Cavendish Professor of Experimental Physics gives notice that the Clerk Maxwell scholarship will become vacant on December 25. Candidates are requested to send in their applications to Lord Rutherford at the Cavendish Laboratory on or before December 1.

THE annual meeting of the Science Masters' Association will be held at Oxford on January 1-4, under the presidency of Dr. N. V. Sidgwick, reader

in chemistry in the University. The following lectures will be given during the meeting: C. N. Hinshelwood, "Some Aspects of Modern Physical Chemistry"; Prof. H. H. Plaskett, "The Physics of Astronomical Vacua"; R. B. Fisher, "Tissue Respiration"; Dr. W. O. James, "Plant Respiration"; Prof. J. S. E. Townsend, "Ionisation by Collision"; Prof. R. Robinson, "The New Aspect of the Elementary Theory of Organic Chemistry"; Dr. K. J. Franklin, "X-Ray Photography of the Circulation of the Blood" (with cinematograph films). A discussion on scholarship examinations will also be held. Further information can be obtained from Mr. H. G. Lambert, Shirley Corner, Boden Road, Hall Green, Birmingham.

THE Battersea Polytechnic's report on the session 1933-34 shows a total enrolment of 3,156, a slightly larger number than in the preceding year. About one sixth of the students attended full-time day courses, chiefly in domestic science (250), engineering (115) and hygiene (47), the remaining five-sixths being evening class students, chiefly of engineering (2,231), chemistry (1,009), domestic science (758), hygiene (742), mathematics (586) and physics (578). In view of the ever-increasing use of electric power for domestic purposes, it is surprising that the classes in 'electrical housecraft' were attended by only 8 students. This year the Electrical Association for Women is lending its kitchen for training purposes. A table of occupations followed by students shows: clerical 608, engineering 533, chemistry and physics 279, sanitary inspectors, etc. 180, teaching 166, domestic service 102, dressmaking, etc. 53, food production 51, shop-assistants, etc. 38, other occupations 137, students only 579, retired and unoccupied 250. A 'follow-up' of former students (mainly day-students) shows the following numbers of posts obtained during the past ten years: 878 posts requiring domestic science qualifications, 327 as sanitary inspectors, etc., 252 as engineers, 206 as chemists, scientific assistants, science teachers, etc., 79 as art and handicraft teachers or practitioners. A students' union was instituted during the past year.

ADULT education is developing and expanding in the United States of America as a result of certain phases of the President's "New Deal". In the May issue of *School Life*, devoted chiefly to summer schools and holiday tasks, is published an article on schools for workers, giving some account of how the Federal Government is co-operating with organisers of workers' educational associations and trade unions in experimental courses preparatory to launching a campaign for a wide extension of adult education classes. Among the subjects studied in these classes for workers are: the economic position of the United States, the labour movement abroad, English and public speaking. The teaching is on the lines of the regular summer-school courses. An editorial forecast assigns to universities of the future the task of providing at minimum costs for summer holiday activities combining learning and recreation for old and young in camps in national parks. At present, the summer-session programmes are too generally limited to meeting the demands of students who want to work for more 'credits'. The same issue quotes a recent appreciation of American educational methods by Prof. A. Einstein, giving first place to the negative virtue of non-interference with personal initiative, independence and joy of living and the urge for knowledge.

Science News a Century Ago

Holland's Oxy-Hydrogen Microscope

The *Times* on November 20, 1834, announced that "Mr. Holland's very entertaining and very scientific exhibition is reopened this day for the season. We were present at a private view last night of the wonders which it presents to the eye. It has undergone many improvements since it was before open to the public, and may, we believe, now be considered what its proprietor states it to be, the largest, most powerful and most distinct microscope in the world. The disc contains 254 square feet and the objects, both animate and inanimate, are variously magnified from a power of 9,000 to a power of 2,624,400 times their actual dimensions. . . . Among the most curious phenomena presented to the eye are the aquatic larvæ, in some of which, so pellucid is the whole internal structure, that the intestinal canal and the peristaltic motion are clearly perceptible. . . ."

Darwin in the Island of Chiloe

During the whole of October 1834, Darwin was confined to his bed at the home of his old school-fellow and friend, Mr. Richard Corfield, of Valparaiso; but at the beginning of November he was able to rejoin the *Beagle*. On November 10, he records, the *Beagle* sailed from Valparaiso to the south, for the purpose of surveying the southern part of Chile, the Island of Chiloe, and the broken land called the Chonos Archipelago, as far south as the Peninsula of Tres Montes. On November 21, the ship anchored in the bay of San Carlos, the capital of Chiloe, and a day or two later Darwin hired horses to take him to Chacao at the northern extremity of the island. On November 26, he records: "The day rose splendidly clear. The volcano of Osorno was spouting out volumes of smoke. This most beautiful mountain, formed like a perfect cone, and white with snow, stands out in front of the Cordillera. Another great volcano, with a saddle-shaped summit, also emitted from its immense crater little jets of steam. Subsequently we saw the lofty-peaked Corcovado—well deserving the name of 'et famoso Corcovado'. Thus we beheld, from one point of view, three great active volcanos, each about seven thousand feet high. In addition to this, far to the south, there were other lofty cones covered with snow, which, although not known to be active, must be in their origin volcanic".

Thomas Hawkins's *Ichthyosaurus*

The geologist Thomas Hawkins, 1810–89, was best known for his collections of fossils from Devon, Somerset and Dorset, some of which were acquired by the British Museum while others were presented by him to Oxford and Cambridge. His "Memoirs of *Ichthyosauri* and *Plesiosauri*" was published in 1834, and in the *Times* of November 21 of that year a correspondent directed attention to the delay of the authorities of the British Museum in placing on exhibition that extraordinary fossil animal "The *Ichthyosaurus Chirologostinos*" of Mr. Hawkins, or "the Viery Dragon that stinged Moses" of the Dorsetshire quarrymen. "I was informed by one of the servants in the Museum," says the writer, "that cases were ordered for Mr. Hawkins's collection and that possibly the *Ichthyos* might be exposed in February. Fully acknowledging the propriety of its being placed in an additional case, I must protest against the absurdity of its remaining concealed till

then. It is not liable to suffer from dust, or a slight touch, and to prevent persons meddling with it, for a few shillings a slight bar might be placed in front of it. . . . There seems to be a strange want of proper management, or something worse than that, on the part of some person or persons connected with the Museum, but whether it rests with Mr. Koenig or a higher authority I cannot say." Charles Dietrich Eberhard König (1774–1851) was the keeper of the Mineralogical Department.

Societies and Academies

LONDON

Royal Society, November 8. A. C. G. EGERTON and F. LL. SMITH: Estimation of the combustion productions from the cylinder of the petrol engine (1). An engine was fitted with a valve so that gases could be extracted at any stage during the compression and working stroke. By analysis of the gas it was confirmed that 'knock' is associated with accelerated flame velocity, but only in the last portion of the gas to burn. Some combustion occurs in the neighbourhood of the valve prior to arrival of flame. The aldehydes reach their maximum concentration (1 in 500) at the moment when flame reaches the valve, the substances behaving as peroxide (1 in 10,000) slightly earlier. Aldehydes were not responsible for the production of 'peroxide' or the 'knock'. Certain organic peroxides were found to be powerful 'pro-knocks'. A. C. G. EGERTON, F. LL. SMITH and A. R. UBBELOHDE: Estimation of the combustion products from the cylinder of the petrol engine (2). The experiments were extended to the study of the behaviour of different hydrocarbons and other kinds of fuel, the 'aldehyde'—a 'peroxide'—formed at various stages being determined by special methods. The substance behaving as peroxide is mainly nitrogen peroxide and the peak in the curve of concentration which occurred before the top dead centre is partly explained by the presence of traces of sulphur. Nitrogen peroxide alone does not act as a pro-knock, whereas organic nitrites are strong pro-knocks. Nitrogen peroxide is, however, formed in greater amounts under knocking conditions and quite early in the stroke. A. R. UBBELOHDE and A. C. G. EGERTON: Estimation of the combustion products from the cylinder of the petrol engine (3). The behaviour of various types of organic peroxides towards various reagents was investigated. By taking advantage of the different rate of reaction of the various peroxides on potassium iodide, it was possible to determine them in presence of nitrogen peroxide. Diethyl and ethyl hydrogen peroxide and acetyl peroxide were found to be violent pro-knock substances. The mol fraction needed to produce pronounced knock was 10^{-5} . A peroxide of apparently similar type to ethyl hydrogen peroxide was detected in the gases from the engine cylinder when run under knocking conditions on pure paraffin hydrocarbons in much the same concentration. H. JONES: Application of the Bloch theory to the study of alloys and of the properties of bismuth. A qualitative explanation is given of the variations of the crystal parameters within the ϵ and η phases observed by Owen and Pickup, and also of the electron-atom ratio at which the ϵ phase begins (Hume-Rothery's rule). A Brillouin zone is found for bismuth containing five electrons per atom. The theory shows why bismuth

does not form a co-ordination lattice. The conductivity of alloys of Bi, Sn, and Bi Pb are considered; the observed variation with composition leads to a determination of the 'overlap' of the Fermi surface into the second zone. From this the diamagnetism of pure bismuth and of Bi Sn, Bi Te alloys are deduced, as is also the magnetostriction, in good agreement with experiment.

PARIS

Academy of Sciences, October 15 (*C.R.*, 199, 689-744). J. COSTANTIN: The influence of high latitudes on the agricultural yields of the potato in North America. The use of phytopathological certificates (as in Canada) is a powerful factor in increasing the yields of the potato. The facts quoted tend to prove that high latitudes tend to increase the yield and reduce disease. WLADIMIR VERNADSKY: Should heavy water be looked for from the geochemical point of view? A general discussion of the possible increase in the proportion of heavy water during geological periods. EDOUARD CHATTON and ANDRÉ LWOFF: A parasitic infusorian of the secreting hairs of Edriophthalm Crustacea and the new family of the Pilisuctoridæ. ALBERT TOUSSAINT: Contribution to the study of the interactions between the sustaining wings when 'taxi-ing'. The application to the case of biplane cells. EMILE SEVIN: Waves, spin and numbers. MAURICE PAUTHENIER and LÉON AGOSTINI: The law of charge of a spherical particle in an ionised field. The theoretical expression for the limiting charge, $3Ea^2$ (E is intensity of ionised field and a the radius of the sphere), has been tested experimentally. When the velocity of the sphere reaches half that of the ions, the expression is verified to within 3 per cent. PIERRE JOLIBOIS: The electrolysis of saline solutions with distilled water electrodes. A method of electrolysing salts is described giving a separation into basic and acid oxides without any metallic deposit. VASILESCO KARPEN: An electric battery utilising the energy of oxidation of alcohol. A modification of the Becquerel battery formed of solutions of caustic soda and of nitric acid, separated by a porous partition, with platinised electrodes. Methyl alcohol is added to the solution of caustic soda and this is oxidised to sodium formate during the action of the cell. AUREL JONESCO: The absorption spectrum of acetylene in the region 2350-2050 Å. BENJAMIN BLOCH and JACQUES ERRERA: The influence of temperature on the absorption of organic liquids in the near infra-red. AUGUSTE ROUSSET: The experimental study of the critical opalescence of binary mixtures. Measurements were made on six mixtures. The theory of Ornstein and Zernike was not found to be verified by any of the six, but the diffusion in three cases is in perfect agreement with Rocard's theory. GEORGES BRUHAT and PIERRE GRIVET: The use of naked compensators in the analysis of elliptical vibrations. HUBERT FORESTIER and GEORGES GUIOT-GUILLAIN: A new ferromagnetic variety of ferric oxide. WILFRIED HELLER: The alteration of hydrophobe sols by the action of light in relation with their natural stability. MAURICE LAMBREY: The decomposition velocity of some nitric esters at a low temperature. Experiments on gun-cotton stabilised either by prolonged boiling with water or by Muraour's method. The initial production of nitric oxide is due to traces of impurities: after the impurities have been decomposed, a measurable decomposition of the pure product takes place at 43° C. It corresponds to the destruction of a

thousandth of the gun-cotton in eleven hundred years. ANDRÉ SANFOURCHE: The oxidation of silicon at low temperature. The attack of various specimens of silicon by hydrofluoric acid has been attributed to the removal of a skin of silica formed by oxidation. Direct analysis of samples of silicon prepared by different methods supports this view. DIMITRE IVANOFF: The constitution of M. Delacere's dypnopacone. CHRISTOPHE GAUDEFROY: The surface of double refraction and the singular property of certain crystalline plates. ADRIEN DAVY DE VIRVILLE: The principal types of shallow pools of the Atlantic shore. ANTOINE MAGNAN, CLAUDE MAGNAN and ALBERT DE VILLELONGUE: Contribution to the study of the vision of fishes. Measurements of the refractive indices of various transparent media of the eyes of fishes. Mlle. EDNA HARDE and MARCEL PHILIPPE: Observations on the antigen power of the mixture diphtheric toxin and vitamin C. COSTANTIN LEVADITI and Mlle. YVONNE MANIN: The mechanism of the spirocheticidal action of bismuth. C. MATHIS, J. LAIGRET and C. DUREUX: Three thousand vaccinations against yellow fever in French Western Africa by means of living mouse virus, attenuated by age. Vaccination against yellow fever, by the method of the Tunis Pasteur Institute, has been carried out on a large scale in French Western Africa. Out of a total of more than three thousand inoculations, there were only two severe reactions and these were rapidly cured. There was a high percentage of positive immunisations.

BRUSSELS

Royal Academy of Sciences (*Bull. Class. Sci.* Nos. 8-9). J. E. VERSCHAFFELT: The Bridgman effect. Thermodynamical theory is applied to the case of circuits containing crystalline wires differently orientated with respect to their crystal axes. Electrocaloric effects, which obey the same laws as the Peltier effect and agree with those found experimentally by Bridgman, are shown to exist. P. BURNIAT: Birational transformations of space having two isolated associated fundamental points. R. PIRARD: On an involuntary birational transformation of space. Mlle. Y. DUPONT: Electromagnetic couples and angular momenta in the gravific of Th. De Donder. J. WOUTERS: The Raman spectrum of carbon bromotrichloride. The Raman spectrum of BrC₂Cl₃ consists of six lines, $\Delta\nu = 774, 715, 425, 295, 247, 195 \text{ cm}^{-1}$. These frequencies are compared with those of other compounds of the general formula ZXY₃, such as HCCl₃, HSiCl₃, BrSiCl₃. M. GONZE: Mechanism of the oxidation of hydrazines by iodine. The reaction between hydrazines and iodine is monomolecular with respect to hydrazine and iodine, and is independent of the hydrogen ion concentration. The observed anomalies in the velocity constant are explicable by the fact that the reaction takes place via free iodine and I₃' ions. M. GONZE: Preparation of *m.m'* trifluorhydratozoluene. By preparing *m.m'* trifluorhydratozoluene and *m.m'* hydrazotoluene, it was shown that the substitution of hydrogen by fluorine greatly increases the stability of the hydrazine. A. J. J. VANDE VELDE: The sterilisation of biological powders (5). It is possible to sterilise arable soil completely without appreciably influencing its biological properties by treating it with carbon disulphide at the boiling point (46° C.). The process is repeated three times, the liquid being removed each time by spontaneous evaporation.

LENINGRAD

Academy of Sciences (C.R., 3, No. 2). N. MUSCHELISHVILI: A discussion of new integral problems of the theory of elasticity in two dimensions. D. KRUTOV: The Picard-Landau problem. V. FESENKOV: Stability of the photometric scale for the focal images of stars. Y. KRUTKOV: Contribution to the theory of the Brownian movement. The distribution of the phases, velocities and displacements of a free particle. B. DERIAGIN: A new law of friction and gliding. A. MITKEVITCH: The effect of eddy currents on magnetic viscosity. A. SOKOLIK and K. SHCHELKIN: Change of velocity of an explosion wave with pressure. V. SHARONOV and E. KRINOV: An experimental study of the special energy distribution of daylight illumination. N. VOROZHTSOV and V. KOBELEV: Kinetics and mechanism of the catalytic exchange of chlorine for the amino-group. E. BOCHAROVA and B. DOLGOV: Synthesis of the higher alcohols from water gas under pressure. V. KHLOPIN, E. HERLING and E. IOFFE: Emission of helium by minerals and rocks. I. LICHZIER, S. ZHISLIN and Y. STUDIJSKIY: Rôle of collagenic fibres in the process of osteogenesis according to data obtained from grafts transplanted on to the allantois.

Forthcoming Events

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

Sunday, November 18

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—F. A. Bannister: "Symmetry".*

Monday, November 19

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Prof. Kenneth Mason: "The Study of Threatening Glaciers".

IMPERIAL COLLEGE OF SCIENCE.—ROYAL SCHOOL OF MINES, at 5.30.—Prof. P. D. Quensel: "Problems of the Archæan and Iron Ore Formations of Middle Sweden" (succeeding lectures on November 20 and 22).*

ROYAL SOCIETY OF ARTS, at 8.—Dr. Herbert Dingle: "Modern Spectroscopy" (Cantor Lectures. Succeeding lectures on November 26 and December 3).

Tuesday, November 20

ROYAL STATISTICAL SOCIETY, at 5.15—at the Royal Society of Arts, John Street, Adelphi, W.C.2.—Prof. Major Greenwood: "University Education: its Recent History and Function" (Presidential Address).

KING'S COLLEGE, LONDON, at 5.30.—W. Allard: "Design of Channels and Structures—Silt—Losses—Salination".*

Wednesday, November 21

SOCIETY OF CHEMICAL INDUSTRY (PLASTICS GROUP), at 7.30.—K. M. Chance: "Urea Plastics" (Joint meeting with the Institute of the Plastics Industry).

ROYAL ENTOMOLOGICAL SOCIETY OF LONDON, at 8.—Miss Lucy E. Cheesman: "An Entomological Expedition to Papua".

Friday, November 23

ROYAL ASTRONOMICAL SOCIETY.—Discussion on "Lightning" to be opened by Dr. B. F. J. Schonland.

ROYAL INSTITUTION, at 9.—Prof. M. Polanyi: "Heavy Water in Chemistry".

Official Publications Received

GREAT BRITAIN AND IRELAND

Eton College Natural History Society. Annual Report, 1933-34. Pp. 43+5 plates. (Eton.) 5s.

Universities Bureau of the British Empire. Report of the Executive Council together with the Accounts of the Bureau for the Year 1st August 1933 to 31st July 1934. Pp. 22. (London: Universities Bureau of the British Empire.)

Department of Scientific and Industrial Research. Report of the Forest Products Research Board, with the Report of the Director of Forest Products Research for the Year 1933. Pp. vi+67+3 plates. (London: H.M. Stationery Office.) 1s. 3d. net.

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March 1934; with Appendices. Pp. 48. (London: H.M. Stationery Office.) 9d. net.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1575: Collected Reports on British High Speed Aircraft for the 1931 Schneider Trophy Contest. Pp. iii+100+60 plates. (London: H.M. Stationery Office.) 10s. net.

Report of the Council of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, intended to be presented at the Annual Meeting of the Society, 30th October 1934. Pp. 42. (Newcastle-upon-Tyne.)

University of London: University College. Calendar, Session 1934-1935. Pp. lxxx+12+576+28. (London: Taylor and Francis.)

Prospectus of Harper Adams Agricultural College, Newport, Shropshire. Pp. 28. (Newport.)

The Wellcome Research Institution and the Affiliated Research Laboratories and Museums, founded by Sir Henry Wellcome; and Exhibits at the Chicago Exposition, 1934. Pp. 90. (London: The Wellcome Foundation, Ltd.)

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 1, No. 9: A Study of a Tectibranch Gasteropod Mollusc, *Philine aperta* (L.). By Herbert H. Brown. Pp. 179-210. 4s. Vol. 58, Part 1, No. 10: The Life-History and Structure of *Hæmatopota puvialis*, Linné (Tabanidae). By Dr. A. E. Cameron. Pp. 211-250. 5s. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Proceedings of the Royal Society of Edinburgh. Vol. 54, Part 2, No. 16: On a New Species of *Psymphyllum* from the Upper Carboniferous of Scotland. By Jessie A. R. Wilson. Pp. 188-192+1 plate. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 9d.

Fifth Annual Reports of the National Radium Trust and Radium Commission, 1933-1934. (Cmd. 4711.) Pp. 34. (London: H.M. Stationery Office.) 9d. net.

North-East Coast Institution of Engineers and Shipbuilders (Incorporated). Report of the Council, 1933-34. Pp. 16. (Newcastle-upon-Tyne.)

The Institute of Chemistry of Great Britain and Ireland. Register of Fellows, Associates and Students. Pp. 414. (London.)

Svenska Ingenjörssällskapet i Storbritannien: The Society of Swedish Engineers in Great Britain, 1924-1934. Pp. 104. (London.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1601 (T. 3496): Accuracy of Performance Measurement. By J. L. Hutchinson and E. Finn. Pp. 5+4 plates. 6d. net. No. 1605 (F.M. 150): Abstract—Flow due to a Rotating Disc. By W. G. Cochran. Pp. 1. 2d. net. No. 1606 (T. 3303): Abstract—

Stresses Induced by Flexure in a Deep Rectangular Beam. By D. B. Smith and R. V. Southwell. Pp. 1. 2d. net. No. 1607 (T. 3290): Abstract—A Modification of Oseen's Approximate Equation for the Motion in Two Dimensions of a Viscous Incompressible Fluid. By R. V. Southwell and H. B. Squire. Pp. 1. 2d. net. No. 1610 (E.F. 297): Abstract—Analysis of Experimental Observations in Problems of Elastic Stability. By R. V. Southwell. Pp. 1. 2d. net. (London: H.M. Stationery Office.)

Battersea Polytechnic. Report of the Principal for the Session 1933-34. Pp. 41. (London: Battersea Polytechnic.)

Department of Scientific and Industrial Research. Report of the Committee on Mechanical Testing of Timber. Pp. vi+41+6 plates. (London: H.M. Stationery Office.) 1s. net.

OTHER COUNTRIES

Regenwaarnemingen in Nederlandsch-Indië, 1931. Pp. 113. (Batavia: Koninklijk Magnetisch en Meteorologisch Observatorium.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions: Vol. 89: 1^{re} partie, Procès-verbaux (Juin 1934). Pp. 64. (Copenhagen: Andr. Fred. Hest et fils.) 3.50 kr.

Bulletins of Indian Industries and Labour. No. 52: Proceedings of the Sixth Industries Conference (Held in Simla on the 9th, 10th and 11th July 1934). Pp. iii+167. (Delhi: Manager of Publications.) 2.6 rupees; 4s.

Anthropological Bulletins from the Zoological Survey of India. Bulletin No. 2: A Comparative Study of the Somatic Affinities of the Maithil and Kanaujia Brahmins of Behar. By Bajra Kumar Chatterjee. Pp. iv+69-216+plates 23-24. (Calcutta: Zoological Survey.) 4 rupees; 6s. 9d.

Memoirs of the Indian Museum. Vol. 11, No. 2: Studies on Indian Jassidae (Homoptera). Part 2: Description of the Genotypes of some of the Genera founded by W. L. Distant, with a Revision of the Genus *Moonia* Distant. By Dr. Hem Singh Pruthi. Pp. 69-99+plates 6-7. (Calcutta: Zoological Survey.) 1.10 rupees; 2s. 9d.

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