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Native Policy in the Empire

LORD NOEL-BUXTON, in bringing forward a motion in the House of Lords on June 9 that native policy in the Empire should be considered in the present session of the Imperial Conference, raised a question of wide and far-reaching implication, involving the status and well-being of vast populations of backward peoples who, whatever their present grade of civilization and condition of tutelage, are nevertheless members of the Empire, and, presumably, will hand on that privilege with its rights and duties to their descendants.

The wording of the motion was as follows :

That this House, in view of the divergences in native policy now developing in different parts of his Majesty's Dominions and Dependencies, believes that the time has arrived for the Imperial Conference to formulate such policy in broad outline, with a view to protecting the rights and promoting the advancement of all races of the Empire, whatever may be their religion and colour, and that such policy should be based upon the principle of trusteeship.

It was, by leave, withdrawn ; but its exact and comprehensive phraseology will not be forgotten when, as is inevitable, the question is raised again and further discussed.

The motion forced not one, but several cards. In the debate which followed, discussion tended decidedly to criticize, defend or extenuate existing policies in native administration, rather than to discuss the merits of the substantive proposal. This is not entirely to be regretted. It afforded an opportunity for expression of opinion on the principle of 'trusteeship', upon which the motion had asked for a direction from their Lordships.

An important exchange of views emerged, which might have been stifled at its inception by an official intimation that at this late date it was impossible to entertain the proposal.

In supporting his motion, Lord Noel-Buxton had little difficulty in making out a case. It is probable that most will agree that the Imperial Conference affords the best, perhaps the only, effective machinery for the full and free discussion of the position, which is not only fast becoming anomalous, but also may—indeed in Africa inevitably will—become dangerous, unless handled with foresight and statesmanship. It is not without significance that Mr. Ormsby-Gore, in his review of the affairs of the Colonial Office during recent years before the Imperial Conference on May 31, stated that he considered that the main political problem which confronts the Colonial Office is still "the relationship between natives and non-natives, both European and Asiatic, in many territories, following the growth of education and the awakening of political consciousness". It cannot be doubted that a colonial administrator of his experience must also have had at the back of his mind the problem as it is manifested in instances which were not under review. In a matter of so delicate a character as this question has become under the provisions of the Statute of Westminster, the initiative demands a strong force of informed opinion as a stimulus to any action which will ensure discussion on an Empire-wide basis.

The anomalies which were adduced by Lord Noel-Buxton in support of his argument might be multiplied manifold ; but it was sufficient for him to contrast the position in West Africa and

in New Guinea with the conditions of the pass system and under-colour bar legislation to demonstrate the gulf that lies between what are, broadly speaking, two schools of thought in approach to the problem of the backward races of the Empire. On one side, as in West Africa, the native is afforded full opportunity for educational and economic development, as well as a measure of co-operation in the administration of affairs. In New Guinea, among peoples who a brief time past were head-hunters, living in the stone age, education in the purpose of administrative measures and some participation in their working have been productive of even an enthusiasm for paying taxes. On the other hand, in South Africa, where racial feelings run high, the prevailing policy is one of repression and domination.

On the main principle, so far as it affects the natives of territories directly under the control of the British Parliament, their Lordships' expression of opinion is virtually unanimously on the side of the benefit of the native being the paramount interest of administration. A word of caution was put forward by the Marquess of Lothian, who in sympathy with the patent difficulties of the Colonial Office, stressed the obligation to white settler as well as native; but the feeling of the House was such as to justify the view that the aim of the Government as stated by the Marquess of Dufferin, Under Secretary of the Colonial Office, "to govern the indigenous races in their own interests and with a view to their elevation in the scale of civilization", will not be allowed, in this 'place' at least, an interpretation which would permit, for example, the natives of the South African Protectorates to be exposed to such regulation as it has been proposed to apply to the indigenous inhabitants of the mandated territory of South-West Africa.

It is possible that some may feel with Lord Bledisloe that at the present moment the needs of the situation will best be met by "the Government on the spot" rather than by any attempt to secure uniformity in a policy formulated by the Imperial Conference. Such a policy would have to apply to different races in different parts of the world, and this, it was maintained by Lord Dufferin in his reply on behalf of the Government, precluded the possibility of dealing with the varied conditions as a unitary whole. There is indeed much to be said for this point of view. Obviously the problem differs from one territory to another. In Canada and Australia, for example, it varies in essential features from the problem of West

Africa—the difference in the relative proportion of native and white alone places the latter in another category; but notwithstanding innumerable and important variations in detail, which necessitate elasticity in organization and machinery as between one part of the Empire and another, the inspiring principle may and should be the same, if trusteeship be adopted as the valid basis of relationship between ourselves and the less advanced races.

The eye of the practical administrator must necessarily be directed in affairs to the next step; but even so, it is well to be sure of the general direction in which that step should lead. The state of affairs which has arisen in regard to the indigenous population of Nyasaland is largely the outcome of well-intentioned but misdirected effort in the past. The measures which are being taken to cope with the situation there, as reported by Mr. Ormsby-Gore in his annual survey of colonial affairs in the House of Commons on June 2, indicate the desirability of a unity of outlook in dealing with certain aspects of the native question in East and South Africa as a whole.

The aim of the Union of South Africa is to ensure the stability of a great and prosperous white man's country; but the native population outnumbers the white by something like four to one. Now, when Black Africa as a whole is awakening to an intense desire for development in one direction or another, South Africa is sitting on the safety valve. Over against the Union's policy of segregation stands as an alternative 'trusteeship'. But trusteeship is no more than a means to an end. Unless its function is interpreted constructively and in the light of scientific study of native institutions and the effect on them of the cultural impacts which must follow from the assumption of the obligation which trusteeship entails, premature inculcation of European ideals, social, ethical and economic, may prove no more beneficial and no less dangerous in the long run than segregation. It cannot be repeated too often, nor too insistently emphasized, that the time has now come when the ultimate aim of such measures as 'indirect rule' and 'trusteeship' should be defined in precise terms. In the formulation of this aim the prior necessity of anthropological study should not be ignored. The anthropologist alone is competent to determine and bring together the data upon which it will be possible to define the direction and rate of change least likely to bring disintegration and disaster in its train.

Hydrography of the Atlantic Oceans

Schichtung und Zirkulation des Atlantischen Ozeans

Lieferung 3: Die Troposphäre. Von Albert Defant. (Wissenschaftliche Ergebnisse der Deutschen Atlantischen Expedition auf dem Forschungs- und Vermessungsschiff *Meteor* 1925-1927, herausgegeben im Auftrage der Notgemeinschaft der Deutschen Wissenschaft von A. Defant, Band 6, Teil 1.) Pp. iii + 289-411. (Berlin und Leipzig: Walter de Gruyter und Co., 1936.)

THE oceanic troposphere, like the corresponding section of the atmosphere, is a relatively shallow layer marked by steep temperature gradients which contrast strongly with the more even conditions of the stratosphere. Prof. Defant and his colleagues have employed these terms consistently since 1929. The waters of the arctic and antarctic regions belong entirely to the stratosphere, and in the Atlantic Ocean the troposphere extends from 45° S. to 55° N., to a depth of 600 metres and 950 metres in the southern and northern subtropical regions, and to 300 metres near the equator.

Prof. Defant's account is based largely on the observations made at 242 stations by the *Meteor*, but with the thoroughness which characterizes all the work published from the Institut für Meereskunde, no source of information has been overlooked, and, in all, the data obtained by twenty-three expeditions have been used.

The main tropospheric currents are horizontal and are confined to the upper strata, but there is also a vertical circulation with widespread influence on the structure of the layer. In the southern and northern subtropical regions, where anticyclonic current systems lead to accumulations of highly saline surface water, there are sinking movements; and in the equatorial zone, which is mainly a divergence region, there are ascending currents.

Owing to two counteracting influences, the powerful warming of the surface water by radiation from sun and atmosphere, and the cooling of the sub-surface water by horizontal advection, the troposphere becomes resolved into three strata: an almost uniform surface stratum, a discontinuity stratum in which temperature and density change rapidly with depth, and a more extensive underlayer which has been called the sub-troposphere.

The surface stratum belongs mainly to the region of the trade wind drifts (the north and

south equatorial currents), but it can be distinguished, though not so clearly, as far as 30°-35° S. and 25°-30° N. Its depth is 140 metres in 20° S., 85 m. in 5° N., and 195 m. in 25° N.; but at the equator and in 10° N. the surfaces of equal density sweep upwards until, on either side of the depression in 5° N., the depth of the uniform stratum is only 70 m. and 53 m. The depth also varies from east to west, being greater in the west, and there are minor variations that are best studied from the author's charts.

The upward sweep of the density surfaces at the equator and in 10° N. is worthy of particular notice. As Sverdrup showed for the Pacific Ocean, the convexity in 10° N. exists because this latitude is the thermal equator of the ocean, and the second upwelling, at the equator, because the effect of the earth's rotation is symmetrical about the equator. The south equatorial current extends into the northern hemisphere as far as 5° N., and the influence of the earth's rotation makes its density surfaces slope downwards to the south in the southern hemisphere and downwards to the north in the northern hemisphere.

In the region of the equatorial counter-current, between 5° N and 10° N., the density surfaces slope upwards to the north, and since such a slope is dynamically stable only if the surface current flows eastwards, it follows that the counter-current is not entirely a compensation current as hitherto supposed.

The discontinuity stratum of the troposphere, marked by a sharp decrease of temperature and increase of density with depth, has an average thickness of 50-100 m. It is traversed by far-reaching undercurrents which have their origin in the subtropical accumulations of surface water, and are made conspicuous by their high salinity. One of the most striking is the *southern hemisphere undercurrent*, which leaves the southern subtropical region and flows northwards along the coast of South America to join the large volume of subtropical water carried by the Gulf Stream.

The sub-troposphere is the least characteristic of the three strata. The temperature and salinity decrease with depth but more slowly than in the discontinuity stratum, and the activity of the water circulation diminishes. The lower boundary of the layer is marked by slightly greater changes, but since the water in the boundary region escapes the aerating influence of both tropospheric and stratospheric currents, its most distinguishing feature is a very low oxygen content.

The value of the report under notice is greatly increased by tables, sections and charts; all the plates are magnificently produced in colour, and they are very easy to understand. The report is a

very worthy addition to the accounts of the hydrography of the deep and bottom waters already published in the same series.

G. E. R. DEACON.

Cancer and Diet

Cancer and Diet :

with Facts and Observations on Related Subjects. By Dr. Frederick L. Hoffman. Pp. xx+767. (Baltimore, Md. : Williams and Wilkins Co. ; London : Baillière, Tindall and Cox, 1937.) 5 dollars.

ABOUT one half of this book consists of reviews of work concerned with questions of diet or cancer and the possible relationship of these to each other, so far as can be found in publications in the author's own library. Most references to original work are obtained from abstracts in the *Cancer Review* and *American Journal of Cancer*. Many extracts are given from the *Cancer Review*, which came to an end in 1932, though the extracts show how valuable a review it was.

Of the work published on diet and cancer, "so much is contradictory that no balance can be drawn between the advocates of one theory or another". Certain foods which have in the past been suggested as the cause of cancer are almost certainly innocuous. Thus potatoes have been indicated as a cause of cancer, apparently because potatoes are themselves subject to disease, but Dr. Hoffman points out that the cancer mortality in Ireland, where potatoes are widely consumed, is lower than in the rest of the British Isles. It has been claimed that injection of tomato juice into animals produces cancer, but there is absolutely no evidence that the eating of tomatoes can induce malignant changes in the body. This book shows that no one food can be considered a cause of cancer.

The second half of the book deals with Dr. Hoffman's own contribution to the subject. He has composed a questionnaire which has been answered by 2,234 people suffering from cancer and by 1,149 controls. The questionnaire deals with age, religion, race, physique, food preferences and medical history. The answers to the questions are tabulated in the appendixes according to sex and occurrence of cancer. In most of the answers there is no significant difference between normal and cancer cases. One of the most striking differences, however, is in the religious categories. Of the cancer cases 57 per cent were Protestant and 32 per cent Catholic, while of the normal cases 45 per cent were Protestant and 42 per cent Catholic. Dr. Hoffman does not discuss the significance of these differences, which may be due to an error in

sampling. Examination of food preferences suggest that the vitamin and total food consumption of cancer cases is excessive, and Dr. Hoffman's main principle is that a diminished food intake would reduce the incidence of cancer. He admits, however, that this is not yet definitely proved and is himself seeking further evidence along the lines which he has already used.

The idea that the average man consumes more food than is good for him is fairly common, particularly among American biologists. Chittenden recommended a protein intake which was about half that present in a normal Western diet, and Raymond Pearl considered that smoking lengthened life because it reduced appetite.

The closing sentence of this book is: "I consider my own duty discharged in presenting the facts as I have found them, which lead to the conclusion that overnutrition is common in the case of cancer patients to a remarkable and exceptional degree, and that overabundant food consumption unquestionably is the underlying cause of the root condition of cancer in modern life." This conclusion is difficult to reconcile with the fact that cancer is not rare among peoples who are not considered to be overnourished, such as Japanese, Chinese, Malays and Filipinos. Further evidence which is contrary to Dr. Hoffman's thesis is given by figures in the Registrar-General's Decennial Supplement for England and Wales (1921), showing that cancer is more common in the lower social classes, which are usually assumed to live on a less liberal diet than the upper classes.

The possibility of error in the method of examining questionnaires is obviously very great as the personal element is predominant in the answers obtained. It is common to meet very fat people who say that they eat practically nothing. Apart from the erroneous answers that may be obtained, the interpretation is extremely difficult to put on a quantitative basis. Finally, assuming that there is a correlation between the incidence of cancer and high food intake, a large appetite might conceivably be due to some inherited factor linked to another factor predisposing the individual to cancer. The relationship of cancer and diet is of interest and may be of importance, but the true nature of this relationship is difficult to determine.

Radio-Frequency Technique

Lehrbuch der Hochfrequenztechnik

Von Dr. Fritz Vilbig. Pp. xx+775. (Leipzig : Akademische Verlagsgesellschaft m.b.H., 1937). 32.80 gold marks.

TO attempt an up-to-date survey of radio-technics, a subject in which the progress daily astonishes us by its variety as well as its rapidity, might daunt anyone. Yet, in this textbook of high-frequency technique, Dr. Vilbig has not only attempted such a task but also has executed it most commendably. Writing with the outlook of a student of what is nowadays often called 'light engineering', rather than that of a physicist, he has given an extraordinary lucid account of both the science and art of modern radio-communication, with just sufficient in the way of backward glances at the older-fashioned methods to satisfy the mildly conservative. In short, he tells us all about the new with just as much about the old as is worth remembering.

The book contains twenty-six chapters, of which the first six are devoted to high-frequency phenomena in open and closed circuits and to the propagation of electric waves either along wires or through space and the ionosphere. Thirteen

chapters are devoted to thermionic valves and their multifarious uses. For the English or American reader there is here one disadvantage to be noted, for the somewhat lengthy columns of valve data all refer to German tubes (Telefunken or Loewe). If the volume is ever translated into English, this will have to be changed.

Four more chapters deal with the application of apparatus and methods in the maintenance of communication, while the last two chapters deal respectively with television and with the thermal and physiological actions of radio-frequency currents. In the chapter on television we note perhaps most markedly the influence of the author's nationality, but from it we can scarcely fail to conclude that Germany lags considerably behind Great Britain in the matter of broadcast television.

Special mention should be made of the informative diagrams and illustrations. There are also a hundred pages of reference to books and original papers arranged under the chapter headings and subdivided chronologically. This list is like the subject matter of the book itself, up-to-date to the end of last year.

E. V. A.

The Case for Racial Crossing

Half-Caste

By Cedric Dover. Pp. 324. (London : Martin Secker and Warburg, Ltd., 1937.) 10s. 6d. net.

THERE is need for a scientific work on the subject of race and racial crossing ; but the present book can scarcely lay claim to fulfil that need. It considers mainly the social and historical aspects of racial crossing, with some references of a less critical kind to its biological and anthropological bearings. It contains a chapter on the condition of the Eurasians, of whom the author is one, and another on the life of a Eurasian poet. The chapter on "Miniature Melting Pots" gives short accounts of mixed groups in many parts of the world. Another chapter is concerned with racial crossing and its results in South Africa, Chapter x is devoted to the American "Negro" (Afroamericans), followed by another on the racial mixtures of South America.

One can appreciate the author's point of view

without sharing it. He looks forward to universal miscegenation as a cure for the world's ills, and favours policies for the "judicious encouragement of interbreeding and the development of mixed groups". But he admits that there is at present "distressingly little evidence of this spirit". It is worth pointing out that even if intercrossing between, for example, whites and blacks were universally regarded as desirable, Europe would still necessarily remain for millennia essentially white and Africa essentially black. Mr. Dover himself quotes the conclusion of Williams on the Maya-Spanish crosses in Yucatan, that after nearly four centuries they "can still be more or less separated into sub-types corresponding to the ethnic elements concerned in the ancestry".

This fact of genetic segregation in racial crosses, together with the great disparities in culture (in the widest sense) between the more divergent human types is, for many, sufficient reason against creating insoluble problems by advocating the

further intermingling of mankind's already sufficiently mixed types. Such advocates usually forget that the diversity of climates alone makes it impossible to build the same kind of civilization everywhere, and that there is already a certain amount of racial adaptation to different environments. Intermixture with a distant race breaks apart and redistributes these adaptational differences, to the detriment of the races concerned. No degree of civilization can do away with the need for such adaptations in the more extreme climates, arctic and equatorial. But every biological rule has its exceptions, and certain racial mixtures, such as Indian-white crosses in the wilder parts of Northern Canada, may be justified in their results.

The author has "made the interesting discovery that peoples similar to the Eurasians may be observed everywhere" (p. 277), but it is obvious that such "similarities" are too superficial to count for much against the disparities which exist among crossed types in different parts of the world. The "brown fringe", which the author hopes to see extended as a "portent of a new humanity" would only increase the number of racial types without contributing materially to the solution of racial problems.

Those who are interested in the more controversial aspects of race crossing will find them sympathetically considered in this book. One of its best features is a rather extensive bibliography.
R. R. G.

Contact Catalysis

The Mechanism of Contact Catalysis
By Dr. R. H. Griffith. Pp. xi+208. (London: Oxford University Press, 1936.) 15s. net.

THE importance to-day of catalytic processes in the chemical industry are obvious to everyone who is acquainted with the catalytic production of sulphuric acid, the synthesis of ammonia from its elements, the manufacture of nitric acid by the oxidation of ammonia, and the manufacture of liquid fuel both by the direct and indirect hydrogenation of coal. Each year finds more and more applications of catalysis to industry, but so far the development of catalysts has been mainly empirical in character, entailing a mass of detailed and expensive investigation prior to each new application.

In the introduction to the book under review, the author points out that if the phenomena of catalysis had been explored completely, it should be possible not only to give a logical explanation of every known example, but also to predict the conditions under which new reactions could be carried out. Our present knowledge does not yet permit of this, but there have been in the last few years many important discoveries in relation to the mechanism of heterogeneous catalysis, and Dr. Griffith has referred to and attempted to correlate what he considers to be the more important of the numerous publications relating to the study of surfaces and to other properties of catalysts. The author is himself responsible for a number of original papers in the field of catalysis and is therefore well able to present the subject

authoritatively. This he has done in a most adequate manner.

Experimental methods employed in the study of reaction kinetics are briefly described in the first chapter, and throughout the book stress has been laid on methods of experiment as well as on the interpretation of results. The study of adsorption of gases by solids has played an important part in elucidating the nature of catalytic action, and a survey of work in this field is presented in the second chapter. The conception of activated adsorption advanced by H. S. Taylor in 1931 has proved a great stimulus to the progress of surface chemistry. In a later chapter the author predicts that the accumulation of facts about the adsorption of a wider range of gases and vapours on surfaces composed of metals, oxides, sulphides and similar surfaces, will eventually prove extremely useful in the development of new catalysts.

The third and fourth chapters deal with promoters and carriers, and with poisoning and retardation. The examination of the catalyst surfaces and the probable spatial arrangement of the adsorbed molecule in relation to the actual configuration of the solid catalyst next receive treatment. It is interesting to note that, at the end of the chapter devoted to the mechanism of catalysis, the author concludes that all recent experimental work on catalysis is leading back to ideas closely approaching the old intermediate compound theory.

The volume contains numerous tables and figures and is provided with an excellent index.

R. T.

The World of Science

By Dr. F. Sherwood Taylor. Pp. xvi+1064+48 plates. (London: William Heinemann, Ltd., 1936.) 8s. 6d. net.

To those who are fond of encyclopædic omnibus volumes this book will give pleasure. Its avowed purpose is "to answer in simple terms the questions which the ordinary man and woman ask about living creatures, the world and the mechanical devices daily encountered by all". One must admire the successful conclusion of the immense task that the preparation of this book must have proved to the author and his assistants. Nevertheless, parts of the book seem to indicate that the weariness known to all authors of large volumes must sometimes have unwittingly crept over Dr. Taylor, and one can well imagine him struggling with the gigantic array of knowledge represented by the whole of science.

The style adopted does not, in general, make for easy reading, the sentences being, for the most part, short and jerky. The various divisions of the branches of science are set out in tabular form on p. 12. In such an up-to-date book we are surprised at the omission of biophysics, especially as biochemistry is included. There are a few inconsistencies in the book itself. On p. 295 it is stated: "It was a longish step to show that matter of all kinds was made up of nothing but these electrons and positive charges", but on p. 531 we read that "atoms are composed only of three things, electrons, protons, and neutrons". The statement on p. 421 that "ultrasonic waves are transmitted very much as light" is misleading. True ultrasonics behave to some extent in a similar way to light, but the mode of transmission is fundamentally different.

It is unfortunate that some of the diagrams have been reduced so much as to detract considerably from their value. Chemical substances and reactions are frequently shown diagrammatically as groups of spheres representing atoms, in the manner used to represent crystal structure. The advantage of this over the more usual chemical formulæ is open to question, for it seems liable to lead to misconceptions.

Despite these criticisms, however, this book contains a vast store of knowledge, accurately presented, and will form a useful addition to the "ordinary man's" library, and the index will enhance its value as a reference book.

H. R. LANG.

Battlefield of the Gods:

Aspects of Mexican History, Art and Exploration. By Pál Kelemen. Pp. 212+61 plates. (London: George Allen and Unwin, Ltd., 1937.) 10s. 6d. net.

"BATTLEFIELD OF THE GODS" should not be passed over lightly as a travel book of the usual type. The author, it is true, is neither archæologist nor ethnologist and in his description of such of the archæological sites of Mexico and Yucatan as were visited by him, there is nothing new in the way of fact; but he has the trained eye of an artist, and he has pondered to some effect the place of art as a functional element in culture. Hence he is able to bring out the significance of the art and architecture of the ancient peoples of Central America as an expression of their racial history, developing under the influence

of their environment. It must be counted as among the more illuminating features of this book that the author's review of post-Conquest development and his studies of ecclesiastical architecture and the Christian religion, as it was adopted by the native, as well as his incidental glimpses of the native mind as it exists to-day, demonstrate vividly how Maya, Aztec and Spaniard have blended to produce what is most characteristic and distinctive in the modern civilization of Central America. In short, in a series of impressionistic sketches he indicates the trend of that continuity of cultural development from pre-Conquest days, of which the evidence is being collected, more scientifically perhaps, but not more convincingly, by the organized research of the Carnegie Institution of Washington.

It should be added that some remarkable examples of post-Conquest ecclesiastical art are figured and described here, which have not previously been published. This book should do much to convince English readers of the interest of a branch of archæology which, unfortunately, has too few supporters in Great Britain.

The Statesman's Year-Book:

Statistical and Historical Annual of the States of the World for the Year 1937. Edited by Dr. M. Epstein. Seventy-fourth annual publication, revised after Official Returns. Pp. xxxvi+1502. (London: Macmillan and Co., Ltd., 1937.) 20s. net.

Few volumes cover a more comprehensive field than this annual, which as usual has been revised up to the end of March in the year of issue. Government, area, population, education, finance, production, commerce, communication and many other topics are descriptively and statistically treated for every State in the world. In addition, there is information on currency, weights and measures and even names of diplomatic representatives, and long lists of authoritative books of reference. The British Empire and the United States of America receive the fullest treatment and occupy nearly half the volume, which despite its many pages occupies a remarkably small bulk. An exhaustive index facilitates reference. As usual, two coloured maps are included: this year they show respectively the Sanjak of Alexandretta in relation to Syria, and Abyssinia with surrounding territories. A number of tables give world production of several important commodities and particulars of fleets and merchant shipping.

Builders' Estimates and Pricing Data:

their Preparation and Analysis. By Henry A. Mackmin. (The Directly-Useful Technical Series.) Second edition, revised and enlarged. Pp. xii+227. (London: Chapman and Hall, Ltd., 1936.) 12s. 6d. net.

THIS work is the third edition of a book first published in 1926 and incorporates not only new matter on recent developments in building construction, but also the methods of estimating used in the Midlands and the north, as well as in London and the south. It is extremely readable, and can be suggested as well suited to those engaged in the technical side of building generally.

B. H. K.

The Nature of Snow*

By Gerald Seligman

ALL ice and snow forms are crystalline. To demonstrate the crystalline structure of even an apparently non-crystalline body such as a shapeless block of ice, Tyndall passed a beam

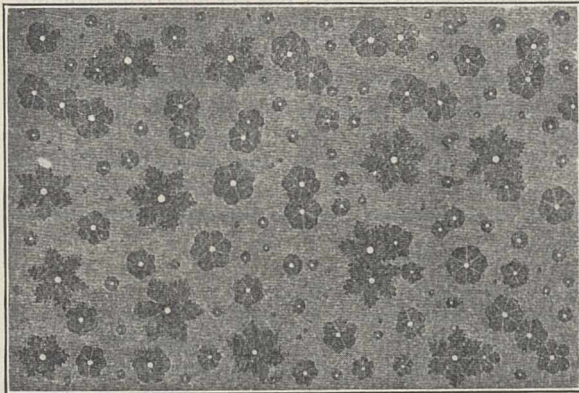


Fig. 1.

NEGATIVE FIGURES IN ICE.

Reproduced from "The Glaciers of the Alps", by J. Tyndall (by courtesy of Sir John Murray).

of light through it. If we repeat this experiment we find that hexagonal cavities are produced and that the process of crystallization is, as it were, reversed, so that we get what are sometimes called 'negative crystals', or as I prefer to call them, 'negative figures', within the body of the ice (Fig. 1). As the action of the beam proceeds, each figure becomes filled with the water which occupied it as ice. In the centre of each figure a bubble forms, which, in reality, is a vacuous sphere due to the water taking up less space than the ice.

These 'negative figures' are very useful in telling us the arrangement of the crystals in a mass of them, such as, for example, in glacier ice. They lie at right angles to the principal axes of the ice crystals, and parallel to the original freezing surface. Therefore, in pond ice, as we should expect, the 'negative figures' are found parallel to the surface of the pond, and this confirms that the ice crystals grow with their principal axes perpendicular to the surface. In artificial ice they are often found more irregularly placed, the incidence of the refrigeration having been irregular.

* From the Friday evening discourse at the Royal Institution delivered on January 22.

In glacier ice we find that the crystals are orientated without any order, for the reason that the glacier crystals have grown from snow grains, each crystal preserving the haphazard orientation of the original snowflake as it fell on to the surface.

SUBLIMATION

Everyone who wishes to understand snow must understand sublimation. Sublimation is, of course, the transition of a solid into a gas and its immediate reconversion into the solid, without entering the liquid phase. Many substances do this, and ice is one. Under suitable conditions it evaporates direct into water vapour, and, again under suitable conditions, this will reconsolidate, or, in loose parlance, sublime, into ice without any water appearing.

The evaporation of ice into water vapour has probably been seen by every winter visitor to the Alps; on a dry, warm day a patch of snow on a rock will vanish into thin air without leaving a trace of moisture. Among other factors, principally those of wind and the relative humidity of the air,

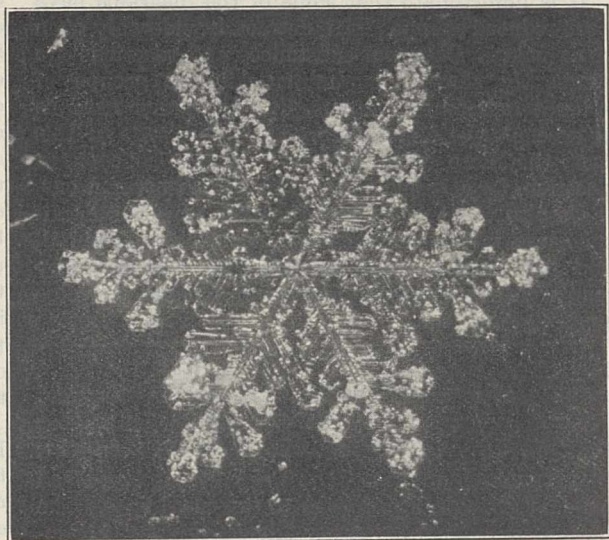


Fig. 2.

A TYPICAL DENDRITIC SNOWFLAKE ($\times 15$).

Photograph by G. Seligman.

ice evaporation is promoted by a relatively high ice temperature; the reconsolidation of this vapour into ice is brought about by a relatively

low temperature. There is scarcely a single snow phenomenon that does not to some extent depend on sublimation. The genesis of snow itself—the growth of the snowflake—is nothing but the sublimation of water vapour out of a supersaturated atmosphere. In this case sublimation starts upon nuclei floating in the air, which may consist of grains of dust, pollen or chemical salts.

SNOWFLAKES

The designs of snowflakes are probably infinite. Bentley, a distinguished American experimenter, photographed some 5,000 types, and believed that he had only attacked the surface of the possibilities.

The simplest form of snowflake is a hexagonal plate about ten times greater in diameter than in thickness. Its diameter might be as large as 1 mm. or 2 mm., or much smaller. More common in the Alps are the dendritic flakes (Fig. 2). When snow falls at a temperature close to freezing point, we get the large cotton-woolly aggregates which are so common in Great Britain, the word 'flake', in fact, denoting its woolly character.

Another form of flake is the prism, and its variant, the needle. Fascicular bundles of needles frequently cross each other at 90°, departing from the usual 60° symmetry of the ice crystal. This is extremely rare in other forms of ice crystal, except in the case of window hoar—the beautiful crystals which form on the inside of window-panes—and in this case also it is of constant occurrence.

The growth of dendritic flakes was explained by Wegener from work done on the crystallization of iodoform by Lehmann in 1888. Using a slightly



Fig. 3.

supersaturated solution, Lehmann stated that first of all a tiny hexagonal crystal formed, and that immediately surrounding it the solution was only saturated, the supersaturated area remaining a little distance away. Consequently, the corners of the hexagon, being closer to the supersaturated part, would grow out, until liquid could penetrate between the rays so formed and build side growths upon them.

Working with iodoform, we have not so far been able to find these two degrees of saturation in the laboratory, but it is a fact that in the sublimed ice crystals which grow on windows, the growing crystal does clear a space all round it. This certainly lends colour to what Wegener has deduced from Lehmann's work. I have observed this space again and again, moving outward as the crystal grows at the expense of the tiny frozen moisture drops covering the pane.

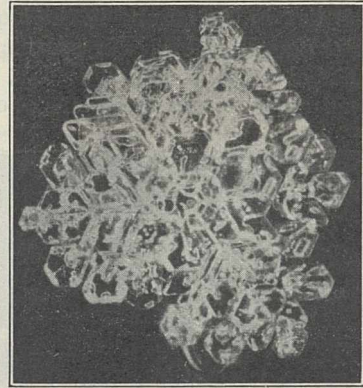


Fig. 4.

A SNOWFLAKE 'ICED-UP' TO FORM A FLAT PLATE OF ICE (× 10).

Photograph by G. Seligman.

Wegener showed, too, that the greater the difference between the vapour pressure of the ice of a flake and that of the surrounding atmosphere—the vapour pressure gradient—the more it favoured the growth of dendritic rays. The lower the vapour pressure gradient, the more the growth of solid plates was encouraged.

With this information it is not very difficult to trace the life-history of a snowflake. Taking the one shown in Fig. 3: at high altitudes, where the vapour pressure gradient was low (owing in this case to temperature and temperature differences being low) the central hexagonal plate was formed. The cold flake then fell to a warmer region, where the vapour pressure gradient increased, and the six rays shot out. Then perhaps it fell out of its snow cloud, when, for another reason (in this case that of lower saturation) the vapour pressure gradient decreased again; a more solid growth resulted and it assumed its final form.

In a converse manner we may be able to obtain a message of the meteorological conditions high up, from the structure of flakes as they reach the earth. This has already been done to some extent, but Nakaya's recent work in making flakes under controlled conditions should enable this, perhaps, valuable addition to meteorological knowledge, to make great strides.

FIRNIFICATION

In any alpine winter snowscape it seems as though Nature has stood still under its winter mantle, and that all is peace. Yet, in truth, the snow cover is a vast and active laboratory in which the flakes are made to undergo incessant and increasing change, until the time when they disappear in spring and commence their long journey to the sea, or, at high altitudes, become converted into glacier ice.

These changes are called 'firnification'. When snow falls, it lies on the ground in the loosest and most impalpable condition. Its specific gravity at this time is about 0.06, that is to say, 1/15 ice, 14/15 air, but under certain conditions of calm and

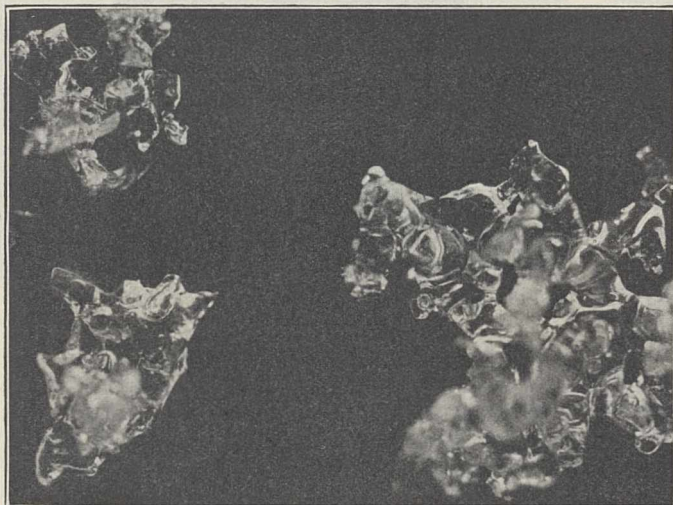


Fig. 5.

ADVANCED FIRN SNOW; SHOWING THE CEMENT BINDING THE GRAINS TOGETHER ($\times 7$).

Photograph by G. Seligman.

low temperatures, it may be only 0.01, that is 1/92 ice, 91/92 air!

The snow immediately begins to settle. The sharp points of the rays evaporate, and the flakes break up, so that the powder of broken flakes sinks together and becomes firmer. Its specific gravity will now have risen to 0.2 or 0.3. At this stage it is called 'powder snow', and is in its most attractive condition for ski-runners, who, as they skim down the mountain-side, can turn in it hither and thither at will.

Then, under the influence of alternate heating and cooling, a crust begins to form on the snow surface which tends first to trip the unskilled skier, and then, as it grows in depth, becomes hard, so that a man climbing the mountain must cut steps in it. In this condition it is known as 'firn snow', from which the whole process derives its name. But when the hot spring sun has thawed the top

few inches of hard firn snow at midday, ski are again able to get a grip, and it then forms one of the grandest and fastest ski-ing surfaces imaginable. 'Spring snow' is the name given by ski-runners to this sun-loosened surface of firn snow. At high alpine altitudes the firn snow becomes so hard that, except on south faces and at mid-summer, it is almost permanently icy. It is, however, not true ice, which is far rarer than is commonly believed; that stage comes later, the once whitish firn snow becoming blue and glassy.

Photomicrographs provide a key to the changes described above. Commencing with a snowflake: warmth first causes a blunting of the delicate rays by sublimation, some of the water vapour being trapped and resolidified in the centre of the flake, to make a continuous flat plate of ice. The original rays are still visible (Fig. 4). These plates shimmer like diamonds immediately after a snowfall. Seen by moonlight, when the darkness allows the rainbow colours to shine out undimmed, they are a sight never to be forgotten.

At the same time, some of the flakes begin to fracture, and we also see some reconsolidation of the sublimed water vapour in the form of granules. At this stage the snow has settled into the 'powder snow' beloved of ski-runners.

Next we have a light firn stage. The granules are united into aggregates, due to the alternate heating and cooling. This corresponds to the light sun-crust stages. In the earlier stages of firnification, sublimation is probably the chief factor. In the later stages thawing and freezing due to temperature alternations become more common. Regelation probably plays some part, too, throughout the process.

The grains have now grown in size and a cement binding them together is clearly seen. It is this cement which melts first under the influence of heat, turning the hard firn snow into the loose wet grains of 'spring snow'. The thawing of this cement also causes glacier grains to disintegrate when the sun shines strongly on the glacier surface.

There is an interesting similarity here between ice and metals close to their melting points. In the latter the crystal boundaries are also found to be surfaces of weakness. It is believed, but I think not proved, that when ice freezes it rejects any salts from the interior of the crystals and they find their way to the crystal boundaries and into this cement. Certain it is that, as would be expected from an impure ice, this cement has a lower freezing point than the pure ice crystals, and melts first, releasing them to form 'spring snow' or loose collections of glacier grains as the case may be.

It is possible that there is a true analogy between the behaviour of ice and metals in this respect.

Fig. 5 is a photomicrograph of very advanced firn snow and shows the cement. The difference between advanced firn snow and ice is that in the former some air always remains between the crystals. (So long as there is air between the crystals it is, by definition, snow.)

It is surprising that the actual transition of firn snow into glacier ice has never been observed in detail, or recorded more closely than these photographs show in rather incomplete manner. This is to form the subject of a research now in course of preparation.

If we could descend vertically through the firn region of the glacier, as if by a shaft, we should there too find the snow becoming denser and more ice-like ; and that is how it is hoped to carry out the research on the transition of snow into ice mentioned above.*

AVALANCHES

The modern study of snow really derives from a need to understand and prevent (or avoid) avalanche accidents. The study of firnification has thrown a powerful light on the most common winter avalanche—that which comes down soon after a fall of fresh snow.

Fig. 6 shows firnification photomicrographs in diagrammatic form : In *A* the very new snow is interlocked by its rays, and is therefore safe on all but very steep hills. In *B* these rays become reduced in size, and the snow particles are therefore mobile. In *C* the flakes break up and form granules, but still lie loose and mobile. In *D* the snow is granular and more compact, and is again safe. *B*, *C* and *D* conditions will occur more quickly if the air is warm. In other words, low temperatures prolong the avalanche danger.

We may summarize the whole lore of this type of avalanche in the following very simple words :

(1) Immediately after a fall slopes are safe, or at least safer than they will become later when the sun shines. (*A* stage.) This has a practical application. If a party of mountaineers is weather-bound in a hut, it should endeavour to make its escape, other things being equal, as soon as a slightest amelioration in the weather has set in, and not wait until the sun has reappeared.

(2) As soon as the air warms up after a snow-fall, the snow becomes mobile, first of course on south, and afterwards on north slopes. (*B* and *C*

stages.) The practical import of this is that, again other things being equal, escape should be made by north slopes, which are not reached by avalanche danger until later.

(3) Cold conditions prolong the danger.

(4) As soon as the snow has become denser powder or 'settled' it is safe. (*D* stage.)

WIND-PACKING

The effect of wind upon snow is to pack it hard, forming a crust. From such a crust the erosive action of wind-driven grains cuts out fantastic figures, which may form a serious obstacle to the explorer in polar regions, for they may rise in

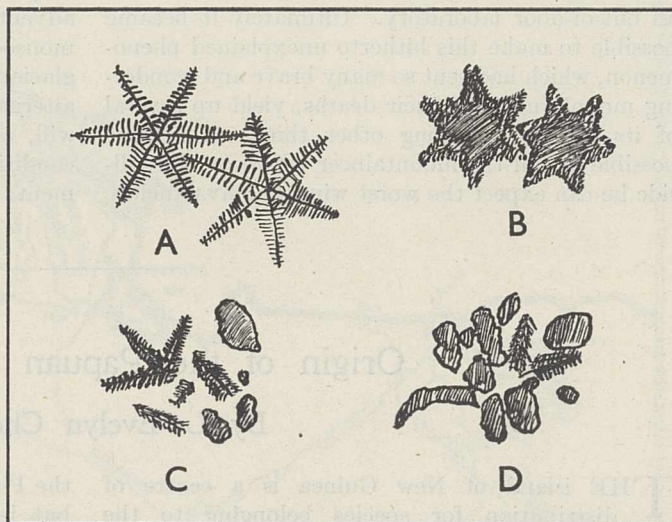


Fig. 6.

DIAGRAM SHOWING THE SAFE AND DANGEROUS STATES OF NEW AND 'SETTLED' SNOW.

high, so-called sastrugi, covering wide areas. These sastrugi have their steep face to the wind, which has a practical application, especially on a flat plain where the wind may be expected to be constant over wide areas—in a fog they provide the traveller with a constant indication of direction.

Cornices, too, are the result of wind action.

The drifting of snow is a study in itself, and a profound one at that. The deposition of snow in drifts is due to a slackening of the wind speed and consequent deposition of the snow grains it was transporting. If the wind still continues to blow while snowdrifts are forming, that is to say, if the snowdrift is not growing in a complete calm, the hardening, or 'wind-packing' as it is called, will extend right through the drift. If this drifting and packing occur on a steep hillside we get a curious happening. The packed snow, when disturbed by the weight of a man, breaks into blocks which slide down the mountain side, causing what

* For this research it is intended to adapt the boring tools of the prospector, and, by the construction of a specially made saw-edged drill head, to bring up undamaged cores of firn snow and ice from different levels in the glacier. Such a tool, constructed for me by Messrs. C. Isler and Co., has already yielded promising preliminary results in glacier ice.

is called a wind-slab avalanche, which may be very destructive.

It is characteristic of wind slabs that they do not bind themselves to the hillside, but have a hollow space underneath, which renders them all the more unstable.

Photomicrographs of the snow composing one of these wind-packed drifts or slabs showed considerable uniformity in grain size. This indicated a method of approach towards the proof of what had hitherto only been suspected, namely, that the snow had been drifted, since drifting sorts out the grains into uniform sized groups.

A study was made of a whole series of photomicrographs both of natural wind slabs and of wind slabs made under controlled conditions in an out-of-door laboratory. Ultimately it became possible to make this hitherto unexplained phenomenon, which had sent so many brave and wondering mountaineers to their deaths, yield up several of its secrets. Among other things it became possible to tell the mountaineer where on the hillside he can expect the worst wind-slab avalanches,

and under what atmospheric conditions they are to be expected.

To put these findings in a nutshell: they are found on slopes to the leeward of the last snow-bearing wind, when the general condition of the air is damp.

This conclusion has already borne fruit. Ever since the fatal avalanche on Mount Everest in 1922, when seven porters met their deaths, leaders of the expeditions have been puzzled by unaccountable avalanches bursting from the North Col with apparently no prime cause. They have now come to realize that these fall under just those conditions which I have pointed out, namely, a wet wind depositing the snow in drifts on lee slopes, and they have been able to link them up with the advent of the monsoon. As soon as the damp monsoon wind blows over the North Col the glacier on its lee side becomes a death-trap. An alternative route has now been reconnoitred and will, no doubt, be used in future, as soon as the conditions begin to favour wind slab development.

Origin of the Papuan Insect Fauna

By L. Evelyn Cheesman

THE island of New Guinea is a centre of distribution for species belonging to the Papuan fauna, which is very distinct and very rich in variety of forms. Yet the bulk of this huge island is part of the Himalayan geanticline, and therefore geologically recent. Since the fauna cannot have evolved upon land recently raised from the sea, there must have been older land from which the new land was populated.

Palæogeologists such as Ortmann, Lapparent, Arldt and others have postulated a land-mass which during the Middle Cretaceous extended from the Asiatic continent south to New Caledonia and eastward to Sumatra and Java. Some time during the Upper Cretaceous, according to the same authorities, New Guinea became separated from Borneo, Celebes and the Philippines, and also from New Caledonia. Later, the entire island is supposed to have been submerged until the Miocene-Pliocene folding movement raised the central ranges and land to the south.

Biological evidence with regard to the distribution of insect species supports these theories of former land-masses up to a certain point. For the Papuan insect fauna appears to be of oriental origin, showing decided affinities with the fauna of

the Philippines, New Caledonia and the Moluccas; but is distant from that of Malaysia, with the exception of a few widely dispersed species which may represent a much older fauna.

The Papuan insect fauna has also spread in a south-easterly direction as far as the Society Islands in the mid-Pacific. I think that later we shall find the Papuan element in the Pacific even stronger than it appears, when we are more familiar with true Papuan forms and are in a position to check old records. For I have discovered in many cases that species recorded as Indo-Malayan, Austro-Malayan and Australasian are in reality Papuan; even so-called Australian species are very often those recorded from tropical Queensland and therefore are also Papuan.

The origin of the peculiar endemic fauna and flora of New Guinea, however, is not explained by the work of geologists. Old mountains of continental rock do exist in New Guinea, in the central ranges and to the north; but these have not been investigated, and may have been submerged before the Tertiary. On the north coast, however, where I recently made a collecting expedition on behalf of the British Museum (Natural History), the Cyclops Mountains and

Mt. Bougainville in Dutch Territory (Fig. 1), and the Torricelli Range in the Mandated Territory, are of pre-Cambrian schists and gneisses, and these mountains at least show no sign of submergence. They all belong to the same geological period and have a similar geological formation.

Before leaving England for Dutch New Guinea, I tried to obtain information of the topography of this region but without success. In Netherlands Indies the Dutch authorities showed me Government geological maps (not available in England), from which it is evident that no marine deposits

formed of elevated coral limestone—the old coast of the former island—and the bed of the lake has been raised 200 feet. The northern side of the range is high and steep, with cliffs sheer to the sea, and has no inlets or anchorage except the two bays east and west. It appears that the island tilted downwards on that side, but was raised on the south together with its fringing coral reefs. Mt. Bougainville farther east is also surrounded by old coral inland.

With regard to the Torricelli Range in the Mandated Territory, an oil company has been

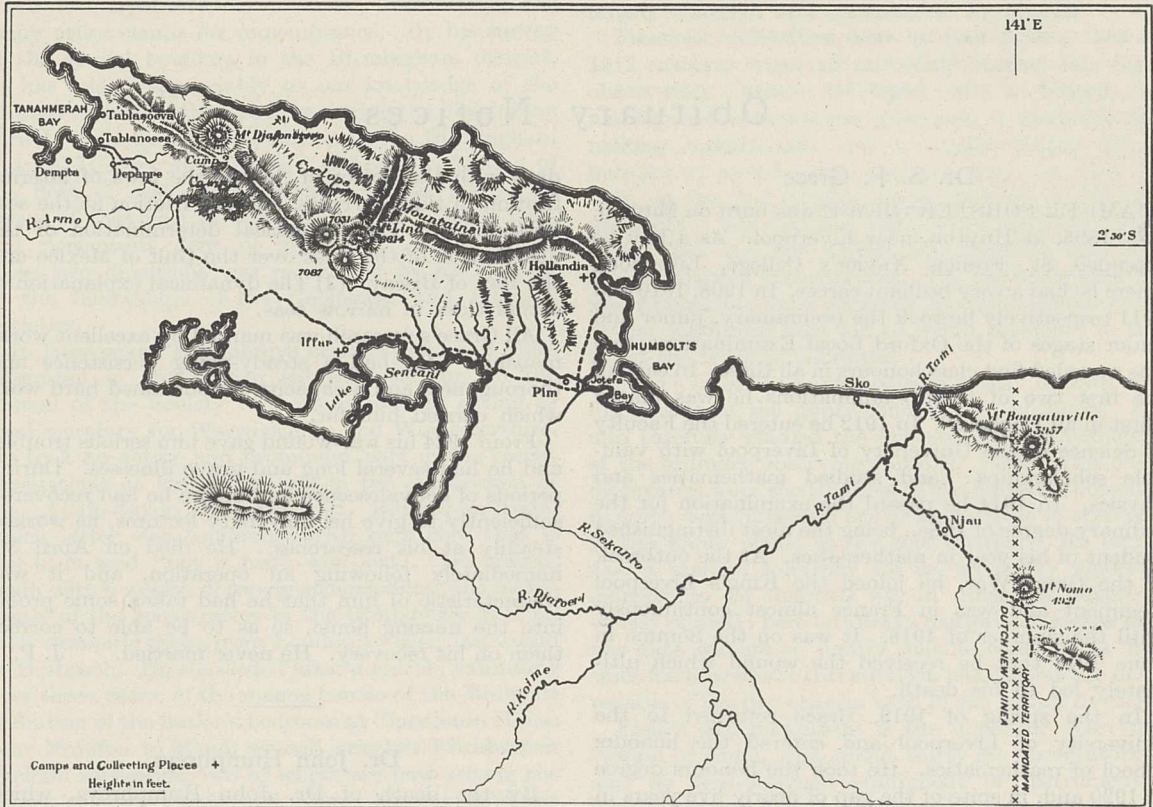


Fig. 1.

MAP OF THE BRITISH MUSEUM (NATURAL HISTORY) EXPEDITION TO THE NORTH OF NEW GUINEA

have been recorded from the Cyclops Mountains or Mt. Bougainville. What is also very interesting is that they were evidently islands, the old shores of which can be traced inland. For inland south of the Cyclops Mountains—which are a coastal range thirty miles long—is a Tertiary limestone zone. In this area I discovered an old coral cliff more than 120 feet high. Rock specimens from this cliff which I brought back with me contain Tertiary Foraminifera; and a fossil reef-shell, *Strombus* sp. from the bank of a stream in that neighbourhood, is also Tertiary.

At the foot of the mountains on the south lies Lake Sentani, the southern shores of which are

working for eight years in that district, and the mountains with the surrounding area have been thoroughly surveyed. The company does not wish to publish maps at this stage of its work, but I learnt from its members that they had come to the same conclusion regarding the Torricelli Mountains, namely, that this range was formerly an island, and there is no evidence of submergence.

This is extremely significant in the early history of the Papuan fauna. We see that there exist in New Guinea to-day at least three mountain groups—and doubtless there are others—which were formerly islands, and have remained above the sea throughout a very long period. It is interesting

too to note that they all have a similar trend, and that they correspond with the crystalline schists of the island of Japan and with those of a range south of the Arfak Mountains in Vogelkopf.

If we assume that New Guinea has not been entirely submerged since very remote ages, and that remnants of the Middle Cretaceous land-mass exist to-day, this is entirely consistent with geological as well as biological evidence. It is not fantastic to consider that the land which rose from the Eocene Sea would unite these old islands, and

their population would spread over the new territory; and isolation upon islands would account for the richness of the Papuan fauna and flora.

The Papuan insect fauna is approximately one third Oriental and two thirds endemic. If we consider that this fauna consists of old forms of Oriental origin together with more recent forms derived from them, that appears to be a very plausible explanation, and provides a most helpful working hypothesis in tracing the affinities and the distribution of species.

Obituary Notices

Dr. S. F. Grace

SAMUEL FORSTER GRACE was born on May 10, 1895, at Huyton, near Liverpool. As a boy he attended St. Francis Xavier's College, Liverpool, where he had a very brilliant career. In 1908, 1910 and 1911 respectively he took the preliminary, junior and senior stages of the Oxford Local Examinations, and was awarded first class honours in all three. In each of the first two of these examinations he was placed "first in all England". In 1912 he entered the Faculty of Science of the University of Liverpool with valuable scholarships; and studied mathematics and physics. In 1914 he passed the examination for the ordinary degree of B.Sc., being the most distinguished student of his year in mathematics. At the outbreak of the Great War, he joined the King's Liverpool Regiment and was in France almost continuously until the summer of 1918. It was on the Somme in June 1918 that he received the wound which ultimately led to his death.

In the spring of 1919, Grace returned to the University of Liverpool and entered the honours school of mathematics. He took the honours degree in 1920 and, in spite of the gap of nearly five years in his studies, his record was one of the best which that particular school has ever had. During the session 1920-21 he worked at the Sorbonne and the Collège de France, holding scholarships which included an 1851 Exhibition Research Scholarship. In 1921 he joined the teaching staff of the Department of Mathematics of the University of Liverpool, and steadily progressed from the lowest to the highest grade of lecturers. He was a born teacher and had a power of getting to know the individual qualities of large numbers of students.

Before going to Paris, Grace began mathematical investigations on the motion of solids in a rotating liquid, the results of which were published in the *Proc. Roy. Soc.* between 1922 and 1926. He then began a series of researches on tides, the results of which were published in the *Geophys. Supp., M.N.R.A.S.* These fall into three groups on the following subjects: (1) The analysis of observational

data with the object of finding the laws of internal friction in tidal currents, and the friction at the seabottom. (2) The theoretical determination of the distribution of the tides over the Gulf of Mexico and the Bay of Biscay. (3) The dynamical explanation of actual tides in narrow seas.

All Grace's research was marked by excellent workmanship. He had a steady-going persistence and thoroughness and a capacity for sustained hard work which carried him far.

From 1924 his war-wound gave him serious trouble, and he had several long and grave illnesses. During periods of convalescence and before he had recovered sufficiently to give his university lectures, he worked steadily at his researches. He died on April 30, immediately following an operation, and it was characteristic of him that he had taken some proofs into the nursing home, so as to be able to correct them on his recovery. He never married. J. P.

Dr. John Humphreys

By the death of Dr. John Humphreys, which occurred at Edgbaston on May 29, scientific and antiquarian circles in Birmingham have lost one of their most distinguished members. Born so long ago as 1850 at Llanfyllin, Montgomeryshire, he came from a family which in the previous century had given to the Church a bishop of Bangor and Hereford.

Entering the dental profession by apprenticeship—the only method possible at the time—Humphreys began to practise in Bromsgrove, but soon moved to Birmingham. In 1883 he joined the staff of the Birmingham Dental Hospital, and with the introduction of a dental curriculum at Queen's College became lecturer on dental anatomy. After the incorporation of Queen's College and Mason College in the University of Birmingham in 1900, he continued in the lectureship, which he retained until his retirement from active professional work in 1919. During the tenure of this appointment the claims of a large practice allowed little time for research, but

in collaboration with his life-long friend Dr. (later Sir) B. C. A. Windle, he contributed several papers to scientific journals, of which one on "Man's Lost Incisors" and another on "Some Cranial and Dental Characters of the Domestic Dog" are particularly noteworthy. At the same time that he was thus engaged, he began to collect specimens to illustrate his lectures, succeeding to such an extent that he ultimately could claim to possess the most complete and valuable private odontological collection in Great Britain—a collection which with characteristic generosity he presented to the University on his retirement.

Although it is safe to say that this gift alone will serve to perpetuate his memory, Humphreys has many other claims for remembrance. By his survey of the glacial boulders in the Birmingham district, he has added appreciably to our knowledge of the ice-movements in that locality during the Pleistocene period, while by his presentation to the Birmingham Natural History Museum of a complete collection of the flora of east Worcestershire he has placed all lovers of that part of our countryside under a deep and permanent debt of gratitude. His work in these two directions was recognized by his election to the fellowships of the Geological and Linnean Societies.

In later years, Humphreys became more and more interested in antiquarian subjects, serving on the council of the Society of Antiquaries and acting as local secretary for Warwickshire and Worcestershire. He took an active and prominent part in the recent excavations at Uriconium and in the exploration of the Anglo-Saxon cemetery at Bidford-on-Avon, which latter was conducted with such care that it has been said "not a bead was lost". He traced, again with a wealth of topographical detail, the movements of the conspirators in the Gunpowder Plot on their dramatic flight from London to their last stand at Holbeach. He succeeded after a search, extending over three years, of the manor houses of the Midlands in finding in the butler's bedroom at Chastleton House near Moreton in Marsh several priceless Elizabethan Sheldon tapestries, two of which are now among the glories of the Victoria and Albert Museum and the Birmingham Art Gallery. Scarcely less dramatic was his discovery of the important "Bowery Papers" in a leather-covered wooden chest in a windowless attic at Cleeve Prior, where they had lain for more than two centuries. In 1924 the University of Birmingham, which had at various times conferred upon him the degrees of master of arts, doctor of philosophy and master of dental surgery, elected him to a readership in mediaeval archæology.

That Humphreys was able to accomplish so much, even granted his length of days, was due to exceptional ability and industry, and perhaps even more to tenacity of purpose. Great as these qualities are, it is for other and rarer qualities that his many friends will chiefly remember him—his wide sympathies, his unaffected friendliness, his complete disinterestedness. No one ever practised with greater persistence and success the gentle art of self-effacement.

W. W.

Mr. J. H. Field

THE scientific work of Mr. J. H. Field, whose death on May 19 at the age of sixty-four years is much deplored, was of a type none the less valuable because it was mainly practical rather than theoretical. He had qualified in physics and engineering at Cambridge and London, and was selected in 1904 for the Indian Meteorological Department to initiate upper-air work. He threw himself wholeheartedly into the task: regardless of hardships, such as those of the Northwest Desert in the hot weather, he adapted Western methods of getting data by kites and balloons to Indian conditions; the instrumental and mechanical equipments were largely designed and constructed by himself.

Financial difficulties were at first acute; but in 1912 matters improved and Field started the Agra observatory, which developed into a factory for making and compressing hydrogen, a workshop for making instruments, and a mother-station for a number of pilot-balloon observatories. In 1924 he took on the less congenial post of head of the Department; and for five years there he showed the enthusiasm and the tireless thoroughness that had always marked his activities. On his retirement he was responsible for a complete and able examination of the conditions that led to flying accidents in the lee of the Rock of Gibraltar.

Field's scientific papers consist mostly of data and discussions of the upper-wind system of India. He also carefully studied the exposure of thermometers at the ordinary observing stations. Perhaps his chief discoveries were the thinness of the monsoon currents in north-west India and the great increase of strength in the upper winds in the cold weather. He found also a marked tendency for an unusually vigorous increase to be followed by an unusually vigorous winter rainfall: here he always recognized that he had not data enough to justify reliable conclusions, but since his retirement this criterion has become the most reliable of the five criteria used in the winter forecast.

Field's real monument is the upper-air observing system of India, with about thirty-six observatories, and its well-designed equipment of instruments; but he secured also a new headquarters building at Poona. He will long be remembered by his staff for the inspiration of his indefatigable thoroughness and for the justice of his rule.

G. T. W.

WE regret to announce the following deaths:

Prof. J. A. Culler, emeritus professor of physics in Miami University, Ohio, on May 18, aged seventy-nine years.

Sir Squire Sprigge, editor of the *Lancet* and author of "The Life and Times of Thomas Wakley" (1896), "Medicine: Its Practice and Public Relations" (1905), "Some Considerations of Medical Education" (1910) and "Physic and Fiction" (1921), on June 17, aged seventy-six years.

Prof. H. E. Slaught, emeritus professor of mathematics in the University of Chicago, on May 21, aged seventy-six years.

News and Views

Royal Society Elections

At a meeting of the Royal Society held on June 17, the Right Hon. the Earl of Athlone was elected a fellow of the Society under a special clause in the statutes which provides for the occasional election of "persons who either have rendered conspicuous service to the cause of science or are such that their election would be of signal benefit to the Society". At the same meeting the following were elected foreign members of the Society: Prof. August Krogh, of Copenhagen; Prof. Otto Meyerhof, of Heidelberg; and Prof. Henry Norris Russell, of Princeton.

Prof. August Krogh

THE election of Prof. A. Krogh to the Royal Society will give much pleasure to his many friends, who have been following with great admiration his remarkable achievements in different branches of physiology. His early work (1904) in collaboration with Bohr and Hasselbach demonstrated for the first time the effect of carbon dioxide on the affinity of hæmoglobin for oxygen. In 1910 Krogh definitely proved that the absorption of oxygen and the elimination of carbon dioxide in the lungs take place by diffusion only and without the assistance of any secretory activity by the cells. This investigation finally settled the long-standing controversy around this problem. We owe to Krogh a series of important contributions to the study of the respiration of insects and the elaboration of a delicate technique for the accurate analysis of minute bubbles of gas. This technique was applied ultimately to the study of problems in other fields of physiology. Krogh's remarkable work on the capillary circulation, which was soon recognized by the award of the Nobel Prize in Physiology and Medicine, is marked by the same insistence on direct proof, combined with a broad biological outlook. The work of Krogh's laboratory to-day is largely concerned with the problems of respiration, especially at high altitudes, problems of circulation, the mechanism regulating the water and salt exchanges in aquatic animals, and the ecology of aquatic organisms in relation to the nitrogen cycle in water.

Prof. O. Meyerhof

WE owe much of our present knowledge concerning the chemistry and thermodynamics of muscle to Dr. Otto Meyerhof. During twenty years he has published a remarkable series of papers—more than a hundred in all—describing experimental studies of the complicated events involved in the maintenance and activity of the contractile tissue. If our knowledge of these is yet incomplete, a survey of Meyerhof's papers alone will show that progress has been real and that his own work has done much to accelerate it. Twenty-five years ago, Meyerhof, who had been a

student of psychiatry and philosophy, influenced by Otto Warburg—who himself became a foreign member of the Royal Society in 1934—turned to biological studies. He first dealt with cell respiration and, among other contributions to knowledge of this, showed that respiration calls for the influence of a soluble agent similar to the cozymase which Harden had shown to be a necessary factor in fermentation. To-day we have come to recognize how significant are these relations. By 1919, Meyerhof had begun to give special attention to muscle, and his earlier chemical and calorimetric studies ran parallel with the myothermic studies of A. V. Hill in Great Britain. This association became very enlightening, especially in bringing to light the time relations of events which occur during and after a contraction. Since then, Meyerhof and his school have described many improvements in technique, and have revealed many significant facts. Of special interest was the proof that the anaerobic breakdown of glycogen to lactic acid which occurs during a contraction is reversed during the aerobic process of recovery; and also the discovery—of much help to himself and to other workers—that many of the significant reactions which occur in the intact muscle proceed in due sequence in a properly prepared aqueous extract of the tissue.

Prof. H. N. Russell

PROF. H. N. RUSSELL, professor of astronomy at Princeton University, U.S.A., is one of the best-known American astronomers. He first became prominent through his theory of stellar evolution, according to which a star, contracting continuously throughout its history, passed successively through a 'giant' stage of rising, and a 'dwarf' state of falling, surface temperature. This theory, regarded somewhat sceptically at first, gained general acceptance through the discovery, by means of Adams and Kohlschutter's spectroscopic method for determining absolute magnitudes, of the reality of the distinction between giant and dwarf stars. The development of the theory of stellar constitution called for some amendment of the original postulates of Russell's theory, and it is characteristic of him that he made no attempt to preserve ideas based on insufficient data, but became a leader in the reformulation which was seen to be necessary. He was among the earliest to realize the importance of Saha's theory of ionization in stellar atmospheres, and took a leading part in working out its implications, always with a keen appreciation of the limitations placed on theoretical possibilities by difficulties inherent in methods of observation. The development of laboratory spectroscopy attracted him strongly, and with the collaboration of Prof. F. A. Saunders he obtained the first evidence of the co-operation of extra-nuclear electrons in producing line spectra: 'Russell-Saunders coupling' is now a

well-established, and the most frequently occurring, type of such co-operation. More recently he has made important contributions to the analysis of complex spectra corresponding to various stages of ionization—particularly those of metals prominent in celestial spectra.

PROF. RUSSELL'S work is marked throughout by a breadth of interest and a clearness of apprehension of essentials which place him among the greatest men of science of the time. There is scarcely a branch of astronomy (with the possible exception of problems peculiar to the extra-galactic nebulae) which has not attracted his attention and become elucidated thereby. He has recently advanced some very suggestive ideas relating to the origin of the solar system, and his text-book on astronomy, written in association with his colleagues, Profs. R. S. Dugan and J. Q. Stewart, is unique in its kind. He travels freely among the American observatories, and has for many years been regarded as a kind of unofficial ambassador-at-large, co-ordinating work of various types and often taking an active part in the solution of the problems encountered. His vivid personality is one of the most conspicuous and characteristic features of astronomical conferences, and the well-deserved honour now accorded him of foreign membership of the Royal Society will give universal satisfaction.

The German Expedition to Nanga Parbat

EVERYONE must sympathize with the Germans who have met with disaster, for a second time, in an attempt to climb Nanga Parbat. In 1934 three members, including the leader, lost their lives on the mountain in a blizzard and one died from illness; added to this, six of their faithful porters also lost their lives. Now news has come that the second German expedition has met with an even greater disaster, seven out of nine members, including the leader, Dr. Karl Wein, together with nine porters, having been overwhelmed by an avalanche at Camp IV. Details of what exactly happened are not yet to hand, but almost at the same time as the news of the disaster was telegraphed an article appeared in *The Times* of June 22 from Dr. Karl Wein, professor of geography at the University of Munich, dated June 6 from the Base Camp. From this it seems the present expedition is following the same route as that of 1934. On June 5 it had reached Camp III, which in the former expedition was at a height of 19,400 ft., while the 'trek' to Camp IV, 20,300 ft., had been made on the following day. In this account Dr. Wein describes a great avalanche crashing down the face of Nanga Parbat, but which with the exception of several stray fragments did not reach Camp II, 17,550 ft., which was being pitched at the time. The rush of air caused tents to be "blown over, tent poles snapped and strong canvas torn". All the members of the party seem to have been thoroughly experienced mountaineers. We shall await with interest details of this, probably the greatest, of Himalayan disasters.

Powers of the National Trust

THE Bill by which it is proposed to extend the powers of the National Trust was considered by the Select Committee of the House of Commons on unopposed Bills on June 17, Capt. R. C. Bourne being in the chair. The object of the Bill is to put into operation the scheme of the Trust for the preservation of houses of historic or æsthetic interest in private ownership, which in part was inspired by legislation framed for this purpose in France. It will enable the Trust to take over and save from breaking up large country houses and estates, while allowing the donor and his family and descendants to continue to occupy, provision being made for the public to have access to them. In addition, the Bill provides for enabling the National Trust to acquire and hold small sites of five acres in extent for the purpose of preserving "view-points"; to enter into agreements with owners restricting the use of land, and empowers local authorities to co-operate with the Trust. By this legislation the National Trust will be placed in a much stronger position in regard to what must be regarded as its most useful function—the safeguarding and ensuring the preservation of sites which on account of their outstanding archaeological, historical or æsthetic interest, are of national, or even of international importance. It will be relieved in no small measure of the constant necessity of urgent and hurried 'last-minute' appeals, which recent rapid land development has made unavoidable, but of which in the end there is danger that the public may become a little weary. The Trust will now be enabled by the Bill to concentrate on appealing to the general public for the preservation of sites of which the national importance will be most readily appreciated, or for which no other provision is possible.

Indians of Canada

AN example of the variation in method in dealing with the less advanced races of different parts of the Empire, to which reference is made on another page of this issue of NATURE (see p. 1083), is afforded in a recent survey of conditions among the Indians of Canada by the Hon. T. A. Crerar, M.P., Minister of Mines and Resources of the Dominion of Canada. Indian administration in Canada is dominated by the twofold aim of protection and advancement. The Indians, at one time rapidly decreasing in numbers and regarded as a doomed race, are now on the up-grade. Since 1927, when they had fallen to 104,000, they have increased to 112,000. This increase is attributed largely to the improved medical benefits they now receive and the greater attention given to hygiene. They live on reservations, of which there are two thousand of varying size, running from a few acres up to five hundred square miles, the total area being 5,170,000 acres, of which 220,000 acres is under cultivation. A fund of fourteen million dollars, accruing from the sale of Indian lands, mining rights, etc., is administered by the Government entirely for Indian benefit. The cultural condition of the Indians depends almost entirely on

their geographical environment. In the East, they are farmers, and although many are very poor and all suffering from the effects of the economic depression, they differ little in condition from their white agricultural neighbours. In the northern hinterland they are hunters and trappers, and have suffered severely from white competition, and the same applies to some extent to the salmon fishing communities of the North-West coast; but the tribes of the Plains region (Alberta) who lost their livelihood with the extinction of the bison and became farmers and ranchers, have in many instances achieved prosperity in two generations. Finally, it may be added, it is possible for an Indian to become enfranchised on certain conditions, and to cease to rank legally as an Indian.

Statistics of Unemployment

THE report of the Ministry of Labour for 1936 directs attention to the exceptionally sharp rise in the numbers available for employment, which increased by 270,000 between July 1935 and July 1936, due mainly to a rise in the numbers of persons aged sixteen years resulting from the increased birth-rate in the immediate post-War years. Against this there was a large increase in the numbers in employment, which in December 1936 reached the highest level recorded since comparable statistics have been kept—11,132,000 as against 10,629,000 in December 1935. There was also a marked decrease in the numbers unemployed, the number of persons registering as unemployed at employment exchanges in December 1936 being 1,629,000 as against 1,869,000 in December 1935. This total includes 69,000 'casuals', 195,000 'temporarily stopped' and 82,000 'juveniles'. Analysis of the age distribution of unemployed men and women indicates that the problem of finding work for those in the older age groups is predominantly one affecting men, and that age proves a handicap to obtaining employment when younger persons are available. Severe unemployment continued in the coal mining industry, but on a lower level than in 1935. The position improved in all the metal trade groups; in the cotton industry, unemployment over the whole year was 15.7 per cent compared with 20.9 per cent in 1935. The position improved in the wool industry but remained severe in the jute industry and in textile finishing. Most other industries showed improvement.

THERE was a marked increase in the number of persons transferred from the depressed areas compared with previous years, and the proportionate increase in the number of families assisted to re-settle was even more notable. In view of the improved employment position, the whole country was thrown open in instructional centre recruitment, preference in allocation to centres being given to men from areas of heavy and prolonged unemployment. Some expansion in physical training is also reported. Juvenile employment conditions also improved, but there was no indication of a general revival of the apprenticeship system of engaging labour. Shortages of juvenile labour relate particularly to boys and girls

in the 14-15 age group, and there was a widespread tendency to raise the starting wage of learners, particularly in unskilled and non-progressive employment. The policy of industrial transference of juveniles was continued in certain areas, as well as arrangements for vocational training and guidance and placing in employment. Reference is also made to progress in the decentralization of the work of the Ministry.

Russian Trans-polar Flight

THREE Soviet airmen, flying a single-engined 960 h.p. monoplane, "Ant 25", left Moscow on June 18 on a non-stop flight to San Francisco via the North Pole. According to the New York correspondent of *The Times*, they were compelled by poor visibility to land at Pierson Field, Vancouver Barracks, in the State of Washington, on June 20, when within six hundred miles of their goal. They had been in the air for 63 hours 17 minutes, and are stated to have passed near the Pole at an altitude of 14,000 ft. The three airmen, MM. Byelyakoff, Chkaloff and Baidukoff, have been decorated with the Soviet Order of Merit, and Mr. Roosevelt, in a congratulatory message to the Soviet Ambassador in the United States, referred to the flight as a "historic feat".

Palaeolithic Implements from Bombay

PALAEOLITHIC implements from the island of Salsette, north of Bombay, of considerable importance as demonstrating for the first time the presence of a palaeolithic culture in this region of India, have been placed on exhibition in the British Museum (Bloomsbury). This series of implements is the result of three years' excavations carried out by Lieut.-Commander Todd in Pleistocene deposits of alternating gravel and clay. The implements are of indurated shale and come from various levels of stratification. They include Lower, Middle and Upper Palaeolithic types, which, however, differ considerably from previous palaeolithic finds in India. The principal site is a quarry at Khandivli, situated some 100 ft. above sea-level near the foothills running up to the mountainous interior. Mesolithic implements occur as surface finds and also in the caves of Padan not far away, where they are associated with rock engravings. Diagrams of the geological conditions and photographs of the sites are also exhibited with the implements.

Research on Diseases of Farm Animals

AN extensive programme of investigation into the cause and prevention of disease in farm animals is being undertaken by the Animal Diseases Research Association at Moredun, near Edinburgh, under the direction of Dr. J. Russell Greig. It has for some time become apparent that the existing laboratories and animal accommodation at Moredun were insufficient for the Research Association's rapidly extending work, and Treasury sanction has recently been given to the recommendation of the Agricultural Research Council and the Department of Agriculture

for Scotland that a grant not exceeding £9,800 should be made available (after taking into account any receipts from other sources) from the Development Fund to enable necessary building extensions to be undertaken. In view of the economic importance of grass sickness, it became clear to the Department of Agriculture for Scotland and the Agricultural Research Council that further extension and intensification of the research into the cause and prevention of this disease are necessary, and the Treasury has sanctioned an appropriation from the Development Fund to the Department of Agriculture for Scotland of a sum not exceeding £3,200 to meet the expenditure for extended work on this disease during the current financial year. Several contributions towards the cost of grass sickness investigation have been received from outside sources, notably that from the Race-course Betting Control Board, which has granted £1,000 for the work at Moredun during 1937. While the cause of this fatal disease, which is reported to have killed 1,200-1,500 horses last summer and is by no means confined to Scotland, is suspected to be due to poisoning developed in the intestine by certain bacteria, taken in on grass or in some other way during feeding, this theory, though promising, is not yet proved. A large-scale vaccination trial, which is being made after careful preliminary experiments, is intended as a further test of this theory.

General Science and Education for Citizenship

PROF. LANCELOT HOGBEN'S address on "The Teaching of Science in the Education of the Citizen" delivered at a conference of higher education members of the National Union of Teachers on December 30 has now been made available in pamphlet form (London: National Union of Teachers). There is much that is controversial in the address, and the Union is careful to disclaim responsibility for its views and opinions; but its provocativeness is stimulating. It starts from the position that the social task of modern education is "to implement the age of plenty. To do it we have to make the record of scientific discovery an open Bible". In the teaching of science should be epitomized the drama of human achievement, and at each stage the question "Did this or that principle, this or that theory, help mankind to lift this or that stone in the building of the temple of plenty?" will serve to discriminate between the essential and the non-essential constituents of any proposed curriculum and to reconcile the competing claims of specialists. But how about preparation for passing examinations designed by specialists without regard to the requirements of intelligent citizenship? Will students taught on these principles be able to cope with them? Will not those who are themselves destined to become specialists suffer?

To these questions, Prof. Hogben gives answers based on his own teaching experience. The keen interest aroused by the approach to science as a social venture, and the framework of important facts and comprehensive principles provided by it make the memorizing of the less vital facts needed for passing

examinations an easy matter and make a sound basis for later specialization. A fatal error in the teaching of science is the presentation of principles without regard to a sufficient background of relevant information. Prof. Hogben finds an illustration of this in present methods of teaching electricity and magnetism. He advocates a greatly extended use of films in the teaching of science. The cinema, he says, can bridge the gulf which now separates people who have a good visual imagination from those who have not.

New Power Station on the Rhine

IN the *Escher-Wyss News* of December, published by the well-known engineering works at Zurich, a complete description is given of the Albruck-Dogern Power Station on the Rhine. The Rhine, which historically has played an outstanding part among the rivers of Europe, has gained appreciably in commercial importance during the last ten years. Formerly its importance depended on navigation, which gradually spread up the river from the Niederrhein to Basle, now a port handling more than 2.2 million tons annually. During the last ten years the utilization of the water-power has proceeded in the opposite direction from the Upper Rhine down the Rhine valley. The part of the river of greatest interest as regards power generation is that lying between the Lake of Constance and Strasbourg. This stretch extends about a hundred miles, and if we exclude the sudden drop at the Rhine Falls, the gradient is about 1 in a 1,000. There are now eight, including the latest, the Albruck-Dogern, low head water-power stations erected along this stretch of the Rhine.

FOR the complete utilization of the Rhine six further stations are projected. The installed output of all the stations together will amount to approximately one million horse power, and the average yearly generation of electricity will be about 5,000 million kilowatt hours. With the exception of the French station at Kembs, all the stations have Escher-Wyss water turbines. The new station at Albruck-Dogern utilizes the flow from the head of the Rhine to the lower course of the Aare as far as the Klingnau power station. The water supplied by the head race has an average flow of 900 cubic metres per second. It is utilized in three vertical shaft turbines each of which is capable of developing 37,600 h.p. under a head of 11.5 metres and with a maximum flow of 290 cubic metres per second. The power station is at Albruck and has a length of 87 metres and a breadth of 29.3 metres. The three sets, each consisting of a water turbine and an electric generator, are arranged in a row at right angles to the canal and 27 metres apart. After passing through a transformer the electric energy is transmitted at 104 kilovolts.

Prepayment Electricity Metres

THE prepayment meter is, in general, suitable for the user of electricity whose means are small. The advantages are that he pays in small amounts and

that he has an incentive to check and control running costs. The disadvantages are that he pays slightly more per unit consumed, and the supply is apt to be interrupted at inconvenient times. To the supply company, the advantages are that there is less accounting as there are no bills, there is a reduction in bad debts, and special applications can be used in hotels and boarding houses. On the other hand, the reading and collecting cost is increased and so also is the maintenance. Mention of coin mechanisms in connexion with measuring holy water began about A.D. 200. A history and criticism of various types of 'coin mechanisms' in connexion with electric meters are given in a paper by J. Prince and M. Whitehead read to the Institution of Electrical Engineers on April 2. Most of the difficulties in connexion with these meters, including the prevention of fraudulently tampering with them, have now been overcome. One of the outstanding points which affect the use of coin mechanisms is the psychological reaction of the peoples concerned. According to the authors, there is a definite objection to prepayment in both Canada and the United States. They are not used in Denmark, France and Portugal. A few are in use in Holland, Austria, Switzerland, New Zealand and Italy. Great Britain seems to be the only country in which there is a great demand for prepayment meters; probably because it provides the best means of promoting the use of electricity among people of small means.

Journal of the University of Manchester

FROM the University of Manchester we have received a copy of the University's *Journal*, No. 1, vol. 1, published by the Manchester University Press. In an inaugural message from the chairman of Council, Sir Christopher Needham, the *Journal* is described as a new venture designed by the Council to meet what it feels to be a responsibility in regard to graduates, to provide news of University interest and information of developments in University policy as well as personal matters. Conversely, an article by Mr. David Cardwell, chairman of Convocation, reminds graduates that active membership of Convocation (which has, since 1915, followed automatically on graduation) affords a means of service whereby the life-long debt they owe to their University may, in some measure, be repaid. The realization of this ideal has been facilitated by the formation of Groups of Convocation formed in Manchester, London, Leeds and Sheffield and contemplated at Oxford, for discussing matters of University interest and such social and other activities as their members may desire. Sir Ernest Simon contributes an article, "A Time for Expansion: the New Buildings and the Future", describing buildings just completed at a cost of £100,000, others (including a new dental school and hospital and physical chemical research laboratory, swimming bath, etc.) which it is hoped to complete by the end of 1938, and a project, illustrated by an architect's drawing, for further urgently needed developments destined to form with the buildings already mentioned a dignified and

impressive quadrangle. Among other contributors to the journal are: Prof. A. H. Gibson (on the Department of Engineering), Prof. Edward Fiddes (on "Some Teachers of Owens College"), Dr. Tyson (on "The Library and its Uses") and Prof. G. H. Thompson (his Ludwig Mond lecture on "Intelligence and Civilisation"). Copies of the *Journal* will be supplied without charge and on application, to graduates and friends of the University.

Dr. H. L. Richardson

DR. H. L. RICHARDSON, of the Chemistry Department, Rothamsted Experimental Station, has been appointed adviser in soils and fertilizers to the National Agricultural Research Bureau, Shaolingwei, Nanking, China. This institution, which was founded in 1931, possesses extensive laboratories and a farm of 400 acres, and has already made great progress in the investigation of crop production, plant diseases, animal production, and crop recording. In addition to conducting experiments at Nanking, it works in close collaboration with the numerous provincial research stations in China. Dr. Richardson received his training at Victoria University College, New Zealand, and the University of London, and joined the Rothamsted staff in 1927. He has been particularly associated with the developments in soils and fertilizers.

Indian Institute of Science

IT is reported from Bangalore that, at a meeting of the Governing Council of the Indian Institute of Science held on June 1, Sir C. V. Raman decided to sever his connexion with the Institute. The Council proposed that he should continue in the Institute as professor of physics without administrative powers, and suggested the appointment of an interim director to administer the affairs of the Institute pending the appointment of a new director. Sir C. V. Raman declined the offer of the Council and was unwilling to continue as a subordinate to any other director. It was recommended by the Irvine Committee that a registrar should be appointed to relieve the director of administrative duties and to be directly responsible to the Governing Council. Early this year, it was reported that Mr. R. H. Beckett had been appointed registrar of the Institute, but we understand that, though he was offered the post, he did not accept it. We are now informed that the registrar will be Mr. C. E. W. Jones, C.I.E., lately director of public instruction, Central Provinces.

Chemical Engineering Exhibition in Germany

ANNOUNCEMENTS have been issued of the meeting in Frankfort-on-Main during the week July 2-11 of the various bodies in Germany concerned with chemical engineering and the holding at the same time of the Eighth Chemical Engineering Exhibition, widely known as the "Achema". At the last Achema Exhibition, held in Cologne in 1934, an impressive picture was given of the high standard of production of chemical engineering plant and apparatus in Germany and the exhibition attracted 49,000 visitors.

In the interim, the importance of this branch of industry has increased all over the world and in addition there has been an unprecedented industrial development in Germany brought about by the planned transformation of the national economic system. It is expected, therefore, that the Exhibition next July will offer unusual opportunities and that it will attract a large number of expert visitors from all parts. The Achema Bureau is located in Berlin, W.35, Potsdamerstrasse 103a.

Proton-Neutron Exchange Interaction

REFERRING to his letter in NATURE of June 12 (p. 1021), Mr. H. J. Bhabha states that he omitted to insert the following at the beginning of the final paragraph: "The above experiment may be done with cosmic rays, but it must be emphasized that we do not know that the penetrating group consists of protons, even though we know it cannot consist of electrons obeying the theory."

The Night Sky in July

THE duration of darkness is too short this month to scan a number of interesting objects. Mars, Jupiter and Saturn are to be seen, followed by Venus, which is a bright morning star. On July 17 at 21^h U.T. (= 22^h summer time), Mars is in conjunction with the moon, and an occultation is visible from Great Britain. The disappearance of Mars behind the moon as seen from Greenwich takes place at 21^h 17.7^m and the reappearance at 22^h 19.8^m. Jupiter is in opposition on July 15; its equatorial diameter is 47½" and its polar diameter 3" less, the oblateness of the disk being apparent in quite a small telescope. On July 22^d 21^h, Jupiter is in conjunction with the moon. The configurations of the four inner satellites of the planet are given for 23^h 45^m in the Nautical Almanac of 1937, p. 625. Saturn with its ring system is, of course, nearly always an attractive object for observation with a refractor of 3 inches aperture or larger. The planet is stationary amongst the stars on July 18. The moon is new on July 8 at 4.2^h and full on July 23 at 12.8^h. The occultation with Mars when the moon is 9.7^d old has been mentioned above. On July 31 a conjunction of Mercury with the bright star Regulus may be noted. The planet is only 0.4° north of the star (geocentric positions). About midnight (23^h U.T.) in the middle of the month, a bright and interesting stretch of the Milky Way is passing the meridian of London. The Constellations Scorpio, Sagittarius, Aquila, Cygnus (south of the zenith) and Cassiopeia, Perseus and Auriga (to the north) mark its span. In latitudes somewhat farther south than that of London, the galactic star clouds in Scorpio and Sagittarius are an unforgettable sight which may be guessed at on clear moonless nights in Great Britain. Though less spectacular, the low eastern sky at midnight contains the constellation Andromeda, and by locating the great nebula, which can be done with the unaided eye, we are seeing out to the depths of space beyond our galactic system. A number of meteor radiants are active during July, among which may be noted the

αβ Perseids with radiant at R.A. 3^h 12^m; Dec. 43° N.; γ Draconids (radiant, R.A. 17^h 56^m; Dec. 48° N.) and the δ Aquarids (radiant R.A. 22^h 36^m; Dec. 11° S.). Some swift meteors may be seen from the radiant at R.A. 21^h 0^m; Dec. 48° N.—the α Cygnids.

Announcements

H.M. THE KING has nominated Sir Arthur MacNalty to be for five years a member of the General Council of Medical Education in the United Kingdom in succession to Sir Henry Dale.

THE following awards from the Lady Tata Memorial Fund for research in blood diseases, with special reference to leukæmia, have recently been made: *Grants for research expenses*, Dr. Julius Engelbreth-Holm (Copenhagen), Prof. Karl Jármai (Budapest), Prof. James McIntosh (London), Prof. Charles Oberling (Paris), Prof. Eugene Opie and Dr. Jacob Furth (New York), Dr. Georg Weitzmann (Leipzig) and Dr. Lucy Wills (London); *Scholarships*, Dr. Jørgen Bichel (Aarhus, Denmark) and Dr. Edoardo Storti (Pavia, Italy).

A CONFERENCE on the "Challenge to Democracy" will be held at Ashridge College, Berkhamsted, by the Association for Education in Citizenship, on July 8-14. Further information can be obtained from the Secretary, Association for Education in Citizenship, 10 Victoria Street, S.W.1.

AN earthquake of moderate intensity was recorded at Kew Observatory on June 21. The first impulses were registered at 15 hr. 26 min. 2 sec. G.M.T. The records indicate that the shock was located about 6,000 miles away, probably in Peru.

PROF. HUGO SPATZ has been appointed director of the Kaiser Wilhelm Institute for Cerebral Investigations.

AN international congress of public health consisting of ten sections will be held in Paris on July 1-10. Further information can be obtained from the Secrétariat Général, Laboratoire d'Hygiène, Faculté de Médecine, rue de l'Ecole de Médecine, Paris, 5^e.

THE Belgian Government has decided to organize a campaign of health with the title of the National Crusade of Health under the direction of the Red Cross.

DR. MAX WIEN, professor of physics at Jena, and Prof. Oskar Seyffert at Dresden, have been awarded the Goethe Medal for art and science by the German Chancellor.

THE first World Congress on the Voice, organized by *Euphonia*, will be held at La Maison de la Chimie, Paris, on September 19-28. Further information can be obtained from Dr. Wicart, 92 Avenue de Wagram, Paris.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1113.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Growth Substances, Root Production, and Cambial Activity in Woody Cuttings

It is now well established that α -naphthalene acetic acid and β -indolyl acetic acid (heteroauxin) are among the most active chemicals which stimulate the production of roots¹. In fact, these substances are put to practical use in accelerating the production of roots from cuttings, herbaceous or woody².

Whilst testing numerous horticultural plants, including species well known to root readily and others more reluctant to do so, examples have been encountered of the stimulation to marked activity of the cambium. The following illustrate this phenomenon seen at various seasons of the year:

(1) Cuttings of *Viburnum Carlesii* were taken in mid-July and placed with their basal ends in a solution of α -naphthalene acetic acid, and others in β -indolyl acetic acid, of a concentration of 1 part in 10,000 of distilled water for twenty-four hours; controls were placed in distilled water. The period of uptake of the solution, due to transpiration in part at least, was terminated by washing in water. Insertion into sand in a propagating frame immediately followed the treatments. Within fourteen days the bark of the treated cuttings was seen to split owing to the rapid formation of new tissues inside. Many roots emerged in twenty-one days; frequently these were formed in rows.

(2) Similarly, cuttings of *Ceanothus dentatus* taken on November 28 and treated as already outlined, responded by the rapid production of a new cylinder of tissue of a thickness of some twenty cells, counted



Fig. 1.

TRANSVERSE SECTION OF THE STEM OF *Ceanothus dentatus* AFTER STIMULATION BY ALPHA NAPHTHALENE ACETIC ACID (NOV. 28, 1936). SECTION CUT JAN. 22, 1937. THE REGION A TO B SHOWS THE NEW PARENCHYMA WITH MEDULLARY RAYS. $\times 60$ DIAMETERS.

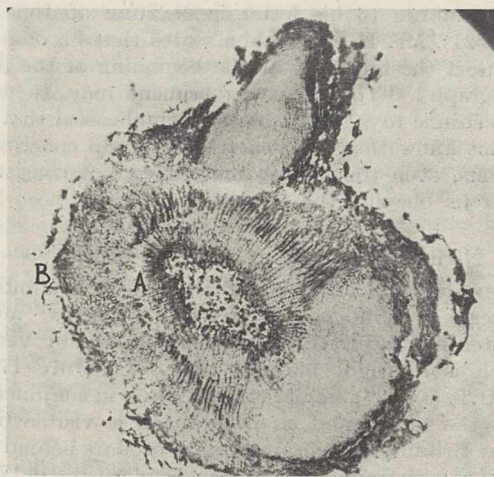


Fig. 2.

TRANSVERSE SECTION OF *Myrtus communis*, STEM SHOWING THE DEVELOPMENT OF ROOTS. IN THE REGION A TO B PARENCHYMA HAS DEVELOPED OUTSIDE THE XYLEM, AFTER STIMULATION BY ALPHA NAPHTHALENE ACETIC ACID (JAN. 12, 1937). SECTION CUT FEB. 19, 1937. $\times 30$ DIAMETERS.

radially. These were formed in less than five weeks. Medullary rays in this tissue, stained deeply, are readily seen in the transverse section (Fig. 1).

(3) With *Myrtus communis* a concentration of two parts in 10,000 of α -naphthalene acetic acid for twenty-four hours was used with cuttings taken on January 11. Rapid cell division afterwards took place resulting in new tissue of a thickness of fifteen to twenty cells, counted radially. Where roots developed, and they were freely formed, as may be seen from Fig. 2, the number of new cells produced radially far exceeded that number.

(4) With *Tricuspidaria dependens* taken in late January, the rate of cell division in the treated series has been observed to be remarkably rapid—a cylinder of a radial thickness of eighteen cells has been formed in twenty-five days.

The control cuttings did not show this activity. In them the production of callus tissue was localized, and limited to the base of the cutting. Generally, in the treated cuttings the rate of cell differentiation and lignification of the new tissue did not keep pace with that of cell formation, resulting in tissue of a parenchymatous nature almost entirely undifferentiated, as is well shown by longitudinal sections. The region of stimulation varied in position and length, but frequently was limited to 1.5–2 cm. and did not usually extend to the base of the cutting. An 'internal

tube of callus' of cambial origin was produced. Thus it was not only a question of the development of root initials previously laid down.

Full anatomical details are not yet available, but the possibility is not precluded that repeated cell divisions took place to form cells in an irregular and intercalary manner as distinct from the more regular centripetal and/or centrifugal abscission usually associated with cambial activity.

The new roots frequently emerged in rows, showing a relationship between their point of emergence and the leaf traces. How far is the position of the root, its form and shape, governed by the constraining resistance of the older lignified tissue experienced by the rapidly expanding tube of internal callus? Can the adventitious root so formed be regarded as parenchyma, moulded into cylindrical shape?

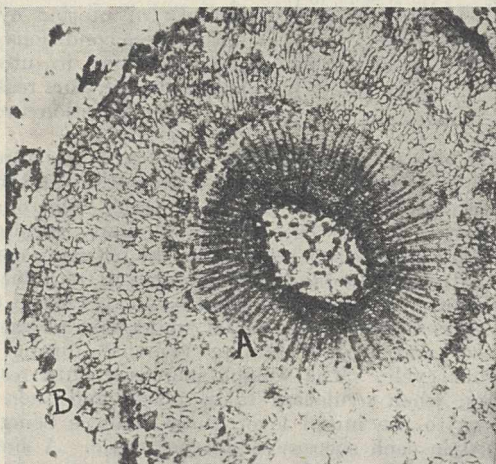


Fig. 3.

Myrtus communis. A TO B SHOWING THE DEVELOPMENT OF PARENCHYMA IN A REGION WITHOUT ROOTS. $\times 40$ DIAMETERS. OTHER DETAILS AS FIG. 2.

Whilst the cambium may be stimulated at different seasons, including the period of natural quiescence, and whilst root formation may also be induced at various times of the year, the response obtained from one species differs in quality and degree with the season at which treatment is applied and with the co-related nature of the material so selected.

It is difficult to refrain from the attractive speculation that the natural seasonal excitation of the cambium results from the downward translocation of similar substances, formed from young leaves the veins of which are directly connected to the outer portion of the wood. Diffusion to, and excitation of, the cambium could readily take place, as shown by the morphological studies made by Priestley³ using the 'strip method'.

I thank Miss W. Hopwood for cutting and preparing sections and Messrs. N. K. Gould and F. C. Brown for the photomicrographic illustrations.

M. A. H. TINCKER.

Royal Horticultural Society,
Wisley, Surrey.
April 27.

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Isolation of Carotene from a Wood-Oil

THE intensive studies of the past few years have illustrated the wide distribution of the carotenoids in Nature, but so far as we are aware, the occurrence of this group of pigments in the oils extractable from timber has not been recorded.

Acacia acuminata, which possesses an extraordinarily hard and heavy stem, is indigenous to Western Australia where, owing to its marked resistivity to termites, it has been extensively used for fencing and similar purposes where this property is of importance. The timber, locally known as 'jam' wood, has a pronounced odour, reminiscent of the common raspberry, *Rubus indoeus*, and this persists in the timber for years, and in the wood-oil obtained by extraction with light petroleum. A suggestion that carotene might be present in the dark red oil was made by Hill¹. It is now confirmed by our isolation of the pigment by chromatographic fractionation on alumina.

The adsorption experiment was carried out on the oil, as preliminary analyses had indicated a very small content of saponifiable matter. A number of coloured zones, indicating the presence of at least six carotenoid pigments, were observed. From one of these an extract was obtained which gave 21 mgm. of crystalline β -carotene, m.p. 178°. The amount present in the oil is probably considerably greater than this yield of 0.21 per cent. Dr. R. A. Morton very kindly carried out a spectroscopic examination of the other carotenoid fractions, but reported that they were not pure enough for spectrographic differentiation and identification. Fifty per cent of a non-odoriferous highly fluorescing oil is unadsorbed by the alumina. This is probably hydrocarbon in character. It is likely that the odour of the timber results from a breakdown of carotenoids to β -ionone, of which it is reminiscent.

No opinion can yet be offered as to whether the high carotenoid content is in any way related to the resistance of the wood towards termites.

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¹ Hill, H. E., *J. Roy. Soc. West. Aust.*, 13, 55 (1931-1932).

Phospholipid Synthesis during Fat Absorption

WE have recently reported some experiments on the distribution and on the rate of 'organification' of phosphorus in rat's tissues¹. With the same radioactive technique we have now investigated the synthesis of phospholipids during the absorption of large quantities of fat.

A rat weighing about 250 gm. was fed on 5 gm. of olive oil and 7.5 mgm. of radioactive sodium phosphate having an activity of 1,600 of our radioactive units (R.U.). Nine hours later the rat was bled. The absorption of the ingested phosphate was very complete, as no more than 42 R.U. was found in the gastro-intestinal tube and in the faeces.

The tissues were extracted with alcohol and alcohol plus ether and the extracts purified with anhydrous chloroform. The phospholipids of the liver and gut were further precipitated by acetone plus magnesium chloride. The acetone precipitate of the liver has been finally fractionated with cold alcohol. We call the soluble fraction 'lecithin' and the insoluble

one 'cephalin', though we are well aware that the separation is by no means a complete one.

The phosphorus of the extracts and their fractions was mineralized and titrated by the Neumann-Macheboëuf procedure. Finally, the phosphorus was reprecipitated as phosphomolybdate and the radioactivity measured. The results are reported in the accompanying table.

Tissue	Weight of moist tissue (gm.)	Lipidic P (mgm.)	Radioactive P (R.U.)			Specific activity			
			in the whole tissue	per gram of moist tissue	per cent of the ingested P				
Liver	'Lecithin'	7.41	8.62	58.2 ± 1.0	7.9 ± 0.1	3.64	(7.1)	6.7	(6.4)
	'Cephalin'	"	2.58	14.8 ± 0.9	2.0 ± 0.1	0.92	(5.1)	4.3	(3.6)
	Total Phospholipids	"	11.20	73.0 ± 1.0	9.9 ± 0.1	4.56	(6.4)	6.0	(5.7)
Intestine	4.22	3.86	40.3 ± 0.5	9.6 ± 0.1	2.52	(10.7)	10.4	(10.1)	
Kidney	2.39	2.80	8.2 ± 0.5	3.4 ± 0.2	0.51	(3.4)	2.9	(2.4)	
Spleen	0.92	0.75	0.5 ± 0.6	0.6 ± 0.7	—	(3.0)	0.7	(-1.7)	
Heart	0.89	0.92	0.0 ± 0.5	0.0 ± 0.6	—	(1.7)	0	(-1.7)	
Skeletal muscle	5.49	2.72	0.3 ± 0.5	0.1 ± 0.1	—	(0.7)	0.1	(-0.4)	
Blood corpuscles	2.39	0.25	0.0 ± 0.5	0.0 ± 0.2	—	(6)	0	(-6)	
Blood plasma	2.61	0.07	0.5 ± 0.5	0.2 ± 0.2	—	(30)	7.5	(-15)	

We give the weight of moist tissue, the weight of phosphorus, its radioactivity (in the whole lipidic extract and per gram of moist tissue, with the statistical error of the measurements) and its specific activity (with possible errors assuming a maximum and minimum value given by the mean value plus or minus three times the statistical error). Dividing the radioactivity by the total radioactivity of the sodium phosphate (1,600 units) one has the fraction of the ingested phosphorus which was found in each organ.

From the table it is apparent that, some hours after the ingestion of the fat and radioactive phosphorus, comparatively large quantities of ^{32}P were already found in the phospholipids of the liver ('lecithin' as well as 'cephalin') and of the gut. The absolute amount was larger in the liver, the content per gram of moist tissue being about the same in the two organs: 'specific activity' was higher in the intestine. Kidneys showed a small, but definite, activity. Heart, spleen and skeletal muscle showed practically no activity. The results for plasma and blood corpuscles are inconsistent, probably owing to the small content of phosphorus.

These findings should be compared with those communicated in our previous letter. Indeed in the experiment, in which ^{32}P was injected parenterally, the rate of phospholipid synthesis was found to be larger in liver, gut and kidney than in other tissues. Further, the rapid formation of phospholipids in liver and intestine during fat absorption is in agreement with many results reached by other methods. Our experiments show that the kidney is also involved in this process, which must be regarded not as a simple substitution of fatty acid radicals into the phospholipid molecule, but as a complete synthesis starting, at least partially, from inorganic phosphorus. We thank Prof. E. O. Lawrence and the Radiation Laboratory of the University of California for their most generous gift of ^{32}P .

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Relation of the Adrenal Cortex to Cyclical Changes in the Female Accessory Reproductive Organs

In a recent communication¹ one of us recorded the fact that periodic uterine bleeding still occurred in a spayed monkey that was being injected daily with a constant threshold dose of oestrone. It was suggested that this phenomenon is due either to the periodic liberation of some other hormone that raises the uterine threshold to oestrogenic stimulation, or to some undefined inherent periodicity in the responsiveness of the uterus to oestrone. Further consideration of the problem leads us to believe that the adrenal cortex may be responsible both for the persistence of uterine cycles under these conditions and for variations in uterine sensitivity. Our reasons for this suggestion are as follows:

(1) The hormones of the ovary and the adrenal cortex are related in chemical structure, and both organs are controlled by the anterior lobe of the pituitary. It has been shown in many species of vertebrate that the weight of the adrenal cortex fluctuates in accordance with changes in reproductive condition. Thus Anderson and Kennedy² found that the adrenal cortex of the rat undergoes alterations in size and lipid staining response during the oestrous cycle. The weight increases until oestrus occurs, when ovulation takes place, and then decreases to the initial level, these changes being repeated in each successive oestrous cycle. A similar increase in the weight of the adrenal cortex at the time of ovulation has been shown to occur in frogs³ and pigeons⁴.

(2) It is well established that at least one of the principles of the adrenal cortex is intimately concerned with the regulation of the water and salt balance of the organism. This is shown by the fact that removal of the adrenals is followed by considerable excretion of sodium chloride and by diuresis. Conversely, Thorn *et al.*⁵ have found that the injection of cortical extract into normal individuals causes a temporary retention of intravenously injected sodium chloride.

(3) The menstrual cycle in monkeys is related to well-marked changes in water-metabolism. Krohn and Zuckerman⁶ and Fisher and Zuckerman⁷ have observed that water is retained in the sexual skin of the macaque and baboon during the first half of the menstrual cycle, and that considerable diuresis occurs when the sexual skin swelling subsides.

(4) Oestrous cycles generally cease after adrenalectomy. It has, however, been found by Kutz *et al.*⁸ that oestrus occurs at normal intervals in adrenalectomized rats if the life and health of the animals are maintained by the administration of salt.

This last observation suggests that the regular occurrence of cyclical changes in the uterus is dependent on a normal water-metabolism. It would also seem that at least part of the mechanism underlying the fluctuations in water and salt metabolism of the female macaque and baboon during the menstrual cycle is the coincident cycle in the activity of the adrenal cortex, the secretion of which fluctuates as does that of the ovary in response to cyclical

¹ NATURE, 139, 836 (1937).

alterations in the activity of the anterior lobe of the pituitary. It is probable that cyclical alterations in adrenal cortical activity still persist in spayed monkeys, and that the consequent hydration and dehydration of the accessory reproductive organs is the factor that is responsible for variations in the responsiveness of these organs to a constant dose-level of oestrone.

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² Anderson, D. H., and Kennedy, H. S., J. Physiol., 76, 247 (1932).

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⁵ Thorn, G. W., Garbutt, H. R., Hitchcock, R. A., and Hartman, F. A., Endocr. inology, 21, 213 (1937).

⁶ Krohn, P. L., and Zuckerman, S., J. Physiol., 88, 369 (1937).

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Effect of Progesterone on Lactation in the Rat

DRUMMOND-ROBINSON and Asdell¹ showed that ablation of the corpora lutea in the pregnant goat caused milk secretion provided the operation was done after the development of the mammary lobule-alveolar system. This suggests that the corpus luteum inhibits lactation prior to parturition, though the

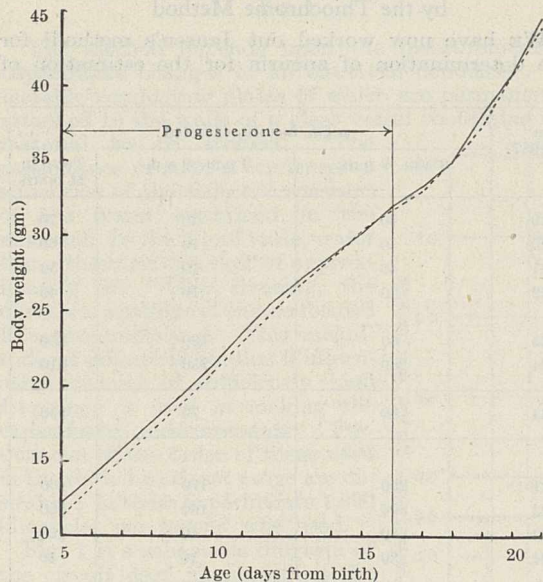


Fig. 1.

AVERAGE GROWTH-RATE OF POOLED LITTERS.

FULL LINE, MOTHERS INJECTED DAILY WITH 1 MG. PROGESTERONE IN 0.2 ML. ARACHIS OIL. DOTTED LINE, MOTHERS INJECTED DAILY WITH 0.2 ML. SESAME OIL.

work of Anselmino *et al.*^{2,3} indicates that the inhibitor is different from the hormone which causes proliferation of the uterine endometrium. On the other hand, Frei and Grüter⁴ reported that injections of suspensions of corpus luteum tissue exerted a favourable effect on lactation in the cow. The experiments reported briefly below confirm the contention of

Anselmino *et al.*, since we have found that administration of relatively high doses of pure progesterone to the lactating rat does not inhibit lactation as judged by the rate of growth of sucklings.

Two groups of four lactating rats were used, one experimental and one control. Litters larger than eight were reduced to that number, as is the standard practice in this laboratory. In the case of two of the control rats, the litters numbered seven and six respectively. One litter in each group suffered reduction by the death of a female during the experiment. Each experimental rat was given twelve daily intramuscular injections of 1 mgm. crystalline semi-synthetic progesterone dissolved in 0.2 ml. arachis oil beginning on the fifth day *post partum*. Total number of young in litters was 17 males and 15 females; average gain in weight of mothers from parturition to weaning, 21 gm. Owing to an error, the controls were given similar injections, not of arachis oil but of sesame oil, but it is extremely unlikely that this would affect the outcome. Total number of young in litters was 14 males and 15 females; average gain in weight of mothers from parturition to weaning, 23 gm. We are greatly indebted to Dr. A. N. Macbeth and Messrs. Organon Laboratories Ltd. for the gift of the progesterone used in this work.

The average growth-rates, from the fifth day *post partum* to weaning, of all the young of each of the two groups of rats are plotted in Fig. 1. It will be seen that there is no difference between the mean growth-rates for the two groups of sucklings, which shows that progesterone, at the relatively high dosage given, neither inhibits established lactation in the rat, nor causes any increase in milk secretion.

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S. K. KON.

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Wettability of the Cellulose Walls of the Mesophyll in the Leaf

THE moisture regain curves (sorption isotherms) of cellulose show a steep rise at high relative humidity, but the water content at saturation (about 18 per cent of the dry weight of raw cotton) is definite both for natural and for regenerated celluloses¹. To explain why no loosely adhering liquid condenses even when ample time is allowed for dispersal of the heat generated, it is sometimes suggested that the vapour, even under the best controlled experimental conditions, is never fully saturated. This view is, however, difficult to reconcile with the definiteness and reproducibility of the saturation maxima, especially as the regain curves are here so very steep. That these curves have a finite and not an infinite slope at saturation suggests another explanation, namely, that a clean cellulose surface may be incompletely wettable by water.

The unwettability of natural cotton is generally ascribed to the existence of a film of wax or oil covering its outer surface. Masson², who directed attention to the marked rise of temperature which the dried

material shows on immersion in water, attributed this thermal effect to the condensation of water which has diffused as vapour across an air film which remains clinging to the waxy surface. In passing, we may remark that this view appears to us to require some slight modification, for it has been found that the bulk of the water neither gains nor loses heat until conduction from the cotton comes into play³.

It seemed to us worth while to study the wettability of other natural cellulose surfaces, such as those which surround the cells in the mesophyll of plant leaves. Strips of leaf, cut so as to permit free exit of air at the top and entry of liquid at the bottom, were placed vertically with their lower edges in contact with water. Capillary rise was in no case observed, and it was found impossible to produce the entry of water into the mesophyll air-space system without either a pressure gradient or prolonged immersion. On the other hand, organic liquids such as benzene, chloroform, ether and essential oils, infiltrate rapidly into the mesophyll air-space by capillarity; vertical strips several centimetres long become completely filled in a very short time although the surface tensions of all these liquids are much less than that of water. Medicinal paraffin shows the same result and on account of its non-toxic character is suitable for comparative experiments with water. The results of many similar experiments show that, whilst all the other liquids named enter the capillary air-space system against gravity, water will not do so.

Leaves infiltrated with water by pressure gradient were found, on exposure to bright sunlight, to clear the mesophyll interspaces of liquid in a period of about two hours. Observed by transmitted sunlight under slight magnification, the retreat of the water appears to be a markedly discontinuous process, the water receding suddenly from areas several millimetres broad, and then halting for a time.

All the above experiments have been carried out with the leaves of *Ficus elastica*, which on account of their architecture are very suitable for this purpose. Moreover, by tearing the blade of this leaf it is possible to expose the mesophyll over an area of several centimetres, and the action of different liquids when placed on the exposed surface can then be followed under the microscope. A drop of water so placed remains supported on the summits of the mesophyll cells and does not flow down and fill the air-spaces. If now a drop of oil be placed at the end of the strip, the oil can be seen to enter the capillary system instantly and advance through the interspaces. Arriving at the drop of water, the oil enters the mesophyll spaces lying under the water, displacing the air, and presently emerging on the far side until the whole strip appears oily. Watched under a

magnification of 100 (without a cover glass), the oil when applied can be seen to rush into the capillary spaces in an advancing wave which is followed at a short distance by the main wave of oil, so that in less than a minute a strip 2 cm. long becomes completely covered. When a drop of water is allowed to remain on the surface of the mesophyll, any part of the drop in contact with the surface of the fine vascular bundles flows out along the bundles, but does not spread laterally over the mesophyll cell-walls.

It is clear from these observations that the surfaces of the mesophyll have but the smallest adhesion to water, but that the outer tissues of the fine lateral veins have a much higher adhesion energy. It then becomes necessary to reconsider the conditions obtaining at the interface where transpiration takes place, for the above observations entirely negative the view that transpiration occurs from a liquid film of water on the cell walls of the mesophyll.

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¹ Sheppard and Newsome, *J. Phys. Chem.*, **33**, 1817 (1929).

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³ Unpublished observations of M. Wahba in these laboratories.

Determination of Aneurin (= Vitamin B₁) in Urine by the Thiochrome Method

WE have now worked out Jansen's method¹ for the determination of aneurin for the estimation of

Subject	Diet	Date (April 1937)	μ gm. aneurin excreted					
			9 a.m.-9 p.m.	9 p.m.-9 a.m.	Total in 24 hours			
G.	Normal	18-19	40	30	70			
	Aneurin-free*	19-20	50	10	60			
	"	20-21	40	10	50			
	"	21-22	30	10	40			
	Normal + 3 × 1 mgm. aneurin†	22-23	60	190	250			
	"	23-24	260	250	510			
Z.	Normal	23-24	80	70	150			
W.	Normal + 3 × 1 mgm. aneurin†	20-21	290	170	460			
		21-22	390	160	550			
	Aneurin-free	22-23	80	40	120			
		23-24	30	10	40			
				9 a.m.-3 p.m.	3 p.m.-9 p.m.	9 p.m.-9 a.m.		
	Same diet + 3 × 1 mgm. aneurin†	24-25	60			100	160	320

* Washed polished rice, crackers, egg-white, butter, sugar.

† At 9 a.m., 1 p.m., 6 p.m.

‡ At 9 a.m., 3 p.m., 9 p.m.

this vitamin in urine. Most difficulties were overcome by diluting the urine by about three times its volume of water, by working entirely in a nitrogen atmosphere and by subtracting the fluorescence of a franconite eluate to which no potassium ferricyanide had been added from the fluorescences of some eluates which

had been treated with different amounts of this oxidizing agent.

The accompanying table shows the results of the first applications of this method to human urine; they are in excellent agreement with the results of Harris and Leong², who used the bradycardia method.

A more detailed account of these and further experiments will be published shortly in one of the Dutch periodicals. We wish to thank Prof. B. C. P. Jansen for his kind interest and Mr. H. N. Zwalf for his skilful assistance.

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A Method for Determining Ice-Water Relationships by Measurements of Dielectric Constant Changes

A NEW method for studying freezing points of soils has been developed by us¹. Freezing point depressions of soils with water contents covering almost the entire growth range of plants have been measured.

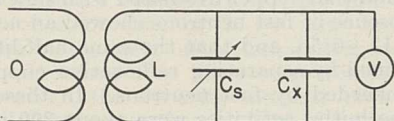


Fig. 1.

The method depends upon the measurement of capacitance changes of an electrical condenser, the metallic conducting plates of which are permanently attached to the walls of a glass vessel containing the material to be studied. The capacitance of such a condenser is a function of the dielectric constant of the water contained in the material. In the liquid state, water has a dielectric constant of approximately 80. After freezing, the dielectric constant of the ice formed is approximately 4. This magnitude of difference obtains if alternating current of sufficiently high frequency is used in making the capacitance measurements. Frequencies of the order of those used in the radio broadcast range are desirable; in these experiments 1,800 kilocycles per second was used.

Fig. 1 is a schematic diagram of the circuit used in measuring the capacitance of the condenser containing the material; *O* is an oscillator which emits radio frequency waves at a frequency of 1,800 k.c./sec.; *L*, *C_s*, and *C_x* form a receiving circuit which may be tuned to the oscillator frequency. *V* is a vacuum tube voltmeter which indicates a maximum when the receiving circuit is tuned to resonance with the oscillator. *C_x* is the condenser containing the material and *C_s* is a calibrated variable condenser.

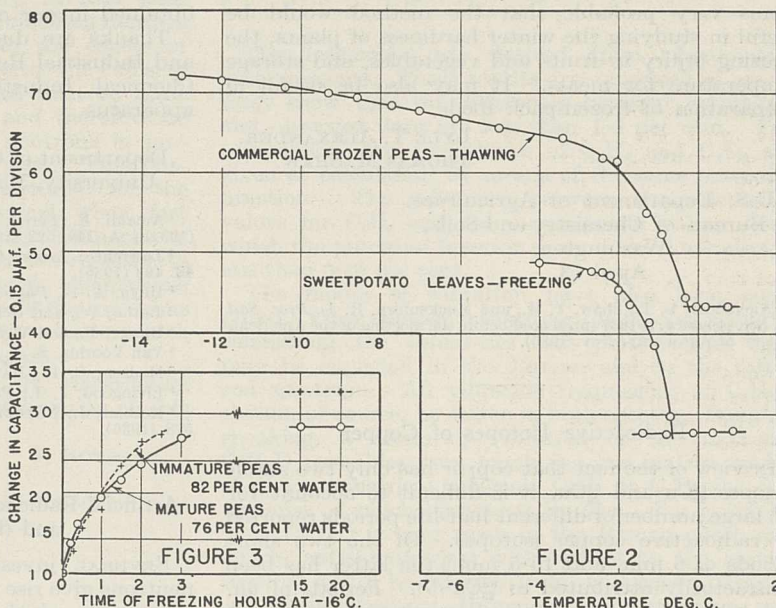
Resonance between the two circuits is obtained for

a definite value of capacitance supplied by *C_s* and *C_x*. Any decrease occurring in the capacitance *C_x*, such as takes place if the water in the material freezes, may be compensated by an increase in the capacitance *C_s*. Thus, by determining the capacitance of *C_s* necessary to tune the circuit to resonance with the oscillator, one can determine any change in capacitance of the condenser containing the material (*C_x*).

Due to the great change in dielectric constant of water when it freezes, a curve of capacitance versus temperature of the condenser containing the material shows a marked change in direction at the temperature where ice begins to form. Thus, it is possible to determine the freezing or melting point of materials, containing, other than water, only constituents the dielectric constants of which show no sharp change with variation in temperature.

The temperature of the material studied may be maintained at a given value as long as is necessary for establishing thermal equilibrium. If this is done, the curve obtained consists of a number of equilibrium values. Hence the freezing point which is obtained from such a curve should be an equilibrium value. It has been recognized that freezing point determinations on colloidal materials by the widely used Beckmann technique are not equilibrium values, and hence their use is questionable where equilibrium conditions are assumed, such as in the calculation of vapour pressures.

This method for determining freezing points has been applied to some plant materials. An example of the kind of data obtained is shown in Fig. 2. The curve for sweet potato leaves is for freezing, while that for frozen-pack commercial green peas is for melting. Supercooling is clearly shown on the sweet potato leaf curve. It is, however, possible to obtain the freezing point accurately since by the graphic method it is not necessary to obtain data exactly at the point of initial ice formation.



If one assumes that the dielectric constants of the materials present in the condenser, other than water, do not change significantly over the temperature range studied, the following interpretations may be made. When the curve is parallel to the temperature

axis, no water is being frozen or melted with change in temperature. When the curve is vertical with respect to the temperature axis, pure water is being frozen or melted. When the curve is inclined to the temperature axis, ice is being separated from or melted into a solution, as in the concentration or dilution of a sugar solution. This latter effect may also be brought about by capillary forces or by colloidal substances the avidity of which for water varies with their concentration.

Fig. 3 shows the results obtained upon freezing fresh green peas using time as a variable instead of temperature. 19 gm. of green peas at room temperature were placed in the condenser and immersed in a thermostat held at -16°C . At the time of immersion and at intervals thereafter capacitance measurements were made. The time required for complete freezing is the time elapsed before the capacitance reaches a constant value. The curves shown are for mature and immature peas taken from the same lot. Since the condenser containing the peas was surrounded by an air jacket, it is possible that the rate of heat transfer was the limiting factor in the earlier part of the freezing time. The method offers the opportunity of determining when such substances are completely frozen throughout. It should be noted that the peas with the higher moisture content showed a greater capacitance change upon freezing. Possibly with improved technique, quantitative interpretation of the relation between capacitance change and the amount of ice formed may be made.

This method is being presented here in the hope that it may prove useful in fields outside those with which we are concerned. The data presented in this paper were obtained with the first apparatus built and are to be regarded only as representative of the type of results obtainable. The functions of the laboratory do not permit the following up of this problem from any except the soil point of view. It seems very probable that the method would be useful in studying the winter hardiness of plants, the freezing injury to fruits and vegetables, and storage temperature for meats. It may also be useful in preparation of frozen-pack foods.

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¹ Alexander, L. T., Shaw, T. M., and Muckenhirn, R. J., *Proc. Soil Sci. Soc. America*, 1, 1937 (presented before the meeting of the American Society of Agronomy, Nov. 1936).

Radioactive Isotopes of Copper

IN view of the fact that copper has only two stable isotopes ^{63}Cu and ^{65}Cu , it is difficult to account for the large number of different half-life periods reported for radioactive copper isotopes. Of the two short periods of 6 min. and 10.5 min., the latter has been satisfactorily attributed to ^{63}Cu ^{1,3,4}. Periods of 6h. and 10h. have been obtained by neutron bombardment^{1,5} and a 12.8h. period given by deuteron bombardment². Since this latter product emits both positrons and electrons, there is good evidence for labelling it ^{63}Cu . A radioactive copper has been chemically separated from zinc bombarded by fast neutrons, of half-life variously reported at 6h. and

10h.^{1,5,8}. Madsen has directed attention to the confusion over these periods and gives the half-life period of the copper obtained from zinc as 17h.⁷

Leo Szilard, of the Clarendon Laboratory, Oxford, informed us that the decay curve of the copper bombarded by fast neutrons from radon-beryllium contained a period of a few hours which was absent when slow neutrons were used, or if the radioactive copper was obtained from zinc by fast neutron bombardment. It was arranged with him that further investigations and chemical separation should be made in this laboratory.

We irradiated 2 gm. mols of pure cupric oxide with fast neutrons from a 200 mc. radium-beryllium source. After irradiation, we dissolved the oxide, added 500 mgm. of nickel salt and precipitated the copper as cuprous iodide. The separated nickel after purification and conversion to nickel sulphide, showed an activity of 80 impulses/min., $1\frac{1}{2}$ hours after irradiation had ceased, decaying with a half-life of 160 ± 10 min. We found the same half-life period in nickel irradiated by slow neutrons, in agreement with Rotblat, Naidu and Heyn⁹. It must be due to a radioactive isotope ^{63}Ni or ^{65}Ni , and may be produced either from ^{63}Cu or ^{65}Cu by capture of a neutron and expulsion of a proton.

We found that copper irradiated with slow neutrons in the absence of fast neutrons showed an activity of half-life 13 ± 0.5 h. and that the same half-life period was obtained by separating radioactive copper from zinc bombarded by fast neutrons. In these experiments the initial activities were about 300 impulses/min. with a background of 20 impulses/min.

This radioactive copper may well be identical with that produced by bombarding copper by deuterons and is accordingly likely to be ^{63}Cu . The 6 min. period of copper obtained by slow neutron capture would then be due to ^{65}Cu .

No indication of a 6h., 10h. or 17h. period was obtained in our experiments.

Thanks are due to the Department of Scientific and Industrial Research for a grant and to Imperial Chemical Industries, Ltd., for the purchase of apparatus.

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¹ Amaldi, E., Fermi, E., and others, *Proc. Roy. Soc.*, A, 146, 483 (1934); A, 149, 522 (1935).

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⁵ Bjerger, T., and Westcott, C. H., *NATURE*, 134, 286 (1934).

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Artificial Radioactivity produced by Fast Neutrons and their Inelastic Collisions

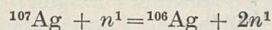
SEVERAL investigators have reported that fast neutrons give rise to a transformation of an irradiated element in which the newly formed nucleus results from the original nucleus through the loss of a neutron^{1,2}.

I have made some experiments on the activation of copper, zinc and silver by fast neutrons. As the efficiency in these cases is small, I used the following arrangement: A foil of the metal under investigation,

measuring 8 cm. \times 5 cm., was wrapped around the source (50 mc. radon + beryllium) in the form of a spiral, so that the effective solid angle was equal to $4 \times 4 \pi$. After activation, the foil was given the form of cylinder of 24 mm. diameter, which fitted the Geiger counter. In this way I obtained an activity which was four times larger than with the usual arrangement. In the case of copper, I found in accordance with Heyn² a radio-element of 11 min. half-period, produced by fast neutrons only. An element of this period was found by Bothe and Gentner³ by irradiation of copper with very hard γ -rays, so that our product must be ⁶³Cu derived from ⁶³Cu by loss of a neutron. The initial activity due to the 11 min. body is about one half the initial activity due to the 5 min. body.

In the case of zinc, I was able to confirm the existence of the 60 min. half-period product. Miss Nuswald, working in this laboratory, has found that this element is an isotope of nickel and not of zinc as stated by Heyn.

In the case of silver, Guében⁴ has reported the formation of a 50 sec. activity which possibly could be attributed to fast neutrons only. I have investigated the activation of silver and found no trace of the 50 sec. product. In the course of these experiments, however, I obtained a definite proof of the existence of a product of 25 ± 3 min. half-period which does not appear after irradiation with slow neutrons. It seems very likely that this product is identical which the 24 min. element obtained by Bothe and Gentner, so that we have almost certainly the reaction



The efficiency of this reaction is about 0.03 of the total efficiency of fast neutrons in producing radio-activity in silver.

In the type of activation studied in this communication, the kinetic energy of the colliding neutron is nearly completely converted into the excess of mass of the system formed, so that after the collision both the colliding and the extracted neutron must have a very small kinetic energy, and therefore be much more efficient than the fast neutrons in producing activation of the 'capture' type. This phenomenon may account, at least partially, for the increase of artificial activity observed when fast neutrons pass through relatively small thicknesses of certain absorbing substances, and attributed hitherto to inelastic collisions⁵. Some rough calculations based on the values of cross-sections of fast neutrons for different types of activation lead to results which are in agreement with the experiments.

I am very much indebted to Dr. H. Herszfinkel for many valuable suggestions in the course of this work.

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Raman Spectrum of Monodeuteroethylene

MONODEUTEROETHYLENE has been prepared (J.C.J.) in two different ways. Starting from vinylbromide and deuterium bromide, obtained by the action of deuterium oxide on redistilled phosphorus pentabromide, the monodeuteroethylenebromide was prepared. This compound was submitted to the action of zinc and yielded monodeuteroethylene. Several spectra of the liquid compound were taken at a temperature of -140°C .; the lines are listed in the accompanying table. The strongest lines of ethylene also appeared.

The monodeutero compound has also been obtained mixed with more highly substituted ethylenes by exchange of deuterium oxide and ethylene on a nickel catalyst at 80°C . (Polanyi).

Using a potential function for the ethylene molecule determined by Manneback and Verleysen¹ in their work on di- and tetradeuteroethylenes, the nine plane vibration frequencies of the unsymmetrical monodeuteroethylene have been computed (G.L. and Y.L.T.). The difficulty of expanding a determinant equation of the ninth degree and finding its roots was reduced materially by using suitable methods of calculation.

	C_2H_4 (calc.)	$\text{C}_2\text{H}_3\text{D}$ (calc.)	$\text{C}_2\text{H}_3\text{D}$ (obs.)	C_2D_4 (calc.)
1	949.7	789.2	—	678.1
2	950.0	947.5	—	758.3
3	1343.9	1268.2	(6) 1284.2	1008.9
4	1444.0	1387.3	(5) 1395.7	1072.8
5	1621.3	1578.7	(10) 1599.1	1428.8
6	2988.0	2266.2	(1.5) 2266.3	2152.5
7	3019.0	3001.8	(2) 2963.2	2283.9
8	3069.0	3045.9	(9) 3015.0	2308.0
9	3107.0	3092.5	(0.5) 3104.8	2325.0

The intensities are derived from photometric measurements. These results are expressed in cm^{-1} . They show that the differences between calculated and observed data are less than 1.5 per cent. For comparison, the frequencies of C_2H_4 and C_2D_4 are given as calculated¹ by means of the same potential function. The difference between the calculated values for C_2H_4 and the experimental values from which the potential function was obtained are always less than 0.15 per cent.

The modes of vibration have also been computed. They suggest interesting qualitative remarks concerning the intensities and polarizations that may be expected in the Raman and in the infrared spectrum. All vibration frequencies of $\text{C}_2\text{H}_3\text{D}$ should, of course, be active in both spectra. Roughly speaking, a mode of vibration of the molecule $\text{C}_2\text{H}_3\text{D}$ resembles very much the one or two modes of the symmetrical molecule C_2H_4 or C_2D_4 the frequencies of which lie nearest its own. For example, ν_9 in $\text{C}_2\text{H}_3\text{D}$ is very weak in the Raman effect and nearly antisymmetrical with respect to the carbon axis, as would be inferred from its position between ν_8 , antisymmetrical, Raman active but weak, and ν_9 , inactive in the Raman spectrum of C_2H_4 . The motion of ν_5 of $\text{C}_2\text{H}_3\text{D}$ is almost perfectly symmetrical with respect to the carbon axis; hence that line is found to be very strong and should be polarized in the Raman spectrum. On the other hand, the modes 1 and 2 in the symmetrical molecule are respectively

¹ Johnson and Hamblin, NATURE, 133, 504 (1936). Meitner and Hahn, Naturwiss., 24, 158 (1936).

² Heyn, NATURE, 133, 723 (1936).

³ Naturwiss., 25, 90 and 126 (1937).

⁴ NATURE, 133, 1095 (1936).

⁵ Danysz, Rotblat, Wertenstein and Zyw, NATURE, 134, 970 (1934). Ehrenberg, NATURE, 136, 870 (1935). Rotblat and Zyw, NATURE, 137, 185 (1936). Collie and Griffiths, Proc. Roy. Soc., A, 155, 434 (1936).

inactive and extremely weak in the Raman effect; this explains why the two lines of lowest frequency could not be observed. The mode 6 is an averaging of the four modes 6, 7, 8, 9 of C_2D_4 .

In the case of C_2H_3D , three more lines should appear in the Raman spectrum below 900 cm^{-1} ; they are due to motions out of the plane of the molecule. For the symmetrical molecule C_2H_4 , two of these modes are Raman inactive; the third one has not yet been observed.

A more extended account of the work is in course of publication in the *Annales de la Société Scientifique de Bruxelles*. The experimental work has been carried out in the laboratory of Prof. M. de Hemptinne.

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¹Manneback, C., and Verleysen, A., *NATURE*, **138**, 367 (1936).
id., *Annales Soc. Scient. Bruxelles*, B, **56**, 349 (1936); **57**, 31 (1937).

Force Constants and Molecular Structures

WE have examined the infra-red absorption spectrum of phosgene vapour. The following fundamental modes have been assigned: $A_1: \omega_1=1827$, $\omega_2=578$, $\omega_3=300$; $B_1: \omega_4=845$, $\omega_5=c.300$; $B_2: \omega_6=444\text{ cm}^{-1}$., the allocation being in agreement with the recent polarization measurement of Ananthakrishnan¹.

The persistence of molecular constants throughout various radicals has been remarked many times: Linnett and Thompson² have proposed using values of the force constants in C_2Cl_4 when compared with those of CCl_4 and C_2H_4 to determine the extent of contribution from resonating structures in the first molecule. The difficulty in obtaining even semi-quantitative measurements in such cases lies in the uncertainty as to what any particular force constant implies: thus for CCl_4 the values for the CCl force constant in the literature range from 1.74 to 3.85 ($\times 10^6$ dynes/cm.) according to the force field used, while Linnett and Thompson introduce another estimate of 4.38. One must hesitate in utilizing force constants derived from not necessarily comparable force fields, especially when the molecules have different symmetry.

The force constants for the ethylenic linkage in C_2H_4 and C_2Cl_4 given by these authors are respectively 9.0 and 5.8: if a correction is applied to the Badger relation so that it may hold for a carbon-carbon link, the first represents the true ethylenic distance of 1.37 Å., while the second gives 1.45 Å. or a 75 per cent single bond effect! Actually, even the refined methods of electron diffraction can scarcely distinguish between the supposed interatomic distances of 1.37 Å. and 1.38 Å.; consequently any great difference between the two force constants is illusory. The divergence may arise from the use of too artificial a force field, and also because the calculations employed are rigorously applicable only to infinitesimal amplitude frequencies.

We have met with rather more success in the treatment of the similar molecules phosgene, form-aldehyde and urea. The carbonyl force constants are of the order of 12.3, 11.5 and 10.2 respectively: and

we may safely regard the carbonyl frequency, ω_1 , for HCHO ($1,744\text{ cm}^{-1}$) as the normal value. Hence the latter arises from a pure double bond; urea ($\omega_1=1,655\text{ cm}^{-1}$) has a considerable single bond contribution, but phosgene in accordance with the very high value $\omega_1=1,827\text{ cm}^{-1}$ has a marked triple

Cl-

bond effect arising from such structures as $\begin{array}{c} \text{C}\equiv\text{O}^+ \\ \diagup \\ \text{Cl} \end{array}$

rather than the single bond nature postulated by Pauling, Brockway, and Beach³ and deriving from

$\begin{array}{c} \text{Cl}^+ \\ \diagdown \\ \text{C}=\text{O}^- \\ \diagup \\ \text{Cl} \end{array}$. The interatomic distances obtained by

these authors for $COCl_2$ are $CO=\text{normal} (?) = 1.28$, and $CCl = 1.68 < \text{normal} = 1.76$; the original results of Dornte⁴ ($CO = 1.15 < \text{normal}$, $CCl = 1.80 \text{ Å.} > \text{normal}$) are qualitatively more in agreement with the spectroscopic observations, while the chemical evidence is altogether in favour of the interpretation of phosgene as an acid chloride and not as a halogenated ethylene.

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¹*Proc. Ind. Acad. Sci.*, **5**, 285 (1937).

²*NATURE*, **139**, 509 (1937).

³*J. Amer. Chem. Soc.*, **57**, 2705 (1935).

⁴*J. Amer. Chem. Soc.*, **55**, 4128 (1933).

Measurement of Pressures in the Upper Atmosphere

IN the course of a series of photographs of the spectrum of the auroral afterglow in pure nitrogen at pressures varying from about 1 mm. to 0.01 mm., it was observed that the ratio of the intensity of the first-negative system of bands to that of the second-positive system changed gradually as the pressure changed. The first negative bands, which are emitted by the molecule ion, increased in intensity until, at the lowest pressure at which it was possible to photograph the afterglow, the spectrum consisted almost entirely of bands due to the ionized molecule.

This result suggests the possibility of measuring accurately pressures in the upper atmosphere of the earth, by simultaneous observations of the ratio of these two band systems in an auroral display and of the height of the aurora. A comparison of these results with those obtained in the laboratory should then give the pressure. A series of careful experiments is now in progress to determine the effect of a small quantity of oxygen on the intensity ratio of these two band systems and also to study the effect of tube size on this ratio. In view of the present results, auroral observers may be led to make observations of the intensity ratio of these band systems as well as of the heights of the displays.

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Permeability of Metals to Hydrogen

It is well known that all the common metals are permeable to hydrogen at high temperatures. The accompanying table brings out the rather remarkable fact that, at 1,000° C., the permeability of the metals for which data are available only varies by a factor of about 10.

RATE OF DIFFUSION OF HYDROGEN IN C.C. PER CM². PER. SEC. AT 760 MM. PRESSURE FOR 1 MM. THICKNESS OF METAL.

Metal	1,000° C.	500° C.	0° C.
Iron	1×10^{-3}	1×10^{-4}	6×10^{-6}
Nickel	2×10^{-3}	3×10^{-6}	1×10^{-11}
Molybdenum	4×10^{-3}	5×10^{-6}	2×10^{-16}
Platinum	1×10^{-4}	1×10^{-5}	5×10^{-15}
Copper	1×10^{-4}	1×10^{-6}	4×10^{-15}
Aluminium	—	2×10^{-7}	2×10^{-23}

Since, however, the temperature coefficient of diffusion varies considerably for the different metals, the rates of diffusion at low temperatures are very different. In the table the rates of diffusion at 0° C.

have been calculated by means of the usual diffusion equation, and it will be seen that the rates for copper and platinum, for example, are now 10⁹ times less than that for iron.

Iron is, in fact, by far the most permeable of these metals at room temperature. Apparatus for work at high pressures is usually made of steel to provide the necessary strength. The diffusion of hydrogen cannot be greatly reduced by increasing the thickness, since the rate of diffusion only varies directly as the thickness. A far more effective method of avoiding trouble from this cause would appear to be to line the steel vessel with a thin layer of one of the less permeable metals, such as copper or nickel. Provided this is free from porosity, 1 mm. of copper would be as effective as 5 miles of steel, and 1 mm. of aluminium would be better than 10¹³ miles of palladium!

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Points from Foregoing Letters

PHOTOMICROGRAPHS of transverse sections of *Ceanothus dentatus* and *Myrthus communis*, showing the formation of cambium after treatment of cuttings with growth substance (alpha-naphthalene acetic acid) are submitted by Dr. M. A. H. Tincker. Similar stimulation of growth and formation of roots was observed in cuttings of *Viburnum Carlesii* after treatment with beta-indolyl acetic acid. The author suggests that the natural seasonal excitation of the cambium may result from the downward movement of similar substances formed in young leaves.

The presence of beta-carotene (a substance related to vitamin A) in the wood oil extracted from *Acacia acuminata*, a tree of Western Australia, is reported by Dr. V. M. Trikojus and Prof. J. C. Drummond.

By feeding a rat with olive oil to which radioactive phosphate had been added, and afterwards analysing its tissues, a group of investigators from the University of Palermo have found a large percentage of the radioactive phosphorus in the phospholipids (both the 'lecithin' and the 'cephalin' type) of the liver and of the gut. Kidneys also showed a small but definite activity, while the heart, spleen and skeletal muscle showed practically none.

Prof. C. N. H. Long and Dr. S. Zuckerman bring forward various considerations which lead them to the view that cyclical alterations in adrenal cortical activity still persist in spayed monkeys and are responsible for the periodic bleeding that can be induced by a constant threshold dose of oestrone injected daily.

Dr. S. J. Folley and Dr. S. K. Kon find that relatively high doses of the sex hormone, progesterone, when given to the lactating rat, do not inhibit lactation as judged by the rate of growth of sucklings. This, they consider, supports Anselmino's view that the inhibitor of lactation is a different hormone.

Prof. D. H. Bangham and Prof. F. J. Lewis show that whilst water adheres but weakly to the mesophyll cell walls in the leaf, organic liquids adhere strongly and rapidly fill the interspaces, under the influence of capillarity. On the other hand, water wets

comparatively easily the outer surfaces of the fine vascular bundles of the leaf. It is concluded that the water vapour of transpiration is not evaporated from a film of liquid water, however thin, on the outer surface of the mesophyll cells.

A new method of studying the freezing points of soil and plant material is described by L. P. Alexander and T. M. Shaw and exemplified by results obtained with peas and sweet potatoes. It depends upon the great change in dielectric constant of water when it freezes, and is applicable whenever the dielectric constants of the materials present, other than water, do not change significantly over the temperature range studied.

By irradiating cupric oxide with fast neutrons from radium-beryllium, Dr. E. A. Oeser and J. L. Tuck have obtained a radioactive body of half-life 160 min. This precipitates with nickel and the authors consider it to be radioactive nickel of mass 63 or 65, produced from copper by capture of a neutron and expulsion of a proton. The authors direct attention to the large number of different half-life periods reported for radioactive copper isotopes and suggest their probable origin.

J. Rotblat has confirmed the existence of the 11 min. radio-isotope of copper, the production of which by fast neutrons was reported by Heyn. He has also found that fast neutrons give in silver the isotope of 25 ± 3 min., probably ¹⁰⁶Ag. In both cases the new product is formed with emission of a nuclear neutron. An elementary process of this type leads to the appearance of two relatively slow neutrons which are more efficient than the primary neutrons in producing artificial radioactivity. This effect may account for the increase of radioactivity produced by fast neutrons after passage through some absorbing substances.

It is suggested by Prof. J. Kaplan that the variation in the relative intensity of bands emitted by the neutral molecule ion and those emitted by the neutral molecule in the auroral afterglow, might be used as the basis for a method of obtaining pressures in the earth's upper atmosphere, by comparing this ratio in actual auroras and in the auroral afterglow.

Research Items

Human Skeletal Material from British Honduras

OWING to the humidity of the soil, little human skeletal material has been recovered from Mayan sites in British Honduras. Skulls, jaws and long bones excavated by J. Eric Thompson at San José in 1931 and 1934 have been measured and described by Mr. Wilfrid D. Hambly, who also compares them with measurements of the living Maya of Yucatan and skeletal material from Baking Pot (*Anthropological Series*, Field Museum, Chicago, 25, 1). Study of the head-form is based on three skulls and three calvaria, each of which yielded some reliable measurements, though only in two were they numerous. The first is that of a child with a cranial capacity of 1,128 c.c. and a cephalic index of 91. A slight antemortem occipital flattening has led to some distortion. The second skull, in the strongly developed occipital protuberances and development of the glabella and supra-orbital ridges, shows male characteristics. There is slight occipital flattening, though it is doubtful whether this is artificial. The third is a male less rounded than other specimens. Considerable antemortem loss of teeth had taken place; there is caries with much signs of wear. In this specimen the facial index can be calculated as 79.1, comparable with a mean index on fifty living Maya males (Steggerda) of 82.46. The fourth skull is the only one which gives the measurements necessary for the dental index, 45.2, bringing the specimen just within the macrodont class. The calvarium, of an aged male, yields an index of 95.2, but there is some distortion. A second calvarium, which shows considerable occipital flattening, has an index of 91.0. The left half of a calvarium has a very pronounced occipital protuberance and its length of 183 mm. is so far in excess of other length measurements as to indicate that it is an aberrant form. Comparative measurements are as follows:

		Length	Breadth	Index	Capacity in c.c.
San José	♂	156.0	139.2	87.6	1266
Baking Pot	♂	173.6	146.0	84.3	1375
	♀	163.2	144.0	88.4	1225
Maya (living)	♂	180.41	153.71	85.01	
	♀	170.57	148.79	87.11	

Snowshoes

A STUDY of snowshoes, which is the outgrowth of an interest in crude bearpaw snowshoes used on occasion by the Grand Lake Victoria Indians of western Quebec, has led Mr. Daniel Sutherland Davidson to some interesting and somewhat surprising conclusions, which have a bearing on general principles of ethnographical observation and the interpretation of geographical distributions (*Mem. Amer. Phil. Soc.*, Philadelphia, 6; 1937). The snowshoe, one of the most important aboriginal inventions in the northern hemisphere, apparently has contributed directly or indirectly to the great expansion of northern peoples and has encouraged man to invade and to reside permanently in regions inland which previously had discouraged occupation. The snowshoe, in concept, appears only to have been invented once. Its distribution is contiguous, but various

peoples have changed and elaborated the original form. The wooden snowshoe, in plank form originally, possibly was brought into America by a proto-Algonkian migration and afterwards diffused to the Caribou Eskimo, who still retain it in its original form. In the Old World the frame shoe appears not to have modified the wooden shoe at all, but rather the reverse. In the New World the wooden shoe never evolved, its modifications being due to adoption from the frame shoe; but in the Old World the wooden shoe changed by modifications inherent in the shoe itself. The bearpaw shoe appears to have originated in Asia, and to have diffused westward to Europe and to have been brought to America by migrating Athabascans, it may be making possible their great expansion.

Migration of Sea-Trout

A MARKING experiment, in which 196 sea-trout smolts were marked in 1933, and 1,798 in 1934, has been carried out in the Wisloka, a tributary of the Vistula, and the results are now described by St. Żarnecki (*Bull. Intern. Acad. Polon. Sci. Lett.*, 8, 449; 1936). The place of liberation was a long distance from the sea and it was hoped that this would give more definite information about several features of the migration. The number of recaptures was low compared with Scottish recoveries in similar experiments, 3 of the first lot and 47 of the second; but it showed that the mean of the periods occupied in the migration from spawning places to the sea was about 5 months and 3 weeks (173.3 days), and that the rate of travel averaged 5.8 km. in the 24 hours. Most interesting perhaps was the fact that the recaptures in the sea showed that the initial direction of the migration of young sea-trout was eastward of the Vistula estuary. This direction corresponds with the flow of the Vistula waters, which where they debouch in the Baltic Sea, run eastward almost parallel to the coast. Whether this be simply due to the fact that the sea-trout having followed the current for so long continue to do so, or to some kind of selection, it affords the migrants a short period of accommodation for the change from fresh-water to sea-water environment.

Respiration in Locusts

RECENT field experiments on the destruction of flights of locusts by the discharge of toxic dusts from an aeroplane raise various problems in connexion with respiration in these creatures. Dr. A. G. Hamilton now discusses (*Bull. Entom. Res.*, March 1937) the mechanism of respiration of locusts and its bearing upon the inhalation of poisonous dusts. Experiments made with flying locusts, suspended from threads in a wind tunnel and immersed in a cloud of finely particulate cuprous cyanide, are described. Several investigators have brought forward evidence showing that the first four spiracles are inspiratory in function and the remaining six are expiratory. There is, however, lack of adequate evidence whether the anterior spiracles also function in an expiratory manner and whether the remaining spiracles, or any

of them, act as inspiratory apertures. In the present paper, confirmation is given to the belief that the first four spiracles are inspiratory organs, but their possible expiratory function has not been subject to investigation. As regards the remaining six pairs of spiracles, only the last or tenth spiracles were found to perform a double function, namely, expiratory in flying locusts and inspiratory when the insects are not in flight. The functions of the different spiracles were determined by the presence or absence of cupric cyanide in the associated tracheæ. By killing the locusts with hydrogen sulphide, the cuprous cyanide is converted into copper sulphide, and since this latter is black it is readily seen in the white tracheal tubes. Its presence implied that a particular pair of spiracles was inspiratory in function.

Interpretation of the Flower

UNDER this general title, Dr. Agnes Arber recently discussed some even more general questions of plant morphology (*Biol. Rev.*, 12, 1937). Goethe's conception that the flower is equivalent to an abbreviated vegetative shoot is handled very sympathetically, and in particular a very good case is made for the thesis that was thoroughly worked out by de Candolle, that the carpel has its equivalence with an infolded foliar organ. A recent opponent of this theory (Grégoire) has complained that nowhere can be found a full and reasoned statement of this thesis, and Mrs. Arber supplies a most convincing brief exposition of the salient features of this analogy between leaf and carpel. She does much more, however, for she points out the result of the impact upon morphological discussions of the evolutionary and phylogenetic atmosphere in which this discussion has continued since the publication of the "Origin". As the result, 'equivalence' has had a new meaning read into it; in the course of phylogenetic history a leaf is assumed to have become a carpel, and Grégoire would reject the foliar theory because in development a carpel does not arise from a foliar primordium. This re-statement of the Candollean hypothesis and its separation from the phylogenetic atmosphere, in which it cannot have its original meaning, is a valuable service to morphology, but perhaps even more valuable for the English reader is the clear statement of the aim of the *Gestalt* morphology of Troll, which is introducing yet a new concept into pure morphological speculation and refuses either to base itself on phylogeny or upon teleological 'adaptive' interpretation. This new morphology is not less interesting because it sees the flower, or the inflorescence that simulates the flower, as the expression of a 'flower type', the significance of which is, as yet, quite elusive.

Hybrid Vigour in *Sorghum*

THE cultivated sorghums all belong to the species *Sorghum vulgare* and are classified into four types, grain, forage, grass and broomcorn types, which have the same chromosome number and are fully interfertile. Messrs. R. E. Karper and J. R. Quinby (*J. Hered.*, 28, No. 3) find that the F_1 hybrids between different types show a degree of hybrid vigour which in some cases is quite remarkable and differs for each cross. The cross between Hegari sorghum and dwarf broomcorn yielded an F_1 more than two and one half times as tall as the parents and producing nearly three times as much forage and grain. In certain crosses the plants were 15 feet tall and yielded

150 bushels of grain per acre. Milo and Hegari always produced extreme vigour and lateness in their hybrids, other varieties producing vigour without lateness. Heterosis is also shown by increased size of endosperm, which is correlated with the vigour of the plant. The extreme vigour of hybrids of Milo and Hegari is attributed to the presence in them of many dominant genes for growth, other varieties having some of the corresponding recessives. In certain crosses there is an increase of yield unaccompanied by increased height or change in time of maturity. Bulk emasculation of the flowers was carried out by means of hot water.

Erysiphaceæ of Japan

YASU HOMMA has recently published a very extensive monograph on the powdery mildew fungi (Erysiphaceæ) of Japan (*J. Fac. Agr. Hokkaido Imp. Univ., Sapporo, Japan*, 38, Pt. 3, 183-461, Feb. 1937). The treatment is exhaustive, and there are two divisions, a general part and a systematic part. The general part deals with the structure, formation and germination of conidia, and the occurrence of fibrosin bodies therein, with the perithecia, their asci and ascospores, with hibernation, host-parasite relations, immunity and resistance. Much experimental work is reported in this section, and very extensive inoculations of the fungus *Erysiphe graminis* f. sp. *Tritici* upon a wide variety of wheat species are described. Germinating conidia of the fungus penetrated the epidermis of both immune and susceptible kinds of wheat, but no further development of the germ tube took place within an immune plant. Infection by conidia was effected most easily during the period of greatest vigour of growth of the host. The systematic part records nine species new to science, and Japan possesses one endemic genus in *Typhulochaeta*. This is distinguished from all other genera of the Erysiphaceæ by the clavate appendages to the perithecium. Eight plates illustrate structural and taxonomic details, and the paper is fully indexed. It contains more than 180 citations of published work, and should provide a valuable book of reference for mycologists outside the territorial limits implied by its title.

Deafness and the Use of Hearing-Aids

A COMMITTEE of the Medical Research Council has issued a report upon the physiology of hearing, giving the results of investigations into the utility of hearing-aids to deaf people ("The Use of Hearing Aids", A. W. G. Ewing, L. R. Ewing and T. S. Littler, M.R.C. Special Rep. Series, No. 219. H.M.S.O. 9d. net). In recent years the assistance that can be given to the deaf has been greatly increased because the extent to which a patient is in need of a hearing-aid, and the kind of aid most suitable, can be ascertained by audiometer tests to a degree previously impossible. The general increase in intensity of sound is only one aspect of the problem, as deaf persons vary in the extent to which they are deaf to different pitches of the auditory range, the object of a hearing-aid being so to modify the sound as to bring it within the range of hearing which the individual retains. The threshold of audibility for speech may be reliably deduced from the thresholds for pure tones obtained with a pure-tone audiometer or beat-tone oscillator. In general, it is within 5-10 decibels of the patient's lowest reading for pure tones over the frequency range 250-4,000 vib. per sec.

Of 158 adults tested, 94 obtained considerable help from a portable valve aid, 18 from non-valve battery aids, 2 from bone-conduction battery aids, 16 from speaking tubes only, and 28 were too deaf to derive help from any aid. Even when the most efficient type of aid is used, proficiency in lip-reading is also required if deafness is to be alleviated to the fullest extent. For teaching groups of deaf children, the class amplifier, into the microphone of which the teacher speaks, has advantages over individual aids.

Ultra-violet Light in the Upper Atmosphere

THE spectrum of the sun, observed through the lower atmosphere, is cut off at about λ 2900 by an ozone layer which probably lies between 20 km. and 50 km. from the earth's surfaces. Phenomena which take place above this layer, such as the night-sky luminosity and the production of ionized layers, depend largely on the ultra-violet rays of shorter wave-length than this. M. N. Saha (*Proc. Roy. Soc., A*, 160, 155) reviews the action of such light on oxygen and nitrogen. The 'negative' bands of nitrogen, due to N_2^+ , have been found in the light of the sky for a short time at sunrise and sunset, and these bands are supposed to be excited by light of wave-length less than λ 660. The intensity of this process indicates that the sunlight intensity at this wave-length is far larger than could be expected from a black body at 6,500° K.—a model which has often been used to represent the sun. The absorption of short wave-length ultra-violet light by oxygen and nitrogen has not yet been sufficiently investigated in the laboratory, but a number of possible processes are examined in the paper.

Nuclear Reactions in the Stars

THE old suggestion of Eddington, that the building up of heavier elements from hydrogen goes on in the stars with continuous production of energy, has several times been examined in the light of modern information about nuclear reactions. C. F. v. Weizsäcker (*Phys. Z.*, 38, 176) has developed this idea in some detail. The nuclear velocities resulting from temperature in the interior of a star are high enough for nuclear reactions of the lightest elements to take place with fairly high probability. These reactions involve both the building-up and breaking-down of nuclei, so that the light nuclei undergo cycles of transformation. Neutrons are produced and are held responsible for the building of the heavy elements. The reactions between light nuclei take place in very deep regions where the density is low on account of radiation pressure. A small part only of the star's mass takes place in rapid cyclic processes, but fresh supplies of light atoms are brought into the active region by convection. The stability of a star against radial pulsations is due, it is suggested, to the damping effect of a time-delayed β -transformation which is a link in the cycle. This effect fails for very slow pulsations, and in fact Cepheid variables of period larger than a certain value are not known. The life-history of a typical star is sketched. In a pure hydrogen star, the first process is the reaction of a proton and an electron to form a neutron: this is endothermic and requires a very high temperature. The cyclic charges begin and the star expands explosively. The star then settles down to a career of slow expansion, which lasts until its hydrogen supply is used up.

Axial Flow Fans and Pumps

IN the preparation of "Data for the Design of Axial Flow Fans and Pumps" (London: The Draughtsman Publishing Co., Ltd. 2s.), Mr. R. Poole has taken as granted the principles and theory of his subject and has confined himself to an exposition of the means and methods by which the actual determination of the design is effected. In the space at his disposal it is possible to deal with only one aerofoil shape—he has chosen Chauert's extended Joukowski aerofoil—but it must be understood that the method is not inappropriate in other cases. This impeller is shaped like aeroplane wings and, therefore, the aerodynamical characteristics of the blades being known, the total pressure and torque on them can be ascertained taking into account their helicoidal path in relation to the fluid. For the theory and research on which the work is based references are made to papers and to Reports and Memoranda of the Aeronautical Research Committee, so that any reader who finds the notes insufficient for his purpose may refer to the usual sources. In design of this nature, the work largely depends on the determination of the appropriate constants and coefficients, and on the application of the relations between such characteristics as lift and drag, velocity, torque, thrust, interference, etc., which have been evolved and ascertained in the course of extended research, and can be expressed and arranged for use most conveniently in the form of diagrams and tables. Almost wholly, then, this pamphlet consists of the curves from which, stage by stage, the required design can be worked out. Only in so far as it is necessary to explain these curves and their purpose does the author employ letterpress, except at the end, where an example of the design of an axial flow fan in conformity with given requirements is fully worked out.

Filter Attachment to Portable Air Velocity Meter

REFERENCE was made in NATURE of June 27, 1936 (p. 1078) to a convenient portable air velocity meter, the 'Alnor velometer', put on the market by Messrs. Air Conditioning and Engineering, Ltd., 4-12 Palmer Street, London, S.W.1. New filter attachments have now been developed for use with this instrument when taking direct air velocity measurements in an atmosphere heavily laden with dust. By the use of a conversion chart, it is possible to use the same instrument with the filter removed.

Measurement of Photographic Plates by Projection

MR. G. F. KELLAWAY has published a paper with this title (*J. Brit. Astro. Assoc.*, 47, 5, April 1937), in which he describes a method for projecting an enlarged image of the negative of a celestial body, by means of a projection lantern lens, on to a graduated screen, such as graph paper. Mr. Kellaway uses a Zeiss triplet of about 28 inches focal length to secure the negative, which is then projected on a screen. Two examples are given, one to determine the position of a star and the other of Whipple's Comet, both results being very satisfactory when compared with the catalogued position of the star or with visual observation of the comet. It is suggested that the method should be used when the object is faint and diffused, and those who possess small-scale cameras could increase their scope of work by spending a few shillings on a projection lens.

The Place of the Social Sciences in Human Knowledge*

THE condition of economics and other social sciences to-day presents a paradox. More and more students each year come to study the social sciences in universities. But there is not a corresponding recognition, either by men of affairs or by men of science in other fields, of the authority of those who teach these subjects.

For this there is one reason, for which workers in social sciences are not responsible; this is the common failure both of the general public and of other scientific workers to understand the nature of economic problems and the distinctions, say, between economics and engineering, or sociology and biology. The engineer or any other technician considers alternative means of meeting a given need. The economist describes and explains the behaviour of mankind in the use of scarce resources. Their spheres are different, and engineering skill is no guide in the solution of economic problems. So mice are not men, and to argue direct from mice, or from fruit-flies, to human society is to court disaster.

There are, however, other reasons for the unsatisfactory status of the social sciences, for which workers in the social sciences do appear to be responsible. There are two reasons in particular. The first reason is the frequent failure of social scientists to be scientific in method: in particular, their neglect of observation of facts, as the basis of theories and as the control of theories. This failure is illustrated by the debate among professional economists, as to the causes and nature of unemployment, that has followed on the publication of J. M. Keynes' "General Theory of Employment". The distinguishing mark of economic science as illustrated by this debate is disregard for the need of verification of theories by observation of facts, even when the theories are theories about the real world and not about abstractions. Economics so pursued cannot claim to be a science. William Harvey founded modern psychology by professing "to study and to teach anatomy, not from books, but from dissections; not from the positions of philosophers, but from the fabric of nature". Economics and other social sciences are still excessively occupied with argument from "the positions of philosophers", though they profess to deal with phenomena.

The established natural sciences may be compared to the visible colours of the spectrum from red to violet; they are spread out in a continuous band of changing character, from the abstraction of mathematics through physics and chemistry to the complexity and lesser certainty of biology. But as sunlight contains rays necessary to health beyond the visible spectrum, so human knowledge is not complete without an extension beyond the recognized natural sciences. In this analogy, economics and the other social sciences are not infra-mathematics, but ultra-biology.

The second reason is the failure of some economists and political scientists to be scientific, in detachment from partisan action and in avoidance of giving

judgment continually on controversial practical issues. The business of the social scientist is to study and compare different types of economic, political and social organization, as the biologist studies forms of life or the chemist compares the reactions of different materials under various conditions. The biologist does not hate rabbits, and love frogs. The chemist, as a preliminary to an impartial comparison of the properties, say, of leather and of rubber and their respective advantages for different purposes, does not join the directorate of a tannery. Yet this is just what the economist or political scientist does who becomes an avowed partisan, whatever his party. The service of social science and the practice of the arts of democratic government are vocations each of which may be pursued with sincerity and singleness of purpose, but they cannot be combined. A social scientist cannot become a politician by speech or writing or affiliation without losing value as a scientific investigator and a teacher. Without derogation from essential academic freedom, those who choose the academic vocation in the social sciences should impose on themselves reticences and self-denials in the political and practical field, which would not be necessary for teachers of other subjects, but are necessary to give to the social scientist that emotional detachment from his subject which comes naturally to the biologist or chemist.

The place of the social sciences in human knowledge is that of the last-born of the sciences of observation; their affinities are here, rather than with mathematics or philosophy or arts. As last-born, they are in their infancy; moreover, their complexity and the lack of precise information makes them slow of growth. Adam Smith (publishing the "Wealth of Nations" in 1776) corresponds in economics to Copernicus in astronomy (circulating his theory in a tract of 1529). To-day, 150 years after Adam Smith, economics could not hope to have travelled as far as astronomy reached in 150 years from Copernicus, that is, to Newton. Economists should be content if they are now as far as Tycho Brahe and they may be encouraged by his achievement. Tycho's theory, that the planets went round the sun and that the sun went round the earth, was wrong: his numerous observations, made with integrity and industry, became the basis of Kepler's discovery of the truth. To be wrong in our theory matters relatively little, if we are honest and industrious in our observations.

Modesty about the present achievements of social science should involve no discouragement; nor should there be modesty in our ambitions. Without better understanding by man of his own nature and that of human society, civilization is in danger. For the good of mankind, the social sciences have still to win for themselves laboriously the recognition and assured place of influence already won by the natural sciences. The two keys that can unlock for them the gateway of their promised land—both keys must be used—are observation and detachment.

* Summary of a farewell address delivered by Sir William Beveridge at the London School of Economics and Political Science on June 24.

Earthquakes in India

THE presidential address delivered by Mr. W. D. West to the Section of Geology and Geography at the recent meeting of the Indian Science Congress is an interesting summary of our knowledge on Indian earthquakes. It shows what careful investigations have been made of the earthquakes of the last forty years, including those of Mr. West himself on the Baluchistan earthquakes of 1931 and the

Severe earthquakes are practically unknown within it, but slight shocks are frequently felt in the extreme south, within the dotted band in Fig. 1. On two occasions (1930 and 1934), weak shocks have been felt in this band at almost the same instants as severe earthquakes in Northern India, and this coincidence Mr. West attributes to the strained condition of the peninsula.

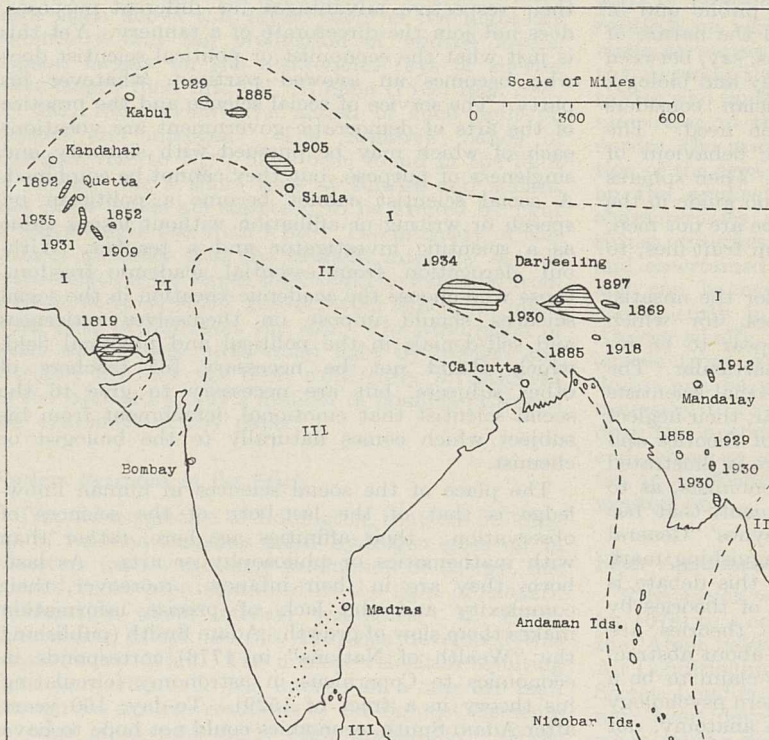


Fig. 1.
DISTRIBUTION OF EARTHQUAKES IN INDIA.

Quetta earthquake of 1935 (NATURE, 135, 661, 1935; 137, 385-386, 1926.)

The whole country is divided into three zones (Fig. 1). The great earthquakes of India are entirely confined to Zone I, the southern border of the belt of Tertiary folding. The shaded areas within this zone represent the epicentral tracts, bounded roughly by isoseismal lines of intensity 9 of the Rossi-Foré scale (corresponding to the partial or total destruction of some buildings). The areas are those of all severe earthquakes since 1850, with the addition of that of the Cutch earthquake of 1819. Zone II, the frontal trough of alluvium, is free from the epicentres of great earthquakes, but parts of it have suffered considerable damage from those occurring in the first zone. Unfortunately, as Mr. West remarks, these zones coincide with the most densely populated districts of India. Zone III, including the whole of Peninsular India, is one of comparative safety.

in 1905 and North Bihar in 1934. Both earthquakes disturbed very large areas, and, as in the majority of those felt in Baluchistan, neither can be assigned to any definite fault or system of faults.

(4) Assam, with three great earthquakes since 1850: the Cachar earthquake of 1869, the first Indian earthquake to be investigated on modern scientific lines, the Assam earthquake of 1897, one of the greatest of all known earthquakes, and the Dhubri earthquake of 1930; as well as two others of less note, the Bengal earthquake of 1885, and the Srimangal earthquake of 1918. The Assam earthquake was remarkable in many respects—the suddenness with which it began, the extreme intensity of the shock over a large area, the variations of intensity from one place to another, the faults along which movements occurred, including the Chedrang fault with its maximum throw of 35 feet, the general upheaval of the country, and the remarkable series

The active Zone I is divided into five sections.

(1) Cutch, in which there has been only one great earthquake, that of 1819, when a dislocation about 90 miles in length was formed, the country to the north being uplifted by amounts ranging up to nearly 30 feet above the depressed country to the south.

(2) Baluchistan, in which the mountains are a southward branch of the great Tertiary system of which the Himalayas form a part. From the sea-coast to Quetta, their general direction is south and north, but, near Quetta, there is a sharp bend, the ranges then running towards the east and south-east. On a detailed map of this section, Mr. West outlines the epicentral tracts of fifteen earthquakes between 1852 and 1935 (five of which are shown in Fig. 1), and it is remarkable how all the stronger earthquakes occurred around the re-entrant angle. Only one of the earthquakes, that of 1892, was associated with a known fault, one that has been traced for 120 miles. If other Baluchistan earthquakes were similarly connected, the faults in question do not seem to reach the surface.

(3) Northern India, with the two great earthquakes of Kangra

of after-shocks; all these features pointing to a complicated origin covering a large area.

(5) Burma, divided into three main structural units—the Shan plateau (A, Fig. 2), consisting of rocks of Mesozoic and older ages, the Tertiary basin of the Irrawaddy valley (B), and the range of the Arakan Yoma of late Mesozoic and early Tertiary times (C). They are separated by zones of faulting, with which many of the epicentres of Burmese earthquakes are associated, especially those of the destructive earthquakes of 1839 and 1858, the former near Mandalay and the latter near Thayetmyo and Prome. During the years 1929-31, there was a remarkable series of eight earthquakes, the epicentres of which, numbered in the order of occurrence in Fig. 2, are marked by a linear arrangement close to the eastern fault.

Most of the Indian earthquakes of the last forty years have been investigated by officers of the Geological Survey of India, yet it must be admitted that the state of seismological research in the country is behind that in some other lands. In Japan there are a hundred and five seismological observatories, in the United States forty-two, but in India only six, and not one official devoted entirely to seismological subjects. Mr. West suggests that the work done more or less independently by the Geological Survey, the Meteorological Department and the Survey of India should be co-ordinated and expanded by founding what would practically be an Earthquake Research Institute with its headquarters, say, at Shillong, provided with many new instruments for stations new and old, and with officers who, after a great earthquake, should at once proceed to the central area and establish round it a network of temporary stations in order to determine the epicentres and focal depths of the after-shocks. C. D.

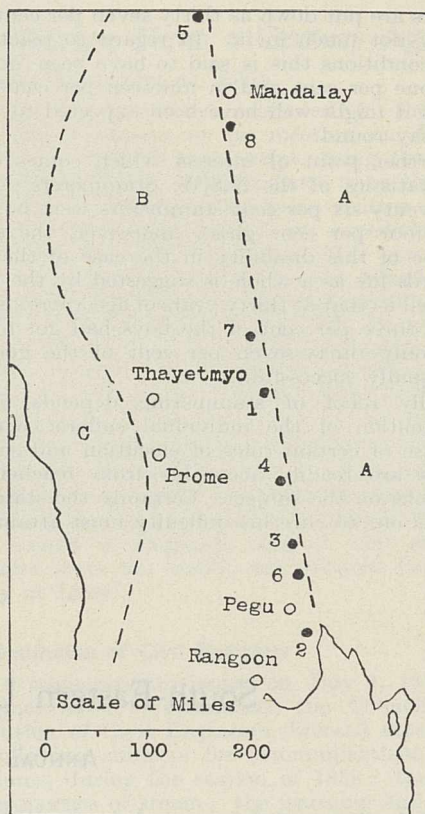


Fig. 2.
DISTRIBUTION OF EARTHQUAKES IN BURMA.

Incidence and Causes of Stammering

STAMMERING is one of those abnormalities sufferers from which fall between two stools. It is scarcely the concern of the family doctor, and yet is outside the scope of ordinary educational methods. Of recent years, psychological treatment has helped many individuals to cope with speech disabilities, but it commonly happens that more time and expense are called for in the achievement of a cure on these lines than stammerers are able to give, and so for one reason or another it usually falls to the lot of the individual stammerer to cure himself.

It is with special reference to some interesting figures supplied by the Stammerers' Club of New South Wales* that this short commentary on an important subject is given; as the result of questionnaires sent out to the members this Club has elicited most interesting information.

Whilst in most instances of stammering there is actual physical disability of some kind, nevertheless, for the most part the trouble is to be found in a constitutional nervousness or sense of inferiority. From the statistics from New South Wales, it is noteworthy that although serious illness is actually

credited with nine per cent in the list of causes, no definite physical disease is said to have any serious influence. The cause of stammering generally is attributed to such psychological causes as shock, imitation, fright and being bullied or laughed at. In all these, it is evident that individual nerve sensitivity or feeling of inferiority is the chief underlying trouble. That this nerve weakness is often inborn seems to be emphasized by the fact that in no less than fifty-one per cent of the instances dealt with the stammerer began before the age of five years, and no less than ninety-three per cent experienced the onset before the age of ten. Granted that unfortunate conditions in upbringing produced such psychological disturbance as to impair capacity for normal speech, it certainly cannot be held that all these stammerers were born with strong nerves or the capacity for developing sound defences against the stresses of life.

As regards position in family, it does not seem to matter whether one is born early or late if one is to experience the disadvantage of stammering; it is true that there is the difference between thirty-eight per cent as regards 'elder' children and twenty-five per cent as to 'youngest', but as the 'intermediate'

* Stammering: its Cause and Cure. (The Handbook of the Stammerers' Club of New South Wales.) Pp. 72. (Sydney: Stammerers' Club of N.S.W., n.d.).

members are put down as thirty-seven per cent there is really not much in it. In regard to reaction to school conditions this is said to have been 'good' in eighty-one per cent and in nineteen per cent 'bad', whereas it might well have been expected to be the other way round.

A further point of interest which comes out of these statistics of the N.S.W. Stammerers' Club is that seventy-six per cent stammerers were boys and twenty-four per cent girls; moreover, the serious influence of this disability in the case of the latter as regards life as a whole is suggested by the figures which tell us that at thirty years of age approximately seventy-three per cent of the boys had got married whilst only thirty-seven per cent of the girls had been equally successful.

Usually relief of stammering depends on the determination of the individual sufferer who will make use of certain rules of elocution and self-help such as are readily accessible from teachers and handbooks on the subject. Certainly the stammerer who sets out to cure his difficulty must attain three

objects; namely, (1) confidence; (2) attainment of a new habit; (3) the maintenance of a restful state of mind and body. He must learn to relax. He must learn to use a new voice with a timing slightly but definitely different from that which he habitually uses when stammering. He can look forward confidently, if he determines to practice and to rely on himself; in any case he can perhaps take some comfort from remembering that he is one of a company of very famous men. Amongst kings one may remember that Louis II and Louis XIII of France are said to have stammered badly. Whilst at least one Queen of England (Mary II) was also troubled in the same way. I have always understood that Charles Lamb abandoned an intended career in the Church because of his speech disability, although stammering has not always been incompatible with a reputation as a famous speaker. Charles Kingsley, Phillips Brooks and Father Hugh Benson, all distinguished in the pulpit, are said to have stammered at times.

E. L. HOPEWELL-ASH

South-Eastern Union of Scientific Societies

ANNUAL CONGRESS AT HASTINGS

THE forty-second Congress of the South-Eastern Union of Scientific Societies was held at Hastings on June 8-12. The Mayor of Hastings, Alderman A. Blackman, welcomed a large gathering of representatives of affiliated societies and other members of the Union at the opening ceremony on June 8, when Prof. F. E. Weiss was installed as president of the Union for the ensuing year, and delivered his presidential address on "Competition and Co-operation in Nature".

In the past, competition in commerce and industry was regarded as beneficial to the community, but competition among industrialists is no longer in such great favour, and even in agriculture efforts are being made to restrict it. On the other hand, co-operation, which is the basis of communal organization, is not generally called in question. Prof. Weiss pointed out that these forces also exist in Nature. Darwin had pointed out that, owing to the enormous reproductive capacity of most plants and animals, a weeding out process is inevitable; there is a struggle for existence under which only the fit survive. Many plants produce hundreds of thousands of seeds, but do not appreciably increase in numbers on an area already covered with vegetation. In the case of plants, the struggle for light is often the dominant factor. There is also competition for the necessary food among animals, and the larger and stronger animals have an advantage over the smaller and weaker ones. In the case of carnivorous animals, however, the race is not always to the strong, but also largely to the swift and agile. Though the dictum "Nature red in tooth and claw" causes some people to regard evolution as a continuous competitive warfare in which might is always triumphant, Darwin pointed out that there are certain instinctive characters in many animals which make for the preservation of the race as a

whole and as apart from the individuals, and that probably in these the basis of our moral nature had its beginnings. Parental instincts play a very important part in the survival of the more highly developed animals; there is here no competition for food between parents and offspring, but, on the contrary, parents will often starve themselves for the benefit of their young. Prof. Weiss then dealt with numerous cases of symbiosis, the classical example in plants being found in lichens. He took two examples to illustrate competition and co-operation among plants, the rosette-forming plants of grass lands illustrating competition, and plants of the Leguminosae with their nodules carrying nitrifying bacteria exemplifying co-operation.

"Our Changing Flora" was the theme of an address delivered by Dr. R. W. Butcher to the Botanical Section of the Union. Man has brought about remarkable changes in the flora of Great Britain. The draining of fens, the turning of heathland into forest, rivulets made into canals, the digging of railway cuttings and making embankments have all played an important part in bringing about changes. There never has been, and probably never will be, anything static about the flora. The ecologist recognizes a continual change of vegetation as a basic principle in plant succession. Captain Diver has directed attention to rapid topographical changes in the South Haven peninsula of Dorset since 1700. Large masses of *Isoetes echinospora* are now found on the bed of Littlesea, yet this plant was unknown there a few years ago. Pearsall has recorded many changes in the vegetation of the English Lakes, these changes being in accord with changes in the nature of the lake bottoms.

Mr. L. F. Salzman gave a paper on "The Writing of Local History" to members of the Archaeological

Section. He likened a local history to a large-scale map, for, he said, it is possible to indicate on such a map features which cannot be shown on a map portraying a whole country. In a local history it is thus possible to emphasize the human side of history.

To the same section Alderman T. S. Dymond read a paper on "The Cinque Ports Barons returned to Parliament, 1366 to 1722". Though the "Return of Members of Parliament", ordered by the House of Commons to be printed in 1878, began with the year 1290, the names of representatives from the Cinque Ports date from 1366 only. From that year until 1844, two members sat for Hastings. Before Queen Elizabeth's time, a representative from the free barons of the Port was chosen. Down to the great Reform Bill, freemen, elected by the bailiff (mayor) and jurats, alone had the franchise; by 1831 their number had fallen to twenty-three. At the election following the Reform Bill, Mr. North (father of Miss North, famous for the collection of Nature paintings in the North Gallery in Kew Gardens) was elected by 356 votes. In contrast with this number, 20,955 votes were cast for the successful candidate at the last election.

"Fossils in their Original Environment" was the subject of a lecture given by Dr. H. Dighton Thomas to the Geological Section. Dealing first with Trilobites, Dr. Dighton Thomas said that the loss of eyes in these organisms was co-related with their burrowing habits; the Welsh beds were deposited in deep water, and in them the Trilobites show a reduction in the development of eyes, and one of them was blind. Brachiopods were common in shallow water after the Devonian period. Changes in the fauna of deposits were brought about by changing conditions of salinity in the water. He does not regard chalk as a foraminiferal limestone, but as a Foraminifera-bearing limestone. The bulk of the chalk is of shallow water origin, and its fauna is not a deep water one. He suggested the collection of fossils from differing horizons in the chalk and the determination of the fauna of the separate zones, as there is a lack of knowledge of the succession of the fauna in chalk in England. The flora and fauna of the London Clay are those of a tropical sea, and plants similar to those in it are still found in lowland tropical countries, Nipa swamps being cited.

Many interesting excursions to places of interest around Hastings were made. At Ashburnham Place, Lady Catherine Ashburnham kindly allowed the King Charles I relics to be inspected, and on the same excursion the sites of Sussex ironworks were visited. The smelting of iron ore and the forging of wrought iron on these sites date from very early times, and were carried on at the site visited until about 1813, the last of the ironworkers dying in a cottage close by in 1883. The geologists paid a visit to Crowhurst Quarry, where faulting is very clearly seen, and one of the visitors picked up a scale, apparently from a turtle, with the markings on the back clearly defined. The natural gas bore at Heathfield Station was inspected. Visits were also paid to local churches and to Pett Level, where, owing to exceptionally low tide, the remains of the submerged forest were plainly visible.

At the annual representative assembly, it was announced that the 1938 Congress would be held at Worthing, under the presidency of Dr. Julian Huxley. Mr. A. W. Farquharson, of Le Play House, 33 Gordon Square, London, was elected honorary general secretary.

Science News a Century Ago

A Spanish Manuscript on Tahiti

AMONG the donations presented to the Royal Geographical Society at its meeting on June 26, 1837, was a Spanish manuscript, being the "Diary of an Expedition to, and Residence upon the Island of Tahiti", by Maximo Rodriguez, written in 1774. Rodriguez had accompanied an expedition from Lima to Tahiti, and with three other persons had spent about thirteen months in the island. Cook had heard of the visit of the Spaniards and had written: "Will anything ever become known to the world of the proceedings of the Spaniards at this island?" After a lapse of sixty years the diary was placed in the hands of a captain in the Royal Navy and by him presented to the daughter of Rodriguez, who having heard that Captain FitzRoy was making inquiries for manuscripts sent it to him begging his acceptance of it, saying that "she felt sure it would be better placed in the hands of an Englishman, and more valued in England, than it ever could be, concealed from the world, and uncared for, in her library at Lima".

The Institution of Civil Engineers

IN a memorandum issued on July 1, 1837, from 1 Cannon Row, Westminster, the Council of the Institution of Civil Engineers directed attention to the following subjects for communications and for premiums, during the session of 1838: the nature and properties of steam; the warming and ventilation of public buildings; accounts and drawings of the Plymouth Breakwater; the rates, from actual experiments, of the velocity, load and power of locomotive engines on railways, first upon levels, second upon inclined planes; description and account of the principles of Huddart's rope-making machinery at Limehouse; the sewerage of Westminster, and drawings and accounts of the shield used at the Thames Tunnel.

A Peat-Compressing Press

THE *Mechanics' Magazine* of July 1, 1837, contained a description of an improved machine for compressing peat invented by the Right Hon. Lord Willoughby d'Eresby. The machine was an upright press at the bottom of which was a rectangular cast-iron box into which a rectangular piston could be forced downwards by means of a rack and pinion. The interior of the box was lined with vertical iron bars between which small spaces were left so that the water could escape as the peat was compressed. "I find", wrote the inventor, "that the machine answers perfectly on about half the sorts of peat usually consumed, that is to say, on those of a fibrous quality; and I am still carrying on the experiment on a large scale. The peat when compressed, has been used with perfect success, instead of coal, for the purpose of calcining lime, for the smith's forge as well as for ordinary fuel."

The Museums of Copenhagen

ON July 2, 1837, Lyell wrote from Copenhagen to one of his sisters: "In the time of Linnæus this city contained finer collections of shells, and finer works were published here by Chemnitz (12 vols.) and

others, than in any country in Europe. It is not wonderful, therefore, that even now some of the Danes should be far ahead, and that as Prince Christian had a taste for natural history, he should have a splendid private collection, and that the curator of his museum (containing above 8,000 specimens of living shells), Dr. Beck, should be one of the two or three best conchologists in the world. But besides this, Copenhagen possesses in its different museums most of the identical shells which Linnæus described in the edition of his 'Systema Naturæ' published during his life; and here therefore alone, we can verify incontestably the species which he really described and named. As Lamarck and others have in very many cases mistaken the shells which Linnæus meant, great confusion has arisen, and it is here alone that this confusion can most readily be cleared up.

"I am going over with Beck an examination of all the fossil species identified by Deshayes with living shells, and it will probably lead to many modifications of my views, at least many of my details, also to many new views which I shall perhaps have to test at Paris before I return."

Edge's Pendulum for Ships

IN 1837, the Society of Arts awarded a silver medal to Adolphus George Edge, a mate in the Royal Navy, for his invention of a pendulum for showing the inclination of a ship when under sail, which could be used for regulating the elevation or depression of the guns. It was tried with favourable results in the *Inconstant* and *Pique*, and at the end of June 1837 Rear-Admiral F. J. Maitland wrote to the Secretary of the Admiralty, from the *Victory* at Portsmouth, saying that as Edge's pendulum had shown its great superiority "to two other pendulums tried against it in the Portsmouth Yacht, I am desirous that my intended flag-ship the *Wellesley* should be supplied with it; and I request you to be pleased to obtain permission for one to be made for me in Portsmouth Yard". A example of the pendulum was placed in the repository of the Society of Arts.

The Endless Ladder

UNDER this title the *Gentleman's Magazine* for June 1837 gives the following description of what appears to be a prototype of the moving staircase. "A patent has recently been obtained for a most ingenious and useful machine adapted to mining and many other purposes, where the main object is to raise or lower weights or packages in constant succession. This simple but very effectual contrivance consists of an endless ladder, made either of chain or rope, which passes under and over two revolving drums or cylinders, mounted upon horizontal axes; one placed at the bottom, and the other at the top of a shaft or plane, to and from which the ladder is intended to reach. A continuous motion being given to either of the cylinders by the power of steam or animal force, the endless ropes or chains furnished with horizontal stairs like those of a common ladder are made to circulate over the revolving cylinders by which they are distended, so that one part of this endless ladder is continually ascending with a slow but uniform motion from the lowermost of the cylinders to the uppermost, whilst vice versa the other part of the ladder is descending to the lowermost in an uninterrupted circulation."

University Events

BIRMINGHAM.—The new A. E. Hills chemistry building is to be opened formally by the donor on July 7. The opening address is being given by Sir Frederick Gowland Hopkins.

GLASGOW.—Prof. G. G. Henderson has presented to the University a valuable collection of books and reprints on chemistry, and also an interesting series of engravings and photographs.

The following candidates were awarded the degree of D.Sc. at the graduation ceremony held on June 16: J. Bell (thesis: "Heavy Water and the Structure of Crystalline Hydrates", with additional paper); J. D. Loudon (thesis: "The Cationoid Reactivity of Nitrodiphenylsulphones", with additional papers); Anne H. McAllister (thesis: "Clinical Studies in Speech Therapy").

Honorary degrees were conferred on the following, among others: *LL.D.*, Prof. J. Boeke, professor of histology and embryology, University of Utrecht; J. M. Cowan, physician, Glasgow; Prof. T. K. Monro, emeritus professor of medicine, University of Glasgow; Sir Robert Muir, emeritus professor of pathology, University of Glasgow; Sir Albert Seward, emeritus professor of botany, University of Cambridge; Prof. R. Stockman, emeritus professor of materia medica, University of Glasgow.

LIVERPOOL.—On June 4, honorary degrees were conferred on the following, among others: *LL.D.*, Lord Leverhulme, formerly pro-chancellor of the University; Sir Hector Hetherington, principal and vice-chancellor of the University of Glasgow, formerly vice-chancellor of the University of Liverpool; *D.Sc.*, Prof. C. T. R. Wilson, formerly Jacksonian professor of natural philosophy, Cambridge; *D.Eng.*, Mr. A. P. M. Fleming, director and manager of the research and education departments of the Metropolitan-Vickers Electrical Co., Ltd.; *Litt. D.*, M. René Dussaud, Department of Syrian and Palestinian Antiquities, Louvre Museum.

MANCHESTER.—In addition to the grant of £5,000, recently announced, in aid of the biochemical research directed by Prof. I. M. Heilbron, the Chemistry Department has now received from the Rockefeller Foundation a further grant of £300 a year for two years in aid of the application, under Prof. M. Polanyi, of physico-chemical methods to the elucidation of problems of biological interest.

A chair of theoretical physics has been instituted in the University to which Prof. D. R. Hartree, at present Beyer professor of applied mathematics, has been appointed.

Dr. J. G. Woolham has been appointed honorary assistant lecturer in physiology. Dr. J. M. Jackson and Dr. J. A. Todd have resigned their posts in the Department of Mathematics on appointment as lecturers in Westfield College, University of London, and the University of Cambridge respectively.

OXFORD.—At Encænica on June 23, honorary degrees were conferred upon the following, among others:—*D.C.L.*: The Right Hon. W. G. A. Ormsby-Gore, Hon. R. H. Brand and Sir Herbert Baker. *D.Sc.*: Prof. Walter Nernst. *D.Litt.*: Dr. G. P. Gooch.

Prof. J. H. Hutton, of Cambridge, has been appointed Frazer lecturer in social anthropology for 1938.

Societies and Academies

London

Royal Society, June 17.

LORD RAYLEIGH: The surface layer of polished silica and glass, with further studies on optical contact. The reflecting power of a polished silica surface examined at normal incidence in a liquid having the same refractive index as the body of the material, varies widely according to the treatment. Surfaces polished by a process which removes material rapidly or surfaces washed in dilute hydrofluoric acid, do not reflect appreciably in the liquid. Surfaces polished by methods which do not quickly remove the material may reflect as much as 0.28 per cent of the incident light. A kind of burnishing seems to take place, which modifies the surface, and may bring up its refractive index from 1.461, the ordinary value, to as much as 1.61, quite as high as light flint glass, and much higher than any known variety of silica. These effects are found in a less degree in ordinary glass, and in a much less degree in crystal quartz. In normal cases the reflected light changes in tint from red to blue as the refractive index of the immersion fluid is increased through the critical value for minimum reflexion. The modified silica surface is anomalous in this respect, the reflexion being red on either side of the minimum value. The explanation of this is discussed.

F. P. BOWDEN and T. P. HUGHES: Physical properties of surfaces. (4) Polishing, surface flow, and the formation of the Beilby layer. The process of polishing is greatly influenced by the relative melting point of the polisher and the solid. If the polisher melts at a higher temperature than the solid, surface flow and polish of the solid will readily occur. If the melting point of the polisher is below that of the specimen, surface flow takes place very slowly or not at all. In general, the amount of surface flow is governed, not by the properties of the polisher and specimen at room temperature, but by their relative mechanical properties at the high temperature of the sliding surfaces. Experiment suggests that polish is brought about by an intense local heating of the surface irregularities to the melting or softening point. The molten or softened solid flows or is smeared over the surface, and rapidly solidifies to form the polished Beilby layer.

D. J. MALAN and H. COLLENS: Progressive lightning. (3) The fine structure of return lightning strokes. The fine structure of return lightning strokes has been studied from the photographs of 120 flashes taken with Boys and other cameras. There are two types of structure exhibited by branched and by unbranched strokes respectively. In the case of a branched stroke the time-luminosity curve at the base of the stroke shows that when the first upward moving luminosity (component 1) reaches a branching point, the channel again increases in luminosity (component 2), the luminosity falling off when the end of the branch has been reached. Later components causing a new increase in channel luminosity may occur when further branching points are reached. These components are thus intimately connected with the branching processes. The components of unbranched strokes are never observed to start before the stroke has reached the cloud. All components associated with branches are found to progress with velocities in excess of 10^{10} cm./sec. Their direction is indeter-

minate. Components not associated with branches but with the cloud charge itself, progress either upwards or downwards, their velocities varying from 2×10^9 cm./sec. to more than 10^{10} cm./sec. The low-velocity components are observed to progress downwards only. The total number of components observed at any point along the channel decreases after passing branching points, the highest number being observed at the base of the stroke. The time-intensity curve at the base of a stroke shows that the first two components are the most important. No evidence of components which can be ascribed to self-oscillation of the channel has been found.

Brussels

Royal Academy (*Bull. Classe Sci.*, 23, No. 2; 1937).

L. GODEAUX: An algebraic variety of three dimensions of bigenus one.

TH. DE DONDER and Y. DUPONT: New theory of the dynamics of continuous systems (5).

E. DE WILDEMAN: The number of carpels of the flowers of *Rubus caesius* L. and the number of the drupelets of its fruits.

TH. DE DONDER: The uniqueness of the adjoint system of De Donder's linear partial differential equations.

D. FREYDENBERG: Note on numerical combinations with a constant sum.

P. BURNIAT: Projective models of canonical surfaces.

A. APPERT: Transitive topologies.

G. DUFRANE: A birational transformation of space having a given fundamental curve.

J. VAN MIEGHEM: Fundamental relation between the variations of pressure and temperature in the atmosphere.

J. L. DESTOUCHES: Minimal conditions which a physical theory must satisfy.

J. FAUTREZ: The athrocytosis of acid colouring matters. Stable and labile athrocytosis.

P. DENIS: A new alkaloid of the Rubiaceae: rubradinine.

M. HOMÈS and G. VAN SCHOOR: The presence of certain growth-promoting substances in *Elodea canadensis*.

(*Bull. Classe Sci.*, 23, No. 3; 1937).

L. GODEAUX: Some algebraic varieties in three dimensions having canonical and pluricanonical surfaces of order zero.

G. HIRSCH: A generalization of a theorem of Borsuk, concerning certain transformations of the *analysis situs*.

O. ROZET: The nets of integral invariants.

S. DE BACKER: Viscous fluids and propagable waves (3).

P. SWINGS and A. GATHOYE: Note on the absolute magnitudes of *Be* and *B* type stars.

M. NICOLET: Theoretical determination of the effects of absolute magnitude of the molecular bands in stellar spectra.

J. EECKHOUT: Polarographic reduction potential of dinitro compounds.

D. CRESPIN and M. DESIRANT: New empirical formula for the spectroscopic determination of the internuclear distance of diatomic molecules.

L. LISON: Structure of the cryptosoleniated region in the Coleoptera *Tenebrio molitor* L. and *Dermestes lardarius* L.

Forthcoming Events

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

Tuesday, June 29

WARBURG INSTITUTE, at 5.30.—K. de B. Codrington: "Play and Ritual".*

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Annual General Meeting.

Dr. H. S. Harrison: "Ethnology under Glass" (Presidential Address).

UNIVERSITY OF MANCHESTER, July 1-2.—Conference on "Magnetism" to be held in the Physics Department.*

ACHEMA VIII.—Chemical Engineering Exhibition to be held at Frankfort-on-Main on July 2-11.

Appointments Vacant

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

LECTURER IN LIBRARIANSHIP in the Municipal College, Romford Road, E.15—The Principal (June 28).

LECTURER IN GEOGRAPHY in the Normal College, Bangor—The Principal (June 28).

ASSISTANT LECTURER IN MATHEMATICS in University College, Cardiff—The Registrar (June 30).

ASSISTANT LECTURER IN ZOOLOGY in University College, Gower Street, London, W.C.1—The Secretary (July 1).

RESEARCH BIOCHEMIST at the Runwell Hospital, Nr. Wickford, Essex—The Physician Superintendent, envelope marked "Biochemist" (July 1).

ASSISTANT LECTURER IN ZOOLOGY (woman) in University College, Leicester—The Registrar (July 3).

LECTURER IN REFRACTORY MATERIALS in the Royal College of Science—The Secretary, Imperial College of Science, Prince Consort Road, London, S.W.7 (July 3).

LECTURER IN MATHEMATICS in King Alfred's Training College, Winchester—The Principal (July 3).

JUNIOR SCIENTIFIC OFFICERS in the Admiralty Scientific Pool (July 9: quote C.E. 4472/37) and ASSISTANTS (grade III) in the Admiralty Technical Pool (July 3: quote C.E. 4473/37)—The Secretary to the Admiralty (C.E. Branch).

ASSISTANT LECTURER IN AGRICULTURAL CHEMISTRY, ASSISTANT LECTURER IN AGRICULTURAL ZOOLOGY, INSTRUCTOR IN POULTRY HUSBANDRY and INSTRUCTORS IN HORTICULTURE in the University of Leeds—The Registrar (July 5).

DEMONSTRATOR IN BOTANY at University College, Southampton—The Registrar (July 5).

ASSISTANT ANALYST in the Borough of Southwark—The Town Clerk, Southwark Town Hall, Walworth Road, S.E.17, envelope marked "Assistant Analyst" (July 5).

RESEARCH ASSISTANT in the Chemical and Animal Nutrition Research Division, Ministry of Agriculture, Northern Ireland—The Secretary, Civil Service Commission, Stormont, Belfast (July 6).

ASSISTANT LECTURER IN ANATOMY in University College, Cardiff—The Registrar (July 7).

ADVISER IN ANIMAL HUSBANDRY in the Department of Agriculture, Malta—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, S.W.1 (July 7).

PRINCIPAL of the County Technical College, Guildford—The Chief Education Officer, County Hall, Kingston-upon-Thames (July 10).

A LECTURER AND AN ASSISTANT LECTURER IN BOTANY in the University of Manchester—The Registrar (July 10).

ASSISTANT CIVIL ENGINEERS (male) in the Civil Engineer-in-Chief's Department, Admiralty, and H.M. Naval Establishments abroad—The Civil Engineer-in-Chief, Admiralty, London, S.W.1, envelope marked "A.C.E." (July 12).

HEAD OF THE MECHANICAL ENGINEERING DEPARTMENT at the Croydon Polytechnic—The Education Officer, Education Office, Katharine Street, Croydon (July 12).

GEOLOGISTS on the Geological Survey of Great Britain—The Director of the Survey, Exhibition Road, London, S.W.7 (July 31).

TEN TEMPORARY GAZETTED CIVILIAN ENGINEERS in the Military Engineer Services, India—The Under-Secretary of State, Military Department, India Office, envelopes marked "C.E. Recruitment" (July 31).

REID LECTURER IN ANTHROPOLOGY in the University of Aberdeen—The Secretary (August 31).

PROFESSOR OF ECONOMICS in the University of Adelaide—The Secretary, Universities Bureau of the British Empire, 88A, Gower Street, London, W.C.1.

METALLURGIST (alloy steels) and TWO METALLURGISTS in the Research and Development Department, The Mond Nickel Co., Ltd., Thames House, Millbank, S.W.1—The Manager.

LECTURER IN MATHEMATICS in the College of St. Mark and St. John, Chelsea—The Principal.

LECTURERS IN ECONOMICS, ELECTRICAL INSTALLATION and ENGINEERING SCIENCE in the Kingston Technical College—The Principal.

Official Publications Received

Great Britain and Ireland

Annual Report of the Zoological Society of Scotland for the Year ending 31 March 1937. Pp. 68+8 plates. (Edinburgh: Zoological Society of Scotland.) [265]

Air Ministry: Aeronautical Research Committee. Report for the Years 1935 and 1936. Pp. 60+6 plates. (London: H.M. Stationery Office.) 4s. net. [265]

Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.) No. 46: Studies on the Ultimate Composition of Biological Material. Part 1: Aims, Scope and Methods. By David Allardice Webb and William Robert Fearon. Pp. 487-504+plate 15. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 2s. [275]

Empire Cotton Growing Corporation. Report of the Administrative Council of the Corporation submitted to the Sixteenth Annual General Meeting on May 25th, 1937. Pp. ii+66. (London: Empire Cotton Growing Corporation.) [275]

The Black Slaves of Prussia: an Open Letter addressed to General Smuts. By the Rev. Frank Weston, Bishop of Zanzibar. Pp. 20. (London: Universities' Mission to Central Africa.) [285]

Armstrong College, Newcastle-upon-Tyne: Standing Committee for Research. Report, Session 1935-1936. Pp. 55. (Newcastle-upon-Tyne: Armstrong College.) [315]

Subject Index to the Geological Literature added to the Geological Society's Library during the Years 1920, 1921 and 1922. Pp. 218. (London: Geological Society.) 5s. [26]

Other Countries

Report for the Year 1936 of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty. Pp. 15. (Cape of Good Hope: Royal Observatory.) [245]

Smithsonian Miscellaneous Collections. Vol. 91, No. 26: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep. New Species of Mysidacid Crustaceans. By Prof. Walter M. Tattersall. (Publication 3413.) Pp. ii+18. (Washington, D.C.: Smithsonian Institution.) [245]

Carnegie Institution of Washington. Catalogue of Publications. Pp. ii+140. (Washington, D.C.: Carnegie Institution.) [245]

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 68: A Guide to the Seasoning of Australian Timbers, Part 2. By W. L. Greenhill and A. J. Thomas. (Division of Forest Products: Technical Paper No. 22.) Pp. 41. (Melbourne: Government Printer.) [245]

Det Norske Videnskaps-Akademi i Oslo. Astrophysica Norvegica, Vol. 2, No. 5: On the Theory of Rotating Stars, 2. By S. Rosseeland. Pp. 249-262. (Oslo: Jacob Dybdahl.) [245]

Transactions of the National Institute of Sciences of India. Vol. 1, No. 10: The Characteristic Properties of Colloidal Solutions of Acidic Substances which distinguish them from Acids in True Solution. By Dr. J. N. Mukherjee, R. P. Mitra and S. Mukherjee. Pp. 227-292. 5 rupees. Vol. 1, No. 11: Biochemistry of *Sonchi* Fermentation. By K. Rami Reddi and Dr. V. Subrahmanyam. Pp. 293-331. 4 rupees. (Calcutta: National Institute of Sciences of India.) [245]

Canada: Department of Mines: Bureau of Economic Geology, Geological Survey. Memoir 202: Contributions to the Study of the Ordovician of Ontario and Quebec. By A. E. Wilson, J. F. Caley, J. C. Sproule and V. J. Okulich. (No. 2427.) Pp. iv+133 (9 plates). (Ottawa: King's Printer.) 50 cents. [255]

Canada: Department of Mines and Resources: Mines and Geology Branch, Bureau of Geology and Topography: Geological Survey. Memoir 205: Mineral Resources of Terrace Area, Coast District, British Columbia. By E. D. Kindle. (No. 2433.) Pp. iv+60. (Ottawa: King's Printer.) 25 cents. [255]

Canada: Department of Mines: National Museum of Canada. Bulletin No. 83 (Anthropological Series, No. 19): Roebuck Prehistoric Village Site, Grenville County, Ontario. By W. J. Wintemberg. Pp. iv+178 (19 plates.) 50 cents. Bulletin No. 84 (Anthropological Series, No. 20): The Sekani Indians of British Columbia. By Diamond Jenness. Pp. iv+82. 25 cents. Bulletin No. 85 (Biological Series, No. 22): The Leptrini of America North of Mexico, Part 2. By Ralph Hopping. Pp. iv+42 (6 plates.) 25 cents. Bulletin No. 86 (Anthropological Series, No. 21): The Indian Background of Canadian History. By Diamond Jenness. Pp. iv+46. 25 cents. (Ottawa: King's Printer.) [255]

Royal Agricultural Society, Egypt. Bulletin No. 28 of the Technical Section, and No. 5 of Royal Agricultural Society, Imperial Chemical Industries, Ltd., and I. G. Farbenindustrie A.-G. Joint Agricultural Research Scheme: Investigations in Egypt of the Interaction of Factors in Crop Growth. 5: Manuring of Wheat, Barley, Maize and Rice. By Frank Crowther, Adolf Tomforde and Ahmed Mahmoud. Pp. 64. (Cairo: Royal Agricultural Society.) [265]

Canada: Department of Mines and Resources: Mines and Geology Branch, Bureau of Mines. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories), July to December 1935. (No. 771.) Pp. iv+234. (Ottawa: King's Printer.) [265]

Bulletin of the National Research Council. No. 99: Mineral Nutrition of Farm Animals. By Prof. H. H. Mitchell and F. J. McClure. Pp. 135. (Washington, D.C.: National Academy of Sciences.) 75¢ 1 dollar.

Fifty-third Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1935-1936. Pp. 275 (Washington, D.C.: Smithsonian Institution.) [275]

Generalization of Aerodynamic and Electrodynamics. Fundamental Equations: Report delivered at a Special Meeting of the Academy of Sciences of the U.S.S.R., 9 December 1936. By P. Kasperin. Pp. 16. (Moscow: Academy of Sciences of the U.S.S.R.) [285]

