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CONTENTS

Anthropological Method and Native Administration

FROM almost the earliest days of the scientific observation of peoples of backward culture, it has been a commonplace of ethnographical literature to deplore the break-up of custom under the impact of European civilisation. This attitude of mind argues a certain confusion of thought. It is unquestionable that the contact of an individualistic economic and social system, such as that of Western culture, with a native society in which the unitary character of the group, whether of the family or tribe, with its attendant aura of religious sanctions, is paramount, has rendered more difficult the task of the investigator of non-European types of social institution and has caused the loss to science of data of high value for sociological studies; but it has to be remembered that this very material of which the contamination is regretted does not, probably in even a single instance, represent a homogeneous, or primitive, cultural phase.

The more intensive becomes the study of the character and 'make-up' of specific cultures, the more apparent does it become that, like the 'pure' race in the classification of the varieties of mankind, a 'primitive' culture is an abstraction, a logical postulate of sociological argument, of which the material counterpart, at this late date in the history of human development, is never likely to meet the eye of the explorer. Just as the existing races of mankind are the products of a long process of racial contact followed by opportunity for differential development, so the forms of social organisation which have hitherto provided the subject-matter of observation and record, are the results of cultural contacts, combinations of different strains of culture, which have attained a certain measure of stability in a period of isolation, partial or complete.

The disintegration of native custom is no new thing. In modern times it differs from previous manifestations of the effect of a clash of cultures, whether inferred from cultural analysis or recorded in history, only in the rapidity with which it is taking place and in the greater disparity of the conflicting elements. Even the latter factor may be too strongly stressed. It is indeed difficult to gauge the degree to which the present break-up of custom is more intense than those of the past. How great, for example, must have been the dislocation which resulted from the disparity in

culture when a sedentary agricultural people of settled habits was overrun by a tribe of war-like nomad pastoralists. The results may be seen in the anomalous social groupings which followed on the Aryan invasion of India or the spread of pastoral peoples over agricultural Africa. As a more familiar, if less extreme, example may be taken the change in social and economic organisation which supervened on the incursion of the Saxons into a Britain the inhabitants of which had attained a nice adjustment of tribal life to their capabilities in exploiting the land, or had become partially urbanised.

Where there has been a default of written records, these and similar hybrid cultures have had, perforce, to be studied each as an integral complex. Their previous history has been purely a matter of inference. As time goes on, however, there is a steadily increasing number of peoples of whom it is possible to say that there are records to show that their culture is no longer as it was first seen or described by the white man. For example, a recent account of female initiation in an African tribe records evidence for no less than four modifications of ceremonial within living memory. ("Valenge Women". By E. Dora Earthy. London, 1933.) The fact that the evidence for these modifications was afforded by native record does not affect the principle. For the present purpose the important point is that, so far as such cultural modifications may be regarded as corruptions of custom due to European contacts and therefore of negligible interest to the science of anthropology—as contrasted with forms of institution and belief recorded at the point of earliest contact—there is danger that the academic study of man may be divorced from actual conditions, to the detriment of the science as an aid in practical affairs.

For many years British anthropologists have urged that some knowledge of the principles of anthropological science is an essential element in the training of those who are to enter into official relations with the backward peoples of our dependencies, and a practical necessity in the successful administration of native affairs. Unfortunately, human nature is not cut to pattern, and the application of general principles to cases in, let us say, the heat of conflict between custom and authority has proved on occasion by no means so simple a function of the spirit as it may have seemed in an academic atmosphere. As a matter of experience, it has been found that to think out, or to inquire into the implications of custom in the light of scientific principles, makes a greater demand on the time and the mental flexibility of an already heavily burdened official than it is possible always to meet.

Under the administrative system known as 'indirect rule' the knot has been cut, as indeed was inevitable to meet the needs of the situation, by a direct record of law and custom as a working organism ; but such a record, however strictly the collection of data has conformed to the canons of scientific method, in so far as it is 'particular', is the raw material of anthropological science rather than a contribution to the scientific study of man as such. Nothing is added to the interpretation of general principles for the use of the administrator outside the immediate sphere of reference. The indisputable scientific value of the official records from West Africa and New Guinea, in the form in which they have been given to the public, is due to the non-essential fact that the collection of the data has been entrusted to officials who happened also to be trained anthropologists.

The ultimate aim of indirect rule is too big a question to raise here. It must suffice to point out that, for the present purpose, it may be regarded as static and conservative. In other areas, in which methods of administration have developed out of a traditional native policy—too often, perhaps, a lack of policy—however much heed may now be given to the preservation of native custom making for stability, there has been a steady drift towards the disintegration of native modes of life. This was an inevitable result of the conditions of white settlement and the exploitation of tropical and sub-tropical lands. Further, in times of stress, native institutions are apt to be set on one side, even when the subject of a pledge, as happened, for example, in the instance of the Kakamega goldfields in Kenya.

In these circumstances, it must be patent that the academic study of the science of man—more particularly of man as a member of an organised society, the subject matter of social anthropology —tends in an increasing degree to lose touch with the everyday problems of native life and administration. In academic studies, material recorded thirty or forty years ago may, and in nine cases out of ten will, have a greater significance than the conditions of to-day. For the administrator, the position is reversed. While it may be eminently desirable that he should have in mind the history of an institution, the important point

for his present purpose is the modified form assumed by, say, the chieftainship, or the tenure of property within the family, as a result of the contact of members of the tribe or family group with white civilisation, and the social and economic conditions which have been introduced thereby. Still more is it important that he should be able to gauge the course of further development by consideration of analogous conditions elsewhere.

Anthropologists in the United States have not been slow to grasp the implications of the changes which are taking place universally in the conditions of life among backward peoples. They are now turning their attention to the special methods of inquiry which these conditions demand. Dr. Margaret Mead, in her book "The Changing Culture of an Indian Tribe" (New York, 1932), has attacked the problem of the outcome of cultural contact on lines which, in part at least, belong to the methods of sociology rather than anthropology. Her work, however, points the direction in which a novel technique covering the methods of social studies and cultural anthropology must be developed to meet the special type of problem arising out of the growing industrialism of countries such as India, China and Japan, in which indigenous culture and the conditions of the modern factory worker meet and react.

Fortunately for the anthropologist, progress among the majority of peoples of non-European culture has not gone so far as to require that he should summon to his aid and adapt to his needs the special methods of sociological investigation in an industrial civilisation. The extent, however, to which changing conditions impose a modification of method and outlook upon the investigator who seeks to gauge the tendencies of development where there is a conflict of the two diverse cultures of the so-called 'primitive' and civilised worlds, may be estimated from certain recent publications, of which two are by an American investigator and one by a British anthropologist*. These three publications, though dealing with very diverse and widely separated peoples, nevertheless may legitimately be grouped together in virtue of a certain community of view. They mark a change in the orientation of research and, it would seem, open a new chapter in the literature of ethnography.

* (1) Modern Samoa: its Government and Changing Life. By Dr. Felix M. Keesing. Pp. 506. (London: George Allen and Unwin, Ltd., 1934.) 16*s*. net.
(2) Taming Philippine Headhunters: a Study of Government and of Cultural Change in Northern Luzon. By Dr. Felix M. Keesing and Marie Keesing. Pp. 288. (London: George Allen and Unwin, Ltd., 1934.) 10*s*. 6*d*. net.
(3) An African People in the Twentieth Century. By Dr. L. P. Mair. Pp. xvi+300+11 plates. (London: George Routledge and Sons, Ltd., 1934.) 12*s*. 6*d*. net.

Dr. Keesing's valuable study of present-day Samoa and his no less valuable account of his investigations among the hill tribes of Luzon, in which he gives special attention to the achievement of the United States administration, serve to illustrate the application of anthropological method to the diagnosis and treatment of current difficulties. His study of Samoa is particularly instructive, for his sketch of native culture as it was before modification by European control shows how far the troubles, which have kept Samoa 'in the news' for so long, were due to a failure to understand the specific character of Samoan social organisation.

Dr. Mair's study of Uganda stands in a somewhat different category; but her appointment to the recently created lectureship in Colonial administration at the London School of Economics gives it an added interest. Forty years ago the Baganda were what it was then fashionable to call 'naked savages', albeit they had a very fairly well-developed culture of their own. To-day they dress in European clothes and ride bicycles; but their problem is still to a large extent unsolved. How far they have progressed, and the direction, may be gauged by Dr. Mair's observations on the people and their reactions, and by contrasting them with the record made by the Rev. John Roscoe more than thirty years ago.

In relation to the more general question, it is perhaps permissible to suggest here that Dr. Mair's experience in the field will afford her the basis for developing her academic function in the direction of making her lectureship a link between the more academic side of anthropology and the scientific study of, and formulation of a practical policy in relation to, the changing habits of a people in the throes of a cultural conflict.

The present trend of development among peoples of backward culture, therefore, would seem to be leading in anthropological studies in relation to practical affairs to the old and familiar conflict between the 'man in the armchair' and the 'man on the spot', who claims an intimate acquaintance with conditions as they are and, therefore, assumes the sole right to decide upon them. Unless the science of anthropology, as understood academically, is prepared to adjust its outlook and to revise its methods to embrace the dynamic as well as the static elements in culture, it is by no means certain that, as in the past, the advantage will lie with those who rely on the results of academic training.

Art, Science and Morality

Beauty and other Forms of Value. By Prof. S. Alexander. Pp. x+305. (London: Macmillan and Co., Ltd., 1933.) 10*s.* 6*d.* net.

IN this work Prof. Alexander has applied what Hume called "the experimental method of reasoning" to the investigation of the whole range of values. Both the origin and the nature of beauty, truth and goodness are to be understood by considering how human beings came to value them for their own sakes and what human impulses produce them. The sciences of value are, as Hume thought they were, sciences of 'human nature'. Their method is psychological and anthropological. The differences between the higher or intrinsic values are to be explained as due to the different ways in which a human individual reacts 'contemplatively' to his natural and social environment, complicated by his instinctive need for conformity with his fellows. To account for the opposition between value and dis-value which is found in each of the spheres of art, science and morals, we have to recognise that judgments of value are not purely subjective, but are relative to the 'standard mind' of any given society. The measure of the truth of value-judgments is neither to be found in any a priori principles apprehended by reason nor in characters which belong to the object valued independently of the evaluator, but in the representative man who embodies the prevailing taste of the society in which he lives. Thus in order to account for the existence of standards of value, we do not need to abandon the 'experimental method' or the point of view of human nature. Anthropology and sociology will explain, where individual psychology cannot, how standards of value originate, compete and come to prevail.

The same method was applied by Prof. Alexander to reach very much the same results in "Space, Time and Deity". The most notable feature of the new work is a much more developed and complete exposition of his theory of beauty, which occupies the first half of the book. Truth and moral goodness are then briefly elucidated by considering the resemblances and differences between them and the value of fine art; and the 'lower' values of satisfaction in man and the animals are treated finally in relation to, and in contrast with, the 'higher' values.

The values of beauty, truth and goodness are not, in Prof. Alexander's view, qualities of the objects to which we attribute them. He describes them as "relations" between the objects which are called valuable and the evaluator. They are "tertiary" or relational qualities which are experienced as the satisfaction by the relevant objects of certain specific impulses in the mind when these have become, as Prof. Alexander puts it, "contemplative". Thus beauty consists in the satisfaction of the constructive impulse, truth in the satisfaction of curiosity, moral goodness in the satisfaction of the social impulse. In becoming "contemplative" these impulses are gratified for their own sake—not in the ordinary course of ordinary practical living—through the creation of a new product (a work of art in the case of beauty, an organisation of our passions and desires in the case of moral goodness, a scientific theory in the case of truth), which would not have existed but for the interference of the human mind with Nature. These products are created by the corresponding impulses for their own satisfaction; and with them the mind enters into a peculiarly intimate relation which confers value upon them. The higher values are thus relative to the mind, but they are not, Prof. Alexander insists, subjective; they are objective in the sense that they are relative to a 'standard' or typical mind.

Prof. Alexander's presentation of his case is intentionally descriptive rather than critical or controversial. This has its advantages as well as its disadvantages. Throughout the book he is anxious to let the facts speak for themselves and not to twist them in the interests of a metaphysical theory. The results of this are particularly valuable in his discussion of beauty, which is happily free from the vagueness and obscurity which are so common in the writings of philosophers on this subject. His theory of artistic value, which it is unfortunately impossible to discuss here in detail, is without doubt the most important contribution that any British thinker has made to the study of æsthetics in the present century. The same scrupulous respect for fact and sensitiveness to Nature in the concrete which influences his whole treatment is reflected in a singularly vivid and charming style, which is not content merely to describe and analyse, but goes on to present or re-create poetically the facts which he seeks to explain.

It is at the same time doubtful whether Prof. Alexander's adoption of a psychological or anthropological method can be justified, and his theory of a 'standard mind' as the basis of our judgments of value made convincing, without a more critical

defence of his general point of view than he has given. If the 'standard mind' represents the average level of opinion in any given society about what is true or good or beautiful, it is hard to see what authority it can claim for its verdicts. If, on the other hand, it represents the opinion of the 'expert' in science, art or morals, it must be pointed out that we submit our opinion to the expert's judgment because he knows what really is beautiful or true or good. The expert's judgment is authoritative not because it constitutes the standard but because it conforms to a standard which is 'objective' in the sense that it is independent of human opinions and tastes. Unless our standards of value are objective in this sense, it is hard to see how either progress or retrogression as opposed to mere change, in art, science or morals is possible, or how the question whether the civilisation of one community is or is not superior to that of another which differs from it can have any real significance. If there is any force in these objections, it will follow that the naturalistic method cannot explain what values are, though it may account for their origin and development in relation to the individual or the social group.

Termites and their Control

Termites and Termite Control: a Report to the Termite Investigations Committee. A Discussion of the Biology of Termites, and an Account of the Termites of the United States, Mexico, the Canal Zone, the West Indies, Hawaii, and the Philippine Islands, with Recommendations for Prevention and Control of Termite Damage by Methods of Construction and the Use of Chemically Treated and Unpalatable Woods. Editorial Board :—Prof. Charles A. Kofoid (Editor-in-Chief), Prof. S. F. Light, A. C. Horner, Prof. Merle Randall, Prof. W. B. Herms and Earl E. Bowe. Pp. xxvi+734. (Berkeley, Calif. : University of California Press ; London : Cambridge University Press, 1934.) 22*s.* 6*d.* net.

A REPORT of a local committee in San Francisco in 1927 attracted attention to the great damage done by termites in California. The public was alarmed and funds were quickly subscribed by various interests to finance an investigation committee, the report of which has just appeared. It is an elaborate work, the result of the collaboration of thirty-four authors, under a board of six editors. The board of directors of the committee consisted of twenty-four members, operating with thirteen sub-committees.

Although we are exempt from the attention of these insects in Great Britain and only two species are known in Europe, there are no less than fifty-five in the United States, the greater part of which are concentrated in the Pacific coast, thanks to the genial climate and contiguity of the neotropical region. Altogether, about fifteen hundred species are known ; twelve hundred of these form the family *Termitidæ*, which are dominant in the tropics, but do little damage. They are rather beneficial to human interests, in spite of their undeservedly bad reputation.

There remain three hundred species divided into four subfamilies which never rest in their function of breaking up cellulose and returning its elements to the atmosphere. Termites are among the few creatures that can digest this refractory material, which they do with the help of an abundant fauna of Protozoa in their intestines.

It is noteworthy that these do not occur in the *Termitidæ* which, living mainly on vegetable detritus, do not require their services. In some genera, and even subfamilies, it appears that each species has a characteristic fauna ; consequently their Protozoa are a great help in the identification and classification of the termites.

Further, H. Kirby has established the extraordinarily significant fact that similar Protozoa are found in the wood-boring cockroach *Cryptocercus punctulatus*, and that in the cockroaches the flagellate genus *Trichonympha*, which is widely distributed among the termites, is represented by several species. This is striking evidence in favour of the accepted view that the termites branched off from the ancestral cockroach towards the end of the Palæozoic era.

Their natural function as destroyers of cellulose brings termites into antagonism with man. It is estimated that the damage done by termites in the United States amounts to no less than 37,000,000 dollars per annum, three quarters of which is in the southern and western area. All wooden structures are mercilessly attacked—power transmission, telegraph and telephone poles, timber stacks, wooden buildings, and interior wooden structures, even furniture.

The use of steel for telegraph poles and railway sleepers, and increased use of cement in building, have reduced termite damage substantially in the tropical parts of the British Empire, but the actual and potential importance of the creature is so great, and so little investigation has been conducted into the problem, that this important work

should be welcome to architects, surveyors, engineers, indeed by all users of wood in the tropics, where it is estimated that termites add 10 per cent to the general cost of construction.

The two methods of attack are construction and treatment. Owing to the diversity of habits of the creature, the first need is to study the local termites and adapt methods accordingly. As an example of construction may be mentioned the raising of woodwork above the ground so as to eliminate moisture and prevent attack by those species which do not make runways.

A long series of laboratory experiments has shown that treated wood is proof only if rendered toxic. The most satisfactory results were obtained with copper sulphate, sodium chloride and zinc chloride. Paint is only a deterrent; fumigation and ground treatments are unsatisfactory; the best results against dry-wood termites were obtained by the use of poison dust, as Paris green, arsenical smelter dust and finely ground sodium fluosilicate. The extract of American redwoods, sequoyin and isosequein, two newly discovered substances with remarkable properties, were found to be highly toxic to termites.

Architects will find great interest in the last chapter with recommendations for construction, for inspection and maintenance, for preventing and repairing damage. It is to be noted that the engineer must often rob Peter to pay Paul, as construction and maintenance may be in conflict.

Conditions are so varied that no golden key can be found, but it seems that the impregnation of wood with coal-tar creosote by pressure treatment gives the most lasting and satisfactory results under severe conditions. As wood-frame construction has been recommended as the best design for resistance to earthquakes, it is especially necessary to take adequate action against these pests in regions so liable.

The work is placed upon the market at a minimum price, and results of sales will be applied for the benefit of further research. The biological portion is of very great interest to entomologists and is a notable addition to the literature of the subject, but the practical portion, on which the existing literature was quite inadequate, is of great value to all architects, engineers and users of wood engaged in construction in all tropical, and many subtropical, countries, and consequently of definite moment to officials and settlers in our African, Oriental and Australian dominions and territories.

M. B.

Industrial Organisation

The Logic of Industrial Organization. By Dr. P. Sargant Florence. Pp. xi+280. (London: Kegan Paul and Co., Ltd., 1933.) 10*s.* 6*d.* net.

FROM the author of such a work as the "Statistical Method in Economics" previously reviewed in these columns, one confidently looks for a clear and orderly presentation of the relevant facts and logical deduction therefrom; and in this latest book by Prof. Florence one is not disappointed. His main purpose is an examination of the structure and functioning of modern industry, to show how this structure and its working are for the most part anything but logical or even properly organised, and to suggest methods for remedying this serious defect.

At first sight one might suppose that the ideal of organised industry is that of a perfectly designed and constructed machine which, despite its almost infinite complexity, functions with the cold precision of a highly efficient machine on a thoroughly logical production schedule. One might suppose further that, if this ideal be completely realised, then the mechanisation of industry of which we hear so much would indeed be advanced to a terrible and ruthless stage, both literally and metaphorically: not only would industry throughout its entire length and breadth use the most efficient mechanical means available in all its operations, but industry itself would also be closely akin to a huge, complicated yet perfectly designed mechanism; and the evils of modern industry would be intensified a hundred-fold. If, for example, we already get over-production and under-employment owing to the increased efficiency and output of machines, to what almost inconceivable extent would this strangely combined excess of one and defect of the other be carried if industrial organisation itself could be likened to a giant machine of maximum efficiency? Of course if this ideal could be properly realised it might mean the total elimination of unemployment in some mysterious way that we cannot foresee, but this is most unlikely. However, such realisation is a very long way off, as this work clearly shows, and in any event this conception of industry as a huge soulless machine is certainly not that of the author.

Most emphatically no, for the human or psychological factors of modern industrialism are here given full weight and first consideration. The worker is not to be sacrificed to mere output, even

if he were a willing victim of such immolation; and the enlightened employer realises more and more clearly that, even from the point of view of maximum production if not from the higher humane and moral point of view, the workers must be treated as men and fellow-creatures, as members of one great brotherhood. If he does not realise it, then the workers very soon make their point of view clear to him and refuse to be exploited. In the present book one of the most valuable and interesting chapters is that dealing with labour stimulus and incentives, in which special emphasis is laid on those fundamental characteristics of human nature which so largely determine a man's attitude to his work and his reactions to the conditions of employment.

The aim kept in view throughout the book is that of industrial efficiency defined as maximum return—physical, pecuniary and psychological—at minimum physical, pecuniary and psychological cost; and a fairly thorough study is made, in general terms, of modern industry in Great Britain, with frequent references to Germany and the United States. A rapid survey of the whole subject matter may be readily obtained from the 'Conclusions' concisely stated in chap. ix, and one can readily see from a good index that among the many vital topics dealt with, administration and training for same, capital and investment, directors and their methods good and bad, labour and work conditions, transport, and so on, are fully treated.

The part played by education and training in industry is to-day of particular importance, and the author's criticism of English education from this point of view, though severe, will scarcely be deemed too drastic. He thinks that our educational system requires radical alteration if it is to help in supplying efficient industrial administrators. On the subject of unemployment the chief suggestion appears to be a more logical distribution of work, mainly by shorter hours, but this bald statement scarcely does justice to the author's contribution to this burning question of the hour. Chap. iv, dealing with investment, employment, management, deserves close and careful reading. Indeed, this applies to practically the whole work, for it sticks closely to the facts of our everyday working life, wastes few words on theorising or philosophical speculations, is nothing if not logical, and is for the most part in the straightforward indicative mood, though the optative—as with any humane writer however factual or statistical—must obtrude now and then.

Plant Analysis

Handbuch der Pflanzenanalyse. Herausgegeben von G. Klein. Band 4: *Spezielle Analyse.* Teil 3: *Organische Stoffe III, Besondere Methoden, Tabellen.* Hälfte 1. Pp. xii+838. Hälfte 2. Pp. vi+839–1868. (Wien und Berlin: Julius Springer, 1933.) 198 gold marks.

THE two volumes now under notice complete this comprehensive work, which has already been noticed in NATURE (130, 617, Oct. 22; 1932: 131, 8, Jan. 7; 132, 584; 1933). They deal, in the first volume, with the amino acids, amides, amines and the betaines, all written by Dr. A. Winterstein, the proteins compiled by Bergmann and Zervas, nucleins by Steudel and Peiser, alkaloids by Seka, cerebrosides by Thierfelder supplemented after his decease by Klenk, all being authorities of repute. In the second volume, Dr. Sjöberg discusses enzymes in general, whilst Dr. Ziese deals with them in detail. The plant antigens are described by Eisler, the plant hormones by Loewe, plant vitamins by Winterstein.

A final section deals at length with special methods of biological analysis, soil analysis; it has a chapter descriptive of the various fermentation processes by Kobel and Neuberg, another handling the nitrogen balance and a very valuable section on plant pigment analysis by chromotographic adsorption methods by Winterstein.

The work concludes with more than 300 pages of tables and index in which all the known plant constituents are listed in alphabetical order with their formulæ, physical constants and solubility.

The above details indicate merely the wide scope of the work, so that it is necessary to testify also to the thoroughness and completeness with which the respective subjects are put on record.

Since our previous review was written, we and several of our younger colleagues have had opportunity to make frequent reference to the earlier volumes, which have proved to be of the greatest use: it is only fair therefore to accord to Dr. G. Klein, the editor-in-chief of the monumental work, the appreciation of those who are working in the field of plant chemistry. It is one which for some time past has been largely neglected, in part owing to the superior attraction offered by problems in animal chemistry, especially the vitamins; but there are signs of a change in fashion, and the problems of the plant are now attracting the attention of many of the younger workers. To them such a summary at the present time is of importance

not only for the information it contains, but also because it is definitely stimulating in indicating the loopholes and the possibilities for new work.

A word of praise must be given also to the publishers for their enterprise, even if tempered with some expression of regret at the price which is charged. Expressed in our currency, the cost puts the ownership of the book outside the reach of all but the most wealthy library, whereas it ought to be widely available for reference purposes.

It is obviously out of the question to attempt any detailed analysis; rather must the book be viewed as a whole, as a record of the present state of knowledge of plant products discovered by the organic chemist. Very nearly all the substances have yielded to his artifices, many only during the last decade; in spite of their complexity, fats, sugars including starch and cellulose, the proteins, alkaloids, saponins, nucleic acids, the plant colours, all have their secrets laid bare—only a few details as to their configuration are withheld. The attack is now on the most complicated constituents of the cell, on the ferments, the hormones and the more complex proteins. Here and there may be found isolated compounds to be investigated among the glycosides, the arrow poisons or elsewhere; but the time has come to establish group relationships, to correlate structure with physiological activity, to seek the origins and the function of compounds of such complexity in plant life.

Had the achievement been a literary one, there would have been the excuse to rhapsodise over its greatness, to bestow laurel crowns; but in science it is otherwise—we are accustomed to pass quickly from the problem solved to the many more which await us, each new worker taking up the torch from the fallen, content to add his mite to the general store of advancing knowledge.

E. F. A.

Short Reviews

Weather: the Nature of Weather Changes from Day to Day. By the Hon. Ralph Abercromby. New edition, revised and largely rewritten, by A. H. R. Goldie. Pp. xii+274+8 plates. (London: Kegan Paul and Co., Ltd., 1934.) 10*s*. 6*d*. net.

THE original edition of this work by the Hon. Ralph Abercromby appeared in 1887 and attracted much attention, passing through seven editions without change. Abercromby set out very effectively the principles of synoptic meteorology, and his generalisations and ideas have become classical. The early hopes of forecasting weather from the travel of cyclones and maps of limited area were not, however, realised, and it is now accepted that 'the whole world is the meteorologist's laboratory'. In the new edition, Mr. Goldie has developed the physical principles and included present-day knowledge of the upper air and modern theories. A recent weather chart of the northern hemisphere shows the enormous advance which has been made in organising observations.

The book is fully illustrated and includes some fine cloud photographs, and these are discussed in relation to the synoptic charts. Bibliographies are given which cover matters that could not be treated completely in the text. Many interesting examples of weather are described in detail with the help of charts and diagrams. The style is clear and will appeal to the general reader as well as the student. Almost every aspect of the subject is discussed, including the Bergen theory of cyclones, the relation of wind to pressure distribution, line-squalls and thunderstorms, visibility and fog, tornadoes and the general circulation—all matters of great practical importance.

АТОМНОЕ ЯДРО (*The Atomic Nucleus*). Edited by M. P. Bronstein, W. M. Dukelski, D. D. Iwanenko and U. W. Khariton. (Problems of Modern Physics, No. 24.) Pp. 227. (Leningrad and Moscow: Izdatel'stvo, 1934.) 3 rub.

THIS book (in Russian) consists in the main part of the description of papers, which were contributed to the First All Russia Atomic Nucleus Congress held in Leningrad on September 24–30, 1933, together with some of the discussions that followed. Eleven papers are included.

The contents start with a paper by F. Joliot on neutrons, which is a summary of present-day knowledge of neutrons, description of the methods of production and conditions of their emission, and finally a discussion of their possible mass. Then follow two rather theoretical papers by F. Perrin and D. Iwanenko on the constitutive parts or units in atomic nuclei. After a paper by D. Skobeltzyn on the problems of cosmic rays, positron theory is discussed in two papers by P. A. M. Dirac and F. Joliot.

Methods used for obtaining high-speed electrons and ions are described by K. Sinelnikow, particularly the methods in use at the Ukraine Physico-Technical Institute in Kharkov, where an impulse generator of 1·5 millions volts produced electrons fairly readily with the speed of 1·3 million volts.

There are also papers by L. Gray, S. Frisch and F. Raselli.

The last paper, by A. Leipunski, deals with the breaking down of atoms and gives a summary of recent work done by Lord Rutherford and co-workers.

Coast Erosion and Protection. By the late Prof. E. R. Matthews. Third edition revised, with an additional chapter and an appendix, by Dr. Brysson Cunningham. Pp. xviii+228+36 plates. (London: Charles Griffin and Co., Ltd., 1934.) 12*s.* 6*d.* net.

THIS work, which is the third edition of the late Prof. Matthews's book on coast erosion and protection, consists very largely of a record of the long experience of the author in dealing with these problems. It deals with the erosion and accretion that is taking place around the coasts of Great Britain and with the various types of sea defences, the merits and defects of each type being discussed in detail. There is some discussion of the action of sea water on concrete, while the effect of harbour projections on the travel of sand and shingle is briefly referred to. The present edition also contains a chapter on recent practice, by Dr. Brysson Cunningham, and an appendix giving the conclusions on coast protection drawn up for the International Association of Navigation Engineers in 1931.

The book is based mainly on papers read by Prof. Matthews before various learned societies, and articles contributed by him to technical journals at different times. These have been collated, and are presented in a somewhat disjointed form. The illustrations are lavish. There are many useful detailed sketches of existing sea walls, groynes and breakwaters, and a very large number of photographs, excellent in their way but of no particular technical value, illustrating the breaking of waves on sea walls and breakwaters, cases of cliff erosion, and the like. As a record of the personal experience of Prof. Matthews, the book should be of use to the engineer engaged in similar work.

Biologie der Tiere Deutschlands. Herausgegeben von Prof. Dr. Paul Schulze. Lieferung 36: Teil 26, *Orthopteroidea* I. Von Max Beier. Pp. 231. (Berlin: Gebrüder Borntraeger, 1933.) 16 gold marks.

THE present part of this work contains three chapters respectively on the Blattoids (cockroaches), the Dermaptera (earwigs), both by M. Beier, and on the Mantids (praying insects) by M. Beier and J. Jaus. The longest of these is the first (116 pp.) which forms an admirable account of the external features, internal anatomy, life-history and physiology of the cockroach, based chiefly on *Phyllodromia germanica.* Particular attention is given to the structure and physiology of the nervous system and the alimentary tract. The account forms an excellent source of reference for information, brought well up to date, on this much-used laboratory type.

The description of the earwig (63 pp.) based chiefly on *Forficula auricularia,* which will also be useful to British students, follows similar lines with the addition of a short section on the chromosome numbers $-22+2x$ in female and $22+xy$ in the male and on the variation in size in the cerci.

The chapter on the Mantids, largely on *Mantis religiosa,* directs attention to several special features of interest, for example, the pigment change in the compound eyes in the evening, the chromosome constitution of male and female, neoteny and regeneration.

The illustrations of all the chapters are well chosen and admirably reproduced, and to each chapter a useful bibliography is appended.

The Statesman's Year-Book: Statistical and Historical Annual of the States of the World for the Year 1934. Edited by Dr. M. Epstein. Seventy-first Annual Publication: Revised after Official Returns. Pp. xxxiv+1478. (London: Macmillan and Co., Ltd., 1934.) 20*s.* net.

AGAIN this invaluable work of reference provides not merely a statistical guide to the countries of the world, their area, population, production, trade and finance, but also an epitome of almost every aspect of public life. The arrangement follows the usual plan, the British Empire with nearly a third of the book, followed by the United States dealt with as a whole and then by each State in turn, and finally other countries arranged alphabetically with the overseas possessions belonging to each. All the figures have been revised by the latest returns available. A year that has seen turmoil in several States has not witnessed any material changes of boundary. The adjustment between Iraq and Syria is shown on one of the two maps, the other of which illustrates the progress of French civil administration into the interior of Morocco during recent years. The introductory tables, which might well be increased in number if space allowed, give the world's production of petroleum, iron and steel, cocoa, gold and cotton, and the world's fleets and mercantile marines. There is a summary of the work of the League of Nations.

The Kinetics of Reactions in Solution. By Dr. E. A. Moelwyn-Hughes. Pp. vii+313. (Oxford: Clarendon Press; London: Oxford University Press, 1933.) 15*s.* net.

A GENERATION back the application of the kinetic theory to chemistry was restricted to the reactions which occur in gases. Progress has enabled reactions in solutions to be examined in the light of the same theory with satisfactory results. The author has selected certain representative examples for his purpose and has produced a treatise which will undoubtedly be of value to the advanced student and worker in physical chemistry. The scope is best illustrated by the table of contents; the respective chapters deal with the collision theory, the Arrhenius equation, a comparison of the kinetics of reactions in the gaseous phase and in solution, and then pass on to bimolecular and unimolecular reactions, equilibria, ionic, catalysed and heterogeneous reactions.

Fifty Years Ago, in the Royal Society of Edinburgh*

By PROF. D'ARCY WENTWORTH THOMPSON, C.B., F.R.S.

THE Royal Society of Edinburgh was a hundred years old just fifty years ago. We are looking back across those fifty years as on a remembered road whereon we all have travelled. Let us step across Princes Street, and pay a visit to the former habitation of the Society.

We pass through a vestibule and enter those beautiful apartments, one opening into another, at which some of us still glance enviously through the tall pillared windows at the foot of the Mound. In the first room, surrounded by books, at a table which we use still, an old man sat reading all day long. It was said of him that few men had absorbed more learning, and exuded less! He was the Society's librarian, Mr. James Gordon. He wore a long, wide-skirted frock-coat, and a black satin stock came close up to his clean-shaven chin. He had a shy but dignified manner, and a hesitation, almost a stammer, in his speech. He wrote the easy, fluent sonorous Latin of the cosmopolitan scholar, and loved to write addresses to be sent abroad to some university or academy. He wrote such a one when Wyville Thomson went to Uppsala for the Linnean Centenary in 1878; and I remember hearing Wyville tell how much it had been admired by the Swedes. So we looked for it the other day and found it in our minutes: *Amplissimis Curatoribus, Rectori Magnifico, Doctissimoque Senatui Universitatis Upsaliensis*:—and so on!

In the next room, a long and beautiful room, our meetings were held. Five large windows looked out on the Castle and the Gardens; but the meetings were at eight o'clock, and the curtains were drawn. Opposite the windows the bookcases were kept low, and there the portraits hung:—our Walter Scott, and Sir James D. Forbes, and Sir David Brewster, and Sir T. Makdougall-Brisbane, and Raeburn's portrait of old John Robison, and later on George Reid's portraits of Christison and of Tait. Half-way up the room, on the window-side, was the president's chair, raised a little, and the table where (as now) the secretaries and other officers sat. On the far side, looking down the room towards the entrance, Tait sat for nearly forty years. I think of Crum Brown, wearing his little velvet cap, sitting beside Tait; of Buchan, at the opposite corner, stroking now and then his long red-brown beard; and Kelvin's eager restless figure in the chair.

Let us recall a certain older meeting, of not fifty but sixty years ago, sixty years almost to a day. David Milne-Home was in the chair, and papers of the usual kind were being read. George Forbes (to-day the oldest of our fellows, save one), son of Tait's illustrious predecessor, talked of an optical illusion which Tait had noticed one sleepless night. Edward Sang had something to say on the properties of fluid drops within crystal cavities; and then a paper was read by a young author, rather a dull paper, on the "Thermal Influence of Forests". It dealt with the island of Malta, where the chairman had a scheme for the planting of trees. It made a good show of meteorological learning, quoting Réaumur, Humboldt, Becquerel, Boussingault, and Scoresby-Jackson's "Medical Climatology". Its style was technical and scientific, rather than literary:—"In addition to the ordinary hours of observation, special readings of the thermometer should be made as often as possible at a change of wind, in order to admit of the recognition and extension of Herr Rivoli's comparison":—and so on. It was almost the first thing the author ever published, and the only scientific thing he ever wrote. He did better, much better, later on, when he wrote a book called "Treasure Island"!

Two events influenced our Society and the scientific world of Edinburgh fifty and sixty years ago. One was the return of the *Challenger* Expedition; the other was the publication of the famous ninth edition of the "Britannica". Just as Robison and Playfair and Brewster and Dugald Stewart, and other members of our young Society, had been contributors to earlier editions, so fifty and sixty years ago, under Baynes and Robertson Smith, scientific Edinburgh was kept busy writing articles, and who should do this and who should get that was discussed eagerly. I can remember a little outburst of Tait's when "Astronomy" went to a certain popular writer whom Tait held to be outside the pale! But soon afterwards, Clerk Maxwell drew up a scheme for the chief scientific articles, and began by writing the article "Atom", in which Kelvin's vortex-atoms, by the way, had full justice done them; and then he wrote his beautiful article "Capillarity"; and Tait wrote on "Light" and on "Mechanics"; and Chrystal wrote famous articles on "Electricity" and "Magnetism"; and Crum Brown wrote a most original article on "Molecule". Besides these and such as these, there were endless biographical articles: Tait's on Sir Wm. Rowan Hamilton among the chief, and Chrystal's on Pascal, Poisson, Riemann and many more. It was a busy time when all these were being written.

As the Encyclopaedia brought the learning of Great Britain to an Edinburgh printing house, so did the *Challenger* Expedition make Edinburgh a centre for the naturalists of the world. Wyville Thomson was a weary man and out of health when he came home from the sea, and he died before his work was done. John Murray, the strong, able man who took his place and filled it bravely,

* Part of an address delivered in Edinburgh on Monday, May 7, 1934, on the occasion of the Society's hundred and fiftieth anniversary.

has overshadowed Wyville's name and memory; but we few who knew him hold him in honour and affection. He had begun as a boy-naturalist by the East Lothian shore, as did old Sir John Graham Dalyell and Francis Maitland Balfour and many and many another. He came under the potent influence of Edward Forbes, who, with Goodsir, was the first to borrow the oysterman's dredge and begin the endless task of the exploration of the sea. With Carpenter, Wyville explored our western waters in the *Porcupine*, and made the cardinal discovery of the warm and cold waters of the Faeroe Channel, on either side of the submarine ridge which bears his name. We owe to him the grandiose conception, the splendid programme and the immense achievement of the *Challenger* Expedition; and the planning on a noble scale of the publication of its results. He saw before he died a few parts of the great publication.

Wyville Thomson was a kindly man and faithful to his friends. He would search all Europe and America too to find the best man to deal with this group of animals or that; but if he found no such specialist he would pick out some friendly naturalist at home or some young pupil of his own. So he gave a certain large group to a very young student, my school-fellow Willie (afterwards Sir William) Herdman; and Herdman brought his first reports before this Society, and became in time the chief authority on the Tunicates in the world.

Herdman was a schoolboy at the Edinburgh Academy sixty years ago, and three other boys, sitting in the same small class, all became fellows of this Society; to one of these four, Dr. J. S. Haldane, we are to-day paying the highest compliment in our power! Some five and twenty years before, other four boys were at the Academy together, all fellows of our Society in after years—Tait and Fleeming Jenkin and Lewis Campbell, and Clerk Maxwell, who towers over all. Maxwell paid our Society his first visit when he was twelve years old. At fifteen he wrote his first paper for us, on "The Properties of certain Oval Curves"; and when he was sixteen, a student under J. D. Forbes, he wrote another, on "Rolling Curves or Roulettes". But Forbes had to read both of these papers, for it was not thought proper for a boy in a round jacket to address the Society! We have just had the rare luck to discover the MS. of the former paper, in Maxwell's schoolboy hand, together with Forbes's report or epitome; which latter, and not the paper itself, was published, in 1846, in our *Proceedings*.

Let us think of a few more who were men of mark here fifty years ago. As to Lord Kelvin, I can add nothing to what has been so often said, of one who is so well remembered. He was a fellow of the Society for sixty years. His papers on the theory of heat, on hydrodynamical questions, on vortex atoms, on gyrostats, on close-packing of atoms and what not more, adorned our *Transactions* for a long generation. He was the unquestioned leader of the Society, the master of all. He was president until his death, except for the few years when that office was incompatible with his presidency of the Royal Society of London.

Alexander Buchan sat at the table for years as treasurer, a tall and striking figure. He was a humorous man, and showed it by the twinkle in his eye. He said once: "Everybody thinks me taller than I am, and wiser than I am, and better than I am"—this last having something to do with the fact that he was an elder under Dr. Whyte in Free St. George's! The 'spells' which have made his name a household word have little to do with his real fame. Seventy years ago he had mapped the isobars and isotherms of the world, and laid the foundations of all we know of atmospheric circulation. He was probably the very first to show that weather 'travels': on which cardinal fact all our weather-forecasting depends.

Fifty years ago Prof. Turner (not yet Sir William) was one of the secretaries to our ordinary meetings, and in 1908, when Kelvin died, he became by acclamation president of the Society. There is scarcely anyone of whom I have so old a memory; for I remember one day, in the year 1867, an uncle of mine rushing into our house, waving his arms, and crying "Turner's got it"! I told Turner so fifty years after, in the Athenæum. He was extraordinarily delighted; he laughed and chuckled; he made me say it all over again. For that had been the great day of his life, when he was elected to Goodsir's chair, after a hard fight with Struthers—to the boundless delight of all the younger men.

Turner lived so long that we can all remember him: his sturdy figure, his rapid walk, his little shake of the head; the twinkle of his eye, his dominant personality. He was a trifle pompous sometimes, and fond of the verbiage of the anatomists. He came along when I was doing my first day's work in the old dissecting-room: "Well, what have you got?" said he. "An arm, sir," said I, very timidly. "Call it a superior extremity; it's so much more precise!" As a demonstrator he was superb. One did not forget one's lesson in a hurry, when Turner had held up nerve or artery in his forceps, and told their names with such a look and voice as though the world depended on them. Of the papers which he read before our Society, many were about whales; for he inherited a lifelong interest in these great beasts from Knox and Goodsir. Turner had none of the poetry, imagination or insight of Goodsir. But there was nothing Turner touched that he did not do with all his might; his love of his subject, his faith and enthusiasm, never flagged for a moment. He was a teacher and a master of men. He fairly won and manifestly deserved the honours that were heaped upon him.

Fifty years and one more year ago, Benjamin Peach was put in charge of the geological survey of the North-West Highlands. Then began a

famous chapter in the history of geology, and the unravelling of one of the most difficult regions in the world. It was Peach who first showed the unconformity between the Cambrian rocks and the still older strata ; he studied the stupendous thrusts of the great rock-masses of the north-west ; and he delighted in the old Cambrian fossils of Durness, which his father, coastguardsman at Wick, had been the first to discover. I do not know that Charles Peach, the father, was ever a member of this Society ; but I will not let his name, nor his son's name, pass, without paying something of the debt he laid me under. He was a famous naturalist of the old simple school. I and two or three others came under his spell when he was very old and we were boys ; and what he taught us, and the love of living things he shared with us, has been worth much to me. What he taught his son was a great deal more. It made him one of the keenest observers, one of the greatest palæontologists and geologists of his time. Both father and son were men of unusual strength and immense vitality ; their voices and their laughter come ringing down the years !

Dr. Edward Sang, teacher of mathematics, died some forty years ago ; he had been a candidate for the natural philosophy chair when Tait won it over Clerk Maxwell. Fifty years ago, an old man, Sang was busy constructing his wonderful tables of logarithms, which have never been printed but are among the Society's most prized possessions. They were among the first tables to be independently calculated since Briggs and Vlacq made theirs, immediately after the "Canon Mirificus". All but a hundred years ago, Sang had read a paper to our Society on Nicol's polarising prism—Nicol being an Edinburgh optician who had just invented this indispensable instrument. Sang's paper was never published, no one knows why ; and when he was dying he spoke of it to Tait, and said he thought he had never written a better thing. Tait made instant search for the paper, had it read and printed, but poor Sang was dead. Had it been published when it was written it would have been one of the important scientific papers of the time ; it contained things which were not said again for nearly fifty years.

John Aitken of Falkirk also lived to a great age, and was a notable figure of our Society fifty years ago. The greatest of all discoverers are those who discover the simplest things, and John Aitken was one of these. "Why is one's breath visible on a frosty day ?" was a question asked, by James Hutton, in one of the first papers ever read before this Society : and Aitken answered it, a hundred years later, in his papers on dust and fog and cloud. How fog and cloud, and all the colours of the sunset, are due to dust-particles in the air, dust far smaller than the motes in a sunbeam ; how and why the colours of the sunset were intensified fifty years ago, after the eruption of Krakatoa ; how and why and when the 'New Moon holds the Old Moon in her arms'—these are some of the things that John Aitken has explained.

George Chrystal came to Edinburgh five and fifty years ago, welcomed with exuberant delight by Tait and others. He was physicist as well as mathematician. He had been one of the first pupils in the Cavendish Laboratory, where Maxwell set him to work on Ohm's law. When he had done, Maxwell said that seldom or never had so searching a test been applied to an empirical law ; and he added the curious remark that the way it had stood the test encouraged one to believe that the very simplicity of a physical law might be taken as some indication of its exactness ! In later years Chrystal became interested in the oscillations or solitary waves on certain lakes, to which, in Switzerland, Forel had given the name of seiches. Here he found simple experiment and difficult mathematics after his own heart ; and the work which he and a certain younger member of this Society did on seiches is as beautiful and as complete an investigation as was ever brought before our Society.

When Chrystal went to Cambridge he found it (as he afterwards said) "almost decadent as an educational institution" ; while in Cayley, Stokes, Adams, Maxwell, it had perhaps the greatest galaxy of talent in all its history ! Chrystal became an enthusiast for education, striving to do here what the Cavendish Laboratory was doing and has done in Cambridge : giving mathematics a meaning, direction and purpose, of which the coach and the examiner had not dreamed. I was in our College Library a day or two ago, and two lads were reading diligently near by. I had the curiosity to look at the books they left behind, and both had been reading Chrystal's "Algebra". I opened the book at a random page ; the chapter was on certain transformations of circular functions ; but the interesting thing was to see how Chrystal guided the student, in a few lines, to Riemann on one hand and Cayley on the other ; and then to Maxwell and his lines of force and equipotential, and so to an endless variety of physical problems. Between such algebra, a weapon in the hand of the physicist, and the algebra of the old school-books, there is all the difference in the world.

With a certain peculiar affection we look back upon Crum Brown. He was one of our secretaries for a quarter of a century and a member of Council for more than forty years. I have already spoken of him sitting quietly at the table, with his little velvet cap upon his head, keenly alive to everything but speaking seldom. Once indeed he brought down the house, with a sort of magic bottle, which squeaked out vowel sounds in a voice not unlike his own, and in so doing demolished a theory of Fleeming Jenkin's to which the Society had listened a few nights before. We students behaved none too well during his lectures, from which we came across the quadrangle to sit quiet as mice under Tait. But we learned afterwards how fine, how erudite, how prescient, how suggestive, how educative Crum Brown's lectures had been.

He was a man of very great originality; he was always before his time. When he took his degree, at three-and-twenty, his thesis "On the Theory of Chemical Combination" won no prize, nor was it printed until many years afterwards; but it was a wonderful exposition of structural chemistry, and contained a system of graphic formulæ, undreamed of at the time, but to all intents and purposes that which came ultimately into universal use. He began teaching in a little extra-mural laboratory of his own in High School Yards, to the smallest of classes. He used to come down to our house of an evening and say (in a voice that some of us can still hear): "As I was saying to my man to-day!"—this was his only student. The great John Hunter himself had once no more! But when the University chair became vacant on Lyon Playfair's retirement, Crum Brown was known to and recommended by Bunsen, Hofmann, Wöhler, Baeyer, Kolbe, Beilstein—in short, by the greatest chemists of the day.

He was a man of insatiable curiosity, interested in what he did not know more than in what he knew. He wrote an important paper on the semicircular canals of the ear and their functions; and illustrated it by curious experiments and exquisite anatomical preparations. He had a passion for making models, geometrical and other. There were times when the glue-pot was always by his fire, and cardboard always ready to his hand; when he was very old indeed he lay quietly knitting, and the little mats he knitted were recondite models of interlaced figures and interwoven surfaces. He had both of these hobbies in common with Maxwell. For Maxwell had made some of the same models when he was a schoolboy, and his are in the Cavendish Laboratory to this day; and he once knitted a kettle-holder gayer than the rainbow, for it depicted a square of unannealed glass placed between crossed Nicol's prisms.

Crum Brown was at heart a mathematician. He said that unless the young chemist learns "the imperial language of science", the higher branches of chemistry (which require reason as well as skill) will pass out of his hands.

I sat in Tait's classroom for the first time well-nigh sixty years ago; and I remember as if it were yesterday the opening lecture which he gave. It was on the rainbow and the aurora—and the moral of it was to show how, of two phenomena, one may have been brought within the knowledge and comprehension of mankind, while the other, no less common nor less beautiful, remains a mysterious pageant beyond our ken. The days went by and every morning Tait gave us of his best; and all he taught us seemed to be just what we had most wanted to know. We also learned the very important lesson (as Prof. Flint long afterwards said) that here was a man whose mind was immeasurably greater than our own.

Tait played with schoolboy zest when it was playtime, and turned easily from work to play. Kelvin said of him that he had made the writing of "T. and T′ " a perpetual joke; his papers here on "Knots" were one long game—always with the joke behind it that in four dimensions there would be no knots at all! Even in class, once in a way, when he had drawn a freehand circle on the board or skilfully thrown a skipping-rope into waves, his eye would meet ours in momentary triumph and schoolboy comradeship. But in fact Tait's life was one of arduous and almost continuous labour; play there might be, but idleness never; and with duty nothing was ever suffered to interfere. Until the end grew near, when his natural strength abated and sorrow came at the last, he kept the light heart and the happy laughter of a boy; and we who were his pupils, forty, fifty and sixty years ago, still think of him with love, honour and gratitude, and know by a lifetime's experience how rare and exceptional were his qualities of heart and mind.

Muḥammad Ibn Umail: an Early Muslim Alchemist

NEARLY twelve years ago, it was mentioned in NATURE of October 28, 1922, p. 574 that a well-known Latin alchemical treatise entitled "Epistola Solis ad Lunam Crescentem" was apparently a translation of the Arabic work "Risālatu'l-shams ilā al-hilāl (Letter of the Sun to the New Moon) by Muḥammad ibn Umail al-Tamimi. This suggestion has been confirmed by Messrs. Muḥammad Turab Ali, H. E. Stapleton and M. Hidayat Husain, who, in a lengthy and valuable communication to the *Memoirs of the Asiatic Society of Bengal* (vol. 12, No. 1, pp. 1–213; 1933), have published the Arabic text of (*a*) the Risāla, (*b*) a prose commentary on the Risāla, by the author himself, entitled "Al-mā' al-waraqī wa'l-arḍ an-najmīyah" (Book of the Silvery Water and Starry Earth), and (*c*) a further poem of Ibn Umail's, entitled "Al-qasīdat an-nūnīyah" (Poem rhyming in Nūn). The edition of the texts is the work of Mr. M. Turab Ali; Messrs. Stapleton and Hidayat Husain contribute an excursus on the date, writings and place in alchemical history of Ibn Umail; an edition, with glossary, of an early medieval Latin rendering of the first half of the Mā' al-waraqī; and a descriptive index, chiefly of the alchemical authorities quoted by Ibn Umail.

Ibn Umail was formerly believed to have flourished in the second half of the third century A.H. (that is, A.D. 864–912), but it is now shown that this date is too early. Upon evidence deduced from the period at which his friends, and authors he makes use of, are known to have lived, it appears that his life probably covered the years from 900 to at least 960 A.D., and that his writings are consequently later than those of Razi (Rhazes).

The statement of the bibliographer Ḥājjī Khalifa that his name was not pronounced Amyal (as has sometimes been supposed), but Umail, is confirmed by the vowel points placed on the name in the Leningrad manuscript of the work. It might, however, be mentioned in this connexion that Ḥājjī Abdu'l-Muhyī, who possesses a very extensive acquaintance with Arabic alchemical literature, and whom the present writer consulted on the point a few years ago, was emphatically of opinion that the correct pronunciation was Amyal. The Latin transcription Hamuel would support the latter as against Umail; it is therefore difficult to arrive at a final decision.

The importance of Ibn Umail's work lies in its early date; in its possible affiliations with the celebrated "Turba philosophorum", the "Shawāhīd" of Razi, and a treatise by the little-known alchemist Mahraris; and in its richly detailed picture of Muslim alchemical thought of the tenth century. Messrs. Stapleton and Husain promise us a detailed study of the text of the Mā' al-waraqī and its comparison with the work of Razi just mentioned, as soon as leisure from their official duties permits. Meanwhile, an inspection of the Arabic version side by side with the Latin translation shows that while the latter is a creditable production for its age, the translator made a great many slips and not seldom failed completely to understand his author. Those historians who can read Ibn Umail in the original will find an abundant store of important and interesting information in Mr. Turab Ali's carefully edited text; but the general reader of alchemical literature must impatiently await an annotated English translation and hope that Mr. Stapleton may not long delay it.

The descriptive index of names of people, countries, places and books mentioned in the Mā' al-waraqī, with its Latin rendering, and in the Qasīdat an-nūnīyah, is largely the work of Prof. Maqbul Ahmad, of Presidency College, Calcutta. It is by no means the least valuable part of the treatise, for it throws considerable light on those personages, real or fictitious, then regarded as authorities, and shows at a glance the books most frequently quoted and therefore presumably esteemed most highly. We note, for example, that Jābir ibn Ḥayyān is mentioned 31 times, Mary the Jewess 27 times, and Hermes no fewer than 51 times. But we feel that we should like to know more of Abu'l-Qāsim 'Abdu'l-Maḥmūd ibn Ḥayyān, an unsuccessful alchemist and contemporary of Ibn Umail, who worked for twenty-three years without letting his furnace go out!

E. J. HOLMYARD.

Obituary

PROF. E. W. HOBSON, F.R.S.

ERNEST WILLIAM HOBSON, who was born at Derby on October 27, 1856, and died rather suddenly, after a short illness, on April 19, 1933, had been for many years one of the first of English mathematicians. Although he lived to be seventy-six, he was active almost up to his death; his last book (and perhaps in some ways his best) was published when he was seventy-four. He was a singular exception to the general rule that good mathematicians do their best work when they are young.

Hobson was the son of William Hobson, who was editor and part proprietor of the *Derbyshire Advertiser*, and was prominent in municipal affairs. He was the eldest of a family of six, J. A. Hobson, the well-known economist, being one of his brothers. His early education was at Derby School, where his mathematical talents were very soon noticed and encouraged. When he was fifteen he obtained a Whitworth Scholarship at what is now the Royal College of Science, and studied physics in London for a short time under Dr. F. G. Guthrie. Two years later he was elected a mathematical scholar of Christ's College, Cambridge. He went into residence in October 1874, 'coached' with Routh, and was Senior Wrangler in 1878.

A Senior Wrangler of those days succeeded almost as of right to a fellowship, and Hobson became a fellow of Christ's, and a lecturer in mathematics, in the autumn of the same year. He also did a good deal of private coaching. In 1883 he was made one of the first University lecturers in mathematics. But 'research' meant much less for a college and even for a university lecturer then than it does now, and Hobson wrote very little, and that of little importance, in his early years. His Royal Society memoir on spherical harmonics, which is now classical, and is the first of the papers on which his reputation rests, was not published until 1896.

Hobson's development as an original mathematician seems now to have been strangely slow. By 1903, however, he had moved a very long way; he had (largely as the result of intercourse with W. H. Young) acquired his interest in the modern theory of functions; and he had abandoned coaching in order to win leisure for research. From this time onward he changed rapidly into the Hobson whom we knew. In 1903 he became Stokes lecturer, a position which is now associated definitely with applied mathematics, and has been occupied, since Hobson held it, by Jeans, Fowler and Dirac; but Hobson was by then very plainly a pure mathematician. The first edition of his great "Theory of Functions of a Real Variable" appeared in 1907. In 1910, at the age of fifty-four, he succeeded Forsyth as Sadleirian professor, and he held this office until his retirement in 1931. He was still surprisingly vigorous, but, as well he might be,

tired, and he admitted that he found retirement a great relief.

Hobson received honours from many quarters. He was elected to the Royal Society in 1893, served twice on the Council, and was Royal medallist in 1907. He was president of the London Mathematical Society in 1900–2, and received its de Morgan Medal in 1920. He was president of Section A of the British Association at Sheffield in 1910. He represented Cambridge at the Abel centenary in Oslo in 1902. He was an honorary doctor of six universities, and a member of various foreign academies. But he said that no honour paid to him pleased him more than the dinner organised in his honour by the mathematical faculty of Cambridge less than a year before his death.

He had many interests outside mathematics. As befitted a man of his origin and training, and an intimate and long-standing friend of James Ward, he was a keen philosopher. Philosophy, indeed, was his strongest external interest, as one could judge from passages of his great book. He was not a 'mathematical logician', but he was attracted by fundamentals, and was the first English mathematician to see the point of the discussions of the 'antinomies' and to recognise the importance of 'Zermelo's Axiom'. It was therefore quite appropriate that he should have been one of the two or three mathematicians who have been invited to deliver Gifford lectures. In these lectures, which were published as "The Domain of Natural Science", in 1926, Hobson defends a rather extreme and rather abstract form of the 'descriptive' view of science.

Hobson wrote five books in all. His "Trigonometry" is a well-known textbook which has run through many editions. "Squaring the Circle", a reprint of six lectures delivered in 1913, is a popular book which may be compared with Klein's "Vorträge über ausgewahlte Fragen der Elementargeometrie". It is more solid than Klein, but is full of interesting information and most agreeably written, and makes one regret that Hobson did so little in the way of popular exposition. The two remaining books, the huge treatise "Theory of Functions of a Real Variable", which occupied him from before 1907 until 1926, and the "Spherical and Ellipsoidal Harmonics", published only in 1931, though a great deal of it was written more than thirty years before, contain the record of most of the chief work of his life.

The "Functions of a Real Variable" was published in 1907, at first as a single volume. Young's "Theory of Sets of Points" had appeared one year before. The modern theories of measure and integration were then almost new, and Hobson and Young were the first to introduce them to English readers. The classical theory of functions of a complex variable had been introduced into Cambridge by Forsyth, but real function theory was practically unknown. To-day it is the part of pure mathematics that has been studied most intensively, and it is to Hobson and Young that the revolution is due. The book, in its various editions, occupied Hobson for twenty years, and it was no doubt the central fact in Hobson's life, both for himself and for English mathematics. The whole theory has expanded out of recognition, and very little of the first edition survives unchanged. In particular, nearly all of Hobson's contributions to the subject were made after 1907 and appear only in the later editions. The most important of these are to the theory of orthogonal series.

It was in 1908 that Hobson published the first of his series of papers on the representation of an arbitrary function by a series of normal orthogonal functions. In these papers he aims at obtaining conditions for the validity of such a representation "comparable in generality with the known sufficient conditions for Fourier series". The series in question include Sturm-Liouville series, Legendre series, and Bessel-Fourier series (and also Hermite and Laguerre series, which Hobson does not consider). The theory of integral equations, as developed by Hilbert and Schmidt, had led to a certain unification in the theory of these series, but only for functions of a severely restricted type; Kneser alone had obtained, for Sturm-Liouville series, 'reasonably general' conditions. Here, and in other parts of the theory of orthogonal series, Hobson's work marks a big advance. All this is set out systematically in its place in Hobson's book, which is, if any book ever was, a 'standard treatise', and is probably the most important book written by a modern English mathematician.

The modern theory of functions of a real variable was in its infancy when Hobson began his work. In England it was practically unknown, and rather derided. There may perhaps have been a little excuse for the people who, like Greenhill, regarded it as a monstrosity, for there was still a faint air of mystery hanging about the elements, and much of the superstructure was inelegant and more than a little tiresome. Hobson and Young were the first English mathematicians to see the significance of the new ideas, and fought what must often have been a rather disheartening fight for their recognition. Hobson lived to see real function theory the most highly developed mathematical discipline in Cambridge, a subject recognised even as 'a good Tripos subject', the most popular and paying subject in 'Schedule B'. The most commonplace Cambridge mathematician now has forgotten the superstition that it is impossible to be 'rigorous' without being dull, and that there is some mysterious terror in exact thought: now we go to the opposite extreme and say that "rigour is of secondary importance in analysis because it can be supplied, granted the right idea, by any competent professional". All this we owe very largely to Hobson, but Hobson never quite understood how completely he had won his fight. He always retained something of the air of the protagonist of an unpopular cause; he was a little too old to understand fully that everything that he had been fighting for had been achieved.

G. H. HARDY.

News and Views

Sir Napier Shaw, F.R.S.

THE Council of the Royal Meteorological Society has made the *Quarterly Journal of the Royal Meteorological Society* of April 1934 a special "Shaw Number", in honour of Sir Napier Shaw's eightieth birthday. Sir Napier Shaw has done a great deal to educate English people to a recognition of the practical importance of meteorology. Under the title "The March of Meteorology" he has contributed to his own number of the *Journal* a valuable collection of random recollections. This contribution is, besides being much else, an inner history of the evolution of the Meteorological Office during a period of about thirty years which followed his first connexion with official meteorology. One of Sir Napier's greatest personal contributions to meteorology has been connected with the thermodynamical theory built up around the idea of the Carnot cycle—a conception of an ideal heat engine often despised by students of engineering as being of no conceivable practical significance. In his "Manual of Meteorology", the general circulation of the atmosphere receives masterly treatment with the aid of this cycle and of the special diagrammatic framework with temperature and entropy as abscissæ and ordinates which he has named the 'tephigram'. Although the full harvest from these ideas is perhaps still to come, they have thrown light on many atmospheric processes previously only very imperfectly understood. Another important contribution, and one that greatly advanced weather forecasting with the aid of synoptic charts, was the "Life History of Surface Air Currents" (1906). This was the joint work of Sir Napier and his personal assistant, R. G. K. Lempfert. This study, in his own words, "began the analysis of the motion of the air of a cyclonic depression into distinct currents which has been so fruitful in the hands of the Norwegian meteorologists". By the writing of these reminiscences at the age of eighty, Sir Napier Shaw shows the staying power characteristic of so many eminent scientific workers who became prominent in a period when the troubles of civilisation were less all-pervading, and he reveals in them the broad outlook more common in a less specialised age.

Weather Observations

A SUPPLEMENTARY contribution to the same number of the *Quarterly Journal of the Meteorological Society* by Col. E. Gold follows Sir Napier's with the title "Incidents in the March, 1906–1914". This deals with a number of aspects of the work of the Meteorological Office not touched on by Sir Napier, among which may be mentioned the important contributions to the relationship between barometric pressure gradient and wind force, and to radiation in the atmosphere, made by the writer himself, and to the perhaps even more important pioneer investigations of G. I. Taylor in the subject of atmospheric turbulence, carried out during his tenure of the Schuster readership at Cambridge. It was during those years that the weather observations made at the health resorts were brought under official control, with the result that a reasonable degree of intercomparability has ever since existed in the tabular weather summaries published in most of the morning and evening newspapers, whereas formerly observers had almost unlimited opportunity for creating a false impression of the amount of sunshine to be expected by visitors favouring their own locality. The vexed question of the most suitable units to be used in British meteorology is also touched upon, a question that does not admit of easy solution seeing that the units that satisfy the meteorologist and are intelligible to the ordinary citizen of France and Germany, are not popular with those who, through not having been educated in natural science, are unfamiliar with the C.G.S. system and the centigrade thermometer.

Water Supplies and Emergency Legislation

THE letter from Vice-Adm. Sir Percy Douglas, chairman of the British Association Research Committee on Inland Water Survey, which appeared in the *Times* of June 14, is an opportune reminder that something more than merely emergency measures to meet the present water shortage is necessary, if the administration of water supplies in Great Britain is to be placed on a sound and satisfactory basis. There may be in the popular mind a tendency to regard the recent appointment of an expert committee to advise the Ministry of Health on measures for dealing with the effects of the present drought as the sum total of all that is possible or due to be done in order to avert disagreeable and even disastrous consequences at any future time. But, as was pointed out in a leading article on the subject in NATURE of April 28, the root cause of the trouble lies much deeper, and will remain untouched by such superficial and temporary relief expedients as may present themselves for adoption during the existing crisis. In contradistinction to the practice prevailing in leading countries abroad, there is at present in Great Britain no official body charged with the duty of ascertaining available sources of supply and of gauging their extent and capacity, still less of supervising their distribution to the general advantage of the community. The necessity for a thorough investigation of the position in regard to both surface and underground yields is abundantly evident, and it would be foolish to disguise the fact, as Admiral Douglas so strongly emphasises, that "before it is possible to allocate the water supplies of the country an intensive and fully complete survey of the resources available is indispensable, and, however well-planned the present emergency measures may be, the need for a systematic national survey remains".

British Science Guild

THE annual report of the Council of Management for the British Science Guild, 1933–34, presented at the annual general meeting on June 12, refers to the

activities of the Parliamentary Science Committee, the headquarters of which are at present at the offices of the Guild. The Committee is already supported by a number of scientific and technical associations, and active steps are being taken to secure the active interest of the majority of scientific societies. The Guild continued during 1933 to make representations to the Government regarding the importance of continuing the work of the Research Association of British Rubber Manufacturers, which the Committee of the Privy Council has now agreed to assist by an annual grant for five years. A preliminary memorandum on the development and finance of industrial research has been issued by the committee set up jointly with the Association of Scientific Workers, and arising out of a meeting of the Committee questions have been raised in Parliament regarding expenditure on wireless research by the Post Office and British Broadcasting Corporation. The question of adopting the French system of automatic time transmission by telephone has been raised with the Postmaster-General and is under consideration. Attention has also been directed to the importance of scientific research in connexion with the newly formed marketing boards.

LAST year a lecture was instituted by the Guild to direct attention to the importance of research and the utilisation of its results in the service of mankind. Largely through the generosity of Lord Melchett and Lord Weir, there has now been instituted a series of such research and development lectures designed especially to bridge the gap that exists between those engaged in national affairs and the man of science. Abstracts of the two lectures of this series given this year by Sir William Bragg on "Refrigeration" and by Lord Rutherford on "Helium and Other Rare Gases" are appended to the report. The report directs attention to the unsatisfactory condition of the Guild's finances. There is a deficit of about £400 a year, but thanks to the offer of a member of Council, it has been possible to arrange to utilise capital during the next three years while a three-year plan is put into operation including a programme similar to that of 1933, every possible assistance to the Parliamentary Science Committee and a sustained effort to increase the annual income.

Science and the Nazis

GERMANY'S latest regulation affecting scientific inquiry may be the logical consequence of principles accepted in that country, but is none the less curious. Herr Julius Streicher's deputy, according to a correspondent in the *Times* of June 13, has issued an order prohibiting scientific lectures on racial questions, since they have a "diluting and distorting effect on the Nazi *Weltanschauung*". Professional men of science, it is added, are not equipped with the necessary knowledge and honest conviction and their lectures are, therefore, a danger to the true Nazi creed. If this statement has any basis at all in fact, it can only mean that German men of science are either too honest or have too keen a sense of the incongruous to accept and reproduce the official Nazi travesty of racial history with which Herr Hitler has hypnotised himself and the German masses. The entire suppression of lectures in one branch of study, however, enforces the lesson that the relation between science and State action is one of extreme delicacy, and that any attempt to drive politics and science in double harness in the interest of a theory of racial or social regeneration, as has been done in Germany, and was attempted in framing the immigration laws of the United States, risks the suppression of honest, but unpopular, inquiry. It is surely inconsistent that the advocates of racial purity in their own part of the world, in their further programme for dealing with Jews, should suggest that the thirty millions of this people should be quartered among the inhabitants of Madagascar.

Central American Hurricane and World Rainfall

WHILE a large area in North America has been suffering from unprecedented drought, a part of Central America has recently experienced a very severe hurricane, although it is early in the hurricane season. A very small proportion only of the tropical storms of the West Indies and neighbouring mainland occur in the first half of June, the time of maximum frequency being not far from the autumnal equinox. The storm in question appears to have passed north-westwards across Salvador before reaching the Mexican coast; it was accompanied by exceptionally heavy rains that caused serious floods. To these floods is attributed the great loss of life, variously estimated at a thousand and at two thousand or more. In the *Times* of June 13 it is stated that the Honduran town of Ocotepeque, near the Guatemalan border, was entirely destroyed. It may be recalled that in 1933 there was a 'record' number of West Indian hurricanes. This early and disastrous opening for 1934 seems ominous. When rainfall is deficient in middle latitudes, there is no more likely place for finding an excess sufficient to keep the world's fall at about its normal amount than in the hurricane belt, and the coincidence of exceptional drought in North America and exceptional storminess in the West Indies may possibly not be fortuitous. Approximate constancy of the world's total fall cannot, of course, be proved or disproved, in the absence of exact measurements over the oceans, but it may be noted that the sun's radiation tends to appear more constant the more exactly it is measured, which seems to suggest that the average rainfall for the year—indirectly dependent, doubtless, on solar heat—may not vary greatly.

Archæology and the Economic Crisis in the United States

EXCAVATIONS on a number of archæological sites in various States, undertaken as part of the emergency measures for the relief of unemployment under the Civil Works Administration in the United States, have produced material which, according to a statement issued by the Smithsonian Institution of Washington, it will take years to work out in detail. So satisfactory have been the results that in several States the work is to be continued by a State subvention now that the grant of the Civil Works

Administration has been exhausted. Among the more successful investigations is the exploration of two Indian village sites on the shores of the dry Buena Vista Lake, Kern County, California. Of these villages, one was entirely prehistoric and may go so far back as the beginning of the Christian era. It is hoped to check the dating by the ring marks of wooden posts recovered from the site. The second village was occupied by Yokut Indians as late as 1772, when it was visited by Spanish missions; but by 1825 it had entirely disappeared. It had evidently been occupied for a long time as no less than seven distinct lake terraces were uncovered in the course of the excavation. From a cemetery on the near-by hillside, 350 skeletons were obtained. In the earlier village, bodies were buried under the floors of the houses. The flint points found here were cruder than those of the later village settlement. Among the results obtained under this scheme of exploration in other States, mention may be made of a mound near Bradenton in Florida, which revealed for the first time the character of a Florida mortuary temple, the identification of a village of the Hitchiti Indians of the Creek Confederacy in mounds near Macon, Georgia, the identification of Guasili, visited by de Soto in North Carolina, and the discovery of house structures and much pottery in the Shiloh National Park, Tennessee.

Excavations at Gaza, 1933–34

OWING to the operation of the Antiquities Law of Palestine, none of the objects excavated at Gaza during the last season by the British School of Archæology in Egypt has been allowed to leave the country. Sir Flinders Petrie accordingly announces that the usual exhibition of antiquities at University College, London, will not take place this year. Lantern lectures on the year's work of the School were delivered at the College on June 14, 16 and 19. The main work of the expedition, of which a preliminary account was given in a letter from Sir Flinders Petrie in the *Times* of June 14, was directed to clearing an area of about four acres along the river side, from which a large number of objects was recovered. One of the most noteworthy results was the large number of gold ornaments obtained from burials and from goldsmiths' hoards. These included ear-rings of granular goldwork of unique type. The prominence of Irish goldsmiths' work is again obvious. On the other hand, in a burial of a little girl, the goldwork is on the Egyptian weights standard and it included pendants of hippopotamus and of Horus. The most marked feature of the finds as a whole is their varied provenance, pointing to the importance of this ancient port, to which the presence of more than 200 hæmatite weights testified. Persian trade is indicated not only by a dagger from Lauristan, but also by an abundance of Persian weights, in number half as many as those from Egypt. Relations with the Caucasus are indicated by daggers of bronze, while the use of the toggle pin, of which specimens were found in all the deposits, belongs to the Caspian. The most considerable building unearthed is of middle Hyksos age and may be a temple.

Infra-Red Lights and Aviation

HOPES that infra-red light might be usefully employed by aviation in foggy weather have, according to Science Service, of Washington, D.C., not been fulfilled. Dr. Irving Langmuir, at a recent meeting of scientific workers and engineers called by the U.S. Bureau of Aeronautics, said that there is no known source of infra-red radiation of the wave-lengths necessary for penetrating fog. The discovery of a way to produce such radiation would be a stroke of genius, and is not likely to occur in the course of routine experimentation. The scientific workers present also discouraged experiments by the Government on proposed schemes for the dissipation of fog by the use of a Tesla coil or other apparatus. Similar plans have been often suggested, and it is now known that it is theoretically impossible for them to work well enough to be of practical value. Dr. W. J. Humphreys said that methods based on scientific principles are much too expensive to be used in aviation. Two possible solutions of the problem of fog landings were approved by the meeting and intensive research was urged along these lines. The first solution was to use radio signals. By the use of suitable instruments, his position with reference to the flying field can easily be found by the aviator. It is now possible to use radio signals the wave-lengths of which are not greater than ten metres. and this is the possible error of the method. It is not necessary to wait until shorter wave-lengths are available. The other solution favoured was a device similar to that used by ships to determine the depth of the sea beneath them. It is quite possible for a suitable instrument to pick up an echo from the ground and show on a dial the height in feet of the plane above it.

Refrigeration

IN connexion with the Refrigeration Exhibition now being held at the Science Museum, South Kensington, a guide has been prepared by Messrs. T. C. Crawhall and B. Lentaigne, which, in addition to describing the exhibits, gives accounts of the scientific principles which underlie refrigeration and of its historical development (pp. 28+2 plates. London: H.M. Stationery Office, 1934. 6*d*. net). A further publication which will be welcomed by all those engaged in the refrigerating industry is the "Five Year Bibliography" of the subject which has been prepared by Mr. H. T. Pledge, of the Science Library (pp. 97. London: H.M. Stationery Office, 1934. 2*s*. net). It is a foolscap pamphlet of 97 pages with the typed entries in two columns under the decimal classification numbers 621.56 to 58, with a short section on air conditioning under 697.9. Under "Refrigerants" 621.564 there are 8 pages of entries which include between eighty and ninety dealing with 'dry ice' or solid carbonic acid—621.564.23—under its various names of neige carbonique, trockeneis, ghiaccio secco, droog Ijs, glace sèche, Cold, Kold-Trol, Cardice, Drikold and others. The fact that the Science Library has prepared more than 120 bibliographies of this type on subjects varying from

Bessel functions to the habits of lizards seems very little known, and much time has in consequence been wasted by research workers in collecting information on subjects in which bibliographies were already in existence.

Street Lighting

ILLUMINATING engineers are beginning to agitate for national control of the lighting of roads and streets. In the *Electrical Review* of June 8, C. W. Sully points out that boroughs and urban councils in Great Britain are granted powers regarding street lighting by the Public Health Act of 1875 and that rural districts exercise their powers under the Lighting and Watching Act of 1833. The public lighting of all our thoroughfares to-day is controlled by Acts published either sixty or a hundred years ago. Our population has nearly trebled since 1833 and has increased by more than seventy per cent since the last Act became law. There were no fast moving vehicles on our roads sixty years ago—there are now two million licensed automobiles. The existence of vast numbers of cinemas and also of greyhound racing tracks encourages pedestrians to use the streets after dark. Yet much of our highway lighting is mounted on similar posts spaced at the same distance apart as when our road vehicles were fitted with lanterns carrying candles. The candle power of the lights have been increased a hundred-fold in order to lessen the risk of accidents but in many roads the lighting is very 'patchy', the lamps acting mainly as beacon lights. It is wasteful to employ large units without suitable directive fittings to ensure a uniform distribution of the light. The new British Standard Specification makes a special feature of this by setting out a spacing ratio for street lights which produces a more uniform illumination. In general this entails altering the height of the posts. It would be advisable if the Government would allot to one of its numerous departments the task of specifying the minimum light to be provided on the various roads which it has already classified. It appears that new legislation is required to deal with this important matter.

Some Aspects of the Vertebrate Brain

In his presidential address before the Linnean Society of New South Wales on March 28, Prof. A. N. Burkitt outlined progress in our knowledge of the structure and workings of the brain. The present lopsidedness of our knowledge, so amazing in the physical and chemical world and so backward as regards the very instrument which has created human civilisation, is the cause of much of the discontent and difficulties of our present age. Recent work upon the sense organs and the impulses they transmit to the brain, and some idea of how closely parallel to the physical reality these impulses may be, was discussed, partly in relation to philosophical problems. The bearing of the evolution of the sense organs upon the evolution of the brain, so ably outlined by Elliot Smith, was briefly mentioned. The importance of the recent discovery that the emotional aspect of life is associated with the activity of a special part of the brain, the thalamus, distinct and separate from the great thinking and discriminatory apparatus, the cerebral cortex, was emphasised, and suggestions were made as to the possible bearing of this knowledge upon the Freudian hypothesis. Finally, an attempt was made to suggest some inkling of the physiological phenomena that occur in the brain during conscious thinking in all its myriad aspects; also the mechanisms concerned in expression and the control of muscles, together with the evolution of these controlling mechanisms and muscles, were briefly outlined.

Organisation of Production

UNDER the title "Prohibiting Poverty", a pamphlet by P. M. Martin, written and published by P. M. Martin, Winter Park, Florida, outlines a plan for obtaining economic security, based on the view that the prime purpose of organised society is to enable everyone to get a living. The plan, described as the "National Livelihood Plan", proposes to separate necessaries from luxuries, and to deal with them in separate departments of government on different principles. The production of necessities is to be organised under a new national organisation, known as the Commons, the function of which is to produce and distribute a basic livelihood in necessities to the entire population. This organisation would operate without money, distributing goods as produced without selling them. It would be recruited compulsorily by the whole youth of the nation from school-leaving age and would utilise the full advantages of scientific discovery in increasing industrial output and efficiency. After eight years' service, the Commoner would pass into the Capitals, in which the existing capitalistic organisation of society would persist, limited, however, to the production of luxuries, and in which his previous labours have earned him or her a free distribution for life from the Commons of the basic necessities of life. The Commons would be directed by a salaried body of technical experts, men of science and investigators concerned with the continual development and full utilisation of improved methods of production.

Animal Breeding in the British Empire

THE Imperial Bureau of Animal Genetics has issued a bulletin of 47 pages by Dr. F. Fraser Darling on animal breeding in the British Empire, obtainable from Oliver and Boyd, Edinburgh, or 33 Paternoster Row, E.C., at 1*s*. It summarises the present position and work in progress in the breeding of farm animals in all parts of the Empire. The first part deals with Great Britain and the Dominions, where conditions are mainly temperate; the second part with India and the Colonies, which are largely in the tropics. The more practical aspects of the breeding of horses, cattle, sheep, pigs and goats are considered. Reference is made to such recent developments as sperm storage for horse insemination, and the fact that breeds of pigs differ in the number of ribs and hence

in their value for bacon. Useful information is given regarding sheep breeding in Britain, Canada, Australia, New Zealand and South Africa, and the varying problems each country has to face. We learn that the world's record for butter-fat production —1,614 lb. in a year—is held by an Australian Shorthorn, that Romney Marsh sheep are successful in New Zealand, and that camel breeding is developed by Government in the Sudan. Zebu cattle and buffaloes have been introduced from India into the West Indies, Tanganyika and British Guiana. Cattle suitable for the tropics can probably be produced by crosses between zebu and certain European breeds. Such crosses between zebu cows and Friesian bulls have produced a satisfactory breed in Trinidad, but Krishna Valley zebu in Tanganyika crossed with Devons or Aberdeen Angus give intractable animals unsuitable for domestic uses.

National Institute of Agricultural Botany

THE fourteenth report of the National Institute of Agricultural Botany records considerable progress in the selection and multiplication of improved crops. Exhaustive tests of yield of many farm and garden plants have been made in different districts, and authoritative comparisons of varieties are now available. Considerable research is being devoted to problems of seed-testing, and a large number of routine tests have been made for other investigators. The classical potato trials at Ormskirk, Lancs, seem to have suffered from severe climatic conditions, but the work on potato synonyms progresses satisfactorily, and should do much to protect the farmer and gardener from unfair exploitation. The head office of the Institute is in Huntingdon Road, Cambridge, and a very close co-operation is maintained with related organisations.

Ichthyology in the United States

THE twentieth anniversary number of *Copeia* (No. 4, December 1933. American Society of Ichthyologists and Herpetologists), which deals with fishes, reptiles and amphibians, is dedicated to its founder, John Treadwell Nicholls. In it are included many interesting and valuable papers, notable among them being "Deep-Sea Stomiatoid Fishes" by William Beebe, in which one new genus and eight new species are described from the Bermuda Oceanographic Expeditions of the Department of Tropical Research of the New York Zoological Society. These were all taken within the eight-mile circle, the centre of which is at lat. 32° 12′ N., long. 64° 36′ W., 9¼ miles south-south-west of Nonsuch Island, Bermuda. The barbels of some of these fishes are very peculiar; one of them, belonging to *Ultimostomias mirabilis* gen. et sp.nov., has a barbel measuring 417 mm. in length (more than ten times the length of the fish itself). Other papers on fish are by Albert Eide Parr, George S. Myers, E. W. Gudger and C. M. Breder, Jr. A new snake from Panama is described by E. R. Dunn and there is an interesting article on the immunity of rattlesnakes to their venom by A. A. Nichol, Volney Douglas and Lewellyn Peck. Other papers are on the nests and young of the Allegheny salamander, the ophidian generic names *Ahaetulla* and *Dendrophis*, secondary sexual characters of *Bufo melanostictus*, and *Pseudemys troostii-elegans* complex, a case of sexual dimorphism.

Strength of Spirits

As is well known, the Finance Act of 1915 provided that where by reason of the high temperature or strength of spirits the ordinary Sikes hydrometer was not applicable, the strength may be ascertained by means of the supplemental Sikes *A* hydrometer, using tables identified as II and IV prepared by the late Sir Edward Thorpe when principal of the Government Laboratory. Under the Strength and Weight of Spirits Ascertainment Regulations, 1930, when the same conditions of high temperature or strength apply, the use of a further supplemental Sikes *B* hydrometer is permitted. When this is used without the poise marked *A* attached, Tables V and VI prepared by Sir Robert Robertson are applicable. Tables II, IV, V and VI have been issued under the authority of the Commissioners of H.M. Customs and Excise in one volume at 2*s*. 6*d*. (London: H.M. Stationery Office): the ordinary tables I and III are printed in a separate volume. The tables cover temperatures from 30° to 100° F.

Institution of Petroleum Geologists

THE summer meeting of the Institution of Petroleum Technologists will be held in London at the Royal Society of Arts on June 28–29. The programme consists of a series of papers, available in advance, on general topics which will be submitted for discussion. The subjects of the first day's discussions are the relation of oil and coal to the petroleum industry, measurement of oil in bulk, and the format of the Institution's *Journal*. The second day is being given to a series of reports on the progress of naphthology; the Refining and Chemical Section, under the chairmanship of Dr. F. H. Garner, will occupy the morning session, while the Field Technology, Geology and General Sections, under the chairmanship of Mr. A. Beeby Thompson, will take up the afternoon session. During the course of the annual dinner on June 29, the Redwood Medal of the Institution will be presented to Dr. David White, of the U.S. Geological Survey, who is known for his studies in palæobotany. This medal is awarded biennially, and is given for contributions to our knowledge of petroleum technology.

Rockefeller Medical Fellowships

THE Medical Research Council announces that, on behalf of the Rockefeller Foundation of New York, it has made the following awards of travelling fellowships for the academic year 1934–35: Mr. I. Aird, demonstrator in anatomy, University of Edinburgh, and clinical tutor in surgery, Royal Infirmary, Edinburgh; Mr. I. A. Anderson, house physician, Royal Infirmary, Aberdeen; Prof. E. G. Oastler, professor of physiology, St. Mungo's College, Glasgow,

and assistant physician, Royal Infirmary, Glasgow; Mr. W. H. Owles, resident medical registrar, Queen's Hospital, Birmingham; Dr. H. L. Sheehan, lecturer in pathology, University of Manchester; Mr. C. Wilson, assistant in pathology, London Hospital. These fellowships are awarded to graduates who have had some training in research work either in the primary sciences of medicine or in clinical medicine or surgery, and who are likely to profit by a period of work abroad before taking up positions for higher teaching or research in the British Isles. All the fellows appointed this year will work at centres in the United States.

International Council of Scientific Unions

THE International Council of Scientific Unions will hold its triennial meeting at Brussels on July 8–14. At the last meeting, in 1931, the title of the organisation was changed from that of the International Research Council to the present one, and the statutes were revised to give greater freedom of action to the international unions. On the present occasion each of these unions, representing astronomy, geodesy and geophysics, chemistry, scientific-radio transmission, physics, geography and biological science, will communicate an account of its activities during the past three-year period. Addresses will also be given by Dr. D. la Cour on the International Polar Year, 1932–33, its aims, methods and some preliminary results; by General G. Perrier, on recent international determinations of longitude; by Dr. E. P. Hubble, on the exploration of space; and by Prof. H. R. Kruyt, on electricity and hydration of colloids.

Announcements

A MOSELEY Research Studentship of the Royal Society has been awarded to Dr. Barnet Woolf for research on bacteriology and immunology.

SIR HAROLD HARTLEY, chairman of the Fuel Research Board of the Department of Scientific and Industrial Research, is inviting a number of scientific workers and industrialists to inspect the work in progress at the Fuel Research Station, River Way, Blackwall Lane, East Greenwich, S.E.10, on June 25. The function will be generally similar to the annual visitation of the National Physical Laboratory, but it is the first of its kind to be held at the Fuel Research Station.

A SCIENTIFIC committee to assist the director, Dr. Louis Martin, has been formed at the Institut Pasteur, Paris, consisting of MM. J. Bordet, director of the Institut Pasteur of Brussels, and Nobel prizeman; G. Bertrand and F. E. P. Mesnil, members of the Institut de France and Académie de Médecine; C. J. H. Nicolle, professor at the Collège de France and Nobel prizeman; A. J. E. Yersin, director of the Instituts Pasteur of Indo-China; and A. Borel, director of the Institut d'Hygiène at Strasbourg. Further members may be appointed later.

AT the seventeenth annual meeting of the American Society of Ichthyologists and Herpetologists, held in New York on May 10–12, the following were elected officers for the ensuing year: *Honorary Presidents*, Leonhard Stejneger and John T. Nichols; *President*, Carl L. Hubbs; *Vice-Presidents*, Dr. E. W. Gudger, Dr. Francis Harper and Clifford Pope; *Secretary*, M. Graham Netting; *Treasurer*, A. W. Henn; *Editors*, Carl L. Hubbs and Helen T. Gaige. The next meeting of the Society will be held in Pittsburgh in May 1935.

MESSRS. A. GALLENKAMP AND CO., LTD. (17–29 Sun Street, and 1–3 Clifton Street, London, E.C.2) announce the introduction of a new type of all-glass syringe for medical use. It is constructed of pyrex glass in various sizes, and is provided with stainless steel needles. Copper-coated glassware—beakers, flasks, etc.—is also supplied by this firm. The copper is electrolytically deposited on the outside, and the advantages claimed are rapid distribution of heat and saving of the liquid should the glass crack.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in mathematics and physics at the Portsmouth Municipal College—The Registrar (June 25). Part-time lecturers and instructors in engineering, welding, electrical installation, etc. at the Willesden Technical College, Denzil Road, London, N.W.10—The Principal (June 25). A professor of botany in the Egyptian University—The Dean of the Faculty of Science, c/o The Director, Egyptian Education Office, 39, Victoria Street, London, S.W.1 (June 25). A head of the Women's Department in the Wolverhampton and Staffordshire Technical College—The Clerk to the Governors, Education Offices, Wolverhampton (June 25). A lecturer in botany and a lecturer in zoology at Armstrong College, Newcastle-upon-Tyne—The Registrar (June 26). A teacher of chemistry at the Doncaster Technical College—The Secretary, Education Offices, Doncaster (June 27). An assistant civil engineer to the Air Ministry—The Secretary (S.2), Adastral House, Kingsway, W.C.2 (June 28). A metallurgist to the British Non-Ferrous Metals Research Association—The Secretary, Regnart Buildings, Euston Street, London, N.W.1 (June 30). A lecturer in science at the Gordon Memorial College, Khartoum—The Secretary (Sir/C A), Board of Education, Whitehall, London, S.W.1 (June 30). An assistant lecturer in electrical engineering at University College, Nottingham—The Registrar (July 2). A research assistant in soil science in the Department of Agriculture, University of Cambridge—The Secretary of the School of Agriculture (July 2). A field officer for investigations on Braxy-like diseases of sheep and a junior research officer for investigations on swine erysipelas at the Institute of Animal Pathology, University of Cambridge—The Director (July 7). A professor of social anthropology in the University of Cape Town—The High Commissioner for the Union of South Africa, Trafalgar Square, London (Aug. 15). A Regius professor of midwifery in the University of Glasgow—The Private Secretary, Scottish Office, Whitehall, London, S.W.1. A chemist at the East Malling Research Station, Kent—The Secretary.

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.*]

Early History of Mendeléeff's Periodic Law

THE statement appears in NATURE of April 28, p. 656, that "Mendeléeff's first table, published in 1871, bears a remarkable resemblance to that of the present day". As a matter of fact, Dmitri Ivanovitch Mendeléeff began his investigations on the correlation of chemical properties with the atomic weight of elements in 1868, and succeeded in evolving the periodicity of this relationship at the end of that year. He printed the first periodic table in the middle of February, 1869, as follows :

An attempt of a system of elements
based on their atomic weight and chemical resemblance

			Ti = 50	Zr = 90	? = 180	
			V = 51	Nb = 94	Ta = 182	
			Cr = 52	Mo = 96	W = 186	
			Mn = 55	Rh = 104·4	Pt = 197·4	
			Fe = 56	Ru = 104·4	Ir = 198	
			Ni = Co = 59	Pd = 106·6	Os = 199	
H = 1			Cu = 63·4	Ag = 108	Hg = 200	
	Be = 9·4	Mg = 24	Zn = 65·2	Cd = 112		
	B = 11	Al = 27·4	? = 68	Ur = 116	Au = 197?	
	C = 12	Si = 28	? = 70	Sn = 118		
	N = 14	P = 31	As = 75	Sb = 122	Bi = 210?	
	O = 16	S = 32	Se = 79·4	Te = 128?		
	F = 19	Cl = 35·5	Br = 80	J = 127		
Li = 7	Na = 23	K = 39	Rb = 85·4	Cs = 133	Tl = 204	
		Ca = 40	Sr = 87·6	Ba = 137	Pb = 207	
		? = 45	Ce = 92			
		?Er = 56	La = 94			
		?Yt = 60	Di = 95			
		In = 75·6	Th = 118?			

Mendeléeff prepared his first essay, "Correlation of the Properties with the Atomic Weight of Elements", early in March, 1869, intending to communicate it to the Russian Chemical Society (which was founded on October 26, 1868) at the meeting on March 6. Illness prevented him from attending, and the paper was read, at his request, by my father, Nikolai Aleksandrovič Menschutkin, at the time professor of analytical chemistry at the University of St. Petersburg. Mendeléeff's memoir was printed in the first volume of the *Journal of the Russian Chemical Society* (1869, pages 60–77); it contains the same table as that printed above, the enunciation of the periodic law and the deductions (*a*) that the atomic weights of some elements must be altered, to fit into the table; (*b*) that undiscovered elements exist, filling up the vacant places of the table.

Continuing his work on that subject, D. I. Mendeléeff communicated further results on August 23, 1869, in a meeting of the Second Congress of Russian Naturalists in Moscow. This communication was published in the Transactions of the Congress (pages 62–71) under the title "On the Atomic Volume of Simple Bodies". Mendeléeff recognised the importance of this periodically changing property of elements for their classification, and gave the following table—the prototype of all later periodic tables :

Li	Be	B	C	N	O	F			
Na	Mg	Al	Si	P	S	Cl			
K	Ca	—	Ti	V	Cr	Mn	Fe	Co	Ni
Cu	Zn	—	—	As	Se	Br			
Rb	Sr	—	Zr	Nb	Mo	—	Rh	Ru	Pd
Ag	Cd	—	Sn	Sb	Te	I			
Cs	Ba	—	—	Ta	W	—	Pt	Ir	Os

In the text, this table is completed by the heavy metals : Au, Hg, Tl, Pb, Bi. Elements, the atomic weights of which were not known with any degree of certainty, such as In, Th, U, Ce, are left out.

I do not propose further to follow up Mendeléeff's work here, only mentioning his communication at the meeting of the Russian Chemical Society of December 3, 1870, in which he divided the elements into the periods, rows and groups, now familiar to all students of chemistry. He also made here detailed predictions of the properties of undiscovered elements, which were verified in the years 1875–86 through the discovery of gallium, scandium and germanium.

Thus Mendeléeff's periodic table actually antedates his periodic law and received its modern form in 1869, not in 1871.

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May 13.

Mesomerism and Tautomerism

THE recognition of valency exchange degeneracy as a matter of primary importance in relation to the energy[1] and reactivity[2] of organic molecules makes it the more necessary clearly to indicate the nature of the conception. It envisages both completely and incompletely degenerate states collectively called 'mesomeric' states ; and these states are described by first setting up 'unperturbed structures', which correspond to classical chemical formulæ but (according to the theory) not exactly to reality, and then 'correcting' these structures by supposing them to undergo a 'perturbation', the nature of which may be indicated by auxiliary symbols.

The idea appears to have gained some ground that the conception of the mesomeric state is unnecessary, that the unperturbed structures are all that exist, and that these pass into each other 'like tautomerides but much more rapidly', the great frequency of interchange accounting for the energy effect. If this view has arisen from the use of the expression 'resonance', a long-accepted synonym for exchange degeneracy, then it must be admitted that an analogy has been suggested which was never intended (the real analogy underlying this term is a mathematical one).

It is a characteristic of tautomeric systems that forms exist which clearly correspond to separate molecular states, because each molecule spends the whole of its life partly in one form and partly in the other, and only a proportionately quite insignificant time in the actual process of transition. If, however, in any of the most typical cases of 'resonance', we attempt to interpret resonance energy as a tautomerism of unperturbed states, the frequency of interchange which it is necessary to assume in order to account for the energy effect is often so great as to require that the molecules must occupy their time in changing, and cannot remain quiescent for significant periods in either of the assumed states ; in other words, the term 'state' loses its meaning in reference to the only states which this theory recognises. The assumed frequency of valency interchange is, indeed, of the same sort of magnitude as the frequencies which are attributable generally to combined electrons, aside altogether from valency resonance. There can be no physical distinction, therefore, between resonance vibrations and other electronic vibrations, and it follows that the unperturbed structures, in which the resonance vibrations are absent by assumption, are

unreal : they are of the nature of intellectual scaffolding, and only the mesomeric state is real. The additional electronic energy associated with resonance naturally implies an altered wave function, but the reasons why we do not associate this energy difference with a definite frequency along a definite path are quite analogous to the reasons for not reverting to Bohr orbits in the description of molecular structures generally[3].

The energy evidence proves this point[1], and the results of infra-red spectroscopy and dipole moment measurements supply important confirmation[4] ; it may, however, be worth noting that the thesis is necessary also on quite elementary chemical grounds[2]. For this purpose, any simple problem of reactivity in which mesomerism plays a leading part will serve, and we may, for example, consider the fact that aniline is a weaker base by about a million fold than a primary alkylamine such as methylamine or *tert.*-butylamine. The neutral unperturbed structure for aniline, NH_2–C_6H_5, requires a basicity of about the same order of magnitude as that of a primary alkylamine ; and the three dipolar unperturbed structures, which may collectively be represented $\overset{+}{N}H_2=\overset{-}{C}_6H_5$, all require a basicity (for ammonium salt formation) of zero. If we were to try to account for the small basicity of aniline by postulating a tautomerism, too rapid for direct detection, between these unperturbed structures considered as molecular states, we should have to assume that the substance exists practically entirely in the betaine forms—an obviously untenable hypothesis. The only way to avoid this difficulty would be to increase the assumed rate of interchange to such a degree that the molecules would almost always fail to remain in the more basic form, NH_2–C_6H_5, for the duration of a molecular collision ; for if this were true, even a high instantaneous concentration of NH_2–C_6H_5 molecules would fail to produce a corresponding amount of basic reactivity. A supposition of this kind, however, is tantamount to discarding altogether the conception of unperturbed forms as molecular states, and adopting in its place the idea of a state distinct in properties from either of the states originally assumed.

Thus mesomerism and tautomerism are different concepts, and we must ascribe to the mesomeric state something more than a titular position in the physics and chemistry of unsaturated structures[5].

C. K. INGOLD.

University College,
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May 24.

[1] L. Pauling and G. W. Wheland, *J. Chem. Phys.*, **1**, 362 ; 1933. L. Pauling and J. Sherman, *ibid.*, 606, 679.
[2] C. K. Ingold, *J. Chem. Soc.*, 1120 ; 1933.
[3] Cf. J. E. Lennard-Jones, forthcoming report by Faraday Society.
[4] References given in [2]. Cf. also N. V. Sidgwick and L. E. Sutton, forthcoming report by Faraday Society.
[5] I myself wrote (before 1928) of valency "tautomerism", but I now regard that expression as an unfortunate contradiction in terms (Cf. ref. [2], p. 1127, footnote 4).

Kinetics of Reactions of Heavy Hydrogen

THE publication, recently, of two notes[1] concerning the reaction of heavy hydrogen and oxygen at elevated temperatures suggests that it may be of interest to mention briefly experiments which have been in progress in this laboratory during the past few months and which have had for their object the possible confirmation or elucidation of the mechanism of some chain reactions. A search has also been made for examples of reactions involving the quantum mechanical leakage of H and of D atoms through potential barriers.

At room temperatures and with excess hydrogen, H and D atoms produced photochemically react with oxygen molecules at exactly the same speed. With excess oxygen under the same conditions, there is a difference (30 per cent for a 66 per cent mixture) which is due solely to collision frequency factors between the mercury atoms and the H_2, HD, D_2 and O_2 molecules. Similarly in the hydrogenation of ethylene and of nitrous oxide and in the reduction of copper oxide by atoms, there is no difference in the velocity of reaction of the two isotopes.

At higher temperatures in the hydrogen – oxygen reaction, where chains are propagated, separation occurs, for example, at 339° C. With a pressure of 5 mm. of a 2 : 1 mixture, the ratio of rates of reaction for a 66 per cent diplogen mixture is 1·26 : 1, falling to 1·10 : 1 at 421°. The difference is probably due to the participation of hydrogen molecules in the chain. In the hydrogen – nitrous oxide reaction, where chains are also propagated and the slowest now involves the reaction of a hydrogen atom, there is no separation whatsoever. With ethylene, there is no separation and no chain propagation. Copper oxide is reduced at different speeds with heavy and with ordinary hydrogen molecules, the separation decreasing with increasing temperature ; for example, the ratio of rates for a 47 per cent mixture are at 156° 1·26, at 201° 1·17 and at 269° 1·13.

So far as these results indicate, therefore, the statement may be made that H and D atoms, even in reactions requiring considerable activation, react at the same speeds in the gas phase, whereas, if the rate determining step involves a molecule or the interaction of the atom adsorbed on a surface, as in the reduction of copper oxide, the greater reactivity of hydrogen is due mainly, if not wholly, to the difference in zero point energies of the H and the D molecules.

H. W. MELVILLE.

Laboratory of Colloid Science,
The University,
Cambridge.

[1] Frost and Alyea, *J. Amer. Chem. Soc.*, **56**, 1251 ; 1934. Hinshelwood, Williamson and Wolfenden, NATURE, **133**, 836, June 2, 1934.

Ionospheric Height Measurement in the United Provinces of Agra and Oudh (India)

THE measurements of the height of the ionosphere have been taken in India for the last three years by Prof. S. K. Mitra[1] and his students in Calcutta. India is such a big country that the measurement at Calcutta alone cannot serve as representative values for the whole of India. Early this year, therefore, it was decided to take measurements at Allahabad ; and the preliminary observations are summarised below.

The transmitter employed was of the conventional type sending 50 pulses per second of $3·8 \times 10^{-4}$ seconds duration. Through the ready co-operation of Rai Amarnath Agarwal—to whom our thanks are due—the receiving equipment was located at his residence in Daraganj, a distance of about 2 miles from the transmitter. The echoes were visually observed on a cathode ray oscillograph.

On May 13, between 18.30 and 20.00 I.S.T., the

height of the *E*-layer was found to be 135 km. and usually four multiple reflections and sometimes as many as six were detected. Between 19.00 and 19.30 I.S.T., the intensity of the first reflection often shot up to 2–3 times that of the ground wave, but this unusual intensity lasted for about 3–5 seconds. Between 19.15 and 19.20, the intensity of the second reflection was found on two occasions to be from 3 to 4 times that of the ground pulse, although the intensity of the first reflection was only about half that of the ground pulse.

Further observations were taken in the early morning hours (5.30–6.30) of May 14. The height of the *F*-layer was found to be 270 km. in the beginning and gradually fell to 250 km. Four reflections were usually present; the first was always the strongest, its intensity sometimes becoming as great as that of the ground pulse.

The distance between the adjacent reflections was always the same, thus showing the presence of multiple reflections between the earth and the ionosphere. Messrs. Mitra and Rakshit[2] could detect the multiple reflections one hour before the sunset, but we have been able to observe multiple reflections in the morning as well.

It appears from our observations that the *E*-layer is predominant during the evening and sunset period, and during the night the ionisation in the lower layer becomes too small, and up to about half an hour after sunrise reflections from the *F*-layer are observed.

The work is being continued.

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May 21.

[1] Mitra and Rakshit, *Phil. Mag.*, **15**, 20; 1933.
[2] *loc. cit.*, p. 26.

Effect of Thunderstorms upon the Ionosphere

MORGANTOWN, West Virginia, U.S.A., is situated on the western slope of the Appalachian Mountains, which run in a south-westerly direction. These mountains cause a great deal of variation in the signal strength of the broadcasting stations along the Atlantic coast as received in Morgantown, and also affect the short-wave band.

One of my students, Mr. A. W. Friend, has been operating a short-wave station here for many years. He informs me that on account of the high hills near his home, his station cannot be heard in the south-eastern sector of the United States *except after a thunderstorm*. He can hear the amateur short-wave stations in the southern States, but they can never hear him if the weather is fine; but after a thunderstorm he can remain in contact with them for several hours.

At my suggestion, Mr. Friend made out the following table from the log of his station. It shows the times at which the stations were able to hear him.

Station	Date	Time	Freq. Kc.	Output, watts
Greensboro, N.C.	April 29, 1931	11.16 p.m.	7,000	12
Wilmington, N.C.	April 30, 1931	6.15 p.m.	7,000	12
Marion, Ala.	June 2, 1931	12.55 a.m.	7,000	12
Atlanta, Ga.	June 5, 1931	10.38 p.m.	14,000	8
Salisbury, N.C.	Aug. 24, 1931	1.05 a.m.	7,000	15

These stations are all located several hundred miles south or south-east of Morgantown, and two-way communication was never possible under normal atmospheric conditions. Mr. Friend's observations strongly support Prof. C. T. R. Wilson's theory that some of the ionisation in the ionosphere is due to thunderstorms. Not all of the abnormal ionisation arises from local thunderstorms, for I have often observed increased ionisation in the *E*-layer after sunset during the winter months when there were no thunderstorms within a thousand miles.

R. C. COLWELL.

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May 18.

Static Charge on a Galvo-Millivoltmeter

IN NATURE of May 19 Mr. H. A. Bromley mentioned the trouble he had experienced owing to the needle of a millivoltmeter being attracted by the electrostatic charge on the surface of the glass window of the instrument.

This trouble has been known for many years, and is usually overcome by wiping the glass with a cloth on which there is a slight trace of glycerine. This so effectually gets rid of the trouble for a little while —when the process has to be repeated—that I think readers of NATURE may be glad to know of it.

ROBERT S. WHIPPLE.
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Velocity of Light

THE chief objection which can be raised at the present time to the hypothesis of a continuous decrease of the velocity of light is that it is only justified if we admit that the work of Michelson and Newcomb in the last century is unreliable. Now, their determinations made in 1882 agree so closely, although made independently, with different instruments and a somewhat different technique, that, in my opinion, they are probably very accurate.

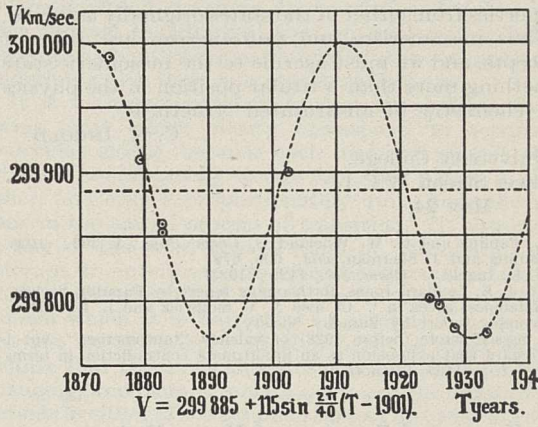

FIG. 1.

Seven years ago, I pointed out that the problem would be simplified if it were admitted that the velocity fluctuates[1]. The arbitrary rejection of some observations would not then be required, there having been a decrease in 1874–1883 and another in 1902–1934. An irregular variation, however, is of little scientific value: it is so easy to fit one to the observations; a regular, periodic variation, on the other

hand, if it fits all the observed values without omitting any, would be much more convincing than a linear law which ignores one third of the data. The remarkably close agreement of Edmondson's sine law of variation[2] with the observations cannot be fully appreciated without a graphical representation such as that reproduced as Fig. 1; it is significant, particularly because of its simplicity and because the period is the longest possible: a sinusoid which would 'pick up' Perrotin's value artificially by a multiplicity of undulations due to a short period would carry no conviction whatever to my mind, but the manner in which the graph 'picks up' (in passing, so to speak) this isolated value of 1902 is most remarkable and, in my opinion, convincing. Such a nine-fold coincidence cannot be fortuitous.

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May 24.

[1] *Astr. Nachr.*, No. 5520: 1927. *L'Astronomie*, November 1927.
[2] NATURE, **133**, 759, May 19, 1934.

Abnormal Permeability Produced in a Steel Wire by Loading

USING the ballistic method previously described[1], recent investigations have shown that an abnormally high value for the permeability of a steel wire can be obtained by loading.

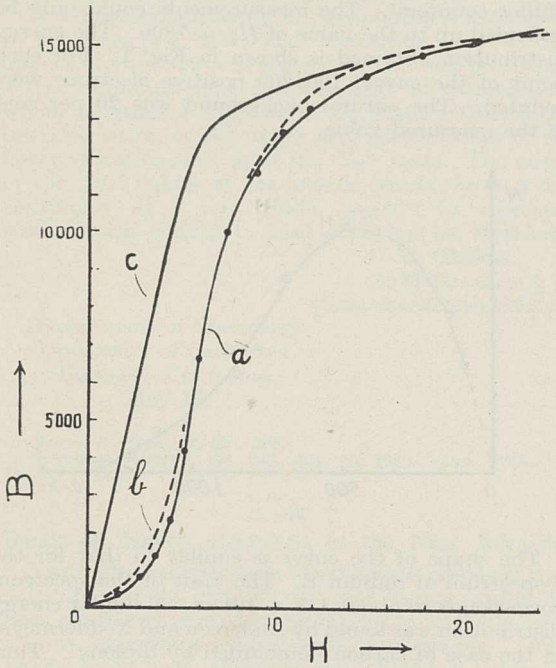

FIG. 1.

In Fig. 1, the curve *a* shows the relationship of *B* and *H* obtained by the ordinary method of reversals for a mild steel wire of 0·092 in. diameter, the wire being unloaded. Curve *b* shows the values of *B* and *H*, also obtained by the method of reversals, when the wire was supporting a steady load of 202 lb. (that is, a stress of 13·7 tons per sq. inch).

By means of the ballistic test described[1], the increase of induction density $\triangle B$ was obtained as a function of *H* when a load of 202 lb. was gently applied. Before each application of the load, the magnetic intensity was raised to a value of about 200 gauss and the desired value of *H* was then reached by reversing the exciting current of the solenoid many times. The curve *c* in Fig. 1 has been obtained by adding the value $\triangle B$ to the corresponding value of *B* given by the curve *a*. It is seen that, for low values of *H*, the permeability given by curve *c* is more than ten times the normal value of the permeability as given by the curve *a*.

Loading the wire when it is placed in a steady magnetic field of suitable intensity gives rise to a very marked increase of permeability.

By means of a somewhat different procedure, Ewing[2] obtained very large increases of induction when an iron wire, which had previously been stretched beyond its elastic limit, was loaded. For annealed iron wire, however, the effect was very much less. So far as I am aware, the results now given are the first yet recorded showing the immense increase of induction produced by loading an unfatigued steel wire.

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Department of Electrical Engineering,
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May 10.

[1] NATURE, **132**, 513, Sept. 30, 1933.
[2] *Phil. Trans.*, 1885.

A Haploid Plant of *Nicotiana sylvestris*

ATTEMPTS to produce a merogonic fully developed animal organism have been unsuccessful; plants appear to be more convenient subjects for this purpose. We know two androgenic haploids at the present time and both belong to the genus *Nicotiana*. One was produced by pollinating a triploid *Nicotiana Tabacum* plant ($2n = 72$) with *N. Langsdorffii* ($2n = 18$). From such a cross a *Nicotiana Langsdorffii* androgenic haploid with 9 somatic chromosomes was produced[1]. The other androgenic haploid was produced by pollinating the amphidiploid *N. glutinosa* × *N. Tabacum* = *N. digluta* with *N. Tabacum* ($2n = 48$). From such a cross an androgenic *N. Tabacum* with 24 somatic chromosomes has been produced[2].

FIG. 1. Somatic metaphase from a root tip of the haploid *Nicotiana sylvestris*.

Recently we produced another *Nicotiana* haploid by pollinating the F_1 hybrid *N. Tabacum* × *N. sylvestris* with pollen from *N. sylvestris* ($2n = 24$). Considering the former two cases, it seems very probable that the haploid thus produced has developed from a sperm nucleus. The haploid is a dwarf *Nicotiana sylvestris* plant with smaller cells than the normal (diploid) *N. sylvestris*. The haploid has two chromosomes with small heads, two with large heads (subterminal constriction), four with medial constrictions and four with submedial constrictions (Fig. 1). In the root tips of the haploid plant, single cells or even whole sectors were found with diploid chromosomal constitution—a condition which often occurs in haploids.

It is most probable that this haploid has developed

from a *sylvestris* sperm nucleus; but it is also possible, although not very probable, that it has originated parthenogenetically from an egg cell having only *sylvestris* chromosomes. Such an egg cell can be produced if all the *sylvestris* chromosomes (12) separate and move toward one pole, while the *Tabacum* chromosomes (24) move toward the other pole during the reduction division in the F_1 hybrid. The chance for such a chromosomal distribution during the reduction division is very small. When we consider the fact that parthenogenesis is a rare occurrence—only one egg cell (haploid) may develop parthenogenetically out of several thousands—it seems very improbable that our *sylvestris* haploid has such an origin.

Detailed morphological description of the haploid and its cytogenetical behaviour will be given elsewhere.

DONTCHO KOSTOFF.

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[1] Kostoff, Dontcho. "An Androgenic *Nicotiana* Haploid", *Z. Zellforsch.*, **9**, 640; 1929.
[2] Clausen, R. E. and Lammerts, W. E., "Interspecific Hybridisation in *Nicotiana*. (10) Haploid and Diploid Merogony". *Amer. Nat.*, **63**, 279; 1929.

Influence of Thyroid Preparations on the Plumage of Birds

IN an earlier communication[1] we described experiments on the supposed influence of the thyroid hormone on the moulting mechanism of feathers in aquatic birds which manifested very striking resistance to thyroid feeding and to the injection of thallium acetate. After controlling the thyroid preparations which produced the shedding of feathers in hens and caused metamorphosis in tadpoles, the thyroid glands of ducks and geese have been examined. The great difference observed between them and the thyroid gland of the chicken was found to be due chiefly to different anatomical structure and to tremendous development of the corpuscula epibranchialia (corpuscula epithelialia or parathyreoidea of other authors) in ducks and geese.

It seemed to us therefore that the corpuscula epibranchialia may have a neutralising effect on the influence of thyroid in our experimental aquatic birds. It is also possible to presume such a neutralising influence in the testis hormone of drakes as suggested in the interesting publication of Mr. R. George Jaap, of the University of Wisconsin, in "Poultry Science", referring to testis enlargement and thyroid administration in ducks, although we used in our experiment both male and female ducks.

Bearing in mind this possibility, we repeated the experiment now with a uniform batch (in regard to origin, age and so on) of hens divided into four groups treated as follows: (1) fed with thyroid preparations; (2) fed with thyroid preparations and given injections of extract (in Ringer's solution) of corpuscula epibranchialia of geese and ducks; (3) fed with thyroid preparations and given injections of testis hormone prepared from drakes' testes; and (4) a control group given injections of Ringer's solution only and including other hens without special treatment.

The result was again very striking. While hens of the first and third groups began on the 8–9th day to lose their feathers and on the 12th day there were all the symptoms of severe moulting, the group injected with the extract of corpuscula epibranchialia as well as the control animals remained quite resistant to thyroid feeding.

This experiment was repeated twice with the same result and at the same time histological examination was made of the corpuscula epibranchialia. Some interesting results were observed; for example, tadpoles given a very small dose of the extract of corpuscula taken from geese died on the second–third day, but the control tadpole fed on goose's thyroid gland and other thyroid preparations continued alive and active.

A detailed report of these experiments is in preparation.

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May 20.

[1] NATURE, **133**, 482, Sept. 23, 1933.

Energy Spectrum of Positive Electrons ejected by Radioactive Nitrogen

THE velocities of positive electrons, emitted by boron when bombarded by α-particles of radium C′ with a range reduced to 6·3 cm., were investigated by the magnetic focusing method, the electrons being detected by coincidences in two contiguous Geiger-Müller counters[1]. The measurements could only be extended up to the value of $H\rho = 7800$. The energy distribution obtained is shown in Fig. 1. For each point of the curve, 100–200 positive electrons were counted. The natural background was 20 per cent of the measured value.

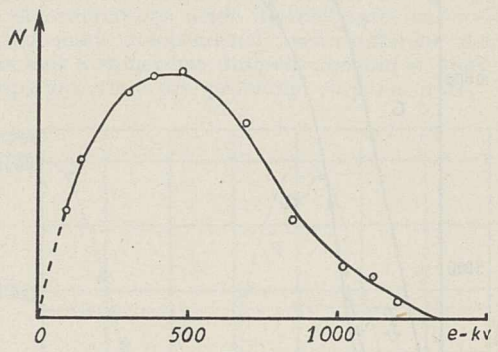

FIG. 1.

The shape of the curve is similar to that for the β-spectrum of radium E. The limit of the spectrum corresponds to about $1{\cdot}3 \times 10^6$ ev. A similar energy distribution was found by Anderson and Neddermeyer in the case of carbon bombarded by diplons[2]. Thus the half period[3] and the energy spectrum of positive electrons of radioactive nitrogen do not depend on the method of its production.

The most probable way of producing N^{13} in our experiments may be assumed to be:

$$_5B^{10} + {}_2He^4 \rightarrow {}_7N^{13} + {}_0n^1$$

while in the case of Crane and Lauritsen, measured by Neddermeyer and Anderson, the supposed reaction was:

$$_6C^{12} + {}_1D^2 \rightarrow {}_7N^{13} + {}_0n^1$$

Thus, starting both from $_5B^{10}$ and from $_6C^{12}$, one gets the same kind of radioactive nitrogen $_7N^{13}$ with the same characteristic constants.

The energy distribution in the case of aluminium and magnesium is similar to that of the β-spectrum of thorium C′ + C″, the limit lying above 2×10^6 ev.

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[1] Alichanow, NATURE, **133**, 581, April 14, 1934.
[2] Anderson and Neddermeyer, *Phys. Rev.*, **45**, 498; 1934.
[3] I. Curie and F. Joliot, NATURE, **133**, 201, Feb. 10, 1934. Ellis and Henderson, NATURE, **133**, 530, April 7, 1934. Crane and Lauritsen, *Phys. Rev.*, **45**, 430; 1934.

Absorption Spectrum of Diatomic Arsenic

A NEW system of some eighty absorption bands has been discovered in the spectrum of arsenic between 2200 A. and 2750 A., which can be definitely assigned to the diatomic molecule. This includes the five faint fluorescence bands observed by Rosen[1] and tentatively ascribed to As_2. The whole system bears a striking resemblance to that of P_2, investigated by Herzberg[2], where $\Delta G''$ is about 750 cm.$^{-1}$ and $\Delta G'$ 470 cm.$^{-1}$. A preliminary analysis gives for arsenic ΔG values that are about 420 cm.$^{-1}$ for the lower and 270 cm.$^{-1}$ for the upper state. The vibrational levels of both states converge very slowly.

The emission spectrum of phosphorus is attributed by Herzberg to a $^1\Sigma_g^+ \leftarrow {}^1\Sigma_u^+$ transition, in which the upper potential curve is crossed by another, possessing a flat minimum and a lower heat of dissociation, which is either a $^3\Sigma_u^+$ or a $^3\Pi_u$ state. This causes predissociation in the upper and perturbation of the lower vibrational levels of the $^1\Sigma_u^+$ state. The graph of the $\Delta G'$ values of our arsenic bands shows a discontinuity at $v' = 4$, which appears to represent perturbation similar to that observed by Herzberg.

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[1] Rosen, *Z. Phys.*, **43**, 69; 1927.
[2] Herzberg, NATURE, **126**, 239, Aug. 16, 1930. *Ann. Phys.*, (5), **15**, 677; 1932.

Bands of 'Heavy' Acetylene in the Near Infra-Red

THE infra-red spectrum of acetylene prepared from calcium carbide and 93 per cent heavy water has been examined photographically up to 12,000 A. with a 4 m. absorbing length at 2 atmospheres[1]. Four bands have been observed, all of which belong to C_2HD as indicated by the absence of alternating intensities. In spite of the high concentration of the heavy water used, no bands due to C_2D_2 have been observed in this region.

So far, the fine structure of the strongest two bands (1·030 μ and 1·094 μ) has been measured. The moment of inertia of C_2HD in its lowest state was found to be $27{\cdot}90 \times 10^{-40}$ gm. cm.^{2}. From the moment of inertia of ordinary C_2H_2 ($23{\cdot}50 \times 10^{-40}$ gm. cm.^{2}) alone, it is impossible to get exact values for both the C–C and C–H distances. It is now possible, however, by combination of the moments of inertia of C_2H_2 and C_2HD to get an accurate value for both these distances without making any outside assumptions. (Naturally the nuclear distances are supposed to be the same in both molecules.) The result is $r_{CC} = 1{\cdot}205$ A. and $r_{CH} = 1{\cdot}062$ A.

As C_2HD is not symmetrical, part of the selection rules valid for C_2H_2 no longer hold. Therefore more transitions occur in C_2HD than in C_2H_2. This fact is illustrated by the accompanying table, where preliminary values for the origins of the C_2HD bands are compared with the corresponding C_2H_2 bands. The nomenclature of Mecke[2] is used with Lochte-

	C_2HD	C_2H_2
$3\nu_a$	9706 cm.$^{-1}$	9641 cm.$^{-1}$
$2\nu_a + \nu_1$	9139	—
$\nu_a + 2\nu_1$	8550	9835
$2\nu_a + \nu_2$	8410	—

Holtgreven and Eastwood's[3] interpretation of the C_2H_2 bands. The combinations $2\nu_a + \nu_1$ and $2\nu_a + \nu_2$ are forbidden for C_2H_2 according to Dennison's selection rules, but not for C_2HD. As will be seen, the strongest band, $3\nu_a$, is slightly shifted to *shorter* wave-lengths in spite of the larger mass of one of the vibrating nuclei, whereas the band $\nu_a + 2\nu_1$ is appreciably shifted to *longer* wave-lengths. It follows that $\nu_a \approx 3300$ cm.$^{-1}$, $\nu_1(s) \approx 2650$ cm.$^{-1}$ against 3277 and 3230 respectively in C_2H_2. This frequency shift is somewhat analogous to that observed by Wood[4] in the Raman spectrum of HDO.

We are preparing to investigate HDO, CH_3D, DCN, and other heavy molecules in the same spectral region.

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[1] H. M. Randall and E. F. Barker (*Phys. Rev.*, **45**, 124; 1934) have recently published a short note on the *far* infra-red spectrum of C_2HD and C_2D_2.
[2] R. Mecke, *Z. phys. Chem.*, B, **17**, 1; 1932.
[3] W. Lochte-Holtgreven and E. Eastwood, *Z. Phys.*, **79**, 450; 1932.
[4] R. W. Wood, *Phys. Rev.*, **45**, 392; 1934.

De Causis Plantarum

IN a review of Dr. Gunther's edition of Goodyer's Dioscorides in NATURE of February 17, reference is made to Goodyer's translations of Theophrastus, and the statement is made that: "so far as is known, the manuscript translation in the library of Magdalen College prepared by Goodyer in 1622–23 is still the only English version of 'De Causis Plantarum'."

It may be of interest, therefore, to direct attention to the fact that the text of Book I of "De Causis Plantarum", with translation and commentary by Robert Ewing Dengler, was presented in 1927 as a dissertation for the doctor's degree at the University of Pennsylvania, and was published by the University among the theses for that year.

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Research Items

Wooden Cauldron from Co. Monaghan, Ireland. A remarkable cauldron of wood has recently been acquired by the National Museum of Ireland. It was found at Altartate, near Clones, Co. Monaghan, in 1933 at a depth of 160 cm. in a peat bog, 356 cm. above the clay at the foot of the deposit. The cauldron was undoubtedly complete when it was found, but was broken by the finder and onlookers. The remains have been restored by Prof. J. Bayley Butler and has been described by Dr. A. Mahr (*Proc. Roy. Irish Acad.*, **42**, Sec. C., No. 3). The dimensions are: opening 34 cm. × 35 cm.; external measurement, 45 cm. × 49 cm.; height, 28·5 cm.; thickness, 0·9 cm. near rim to 2 cm. The vessel is now slightly elliptical, doubtless owing to warping. The wood is poplar; the handle, only one remaining, of yew. The cauldron is unique, owing to the handles and the ornamentation on the upper portion. The handle, something between a triangle and a semi-circle, is a translation into wood of the ring-handles of the well-known riveted cauldrons of the late bronze age of Britain, the ribbed lugs carved out of the solid wood also being reminiscent of the metal staples found in these cauldrons; but the lugs of the Altartate vessel are on the shoulder, the difference being due to the material. The ornamentation consists of six concentric patterns with central dots, encircling the upper portion. The circles, which are not closed, are connected with each other by tangential bands, these being a continuation of the bands forming the incomplete circles. The concentric pattern is a faint reminiscence of the old metal rivets, but has become purely ornamental. Looked at as a whole, the pattern has a 'step' character, like a debased spiral ornament. No similar pattern is found in the Irish bronze age, and it seems to be nothing but a clumsy expression of a provincial La Tène art. The vessel may, therefore, be a belated descendant of metal cauldrons which had gone out among the well-to-do, but lingered among the poorer classes. The suggested date of early iron age is confirmed by a pollen analysis by Prof. Knud Jessen.

Diving Powers of Whales. It is little likely that the physiological processes of the larger Cetacea will ever become known from direct observation. For this reason Mr. A. H. Laurie has felt that it would be well worth while to undertake a careful and detailed study of the properties of fresh carcases of the Southern Blue and Fin whales in the belief that he might thereby be enabled to make tentative but nevertheless useful deductions as to their mode of life. The results of his observations and experiments ("Discovery" Reports, **7**, 363–406; 1933) provide striking confirmation of the soundness of this belief. After analyses of the data which he has been able to collect, Laurie supports the view—stoutly opposed by certain cetologists—that whales are capable of diving quickly to great depths and as rapidly returning again to the surface. If this indeed be true (and the bulk of the evidence seems to point to this conclusion) certain physiological considerations of great interest are involved, the most important of which is the whale's immunity from caisson sickness. On the basis of human performance, a whale which dives to a depth of 100 metres and stays down there for 15 minutes will require to spend rather more than 1½ hours in returning slowly to the surface, in order to avoid this malady. Yet all whalers are agreed that whales rise from deep soundings much more quickly than that. Up to the present, no convincing reason why whales enjoy immunity from caisson sickness has ever been put forward. A very surprising yet exceedingly plausible explanation is now indicated by the results of Mr. Laurie's observations and experiments. He has found that whale blood, both adult and fœtal, contains vast numbers of tiny bacteria-like organisms, provisionally referred to as *X* organisms. These *X* organisms appear to possess the power of bringing about some kind of 'nitrogen fixation', with the result that excess nitrogen dissolved in the blood under extra pressure does not escape from it on decompression and cause caisson sickness in the animal (see also NATURE, **133**, 636, April 28; 874, June 9, 1934).

Adoption of an Orphaned Brood by a Wasp. In the *Entomologist's Monthly Magazine* for April 1934, Mr. G. E. J. Nixon describes the finding of a rudimentary nest of *Vespa vulgaris* containing sixteen cells, and of about the size of a golf ball. The nest was dug out from the ground along with the queen and carried indoors. The queen made no attempt to leave the nest until it was indoors and then it flew to a window. The nest was suspended across the top of a fairly large and deep box and, after several attempts to escape, the queen was ultimately induced to adopt the new abode and was regularly fed. At the time when the nest contained two cocoons and many larvæ of different sizes she disappeared and was not seen again. Three days later a queen of the allied species *V. germanica* was obtained, and this individual adopted the orphaned brood just as completely as if it were her own. She accepted blow-fly puparia and caterpillars which she malaxated and fed to the brood. The experiment was brought to a conclusion owing to an accident which caused the comb to fall and become broken.

Sex in the Myxomycetes. A paper by S. Abe in vol. 1 of the Science Reports of the Tokyo Bunrika Daigaku (Tokyo University, Koishikawa, Tokyo) describes some very interesting experiments on male and female gametes of various slime fungi ("On the Syngamy of some Myxomycetes", pp. 193–202, Jan. 23, 1934). The work deals with the planogametes of *Fuligo septica*, *Erionema aureum*, *Didymium nigripes*, *Physarum crateriforme* and *Stemonites fusca*. It was observed that one of the gametes (the male) moved towards the other, and the two can be further differentiated by staining reactions. Neutral red, safranine, neutral violet, methylene blue and cresyl blue all stain male and female gametes differently. The female gamete has a positive charge, whilst the male is negative.

Ice in the Arctic Seas. The survey for 1933 of ice in the Arctic Seas (*Isforholdene i de Arktiske Have*) by the Danish Meteorological Institute shows that unusually favourable conditions prevailed in the Barents and Greenland Seas, where for the greater part of the year the ice was well to the north of the average limits. Off Spitsbergen there was no ice to the west in winter and spring or from the middle

of June through the summer and autumn. The north coast was clear from May until August and the east coast was almost clear in August. Novaya Zemlya was almost clear in July and entirely clear in August, in which month Franz Josef Land was accessible in open water. Not during the last 34 years have conditions been more favourable on the east coast of Greenland. In March and April the edge of the pack was 120 miles west of its normal position and by August the whole coast between lat. 70° N. and Cape Farewell was clear of ice. The coasts of Iceland were free throughout the year. On the Newfoundland Banks, ice was rare except in May. Davis Strait was unusually clear in most months. Hudson Strait was almost clear in August. On the other hand, conditions were severe in Bering Strait and the Beaufort Sea and towards Wrangel Island. North of Asia, so far as information goes, the ice was abundant but it was mainly new ice. The White Sea did not clear until May. On the whole, it would appear that the outflowing polar drift was checked in the Barents and Greenland Seas and diverted towards Alaska and eastern Siberia.

Three Commercial Sands of Canada. Several reports of the Canadian Department of Mines, published early this year, have reached us ; these appear to be mainly of interest to Canadians, but one, "Investigations of Mineral Resources . . . ", makes a somewhat wider appeal. This pamphlet contains three papers all referring to certain sandstones ; the first is an account of a bed of Potsdam sandstone between Buckingham and Gatineau Point, Quebec ; it appears to be a friable sandstone easily disintegrated into individual quartz grains which are rounded to sub-angular. The authors (L. H. Cole and R. K. Carnochan) conclude that this deposit will probably yield a silica sand sufficiently free from iron for glass making. The second paper, by L. H. Cole, refers to a band of Chazy sandstone at Hawkesbury, Ontario. The stone appears to be fine grained and strong, is easily carved and worked, and apparently would make a good building stone, for which purpose it appears to have been used for something like a hundred years. The third paper gives an account by S. C. Ells of the bituminous sands of McMurray, Northern Alberta. The author holds and has held for a considerable time "that the McMurray deposit of bituminous sand should be regarded as a potential source of liquid hydro-carbons". The quantity of available bituminous sand appears to be very large ; it is assumed that its bitumen content is 12½ per cent and that the petroleum products derived from the bitumen would be about 75 per cent by volume of the bitumen. The author estimates costs of production and shows that the material can be worked at a profit, and concludes that the conditions are "favourable to commercial development of the Alberta bituminous sands".

Treatment of 'Slurries' in Coal Washing. Every advance in technology creates new problems. The need for cleaner coal led to development of coal washing. But coal is friable and contains dust, which interferes with the efficiency of most washing processes. Therefore the dust may not be permitted to accumulate in the wash water, and tanks are provided where the dust is allowed to settle and form a 'slurry' or mud of particles of coal and earthy matter. Owing to the fineness and character of the dust particles, the clarification of the wash water is often difficult, and chemical precipitants are added to promote flocculation and deposition of the slurry. This may contain more water than fuel and must be 'dewatered', after which it may be used as a low-grade fuel or incorporated in the slack fed to coke ovens. The 'de-dusting' of coal and the treatment of 'slurries' form the subjects of Memoranda 13 and 14 of the Institution of Mining Engineers. During coal strikes, accumulations of slurry have proved unsuspected fuel reserves of no small importance.

Hot Wire Anemometers. The lecture on these instruments and their uses given at the Institut de Mécanique des Fluids of the University of Paris by Dr. E. G. Richardson, of Armstrong College, Newcastle in March 1932 has been amplified by him and issued as an Institut pamphlet with the title "Les Appareils à Fil Chaud" (Paris : Gauthier-Villars). It extends to 68 pages and is well printed and illustrated. After showing how the change of resistance of a wire carrying an electric current, due to the movement past the wire of the gas or liquid in which it is placed, may be used to determine the speed of the fluid, he shows how by placing two wires parallel to each other and near together the sheltering action of one wire to the other allows the direction of the motion of the fluid to be determined. The effects of to and fro movements of the fluid, and of solid walls are also traced. The second part gives an outline of the results obtained by these methods for the motions of the air about the wings of an aeroplane, about a cylinder and in the pipes and cavities of musical wind instruments. References to 62 papers dealing with the subject are given. There are a few misprints : Fig. 2, p. 16, and Camobell, p. 57, are examples.

Atomic Weight of Cæsium. The atomic weight of cæsium in use for some time rests on the work of Richards and Archibald and Richards and Françon, who found the value 132·81. Aston, and Bainbridge, however, found by the mass-spectrograph that cæsium is a simple element, and Aston's packing fraction together with the conversion factor from O^{16} to O = 16 of 1·00022 leads to Cs = 132·904. A re-determination of the atomic weight by chemical methods, using cæsium from pollucite of Maine, U.S.A., made by G. P. Baxter and J. S. Thomas (*J. Amer. Chem. Soc.*, May), has given a result in close agreement with that of Aston, although sufficient reasons for the difference between their results and those of Richards and his collaborators are difficult to discover. The cæsium salts were very carefully purified and showed no trace of rubidium or potassium on spectrographic examination. The chloride was fused in a platinum boat in an atmosphere of nitrogen, hydrogen, or various mixtures of hydrogen and hydrogen chloride, before weighing. The silver precipitation method, with adjustment of the end-point with a nephelometer, was used. Fourteen experiments are reported, the average ratio CsCl : Ag being 1·56063, or Cs = 132·903. By rejecting one experiment, which gave rather low values, the averages are CsCl : Ag = 1·56065 and Cs = 132·906. The values for the first seven determinations, for which probably the material was of slightly better quality, are CsCl : Ag = 1·56070 and Cs = 132·911, the value finally adopted being Cs = 132·91. It is very reassuring that the chemical and physical methods have been found to agree so well in this region of the atomic weight scale, and that a supposed anomaly has been removed.

Callender's New High-Voltage Research Laboratories

THE new high-voltage research laboratories of Callender's Cable and Construction Co., Ltd., are being opened on June 22 by Lord Rutherford, before a distinguished company, which will include the Council of the Institution of Electrical Engineers, by special invitation of the president, Mr. P. V. Hunter. The laboratories occupy the buildings of the old Kensington and Notting Hill Gate Power Station, at 38 Wood Lane, W.12. The large space and headroom provided by these buildings have made them especially suitable for conversion to high-voltage laboratories. Altogether, 30,000 sq. ft. of ground floor space have been equipped as research laboratories, together with associated stores and workshop. The laboratories have been organised and equipped in a manner which will enable research work to be carried out in any field associated with the transmission of electrical power.

The main high-voltage equipment consists of two transformers by Ferranti, each for 500 kva. continuous output at 500,000 volts. It is believed that these are the largest transformers of this voltage available at present in the industry. The large size of the transformers has been made necessary by the large capacitance current which is required for cable testing at high voltage. These two transformers are situated in adjoining laboratories which are 130 ft. long, and 45 ft. and 28 ft. wide respectively. One of these transformers has been mounted on porcelain insulators, so that the tank of the transformer can be raised to a voltage of 500 kv. to earth. In addition, a large opening in the wall dividing the two laboratories enables the two transformers to be connected in parallel or in cascade, thus providing 1,000 kva. at either 1,000 kv. or 500 kv. The lay-out of these two laboratories represents a distinct departure from the usual practice in high-voltage laboratories. The two transformers have been located in the middle of the laboratories. Each transformer thus commands two testing areas, one on each side. In this way, it is possible for preparation work to be pressed forward in one area while the transformer is testing in the other area, with a complete absence of risk to the personnel concerned. It is a general experience in high-voltage laboratories that the preparation time far outweighs the time spent in actual testing. It has been found, however, that the above arrangement of the transformers makes for efficient use of the testing equipment.

The question of supply to the transformers received very careful consideration. It was required that high voltage should be available at any frequency between 25 cycles and 75 cycles per second. At the same time, the very sharp response curve of the vibration galvanometer used in making dielectric loss angle measurements made it essential that, when testing at any given frequency, the alternator speed should be held absolutely constant with variation of load or with variation of such factors as the supply voltage. It was not found possible to obtain sufficiently constant speed regulation with the usual arrangement of a Ward-Lennard set. The arrangement finally selected consists of a 3-phase synchronous motor, driving a 3,000 volt single phase alternator through a fluid gear box, which provides a continuously variable gear ratio over the above range. All this equipment is by Haslam and Newton, Ltd., of Derby. From the testing which has so far been carried out, it appears that this equipment is likely to prove entirely satisfactory.

The cable life testing laboratory contains transformer equipment by British Thomson-Houston Co., Ltd., which enables long lengths of buried cable for 66 kv. and 132 kv. systems to be tested at twice working voltage, under conditions which simulate service conditions. The two high-voltage transformers are for 500 kva. and 1,000 kva. respectively. These transformers are supplied by 3,000 volt single phase alternators, direct coupled to 3-phase synchronous motors. In addition to the high-voltage transformers, two loading current transformers supply a total of 1,500 amp., the high-current windings being insulated from earth for 170 kv. This enables cable heating current to be superimposed on the cable conductor without interrupting the high voltage, and in this way the cables are passed through periodic heat cycles. An unusual feature of this transformer equipment is that double electrostatic screens have been provided between the primary and secondary windings for the purpose of enabling accurate dielectric loss angle measurements to be carried out on cables which are buried, and in which, therefore, the cable sheaths are necessarily earthed. The cables are buried in runs of about 200 yards in land adjoining the laboratories which consists of made-up soil representative of normal London conditions.

In addition, the laboratory possesses a large amount of smaller transformer equipment for voltages up to 120 kv. which is used for the development of cable accessories such as joints and sealing ends, and for general investigations into the theory and mechanism of breakdown of high-voltage cable dielectric.

Smaller laboratories are provided for dielectrics, chemistry and physics, and these provide all facilities for a large number of investigations which arise out of the main research programmes on the high-voltage cables themselves.

Conversion of Municipal and Village Wastes into Humus

ALTHOUGH at the moment many agricultural regions are more concerned with the profitable marketing of their surplus produce than with methods designed to increase crop-production, nevertheless there are important exceptions to this general rule. In India, for example, the food supply of the villages, some 500,000 in number, is markedly deficient in amount, while the low quality is considered by many medical authorities on the spot to be one of the chief factors responsible for the poor general health and want of resistance to disease on the part of the population. In other parts of the tropics the maintenance of the food supply of the people is always one of the major anxieties of the authorities. In such circumstances any practicable method, by which the local food crops can be improved and to

some extent ensured, will at once command attention. Such a method has recently been worked out at the Institute of Plant Industry at Indore in Central India. The earlier results were published by Messrs. Howard and Wad in 1931 as "The Waste Products of Agriculture" which was reviewed in NATURE of November 21, 1931. In the February number of the *Indian Medical Gazette* of the present year, Messrs. Jackson and Wad have successfully applied the Indore method of manufacturing humus from agricultural wastes to the conversion of night soil and town refuse into a valuable compost*.

During 1932 and 1933 town wastes have been converted into humus at three centres—(1) Indore City, where the waste products of 60,000 inhabitants were dealt with; (2) the Indore Residency enclave, with a population of 4,000; and (3) the lines of the Malwa Bhil Corps where the numbers are about 1,000. These three centres are representative of a large municipality, a small town or military cantonment and an ordinary Indian village. The arrangements for the conversion are very simple and inexpensive. The humus factory consists of: (1) a metalled service road, 20 ft. wide; (2) a charging trench on either side, 2 ft. deep and 15 ft. wide, the floor and sides of which are preferably made smooth and impermeable so as to prevent the breeding of flies; and (3) metalled storage areas, at least 20 ft. wide, on which the ripe compost can be piled in heaps until it is sold. The manufacture of compost, which takes about a month, consists in the proper arrangement and moistening of the raw materials—town and village refuse and night soil—in the charging trench, followed by the turning of the charge three times at suitable intervals. An intense fermentation accompanied by a rapid rise in temperature to above 50° C. at once sets in. The copious aeration which is ensured by the proper admixture of the materials leads to the rapid oxidation of the organic matter and to the destruction of all noxious odours, while the high temperature destroys the fly maggots and probably the ova of helminths and the spores of pathogenic bacteria as well.

The chemical composition of the final product is very satisfactory. The percentage of nitrogen on a dry basis is nearly 1 per cent while the percentages of phosphorus, potash and lime are ample. The results obtained with such crops as sugar-cane, wheat, cotton, lucerne and vegetables are such that the product finds a ready sale. The sale proceeds are considerably greater than the cost of manufacture and therefore a substantial profit is obtained, instead of the usual loss. During the last year at Indore City, for example, a net profit of Rs. 3,085 was obtained. Under the old method of disposal at this centre the net deficit was Rs. 4,535. From the point of view of sanitation and public health, two of the medical officers in Central India—Colonels Tyrrell and Nicholson—record their opinion on the process. Both consider that the method is likely to prove the most satisfactory system so far employed for the disposal of municipal wastes.

The Indore results are already being taken up at other centres in India. The process has been adopted by the Military Cantonment at Neemuch, and at Okara, a small town of 9,000 inhabitants in the Punjab. At the suggestion of Sir Malcolm Hailey, the Governor of the United Provinces, the Public Health Department has decided to experiment with the method, while the Public Works Department of New Delhi is examining the process with the view of applying it as a solution of their very serious refuse disposal problem.

* Institute of Plant Industry, Indore, Central India. Bulletin No. 1: The Sanitary Disposal and Agricultural Utilization of Habitation Wastes by the Indore Process. By F. K. Jackson and Y. D. Wad; with Notes on the Sanitary Aspect by Lieut.-Col. J. R. J. Tyrrell and Lieut.-Col. M. A. Nicholson. Pp. 26+3 plates. (Indore.) 8 annas.

Measurement of Noise

IN a paper read to the Institution of Electrical Engineers on March 8, Messrs. B. G. Churcher, A. J. King and H. Davies read a paper on experiments on the measurement of noise, with special reference to engineering noise problems (see also NATURE, 132, 350, Sept. 2, 1933).

The authors point out that the old conception that sounds can be classified into music and noise is untenable. For their purposes they define noise as irksome or undesired sound. For example, the sound of a radio set operated in a room to the pleasure of some of the occupants may constitute an irksome noise to others who wish to converse. They discuss the laws governing the threshold of hearing, the relation of the magnitudes of the stimuli at different frequencies which produce equal sensations of loudness and the relation between stimulus and sensation. They define the threshold as the largest sound the complete removal of which is not detected.

In determining the threshold, it is essential that there is no 'background' noise. The range of frequencies covered is 100–6,400 cycles per second at octave intervals so that measurements were made at seven frequencies. Points determined in this way are sufficiently close to define the threshold curve.

The experiments were carried out in the laboratories of Metropolitan-Vickers Electrical Co., Ltd. Fifty persons were experimented on and were divided into male and female groups. At 100 cycles per second the female group is 2–3 decibels less sensitive than the male. At 800 cycles per sec. there is a tendency in both groups for sensitivity to decrease with increasing age, but the female group is now 2–3 decibels more sensitive than the male. At 6,400 cycles per sec. the average sensitivities of the two groups are approximately equal, the three oldest males having a much lower sensitivity than the rest.

The old loudness scale used by the authors and the decibel scale are logarithmic scales of physical stimulus. Doubt is thrown on the correctness of this method of measuring sound sensation. Experience has shown that the rate of increase of loudness with the decibels above the threshold is comparatively small at low intensities and much larger at high intensities. Masking and balancing methods of measuring the noise were experimentally tried and the latter was found much the more satisfactory. A pure tone was taken as the standard sound, as it is easy to specify and reproduce accurately. The procedure is to find the physical magnitude of the standard stimulus which produces a loudness sensation of the same magnitude as that due to the source under observation. The judgment of loudness

equality is much simpler than the estimate of the magnitude of loudness. It was most important that the response of the telephones used should have a linear relation with the amplitude of the disturbance especially at high values of the amplitude.

The authors have made measurements of the magnitudes of common noises on various scales. In what follows, we give them in loudness units. Calling zero the threshold of hearing, the ticking of a watch at three feet would be unity. In a quiet saloon motor-car it would be 10. Ordinary conversation at three feet would be 20, but if in a suburban steam train with the window open it would be 50. A loud motor horn at 100 feet was found to be 100 and two circular saws at three feet 160.

The effect of placing the source inside a building is very pronounced. An 800 cycle tone placed in an enclosure had a loudness of 41, whilst outside it was only 2·4. In making these measurements it is vitally important to take the background of noise into consideration. It is a matter of everyday experience that one sound can 'drown' another. A list of typical noise levels is given. For example, a busy main street in a certain city had a noise level of 22. When trains were passing it rose to 53. On a weekday on the ground floor of an office in the street with the windows open, the noise level was 22, but shutting the windows reduced it to 11. On a Sunday morning with the windows open it was 0·6 and closed 0·2. In a dining car in a train travelling at 60 miles per hour the level was about 50, but in a tunnel it rose to 82.

When apparatus is installed near a main street in a busy city, we have to consider a background of between 20 and 50. In this case a comparatively loud noise is scarcely noticed. On the other hand, when a residential hotel has to be considered, special precautions have to be taken. The screening effect produced by adjacent buildings is sometimes of assistance. At certain hours of the night the background may be so low as 1 unit and a much lower noise emission would have to be aimed at. If the problem is to be adequately dealt with in quiet residential districts, some form of enclosure must be used.

Permeability Tuning in Radio-Frequency Circuits

VARIABLE condensers are now so commonly employed in radio receivers to tune circuits including a constant inductance that the use, some years ago, of variable inductances or variometers with fixed condensers is apt to be forgotten. For some purposes, however, the latter arrangement may have considerable advantages. A paper by W. J. Polydoroff[1] refers to the advantages, particularly in the matter of selectivity, which result from tuning radio receiver circuits in such a manner that the ratio of the inductance to the resistance of the circuit remains constant. These desirable results may be conveniently accomplished by a new type of ferro-inductance. The coil itself is designed to have the desired performance at the highest frequency in the band to be covered. The effective inductance is then increased to tune to lower frequencies by introducing a magnetic core into the field of the coil. As the core is inserted into the coil, more lines of the magnetic field are intercepted by the core, and in effect, the average permeability of the medium surrounding the coil increases from unity, for air, to a certain maximum when the coil is entirely encased in the core : hence the term 'permeability tuning'.

The successful application of this principle to radio-frequency circuits depends upon the production of an iron-core material having an appreciable permeability at the working frequency, but free from the property of introducing undesirable resistance into the circuit. For many years, thinly laminated iron and stranded cores have been used for audio frequencies, while compressed iron dust cores have also come into use for frequencies up to about 50 kilocycles per second. Quite recently, considerable attention has been paid to the use of both iron and high permeability alloys for the construction of these dust cores, in order to obtain the necessary high permeability without the accompaniment of serious losses at radio frequencies.

In his paper, Polydoroff describes the use of pure iron reduced by hydrogen as a primary material for radio cores. While hysteresis losses are apparently vanishingly small at radio-frequencies, the eddy-currents are proportional to the square of the frequency and to the length of the circular path around each minute particle. The research described was directed at the broadcast frequency band, 550–1,500 kilocycles per second, and in this band the optimum grain size of the iron proved to be about 5 microns in diameter. This iron powder is mixed with a suitable insulating varnish and compressed in heated moulds of the desired shape, using pressures up to twenty-five tons per square inch. The resultant product has the appearance of solid iron, exhibits fair mechanical strength, and can be machined in the usual manner. The effective permeability obtained in such materials varies from about 5 to 12 according to the pressure employed in the moulding process.

The paper describes the use of this type of iron core in various types of radio receiver circuit. A good quality single layer solenoid of small dimensions is used as the inductance, and the core is made of two parts, an outer cylindrical shell and an inner plug, so as to enclose the coil in the position of maximum inductance. A semi-fixed condenser is attached to the end of each coil, and this is initially adjusted to give resonance at the highest frequency required. The cores are mounted on a common platform and inserted in their respective coils by a single tuning control. Provision is made to move each coil or each core separately in order to produce synchronisation at the middle of the range.

In receivers employing as many as six tuned circuits, no difficulty has been experienced in maintaining synchronism and constancy of the inductance to resistance ratio throughout the whole frequency band. The arrangement is equally applicable to the supersonic heterodyne and the straight radio-frequency amplifier types of receiver, and the advantages of the latter with the possibility of increased selectivity may give rise to interesting developments in the future.

[1] "Ferro-Inductors and Permeability Tuning", *Proc. Inst. Rad. Eng.*, May, 1933.

University and Educational Intelligence

CAMBRIDGE.—The title of Stokes lecturer in mathematics has been conferred on Dr. M. Born.

Prof. E. A. Owen, professor of physics at University College, Bangor, of Trinity College, has been approved for the degree of Sc.D.

The subject for the Sedgwick Prize for the year 1937 is "The Application of Modern Technique to the Elucidation of Some Specific Geological Problem". The prize is open to all graduates of the University, and essays are to be sent in on October 1, 1936.

OXFORD.—The question of the provision of sites in the University Park for the extension of the science departments, which has lately given rise to much discussion, has been settled by the adoption of certain decrees by Congregation. By these it is provided that, in addition to the area at present reserved, a further area on the western frontage should be allotted for such extension when required, while the remainder of the Park should be declared a public open space. This arrangement has been approved without opposition, though it would appear that if the requisite negotiations under the provisions of the Town and Country Planning Act, 1932, are carried through, the University will to some extent have forgone its freedom of action with respect to the portion not reserved for science.

THE following International Lady Tata Memorial Scholarships, each of the value of £400 for the academic year 1934–35, for research work in diseases of the blood with special reference to leukæmias, have been awarded: Dr. W. Büngeler (Danzig), Dr. L. Doljanski (Copenhagen), Dr. M. C. G. Israels (Manchester), Dr. C. Oberling (Paris), Dr. J. Engelbreth-Holm (Copenhagen), Dr. M. O. K. Jørgensen (Aarhus, Jutland), Dr. R. Meier (Leipzig), Dr. Lucy Wills (London).

"LEHRFREIHEIT" manifestoes by organisations representing twenty-two thousand American professors have been recently promulgated. They are reviewed in a Press *communiqué* circulated on March 12 by the Institute of International Education of New York. Specific reference to any foreign country is avoided, but recent events in Germany are doubtless responsible for these declarations, which do not ignore the fact that the United States itself is not immune from attacks upon academic freedom. The following excerpts are typical: American Association for the Advancement of Science—"Our existing liberties have been won through ages of struggle and at enormous cost. If these are lost or seriously impaired there can be no hope of continued progress in science, of justice in government, or international or domestic peace, or even of lasting material well-being. . . . Whether by governmental action, administrative coercion or extra-legal violence, we feel it our duty to denounce all such actions as intolerable forms of tyranny." American Political Science Association—"Every people has the right to live under the form of government it selects for itself. It is not for outsiders to object because they do not like it. But it is reasonable to deplore an action anywhere that may be absolutely destructive of gains in human progress that have been made only by great sacrifice. Freedom of teaching is one such gain."

Science News a Century Ago

Sir Gilbert Blane, F.R.S.

June 26 marks the centenary of the death of Sir Gilbert Blane, F.R.S., who with Robert Lind contributed more than anyone else to naval medicine and hygiene and the welfare of seamen. He was born at Blanefield, Argyllshire, on August 26, 1749, and received his medical education at Edinburgh under the celebrated William Cullen. After obtaining his M.D. degree at Glasgow in 1778, he went to London, became private physician to Sir George Rodney and accompanied him on a voyage to the West Indies. On his return, he submitted to the Board of Admiralty a memorial on the lack of cleanliness, ventilation and dryness in ships, the need for a supply of lemon juice for the prevention and treatment of scurvy, the prevalence of drunkenness, the inadequate care of the sick aboard ship, the absence of proper bedding and soap, and the need of a free supply of medicines and other necessaries to naval surgeons. In 1782 he left Plymouth with Rodney and remained on active service until the end of the War with the American Colonies, during which time he collected materials for his principal work entitled "Observations on Diseases of Seamen" published in 1785. This book consisted of three parts, devoted respectively to the health and diseases of the Fleet during the years 1780–83, the causes and prevention of diseases in fleets, and the description and treatment of affections such as fevers, dysentery and scurvy, most frequently seen at sea. During the last forty years of his life, Blane was frequently consulted by the Government and others on various aspects of public health, especially in connexion with the Navy.

Babbage and Parliament

In his "Passages from the Life of a Philosopher", Babbage gives an entertaining account of the elections in which he took part. On more than one occasion he was invited to become a candidate for Parliament, and on June 27, 1834, was nominated for Finsbury. In proposing his name, Mr. F. O. Martin said that although Mr. Babbage had never been in Parliament before, that did not take from his utility. He had, however, laboured to serve the public in other capacities, and had the honour of being the successor in an office formerly filled by the illustrious Newton. He was an advocate for the emancipation of the Jews, and the removal of the disabilities affecting their Dissenting brethren.

The candidature of Babbage was not regarded with favour in some quarters, as there were three other candidates; and in the end his name appeared at the bottom of the poll with 379 votes, while the two successful candidates secured 2,514 and 1,915 votes respectively. In his "Passages", when recalling that he afterwards declined the honour of standing for Stroud, he wrote: "I was not particularly desirous of wasting my time for the benefit of my country. The constituency of Finsbury had already expressed their opinion that Mr. Wakley and Mr. Thomas Duncombe were fitter than myself to represent them in Parliament, and in that decision I most cordially concurred."

Travels of Lieut. A. Burnes

On June 28, 1834, the *Athenæum* began a long review of the "Travels into Bokhara" of Lieut.

Alexander Burnes with the remark that, "Since the days when we hung with rapture over the pages of Cook's voyages and felt ourselves inspired by some portion of the enthusiasm that animated the adventurous navigator, we have met with no work by which we have been more interested, delighted and instructed than the travels of Lieut. Burnes". Born at Montrose on May 16, 1805, Burnes at the age of sixteen years entered the Indian army. He became well acquainted with Oriental languages, and soon gaining promotion, became an assistant political officer and was sent on various missions. In 1832, at his own request, he was sent on a twelve-months' expedition into Central Asia. "By his success in this expedition," one writer said, "our traveller at once became famous. He had retraced the greater part of the route of Alexander, surveyed the kingdoms of Porus and Taxiles, sailed on the Hydaspes, crossed the Indian Caucasus, beheld the scenes of the inroads of Jengis, and Timour, and Baber; but more than this, he had detected a new pathway by which India might be invaded." From this journey, Burnes in 1833 returned home to receive the medals of the Geographical Societies of London and Paris and to be lionised by society. Returning to India in 1835, he was employed by the Government on a mission to Afghanistan and six years later lost his life in the terrible massacre of November 1841.

Sir James South's Telescope

Referring to the note in these columns under this title in NATURE of June 9, p. 882, Messrs. Sir Howard Grubb, Parsons and Co. inform us that they have a copy of the extraordinary poster which Sir James South used to advertise the sale of his great equatorial telescope. The accompanying reproduction is from a photograph of the poster.

OBSERVATORY,
Campden Hill, Kensington.

To Shy-cock Toy Makers–Smoke Jack Makers–Mock Coin Makers–Dealers in Old Metals–Collectors of–and Dealers in Artificial Curiosities–and to such Fellows of

THE ROYAL ASTRONOMICAL SOCIETY,

as at the Meeting of that most learned and equally upright Body, on the 13th of May last, were enlightened by Mr. Airy's (the Astronomer Royal's,) profound *exposé* of the Mechanical Incapacity of English Astronomical Instrument Makers of the present day.

TO BE SOLD,
BY HAND, ON THE PREMISES, BY
Mr. Macleland,
On WEDNESDAY next, DEC. 21st,
BETWEEN 11 AND 12 IN THE FORENOON,
Several Hundred-weight of Brass, Gun Metal, &c. &c. being the Metal of the
GREAT EQUATORIAL INSTRUMENT,
MADE FOR THE KENSINGTON OBSERVATORY,
BY MESSRS
TROUGHTON AND SIMMS,
The Wooden Polar Axis of which, by the same Artists, and its Botchings cobbled up by their Assistants.

MR. AIRY AND THE REV.D R. SHEEPSHANKS,
were, in consequence of public advertisement on the 8th of July, 1839, purchased by divers Venders of Old Clothes, and Licenced Dealers in Dead Cows and Horses, &c. &c. with the exception of a fragment of Mahogany, specially reserved, at the request of several distinguished Philosophers, which, on account of the great anxiety expressed by Foreign Astronomers and Foreign Astronomical Instrument Makers, to possess, when converted into Snuff Boxes, as a *souvenir piquant* of the state of the Art of Astronomical Instrument Making in England during the 19th Century, will, at the conclusion of the Sale, be disposed of, at—per pound.

H. Johnson, Printer, 3, Wells Street, Oxford Street.

Societies and Academies

LONDON

Physical Society, June 1. G. F. HULL, S. E. GREEN and MARY BELL: The pressure of radiation. A historical statement. A brief account of some early experiments on radiation pressure, dealing in particular with the investigations of Lebedew and of Nichols and Hull. A. H. JAY: The estimation of small differences in X-ray wave-lengths by the powder method. It has been found possible by the use of a microphotometer to determine accurately the positions of lines at high angles of reflection on a powder photograph. With a powder photograph of clear colourless quartz taken with copper K_α radiation, the distance apart of the two component lines of a well-resolved doublet was measured to within 0·0002 cm. The measurements were then corrected for systematic errors—eccentricity of specimen, absorption of the radiation in the specimen, and divergence of the X-ray beam. The wave-length difference $(\lambda_2-\lambda_1)$ was finally calculated in terms of the given wave-length λ_1. The value of $(\lambda_2-\lambda_1)$ for copper K_α radiation is given as 3·833 X. H. STAFFORD HATFIELD: The action of alternating and moving magnetic fields upon particles of magnetic substances. An explanation of the translatory movement observed by Mr. W. M. Mordey in magnetic particles subjected to a multi-phase alternating field. A. MORRIS CASSIE: Time scale and electron relay used with a cathode ray oscillograph for the investigation of switch-gear and circuit phenomena. E. GWYNNE-JONES: Note on the hyperfine structure in the arc spectrum of xenon. The hyperfine structures of the Xe I lines λλ 9045, 9799 and 9923 are described and analysed, and the hyperfine separations of the terms $2p_9$ and $2p_{10}$ are derived. It is also found that the lines $1s_5-2p$ are readily self-reversed. Previous nuclear spin data are confirmed.

PARIS

Academy of Sciences, April 30 (*C.R.*, **198**, 1557–1644). P. VIALA and P. MARSAIS: The biology of *Pumilus medullæ*, the cause of the parasitic *court-noué* of the vine. This parasite belongs to the family of the Sphæriaceæ: it forms a new genus near the genera *Xylaria* and *Eutypa*. BORIS KAUFMANN: General closed surfaces and the local dimension. GEORGES KUREPA: Ramified tables of *ensembles*. MAURICE JANET: Systems of two partial differential equations with one unknown function of n independent variables. ANDRÉ MAGNIER: The integral of Kronecker. F. MARTY: The modulus of the Maclaurin coefficients of a univalent function. G. DEDEBANT, PH. SCHERESCHEWSKY and PH. WEHRLE: The statistical similitude in turbulent movements of fluids. MAX SERRUYS: The passage from the deflagrating to the detonating regime in petrol motors. JEAN LOUIS DESTOUCHES: The definition and properties of the centre of gravity in wave mechanics. HENRI MINEUR: Researches on the movements of the *B* stars. J. GÉHÉNIAU: The magnetic electron and the correspondence principle of Th. De Donder and J. M. Whittaker. BERNARD KWALL: A system of real matrices which interpose in the theory of the magnetic electron when placed in space-time of special relativity. PIERRE VERNOTTE: How to approach the problems of the propagation of heat with fixed boundaries when the thermal properties of

the medium depend on the temperature. ALBERT MILHOUD: The electromotive force produced by the flow of steam. Study of the effects of variations of diameter and length of tubes forming the jets and pressure of the steam on the electromotive forces produced. The latter may amount to several thousand volts: a super heat of 30° C. completely suppresses the electrification. N. STOYKO: The interference of short electric waves in the case of superpropagation. F. TROMBE: The magnetic properties of metallic cerium, lanthanum and neodymium at various temperatures. These experiments, the results of which are given as curves, were carried out on exceptionally pure specimens of the metals. M. DODERO: The preparation of calcium silicide by high temperature electrolysis. The electrolysis of calcium silicate, with the addition of calcium fluoride and chloride, gives alloys of free silicon and the silicide $CaSi_2$, the proportion of free silicon diminishing with the temperature. J. DEVAUX: Study of the solar spectrum in the extreme infra-red. RENÉ COUSTAL: The action of the silent electric discharge on certain phosphorescent substances. J. P. MATHIEU: The configuration of some optically active hexacoordinated complex compounds. IVAN PEYCHÈS: The rotatory power of the tartrates of the alkaline earths. R. ARNOULT: The magnetic spectrum of the β-rays emitted by thorium $B+C+C'+C''$. RENÉ DUBRISAY: A method of capillary analysis. MLLE. PAULETTE BERTHIER: The soaking of porous bodies by liquids. RAYMOND: A method of separating antimony and tin. The method is based on the use of triethylolamine, $N(CH_2CH_2OH)_3$ as a reagent. F. DIÉNERT and F. VILLEMAINE: The estimation of small quantities of nitrates in waters rich in organic matter. HENRI WAHL: The nitration of chloro-*p*-xylene. CHARLES DUFRAISSE and ARNALDO PERES DE CARVALHO: An attempt at the preparation of rubenes derived from fluorene: formation of a red non-rubenic compound. Internal tensions and the probabilities of formation of rubenes. N. MENCHIKOFF: The southern bank of the Jurassic Mésogée in Algero-Moroccan borders. RAYMOND FURON and CONRAD KILIAN: The discovery of the Senonian at Damergou (French Niger). JACQUES DE LAPPARENT: The development of the Rosaline limestones in Greece. MLLE. MADELEINE FRIANT: The comparative evolution of the upper molars in the primates and primitive insectivores. H. S. REED and J. DUFRENOY: The methods of calculation of the theoretical curve of growth of vine shoots. PIERRE DANGEARD: The budding of the nucleoles observed in *Lathræa Clandestina* and in some plants with prochromosomes. R. REILHES: The modifications of the lipid concretions (Mirande's sterinoplasts) in the bulb of *Lilium candidum* with the temperature. LOUIS FAGE: The presence of luminous organs in the pelagic amphipods. LÉON BERTIN: A new species of abyssal fishes: *Saccopharynx Schmidti*. RAYMOND-HAMET: The influence of atropine on the intestinal effects of adrenaline. G. TANRET: The glucoside from the seeds of *Coronilla*. PIERRE GRABAR: Study of serum proteins by filtration on membranes of graduated porosity. E. WOLLMAN: Researches on autolysis. The specific autolysines.

MELBOURNE

Royal Society of Victoria, April 12. JANET W. RAFF: Observations on saw-flies of the genus *Perga*, with notes on some reared primary parasites of the families *Trigonalidæ*, *Ichneumonidæ* and *Tachinidæ*. This paper records the results of breeding saw-flies from fully grown larvæ, collected for the most part near Melbourne since 1928. Most of the breeding has been carried out under quarantine conditions. The paper includes a revision of the life-history of *Perga* as seen from numerous broods of larvæ. Three cases are quoted where prepupal instar was extended for an extraordinarily long period. Part of the paper concerns the details of emergences of several individual broods of larvæ, of emergences of adults, of the appearances of sexes, and the extent of parasitism. A third part embraces notes on reared primary parasites. One of the Trigonalidæ is recorded for the first time as a primary parasite, and the habits of this rare family recapitulated. Evidence of lengths of stages of the Ichneumonidæ and Tachinidæ have been obtained from examination of cocoons from time to time, during breeding experiments.

VIENNA

Academy of Sciences, March 1. KARL WOLF: Bending vibrations of an elastic strip. Calculation of the frequency of such vibrations for a strip fixed at the mid-points of its two ends gives an approximate value about six per cent different from that determined by 'one-dimensional' calculation. H. KUN: Female sexual hormone and psychic heat in the female. HANNS TOLLNER: Astronomical determinations of position on Jan Mayen; continental drift. HANS HORNICH: Remarks on a special class of Riemannian surfaces. J. KISSER and H. ERTL: Distribution of traumatic substances in cases of traumatic curves in plants. VIKTOR OBERGUGGENBERGER: Extinction of effective wave-lengths.

March 8. ERNST SPÄTH and JULIUS ZELLNER: Marasmin. This compound, obtained from the fungus *Marasmius Scorodonius*, is identical with *l*-leucine. GEORG KOLLER and KARL PÖPL: A chlorine-containing lichen constituent. The constitutions of (1) monochloratranol, formed on acetolysis of an atranorin derived from *Pseudevernia furfuracea*, L. vars. *ceratea* and *isidiophora*, and (2) its mother substance, monochloratranorin, are given. EDUARD HASCHEK: Fundamental sensations (2); influence of the eye-medium on the perception of colour. RUDOLF KALINA: Calculation of the stresses in metal girders with continuous welded seams. LOTHAR GEITLER: Change of form of pennate diatoms. FRIEDRICH TRAUTH: Geological studies in the western lower Austrian Alps. VIKTOR PIETSCHMANN: Three new fish from the coastal waters of Hawaii. *Scorpaena fowleri*, *Dascyllus edmondsoni*, and *Asterropterix eumeces* are described.

March 15. PAUL LUDWIK and RUDOLF SCHEU: Interference of X-rays. FRITZ WESSELY and KONSTANTIN DINJAŠKI: Action of light on substances of the furocoumarin type. When subjected to the action of daylight or ultra-violet light, pimpinellin I, a constituent of the roots of *Pimpinella saxifraga*, yields two dimerides. Such dimerisation is not, however, a general property of the furocoumarins. HERBERT HABERLANDT, BERTA KARLIK and KARL PRZIBRAM: Fluorescence of fluorite (2). Experiments with synthetic material show that the blue fluorescence bands are to be attributed to europium and the green low-temperature bands to ytterbium. A connexion between the radio-photofluorescence bands

and the divalent forms of the rare earths is indicated. KONRAD FUNKE and GREGOR PRINZ YPSILANTI: Position of the substituents in dinitroperylene. OTTO KOLLER: Fauna of southern Burgenland (Strembach Valley).

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, **20**, 93–144, Feb. 15, 1934). JOEL STEBBINS and ALBERT E. WHITFORD: The diameter of the Andromeda nebula. A photoelectric photometer has been attached to the 100-in. reflector at Mount Wilson. The telescope is set on the nucleus of the nebula and measures of the sky, or of sky plus nebula, are taken at the same hour circle at intervals of 10′ in declination. The data obtained indicate that the nebula is much larger than has hitherto been appreciated from photographs; the known diameter of the nebula north and south from the nucleus and the apparent minor axis or width should be more than doubled. DONALD A. JOHANSEN: Haploids in *Hordeum vulgare*. About 10 per cent of a commercial sample of barley gave plants with very few root tips; the seeds appeared to have more copious endosperm. They proved to be haploids with seven somatic chromosomes. W. E. CASTLE: Possible cytoplasmic as well as chromosomal control of sex in haploid males. Haploid males are only somatically male and this cytoplasmic influence is exerted to overbalance the female tendency of the chromosomes unless dissimilar sex chromosomes are present. J. L. CARTLEDGE and A. F. BLAKESLEE: Mutation rate increased by ageing seeds as shown by pollen abortion. The experimental seeds were *Datura* stored at room temperature for periods up to ten years. HARRIET B. CREIGHTON: Three cases of deficiency in chromosome 9 of *Zea mays*. K. G. EMELÉUS: Notes on intensities in the spectrum OII. M. H. JOHNSON, JR.: On the vector model for almost closed shells. G. PINCUS and E. V. ENZMANN: Can mammalian eggs undergo normal development *in vitro*? Ova from a doe rabbit of one breed were fertilised *in vitro* with sperm from a buck of another breed, and then transferred to a doe of a third breed made pseudo-pregnant by mating with a vasectomised buck of a fourth breed. Young were successfully born which bore none of the characters of the third and fourth breeds used. Another similar transference of ova was also successful. The experiments also show that the corpora lutea of pseudo-pregnancy are functional. NELSON A. WELLS and CLAUDE E. ZOBELL: *Achromobacter ichthyodermis*, n. sp., the etiological agent of an infectious dermatitis of certain marine fishes. This organism causes a highly fatal dermal infection of *Fundulus* in Nature, the effect of which becomes serious in aquaria for *Fundulus* and also for other fish. The organism has only been cultured successfully in sea water substrata. It survives 40° C. for 10 minutes but is killed at 45°; optimum for multiplication, 25°–30°; optimum virulence for *Fundulus*, 20°–25°. Fish in water above 30° resist innoculation, and diseased fish, if acclimatised to 32°–35°, completely recover. G. A. MILLER: Minimum number of squares in a group when not all of them are relatively commutative. EDWARD KASNER: General theorems on trajectories and lines of force. GUSTAV A. HEDLUND: On the metrical transitivity of the geodesics on a surface of constant negative curvature. EINAR HILLE and J. D. TAMARKIN: On the theory of Laplace integrals (2).

Forthcoming Events

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

Monday, June 25

ROYAL GEOGRAPHICAL SOCIETY, at 3.—Annual General Meeting.

INSTITUTE OF PHYSICS (MANCHESTER SECTION), at 5—(in the Physics Department, The University).—Dr. J. M. Nuttall: "Units of Matter".*

Tuesday, June 26

EUGENICS SOCIETY, at 5.15—(in the Rooms of the Linnean Society, Burlington House, W.1).—Prof. F. A. E. Crew: "The Inheritance of Educability in the Rat".*

Wednesday, June 27

INSTITUTE OF PHYSICS (MANCHESTER SECTION), at 5—(in the Physics Department, The University). Prof. W. L. Bragg, Dr. A. J. Bradley and Dr. C. Sykes: "Alloys".*

INSTITUTION OF PETROLEUM TECHNOLOGISTS, June 28–29.—Summer meeting to be held at the Royal Society of Arts, London. President: T. Dewhurst. Discussions: "Oil and Coal"; "Progress of Naphthology".

Official Publications Received

GREAT BRITAIN AND IRELAND

Memoirs of the Cotton Research Station, Trinidad. Series B, Physiology, No. 6: Studies on the Transport of Nitrogenous Substances in the Cotton Plant. Part 6: Concerning Storage in the Bark. By T. G. Mason and E. Phillis. Pp. 315–333. (London: Empire Cotton Growing Corporation.) 2*s.* 6*d.*

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1933. Pp. iv+512+56+18 plates. (London: H.M. Stationery Office.) 15*s.* net.

The Lister Institute of Preventive Medicine. Report of the Governing Body, 1934. Pp. 32. (London.)

OTHER COUNTRIES

Suppléments au Bulletin biologique de France et de Belgique. Supplément 17: Recherches sur la spermatogenèse des phasmes; mâles d'origine bisexuée. Par Dr. Maurice Favrelle. Pp. ii+155+3 plates. (Paris: Laboratoire d'Evolution des Êtres organisés; Les Presses universitaires de France.) 55 francs.

Zentralanstalt für Meteorologie und Geodynamik. Publikation Nr. 139: Jahrbücher der Zentralanstalt für Meteorologie und Geodynamik. Amtliche Veröffentlichung, Jahrgang 1928. Neue Folge, Band 65. Pp. xx+A42+B58+C48+D8. Publikation Nr. 140: Jahrbücher der Zentralanstalt für Meteorologie und Geodynamik. Amtliche Veröffentlichung, Jahrgang 1929. Neue Folge, Band 66. Pp. xx+A42+B61+C52+D6. (Wien: Gerold und Komp.)

Commonwealth Bureau of Census and Statistics, Canberra. Official Year Book of the Commonwealth of Australia. No. 26, 1933. Prepared by E. T. McPhee. Pp. xxxii+942. (Canberra: Government Printer.) 5*s.*

Istanbuler Forschungen. Herausgegeben von der Abteilung Istanbul des Archäologischen Institutes des Deutschen Reiches. Band 5: Die Felsbilder von Yazilikaya. Neue Aufnahmen der Deutschen Boğazköy-Expedition 1931. Zusammengestellt und eingeleitet von Kurt Bittel. Pp. 12+31 plates. (Bamberg.) 10 gold marks.

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 86. Zoological Results of the Third De Schauensee Siamese Expedition, Part 2: Birds from Siam and the Southern Shan States. By Rodolphe Meyer de Schauensee. Pp. 165–280. (Philadelphia.)

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