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## Social Aspects of Nutritional Science

**T**HOUGH there is still a tendency among certain people to deplore the passing of the "good old days", it has to be acknowledged that during the past century and a half the lot of the poorer sections of the populations of western Europe has been enormously improved. In the past, war, famine and pestilence have decimated many countries; to-day, in Europe, famine is the exception and many types of pestilence have been already almost forgotten, although the widespread occurrence of infectious diseases, especially influenza in pandemic form, yet offers many problems for preventive medicine. The advance in public health and well-being, strikingly shown by the fall in the death-rate and the extension in the expectation of life of the individual, was made possible by the advances in sanitation and medical knowledge, and the improvement in the social conditions of the lower-income groups was due to the rapid growth of wealth, which resulted mainly from the advances in scientific knowledge and its application. The awakening of the social conscience of the community has frequently played no mean part in these advances.

In spite, however, of the improvement in the health of the people, it is only comparatively recently that it has been realized what an important part nutrition plays in maintaining health: with increasing wealth, diet has become more abundant and more varied, but the improvements in the past have been largely the result of the unconscious and instinctive groping of men for a better and more abundant life. To-day, medical science can state, within limits, what is a good and what is a bad diet: therefore, it is possible from dietary studies to determine whether people are eating the right kinds of food in sufficient quantities.

Further, our knowledge of the results of consuming ill-balanced diets has increased to the extent of enabling us to say, in many cases, from a clinical examination, whether malnutrition is present and what particular element in the diet is lacking, even apart from the obvious occurrence of what are now known as the frank 'deficiency diseases', such as scurvy, rickets or beriberi.

Perusal of the recent report of the League of Nations on nutrition, reviewed elsewhere in this issue, shows, however, that in spite of the general improvement in the social conditions of the poorer sections of the communities of western Europe in recent decades, much malnutrition still exists, even in the richer countries. The evidence is both clinical and economic: dietary and income surveys have shown that among the lowest-income groups it is simply impossible for the members to obtain a proper diet, since the family income is insufficient! Nutrition policy, therefore, must be directed both to educating people in the elements of correct dietetics, and also, which is even more important, to enabling *everyone* to make full use of our present knowledge, by bringing the foodstuffs essential to health and physical development within reach of all sections of the community. No campaign for improving physical fitness can succeed when nutrition is at fault.

What, then, does improved nutrition imply? Usually an increased consumption of animal protein, milk, eggs, 'fat' fish, green vegetables and fresh fruits, with a decreased consumption of cereals: in other words, a decrease in the consumption of the purely energy-bearing foods, and an increase in that of the so-called "protective" foods, which are in general the more expensive. Dietary surveys have shown that with increasing



income, more of the protective foods are consumed ; the problem is therefore largely economic—how to increase the incomes of the more poorly paid sections of the community, or, alternatively, how to reduce the price of the protective foods, which comes to the same thing. One objection, that the shift in consumption will cause distress among many agriculturists, is shown in the League of Nations report to be of no weight. For many years agriculture has been adapting itself to just such a shift in consumption, which has occurred with the general increase in wealth of many countries ; moreover, cereals formerly produced for human consumption can also be used as animal feed when the demand for meat and milk increases.

It is impossible to-day for Governments to divest themselves of responsibility for the nutrition of their peoples ; nutrition should be considered to-day the most important of all the social services.

Education in the correct principles of nutrition and avoidance of policies which may prevent the full use of adequate diets should be the foremost considerations of legislators as steps in the improvement of the well-being and health of their peoples. It must be emphasized that the problems are indeed complex ; thus a simple reduction in the price of food may benefit the urban consumer but bring ruin and malnutrition to the agricultural producer.

The League's report on nutrition should be in the hands of all who have the welfare of their people at heart, especially those entrusted with the direction of policy. If Governments can achieve for their peoples adequate levels of food consumption, further progress, in no way less spectacular than that achieved during the nineteenth century, can be made in increasing the quantity and raising the quality of human life.

## Logic and Empiricism

Actes du Congrès International de Philosophie scientifique, Sorbonne, Paris, 1935

1 : Philosophie scientifique et empirisme logique. Pp. 81. 12 francs. 2 : Unité de la science. Pp. 77. 12 francs. 3 : Langage et pseudo-problèmes. Pp. 60. 10 francs. 4 : Induction et probabilité. Pp. 65. 10 francs. 5 : Logique et expérience. Pp. 80. 12 francs. 6 : Philosophie des mathématiques. Pp. 85. 12 francs. 7 : Logique. Pp. 73. 10 francs. 8 : Histoire de la logique et de la philosophie scientifique. Pp. 92. 12 francs. (Actualités scientifiques et industrielles, 388-395.) (Paris : Hermann et Cie., 1936.)

SCIENTIFIC philosophy may be in a state of flux in its details, but there is one guiding principle which seems to give at least a unity of purpose to the numerous schools of thought which have made logic their chief interest. This principle requires that the reconstruction of our knowledge should be made on the basis of experience alone, free from anthropomorphic additions, and by means of a unified scientific language shaped out of logical syntax. Let it be said at once that few thinkers would dispute the fundamental importance of this principle, provided that it is interpreted in a liberal spirit. It seems, however, that the more vocal logicians of to-day deliberately restrict experience to sense-data alone,

thus leaving out those no less important aspects of experience which refer to moral, æsthetic, mystical and religious values. Without arguing the point as to whether it is possible or not to achieve a complete synthesis of our knowledge with these initial restrictions on the meaning and acceptance of experience, it can be admitted that this narrow interpretation of the guiding principle of scientific philosophy has aroused the enthusiasm of all those important thinkers who have adopted Russell's motto that logic is the great liberator of the mind. The Paris Congress of Scientific Philosophy is the first result of their intellectual crusade, though some of its meetings were tempered by the presence of more traditional thinkers.

Unity of purpose, however, is not incompatible with difference of interests ; and it is not one of the least remarkable aspects of the vitality of logic that it has developed in so many directions. The variety of the papers under review bears witness to this statement. Thus, the first fascicule devoted to "Philosophie scientifique et empirisme logique", contains a series of declarations of faith in logical empiricism by some leaders of the movement such as Russell, Frank, Reichenbach, Carnap, Neurath, Enriques, Morris, Wiesner, Chwistek, Kotarbinski, Ajdukiewicz and Prof. Louis Rougier, who organized the Congress successfully and supervised the publication of the papers.



Most of them are inclined to think that speculative metaphysics does not even deserve the honour of a discussion, and they busy themselves with the organization of a "scientific empiricism which by doing justice to the three dimensions of meaning is able to unite the attitudes of formalism, pragmatism and traditional empiricism, and at the same time to give the promise of resolving the inadequacies which have beset previous forms of empiricism" (C. W. Morris, 1, 56). The elimination of idealism from mathematics as well as from other sciences is suggested by the use of the super-general science of 'semantics' (Chwistek, 1, 79).

The conditions of unifying the sciences and of illustrating their unity by means of an International Encyclopædia, are discussed in the second fascicule, "Unité de la science", in which, besides the able papers of representatives of the Vienna Circle, there is an important contribution by Lecomte du Noüy on the unity of the method of the physical and biological sciences, and an excellent discussion of the notion of 'type' by C. G. Hempel and P. Oppenheim. With regard to the International Encyclopædia, as originally conceived by O. Neurath, its purpose will be to show the 'structure' rather than the totality of our knowledge; and because of its purpose, it will have to make use of 'graphical representation' as an essential element of unification of our knowledge. The main conception and general plan of this International Encyclopædia have been approved by the Congress, which passed a resolution expressing its willingness to co-operate in the execution of the scheme, and appointed a special committee to discuss ways and means of unifying logical symbols. Semantics and linguistics are the subjects of the third fascicule, "Langage et pseudo-problèmes", which contains papers by Tarski, Padoa, Chevalley, Rougier, Vouillemin, Matisse, Feigl and others. The accusation levelled by Rougier against Aristotelian logic, that it helps to create pseudo-problems rather than solve them, is more dogmatic than convincing. A direct reply to this charge is given in a paper by the present writer on the significance of logical symbols.

Two essential problems of logical theory are discussed in the fourth fascicule, "Induction et probabilité", by Reichenbach, Carnap, Schlick, Zawirski, Hosiasson and Finetti. The arguments, however, are rather one-sided, as they refer to Reichenbach's well-known doctrine of probability, and to the assimilation of probability with a plurivalent logic proposed by the Polish school. Though the debate of this dual problem would have gained if it were less restricted, the papers in this fascicule clarify many aspects of the esoteric teachings of logical empiricism.

The fifth fascicule, "Logique et expérience",

contains papers on definition and experience by Ajdukiewicz, Benjamin and Renaud, on the formalization of experience by Petiau, Destouches, Métadier, Habermann and Chwistek, and on protocol-judgments by Braithwaite, Rasmussen and Grelling. Most of the arguments refer to physical experiments rather than to physical experience under the influence of different types of causes and conditions. Owing to the paramount importance of experience in logical empiricism, it was legitimate to expect a fuller treatment of sense-data and of their integration in a unified system of knowledge.

The sixth and seventh fascicules deal respectively with "Philosophie des mathématiques" and with "Logique". This seems to point to a real division between mathematics and logic, a conception heretical to the Russellian tradition, but none the less true and widely accepted. It inspires most of the papers on mathematics and reality (Gonseth and Lautman), on the theory of groups (Juvet, Bouligand, Destouches), or the intuitionist logic (Mania, Jaskowski, Reymond, Becker and Schrecker), on logical syntax (Tarski, Helmer, Sperantia and Lindenbaum) and on mathematical logic (Bachman, Padoa, Bergmann and others). These papers carry further the process of clarification of mathematical logic which was initiated when flaws were discovered in the awe-inspiring and monumental "Principia Mathematica".

The historical aspect of the problems raised by logical empiricism is the subject of the eighth and last fascicule, "Histoire de la logique et de la philosophie scientifique". One will not find in it any elaborate considerations about the historical development of logic as a whole. With the exception of an essay by Jasinowski on the limitations of Greek mathematics, all the other papers (Scholz, Reymond, Bachmann, Padoa, Tegen, Ayer, Hollitscher, Zervos, Jörgensen, Frank and Heinemann) refer to the development of logical empiricism in the various countries of Europe, and to some particular aspects of the development of mathematical logic. As such they are very valuable. Ayer's paper on the analytic movement in British philosophy is particularly interesting, inasmuch as it explains some fundamental differences between this movement and the Continental developments of logical empiricism.

The importance of some of the technical results obtained by those who favour logical empiricism explains why this school of thought continues to attract much interest and controversy; and though logical empiricism has now lost the aggressiveness it showed at its earlier stages, it has still great vitality and real influence, which cannot be neglected in assessing the philosophical climate of our generation.

T. GREENWOOD.



## A Survey of Organic Chemistry

### Lehrbuch der Chemie

Von Prof. Walter Hückel. Teil 2: Organische Chemie. Pp. xvi + 602. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1937.) 18 gold marks.

THE author of a compact text-book of organic chemistry lays himself open to criticism because his selection of subject-matter can never meet with complete approval of other teachers and writers on the subject. Stressing fundamental principles and including only such descriptions of compounds as he deems necessary for the purpose of illustration, his work will probably be judged as lacking in subject-matter, a fact of which the author is fully conscious, realizing that, in its forty volumes, the present edition of Beilstein's "Handbuch" is still incomplete and when finished will only deal with the subject-matter of organic chemistry up to 1919. The literature of organic chemistry must be much greater than that of any other experimental science, and this literature takes little or no account of the vast amount of information obtained through detailed investigations by large industrial organizations. The rapid growth of this literature makes the writing of new text-books of organic chemistry increasingly difficult, and the justification of their publication should lie in the up-to-date treatment of classical organic chemistry and the careful choice of subject-matter to illustrate the general principles.

Prof. Hückel is not only an investigator but is also the author of the well-written "Theoretical Outlines of Organic Chemistry", of which the second edition appeared in 1934. To many British readers the present work will seem more old-fashioned than they would expect from him. On the other hand, the order of the subject-matter is different from that in many text-books, and few authors would discuss the alkaloids before the systematic treatment of stereochemistry and aromatic compounds.

Prof. Hückel has restricted the subject-matter of systematic organic chemistry to meet the first requirements of the general student and the large class of those who are required to possess a knowledge of organic chemistry as a medical science. He has omitted, for example, a number of the so-called classical syntheses, including those of quinoline, isoquinoline and indole. From a biological point of view, it can be maintained that these are key substances the study of which the author might have included in a book to be used

by biology students even if other subjects had to be dealt with in less detail. Even urea, the synthesis of which marks the beginning of systematic organic chemistry and which might well form the starting-point of a modern course of lectures in the subject, has to be given a far too condensed treatment so as to provide space for much more 'spectacular' and highly complicated subjects.

The survey of organic chemistry given by Prof. Hückel is much more comprehensive than that usually given in a text-book of this type. There would appear to be justification for the inclusion of the good but necessarily brief accounts of the carotenes, vitamins and the hormones, including the sex hormones; but it may be doubted whether the student has gained sufficient knowledge from the previous hurried treatment of the simple and fundamental compounds to appreciate fully the complexities of this advanced work. The additional disadvantage lies in the fact that perhaps many readers will not realize that this is far from being a finished chapter in organic chemistry. Undoubtedly, the average student will find this book inspiring because the subject-matter is dealt with so broadly, although he may not realize at this stage that there are defects in the treatment of what he may have come to regard as the dry bones of the subject.

One unusual and interesting feature in this kind of book is the inclusion of short biographical notices in appropriately placed footnotes. It is perhaps natural that the great majority of these are of German chemists, and of British modern investigators Prof. Robert Robinson is the only one so distinguished. Without detracting from the work of organic chemists in other countries, it is rather remarkable that in this modern text book there is no mention of the classical work of Sir William Pope or of Sir Arthur Harden in connexion with the development of our knowledge of stereochemistry and fermentation respectively. Omissions are not confined to the work of non-German investigators. The account of the reactions of aromatic diazo compounds is very brief and there is no mention of the well-known (Bartmann) reaction which now constitutes the method for the preparation of aromatic arsenical compounds of various types of the highest importance as chemotherapeutical agents.

There are a few typographical errors, and the wrong formula for thyroxine may be one of these. It is much more serious as indicating a certain



lack of care in the compilation of the book that the crystal drawings of the enantiomorphous sodium ammonium tartrates reproduced by the author and evidently copied from older text-books have little relation to the crystalline forms of these

substances and may be described as representing crystal monstrosities. It is unfortunate that the author of a new text-book should be so uncritical as to reproduce what has long been known to be an error in older books. CHARLES S. GIBSON.

## Religion and Medicine of a West African People

### Religion and Medicine of Gã People

By M. J. Field. Pp. xi + 214 + 16 plates. (London: Oxford University Press, 1937.) 17s. 6d. net.

THERE is a charming feminine inconsistency between Miss Field's announcement that she refrained from studying anything that anyone else had ever written concerning the subject upon which her own researches were to be directed—her only lapse in this respect being the "perfunctory" perusal "eight years ago" of a work dealing with a neighbouring tribe—and her acknowledgement of advice and criticism from various experts in her particular subject.

The author may, however, have had in mind the example of certain anthropological students, who, having sat with reverence at the feet of some great master, the originator of a new school of thought, are so influenced by his teaching that they, perhaps unconsciously, find further proofs to back up—or to bolster up—those pet predilections of a beloved teacher. Modern youth, however, of both sexes, is now inclined to display independence, and the functionists, diffusionists and what-nots, need not be surprised to discover rebels in the ranks of former pupils. It is well that it should be so. There is no science where an open mind and freedom from preconceived ideas are more essential than in a study of mankind's primitive institutions.

The title of this eminently sympathetic and thorough piece of field work perhaps disarms one otherwise obvious criticism.

It deals—and only purports to deal—with "religion and medicine"; in anthropological parlance, the latter term is often synonymous with the former. Yet there will be many, besides the writer of this notice, who would have wished to know more of the origin of this interesting West African people. Their curious affinity in customs, in language, and most of all in their folk-lore, with their northern neighbours, the Twi-speaking tribes, is very marked. Miss Field states, for example, that the religious songs at a certain ceremony were in the forgotten "Obutu dialect", and adds that these were often "mere gibberish to both singers and hearers". In a footnote, however, she states that her informants insisted that this "gibberish"

was Twi, but she adds that could not be so, for it would mean that the particular custom was a late, not an early, cult. "Fleeting glimmers" such as this—to use Miss Field's own expression—make us all the more anxious to probe still further into the question how far the Gã have been influenced by their northern neighbours.

The book plunges straight away into an account of Gã gods and their servants. In the first paragraph is the arresting statement that the whole idea of the *fetish* is foreign to Gã worship. "The typical Gã high-priests," the author writes, "have no fetishes and are not fetish priests". There is, of course, now, every reason to believe that among the Twi and Ashanti, the indigenous cults were equally free from the influence of the *suman*. These Gã people of the lagoons and Atlantic free-board appear, in spite of centuries of contact with Europeans, to have retained, unchanged, certain primitive institutions which have been lost or become obscured among the inland tribes. This has perhaps been due to the greater wealth and rise of native kingdoms and warlike confederacies among the latter, which postulate external influences, in their case, from the north, that is, from the great inland kingdoms of Ghana and Melle.

Miss Field also refers to the survival of priest-kings, still faintly discernible in the Ashanti *Asase-wura* (master of the earth) and functioning more clearly in the Ashanti hinterland in the person of the *Tendana*. "Gã governments," she writes, "were originally absolute theocracies, and the only rulers were the priests". Scores of similar analogies rise before the reader who is familiar with the Twi-speaking and other Gold Coast peoples. It is to be hoped that the author will one day bring her scholarship to bear on the problems thus suggested.

This book is a model of what sympathy and painstaking research can achieve. It is, indeed, on books of the kind that the whole science of anthropology is being reconstructed. Those scientific investigators who cannot themselves embark on field work can wholly rely upon, and safely draw correct deductions from, such a work.

R. S. RATRAY.



## An Irish Pilgrimage

### The Way that I Went :

an Irishman in Ireland. By Robert Lloyd Praeger. Pp. xiv + 394 + 39 plates. (Dublin : Hodges, Figgis and Co., Ltd. ; London : Methuen and Co., Ltd., 1937.) 21s. net.

THE way that the author went was all over Ireland, often to little-known areas, especially when obtaining data for "Irish Topographical Botany", a book for the achievement of which students of distribution will remain permanently indebted to him. Of the present work, Dr. Praeger writes, "this is not a guide book—Heaven forbid." Yet it partakes in no small degree of both the virtues and defects of that type of literature. As in the conventional guide book, the only connecting theme is that of location, and this produces a certain inconsequence which renders the book easy to dip into at any point but less suited for continuous reading. Unlike the conventional guide book, the text is more concerned with the works of Nature than the works of man, and the reader who loves the countryside can here share the author's simple pleasures. The work is, in fact, a *pot pourri*, albeit an unusual and charming one, of facts and reminiscences concerning, *inter alia*, the topography, geology and natural history of Ireland.

Whether the author is writing of how the pied wagtails have learnt to appreciate the night-life of Dublin, of the sole Irish stations for the rock rose on the Carboniferous Limestone at Ballintra and

the cloudberry on the bogs of the Sperrin, of cliff scenery or the story of the rocks, all are presented with a personal touch that gains materially from the many parts that the author has himself played in the investigation of Ireland's wealth of natural interest.

Dr. Praeger pays a well-merited tribute to the value of natural history societies in general, and particularly to his personal debt to the Belfast Naturalists Field Club, which he joined at eleven years of age. His emphasis on the value of intensive studies of limited areas, which has proved so valuable elsewhere, is enforced by the data obtained during the Clare Island survey, which added no fewer than 2,000 species of organisms to the Irish lists and 109 animals and 11 plants which were new to science.

The work is clearly intended for the general reader, in deference to whom 'popular names' for animals and plants are mainly used, sometimes at the risk of ambiguity. Occasionally unexplained technical expressions are employed which may form a stumbling-block to a few, but there is little doubt that the intelligent traveller in Ireland will find in these pages much to open his eyes to the interest of his environment. The book is illustrated with a number of excellent photographic reproductions and text figures. It is unfortunate that one of the latter, purporting to represent "diatoms from Lough Neagh," should consist almost exclusively of figures of desmids. E. J. S.

## Directive Evolution

### The Evolution of the Australian Merino

By E. W. Cox. Pp. xxii + 160 + 31 plates. (Sydney and London : Angus and Robertson, Ltd., 1936.) 21s.

TO the student of evolution this history of the Australian merino will be of great interest, for it not only gives a narrative of the ways in which the breed was formed, but also seeks to analyse the factors responsible for its successful development.

After tracing the history from Spain, through England, France, Austria, Germany and United States to Australia, detailed accounts are given of the development of the main flocks and lines of blood in the various Australian States. In the later chapters dealing with the ways and means

of the evolution, geneticists will find much of interest.

The history of the Australian merino forms perhaps one of the best examples of the evolution of an animal directed by man towards a certain purpose—the production of large amounts of good quality wool. What directive evolution means can be gathered from the advice given to the prospective flock master, who "must visualize the type he wishes to attain and the wool it is to grow. That 'dream-sheep' must be kept before his mind at all times."

As an example of what has been achieved by this method, the average cut in 1800 was 4 lb. for a ewe and 7 lb. for a ram, while to-day almost



any of the great studs average more than 15 lb. for a ewe and more than 20 lb. for a ram—wool, too, of better quality.

Photographs of the champion rams each year from 1895 until 1936 show clearly the changes which have taken place in the body form of the Australian merino. Progress in the development of the body and in the constitution has been marked. The hardest improvement to obtain appears to have been to increase the length of the staple without loss of the other properties, but this has been done by the gradual process of selection. The success of the outstanding Peppin stock is attributed to the founder's idea of letting the sheep develop to suit the food and climate of the country. The failure of the Vermont stock from America, after their size had led to a craze for their importation, is attributed to a lack of suitability to environmental conditions.

It is concluded that breeders should preserve and utilize by inbreeding the outstanding qualities of every excellent animal: inbreeding is the most powerful tool available to the breeder. Inbreeding of a good strain makes it possible to produce superior animals more quickly than by any system of selecting and mating unrelated animals. The behaviour of strains when submitted to inbreeding is the surest test of their worth.

As to probable future developments, the author foresees breeding in much smaller flocks, and with this the danger of the loss of uniformity which is the feature where one man has directive control over large numbers of animals. A knowledge, too, is needed of the chemical nature of the food best suited to wool growth, for the best sheep are produced on the medium grass and salt bush country and not on the rich fattening areas.

J. H.

## Science and Free Will

### Free Will or Determinism

By Dr. M. Davidson. Pp. xv + 203. (London: Watts and Co., 1937.) 10s. 6d. net.

IN recent years experimental work in physics has led to theoretical conceptions which suggest that the movements of atoms and electrons are just as indeterminate as human action. Yet it is doubtful if Prof. Max Planck's quantum theory will rule out determinism for those who prefer, for logical or other reasons, to hold to that view. It has not made Dr. M. Davidson or Prof. H. Levy relinquish a strictly mechanistic view of Nature. Prof. Levy, for example, argues that those who maintain that recent physical research has exposed a fundamental indeterminacy in Nature must explain away the determinism that has been established on the large scale. On the other hand, Sir Arthur Eddington asserts that "Classical physics foists a determinate scheme on us by a trick; it smuggles the unknown future into the present, trusting that we shall not press an inquiry as to whether it has become any more knowable in that way". Perhaps the truth is that if one believes in free will for other reasons—the experience of volition, for example—one is thankful for the quantum theory as a crack in the fabric of the mechanistic view of Nature. Judicious leverage may, one hopes, make it wider. Hence the anxiety in some quarters to fill it with cement.

Perhaps the best line of attack on the mechanists

is not to look for cracks in their system, but to ask whether a strictly mechanistic view has not its difficulties too, though they can be easily ignored because they lie on the surface. Is it not now coming to be recognized that the method of science is, after all, realist, not nominalist (to use the scholastic terminology)? Does science not proceed on the theory that reason and logic have a reality of their own, even apart from particulars? In a word, is not science idealist (to use modern terminology)?

In his chapter on the mechanistic view of life, Dr. Davidson seems to end up on a note of some dubiety. For while he says that Loeb and his school have pushed the problem back a long way, he adds that it still remains unsolved, though it does seem that "some day the final word on vital phenomena may be spoken by the physicist". Then he observes that, "In the present state of our knowledge we can only endorse the words of Dr. Benjamin Moore: 'In the processes of cell reproduction and division there is a type of energy at work never found elsewhere than in living organisms'." But the late Dr. Moore's doctrine of a vital force was, from the mechanistic point of view, a heresy.

Dr. Davidson has provided a useful summary of arguments in favour of holding fast by the deterministic view, though he cannot be said to have contributed anything new to the solution of the problem.

J. C. H.



### Science and Common Sense:

an Aristotelian Excursion. By W. R. Thompson. Pp. vii+234. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 7s. 6d. net.

DR. THOMPSON is a biologist of distinction whose published work is characterized by depth and originality. In this book he has departed from his usual field of observation and experiment and set himself the task of examining certain aspects of present-day scientific thought. He contends that some of the paradoxical statements made in connexion with physical theory would, in other circumstances, be regarded as contrary to logic and common sense. Biologists, he says, show signs of being imbued with this same mental attitude owing to the influence of mathematical physics.

Dr. Thompson's views are developed in some eight chapters, and perhaps the most significant are those concerned with the use and abuse of mathematics and of philosophy. The concluding chapter examines certain concepts of evolution. While the doctrine of evolution is a long way from being played out, it seems to have lost much of its interest, workers to-day tending to pursue matters more capable of experimental verification. Attempts to extract from the world as it now is have not yielded the true history of its past. Without the help of philosophy, the legitimacy of the principle of evolution would be impossible to uphold. The rejection of philosophical methods and principles would ultimately turn scientific work into a mere cinematographic record of events. With reference to mathematics and biology, the author stresses that the growing tendency to restate biological problems mathematically is beginning to produce "a kind of sublimation of biological facts into mathematical figments" which are commonly believed to be their equivalents. This practice, he observes, leads to quite fallacious notions about living things.

We commend Dr. Thompson's book as a critical and suggestive analysis: it aims at showing up in proper perspective some tendencies of modern scientific thought.

### Zero to Eighty:

being my Lifetime Doings, Reflections and Inventions, also my Journey around the Moon. By Akkad Pseudoman (Dr. E. F. Northrup). Pp. xii+283+15 plates. (Princeton, N.J.: Scientific Publishing Co., 1937.) 3 dollars.

It may not be generally known that there is a British Interplanetary Society and an American Rocket Society, the members of which are heralding the dawn of interplanetary travel. In his volume "Rockets through Space", published last year, Mr. P. E. Cleator, president of the former, has given an account of the unsuccessful attempts which have been made to make a rocket leave the earth and visit other planets. Dr. E. F. Northrup, in "Zero to Eighty", is very much more likely to convince us that such methods will ever succeed, for he is at great pains to give us scientific chapter and verse for every event in his imaginary journey around the moon and back.

The story is told as an autobiography—the life, inventions and reflections of a man of science, Dr. Akkad Pseudoman, living from A.D. 1920 until 2000—and is claimed to present a reasonable scientific solution to the problem of escaping from the earth's gravitational attraction and navigating projectiles in celestial space. Dr. Northrup's projectiles acquire its huge velocity by eddy-current thrust in a long coil of special design which is excited by three-phase current. It is steered by means of rockets.

Akkad Pseudoman has all manner of adventures. He has a Russian assistant, who is claimed by the Soviet Government when all his plans are ready and who organizes a rival flight. He is kidnapped and is rescued as a result of his wife's knowledge of chemistry. He makes a fortune and is able to found a School of Associative Science where science and philosophy are trained.

Dr. Northrup's book does not, it is true, provide the general reader with such delectable fare as does Jules Verne in "From the Earth to the Moon, and a Trip Round It"; but the scientific reader cannot fail to be interested in the technical argument, which is expounded with striking lucidity.

### River Flow Records

By Capt. W. N. McClean. Series A: River Garry Sheet No. 1. 1s. 6d. Sheet B: River Moriston Sheet No. 1. 1s. 6d. Series C: River Ness. Sheet 1-14. In portfolio. 15s. (London: River Flow Records, 1937.)

THE hydrological activities of the private organization known as River Flow Records (director, Capt. W. N. McClean, Parliament Mansions, S.W.1) have been in evidence for some time, and the publications under notice represent the data accumulated over a period of several years in the basin of the River Ness, Inverness-shire. Records of the River Garry, one of the tributaries of the Ness, were instituted so far back as December 1912, and then, after a prolonged interval, were resumed in 1929 on the establishment of a water-level recorder at Invergarry, with fresh measurements of flow. The survey of the River Moriston, another tributary influent, was instituted in 1929, following the rejection of the West Highland Water Power Scheme. In both cases, from July 1929 until March 1931, the records were issued quarterly in tabular form. In the present publication they, and the complete set of records for the River Ness, are given in graphical form, based on the wide range of flow-gauging made since 1931.

It is obvious that these readings must be of great service to all who are concerned with the hydrology of the Ness Basin, as, indeed, to water engineers generally, and it is to be hoped that the organization will receive substantial public support from the purchase and circulation of these admirable charts embodying, as they do, the results of prolonged and careful observation, carried out on scientific lines and rendered available in a compact and easily accessible form by the commendable enterprise of the undertaking.

B. C.



## Air Ministry

Meteorological Office. *British Rainfall, 1936: the Seventy-sixth Annual Volume of the British Rainfall Organization. Report on the Distribution of Rain in Space and Time over the British Isles during the Year 1936 as recorded by over 5,500 Observers in Great Britain and Ireland.* (M.O. 415.) Pp. xix + 292. (London: H.M. Stationery Office, 1937.) 15s. net.

THE seventy-sixth volume of this valuable report on the year's rainfall contains the usual general table of returns from about 5,500 stations in the British Isles. In addition there are sections dealing with such special subjects as droughts, wet spells, duration of rainfall, heavy falls, monthly and seasonal rainfall, evaporation and percolation. From the foreword we learn that the revised system of classification of heavy falls in short periods, described last year in a special article by Mr. E. G. Bilham, has now been introduced. The main effect of the new scheme is to exclude many falls lasting only a few minutes from the 'noteworthy' category. It is also interesting to learn that the arrangements for charting rainfall month by month have now been so greatly improved that the charts prepared for the Monthly Weather Report are accepted, without substantial revision, for publication later in "British Rainfall".

Although the rainfall of 1936 exceeded the normal by nine per cent over England and Wales, there was a marked deficiency in Scotland, amounting to twenty per cent in the Western Highlands. In a special article by Dr. J. Glasspoole, details are given of the unprecedented deficiency of rain in western Scotland during the period November 1935 to June 1936. There is also a valuable article by Mr. L. C. W. Bonacina on the snowfall of the decade 1926-35.

## Die Fermente und ihre Wirkungen

Von Prof. Dr. Carl Oppenheimer. Supplement. Lief. 6 (Band 2, Spezieller Teil: Haupt-Teil 13-15). Pp. 783-942. (Den Haag: Dr. W. Junk, 1936.) 10 florins.

THE sixth part of this important supplement deals with the proteinases, in particular with tryptase, pepsinase, chymase (rennet) and also papainase: it follows the plan already indicated. Frequent use of the supplement confirms the opinions already expressed as to its utility and the clarity with which the great amount of information is presented. Sections dealing with the occurrence and distribution of these enzymes may be particularly cited for their completeness and value to the physiological chemist. Naturally, exact directions are given for the preparation of the crystalline enzymes, and one could have wished for some photographs of these crystals in order to bring home to the sceptics their beauty and the magnitude of the achievement.

Prof. Oppenheimer indicates that the completion of the supplement will occupy another year and a half, and he pleads for reprints of papers on enzymes to be sent to him so as to hasten and facilitate this reference to new work, a request which we recommend also to our readers. The address is: Berlin, W.15, Kurfürstendamm 61.

E. F. A.

## British Museum (Natural History)

Catalogue of Fossil Cirripedia in the Department of Geology. Vol. 2: Cretaceous. By Thomas Henry Withers. Pp. xiv + 534 + 50 plates. (London: British Museum (Natural History), 1935.) 30s.

WHEN the first volume of this Catalogue was published in 1928, the earliest cirriped known was *Eolepas* from the Rhætic. A much earlier form has since been discovered in the middle Carboniferous of the Donez and Kusnetzk Basins, U.S.S.R. This is a Lepadomorph barnacle, and it shows that the Cirripedia must already have been in existence for a long period, but gives no evidence of the origin of the group. Among many interesting points in phylogeny the author brings forward evidence to show that the three sub-orders of the sessile Cirripedes (the Brachylepadomorpha, the Verrucomorpha and the Balanomorpha) have been derived independently from a pedunculate stock. The Cirripedes show a great development in the Chalk, where nearly a hundred species and varieties are known, but there is an unaccountable imperfection of the record in the Lower Cretaceous deposits, in which only six species have been found; this makes it difficult to connect some of the Jurassic forms with those of the Cretaceous.

The introductory chapters deal with the history of research, phylogeny, ontogeny, distribution, etc. The main part of the work is a systematic account of all the known genera and species of Cretaceous Cirripedes. The reconstructions of some of the more important forms add greatly to the interest of this comprehensive work.

## Design:

a Treatise on the Discovery of Form. By Percy E. Nobbs. Pp. ix + 412. (London: Oxford University Press, 1937.) 30s. net.

THIS interesting work fills a gap in aesthetic theory, in so far as the discussion of the subject is developed by a practitioner from fact to principle. Many problems of mechanical, of psychological and of philosophical interest are involved in what seems to be the simple art of design. Illuminating suggestions are offered by the author for the solution of such problems, though he is careful not to commit himself to any particular school of thought. Gestures which seem to be innate for the artist, such as the use of scale and proportion, the materialization of ornament, the appreciation of colour and the realization of form, involve a series of elements which the author brings out and discusses with clarity and conviction.

It is in the third part of the book that the mutual process of discovering pure form is described by the consideration of a series of progressively complicated problems of accommodation. It is thus shown that the discovery of pure form is expression, but not art, and that the loss of purity in the form may be compensated for by its artistic elaboration, or by the incorporation with it of extraneous subject-matter by way of adornment. An excellent selection of illustrations gives an added emphasis to the aesthetic views put forward.

T. G.



## Nutrition and Health

TWO years ago the League of Nations set up a Mixed Committee on the Problem of Nutrition, consisting of agricultural, economic and health experts, and including representatives of the Advisory Committee on Social Questions, the International Labour Organisation and the International Institute of Agriculture. An interim report was published more than a year ago, in four volumes: the report proper, a report on the physiological bases of nutrition, and volumes entitled "Nutrition in Various Countries" and "Statistics of Food Production, Consumption and Prices", the latter being compiled by the International Institute of Agriculture, Rome. The interim report was devoted primarily to explaining the new conceptions which, in the opinion of scientific investigators, should govern human nutrition, to showing the effects of disregarding these rules, and to framing recommendations which might form the guiding principles of national nutrition policies. The economic and agricultural aspects of the problem, briefly referred to in the interim report, were reserved for further treatment, and the final report, which has now been published\*, is primarily concerned with them.

The report is divided into three parts: the first, which has three chapters, describes the activities of the Mixed Committee and of other international bodies working on the problem of nutrition, outlines the general trend of progress in nutrition and public health during the past century, and finally summarizes the contents and conclusions, reproducing also the recommendations published in the interim report. The second part is devoted exclusively to the health aspect of nutrition, and reproduces, with such minor modifications as recent research has made necessary, the section of the interim report dealing with nutrition and health. The third part, which constitutes the bulk of the report, deals with the economic and agricultural aspects of the nutrition problem: in its seven chapters the recent tendencies in food-consumption habits and in agricultural production are traced, the problem of food prices and the role of income in determining nutritional levels are analysed, and the part which education can play in determining food habits is considered: finally, a chapter is devoted to showing that in spite of the gradual improvement in nutrition which has taken

place in recent decades, malnutrition still exists in all countries, even in those with the highest general plane of living. The report is mainly concerned with conditions in Europe and countries with a Western civilization, since the Committee found that it would not be possible, in the time at its disposal, to obtain adequate documentation of conditions in the Far East; the Health Organisation is, however, taking measures to promote a full consideration of the problem of nutrition in this part of the world.

The advance in our knowledge of the principles of correct nutrition makes it possible to lay down with some precision what is an adequate diet in different circumstances. The report divides food-stuffs into two classes: (1) the protective foods, such as milk, glandular animal tissues, eggs, 'fat' fish, green vegetables and fresh fruit, which provide minerals, vitamins and 'good' (or animal) protein; and (2) the energy-bearing foods, such as fats, cereals and sugar. The basic figure for the energy requirement of the average adult, male or female, living an ordinary everyday life in a temperate climate and not engaged in manual work, is fixed at 2,400 calories net (that is, after deducting waste in cooking and at table) per day. It is suggested that 1,400 calories should be obtained from protective foods, and the use of highly milled cereals and an excessive amount of sugar in the diet is deprecated: special attention is directed to the value of the potato as a food rich in calories and in starch, which is particularly suited as a substitute for sugar and cereals in the modern European diet. Among the protective foods special emphasis is laid on the need for milk in the human dietary and on the value of fish liver oils as supplements for their content in vitamins A and D.

The report directs attention to the improvement in nutrition and public health during the past century, owing to the improvements in economic welfare and sanitation and to the advances in medical knowledge, and presents statistics to show that in all Western countries the average diet of the population has become increasingly diversified during recent decades, with a definite tendency, stronger in some countries than in others, but everywhere present, for the consumption of protective foods to increase, and for that of the purely energy-bearing foods, such as cereals and potatoes, to decrease. The changing content of the diet is not an accident: it corresponds to a genuine change both in physiological requirements and in the power to satisfy them.

\* Nutrition. Final Report of the Mixed Committee of the League of Nations on the Relation of Nutrition to Health, Agriculture and Economic Policy. (Official No. : A. 13, 1937, II, A.) Pp. 327. (Geneva: League of Nations; London: George Allen and Unwin, Ltd., 1937.) 7s. 6d.



The principal cause is the reduction in the expenditure of muscular energy, brought about by the increased mechanization of industry and agriculture and the reduction of the hours of work, and by the rise in the proportion of the population engaged in commerce, clerical work and other quasi-sedentary occupations. Simultaneously, mechanization has increased output per head and raised the purchasing power of all classes of the population. Nor must the improvements in the methods of production and distribution of agricultural products—for example, by the widespread use of refrigeration—be left out of account.

Although the diet of most Western countries has improved very considerably during the past twenty or thirty years, and consumption habits are tending to change along the right lines, yet the report adduces evidence that, even in those countries where the improvement in dietary habits has been most marked, the diet of a substantial proportion of the population remains deficient in essential nutritive elements. Reference is made to evidences of malnutrition, when the dietary needs of different classes of the population are considered, such as expectant and nursing mothers, infants, children and adolescents, as well as adults; whilst a special chapter at the end of the report gives statistical evidence for the statement that malnutrition still exists in countries of the most diverse social structure and stage of economic development. Such malnutrition need not result in the appearance of frank 'deficiency diseases' among the population; in fact, the report emphasizes that, although preventive action against such diseases as scurvy, rickets and beriberi is impressive, yet it is probably of less importance to the human race than the acquisition and application of such knowledge as will also improve the general condition and well-being of every man, woman and child, through the better choice, provision and utilization of foodstuffs.

Almost half the report is devoted to the effects of changing habits of food consumption upon agriculture and the economic aspects of the question of improving nutrition, including the relationship between food prices and consumption and factors affecting the former. It is pointed out that agriculture has had no difficulty in meeting the changes in food consumption which have occurred during the past few decades, and that the adjustments necessary in the future should not be impossible, although certain difficulties exist; moreover, the change in dietary habits to which the report looks forward will be steady and gradual. Although it is likely that the demand for the protective foods will rise, yet it is considered that a considerable increase in the consumption of foods of high energy value will be required to bring the

calorie content of the diet of certain sections of the population of a very large number of countries up to standards of adequacy. The increase in the demand for energy-bearing foods will more than counterbalance the decrease which accompanies an increased demand for protective foods. Also, as in the classical case of Denmark, a shift from exportation of cereals to dairying and animal husbandry need not mean a reduction in cereal cultivation; in fact, the output of cereals was increased owing to their demand for animal feed.

The obstacles in the way of adaptation of production to the new consumption trends are shown to be natural conditions, the conservatism of producers, commercial policy and penury of capital, as well as the perishable nature of many of the protective foods; wise and sympathetic consideration will overcome many of them. It is pointed out also that the contribution of agriculture to improved nutrition has not been merely adaptive only. The application of science to agriculture has produced a technical revolution parallel to, though less spectacular than, the industrial revolution. Mechanical processes have replaced hand-labour and the application of biological and chemical science has resulted in the improvement of both plants and animals or animal products used for food. Thus the breeding in Canada of Marquis wheat, which ripens early, has added 100 million acres to the potential wheat belt of Canada alone, by extending it northwards, and the annual milk yield per cow in most countries has been enormously increased. Even if, during the next five years, no further new discoveries were made but intensive national efforts were concentrated on securing the application of existing knowledge, the results on agricultural prosperity and nutritional standards would be enormous.

Turning now to the influence of food prices upon consumption, the report points out that the relationship varies in the case of different foodstuffs. Thus the demand for butter is elastic, consumption increasing markedly in recent years in countries where the price has been relatively low; in Great Britain during the years 1923-33, whatever the price prevailing, a rise or fall in the price of butter of 1d. per lb. decreased or increased demand by 39,000 cwt.; and a rise or fall in the price of cheese of 1d. per lb. similarly decreased or increased demand by 133,000 cwt. The 'elasticity', therefore (that is, relation of proportionate change in demand to proportionate change in price) was greater when consumption was low (and prices high) than when consumption was high (and prices low). In the case of milk, the response of consumption to changes in price has been found to be fairly low; and the same is also true of cereals. The demand for bread is inelastic, since the first



desire of the consumer is to satisfy his hunger ; and even though bread prices are kept high, bread generally still remains the cheapest way of doing this. Paying more for the bread he eats is equivalent to a reduction in the real income of the consumer, with the result that his purchases of the higher-priced protective foods are restricted, with consequent deterioration of the diet.

Evidence is adduced, in the chapter on the relation of income to nutrition, that usually the sources of 'good' protein and foods rich in minerals and vitamins are more expensive than the purely energy-bearing foods. This applies particularly to fruit, vegetables, meat, fish and eggs ; while dairy products—also 'highly' protective—occupy an intermediate position. These foods, though expensive as sources of calories, are relatively cheap as sources of minerals and vitamins ; their expense, however, militates against their consumption by the poorer sections of any community. With rising income, calories are purchased from more varied and expensive sources, which are usually more nutritive ; thus a steady increase in the percentage of both proteins and calories derived from animal sources has been found to accompany a rising income per consumption unit. The evidence for the existence of malnutrition in many countries is supplemented by studies of the cost of adequate diets, which

disclose the fact that the incomes of the poorer sections of the population are actually insufficient to provide their members with a minimum adequate diet.

Finally, the report gives consideration to methods of improving nutrition ; it insists, in the first place, that the problem must be recognized as one of primary national importance. It recommends the establishment in each country of National Nutrition Committees, containing scientific investigators, economists, agricultural experts, consumers' representatives, teachers and administrators, which would initiate investigations into the facts of nutrition, educate the consumers and make recommendations for improving the national diet. The report recommends the extension of social legislation for the protection and improvement of the health of the people, and directs attention to the value of school meals and to methods for increasing the consumption of milk. Policy must also be directed towards helping the orderly expansion of agriculture and its adaptation to the changing demand ; at the same time, attention must be given to improvement of transport and distribution, with the view of reducing the margin between the price received by the producer and that paid by the consumer. Adequate nutrition must be one of the factors considered by each country in determining its economic policy.

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## Investigation of the Upper Air

AT the Nottingham meeting of the British Association a discussion on the upper air which was held on the morning of September 6 was preceded by a demonstration of the ascent of a sounding balloon, organized by Prof. D. Brunt. The demonstration attracted the attention of large numbers of members of the Association, as well as of the general public. The balloon carried a Dines meteorograph, recording pressure, temperature and humidity at all stages of the ascent. The instrument was attached to the balloon by a Baker release, which consists of a small aneroid box with a catch capable of being set so that it is released from the balloon at any desired height. In the demonstration the catch was set to liberate the instruments at a height of about 12 kilometres.

The instruments were in fact released from a height of 12.3 km., and were found 4 miles east of Grantham and returned to Kew Observatory in good condition. The record of the meteorograph showed that the balloon had probably entered the stratosphere at a height of 12 km., where the

temperature was  $-55^{\circ}\text{C}$ . The temperature fell steadily through the whole range of height attained, except in a layer from  $\frac{1}{2}$  to 1 km. above the ground, where it increased by about  $1^{\circ}\text{C}$ . The record of humidity, which was probably only reliable in the lower half of the ascent, showed no features of particular interest. The general features of the temperature record agreed with those shown by the aeroplane ascent at Mildenhall on the same morning.

In the subsequent discussion in Section A, Prof. D. Brunt explained the division of the atmosphere into troposphere and stratosphere, and explained why frequent measurements of temperature and humidity in the free air are of importance to the forecaster. The method demonstrated before the meeting has the disadvantage that days or even weeks may elapse before the record of the Dines meteorograph, or any other instrument sent up on a free balloon, is available for study. The alternative method of upper air observation which is in general use in



meteorological services is that of observing from an aeroplane. This method is expensive and is restricted to those days when it is possible for an aeroplane to fly. In consequence, efforts are now being made to develop wireless methods.

Mr. L. H. G. Dines, of Kew Observatory, described the meteorograph in greater detail, and showed a number of specimen records obtained by its use. On account of the lightness of the instrument, it can be sent up with any other instruments used for the investigation of conditions in the upper air.

Prof. K. O. Lange, of Blue Hill Observatory, Harvard University, described a wireless transmitter which has been developed at Blue Hill, for use on balloons in conjunction with a receiver at the ground. The transmitter sends out waves of constant frequency, and the aim of the designer of the instrument is to replace the measures of the meteorological elements by time intervals. The meteorological instruments are an aneroid, a bimetallic thermometer and a hygrometer. Each of these instruments is equipped with a pen arm, and these pen arms, together with a fixed pen, slide over a small cylinder on which is wound a fine platinum wire in the form of a helix. The helix and the pens are wired to the transmitter, and the cylinder on which the helix is wound is rotated by a clockwork which makes two revolutions per minute. The contacts of the fixed pen with the helix bring the transmitter into action at regular intervals of  $\frac{1}{2}$  minute, while the pens attached to the meteorological instruments bring the transmitter into action at times which are determined by the readings of these instruments. The signals being recorded on the drum of a chronograph, the lags between the records given by the moveable pens and the fixed pen are readily estimated and converted into the readings of the corresponding meteorological element.

The instrument shown by Prof. Lange is extremely compact, being contained in a small wooden box, the external dimensions of which do not exceed 8 in.  $\times$  4 in.  $\times$  3 in. This method is now being adopted at some of the upper air stations in the United States, instead of the aeroplane ascents which have hitherto provided the data required for weather forecasting. It is likely that the same or similar instruments will be in general use in many parts of the world within a few years, in view of the saving of money, combined with the enormously increased frequency of observations, which will be obtained when this method supplants the aeroplane. The use of such instruments will open up the possibility of obtaining observations of the conditions in the central part of depressions and in other conditions when it is impossible for an aeroplane to make an ascent, as in rain or fog.

Prof. F. A. Paneth, in continuing the discussion, explained the methods by which he and Mr. Dines had obtained samples of air at high levels in the atmosphere, and showed some of the results of analysing these samples. The most interesting result so far obtained is the apparent increase in the proportion of helium present in air at levels of 25 km. and upward, indicating a tendency for the component gases of the atmosphere to separate out according to their molecular weights at such levels in the atmosphere. Further observations will be required before this can be accepted as conclusively proved. Prof. Paneth emphasized the importance of analysing samples of air from high levels for their water-vapour content. In view of the fact that nearly all the radiation and absorption of long-wave radiation in the atmosphere are produced by water vapour, it is of the greatest interest to meteorologists to know how much water vapour actually is present at high levels in the atmosphere. D. B.

## The Percy Sladen Expedition to Lake Titicaca\*

By H. C. Gilson, Leader of the Expedition

SINCE April 14, the day after the arrival of the main body at Puno, the Expedition has been established in a hacienda (Camjata) on the peninsula of Capachica, which bounds the north side of Puno Bay (see Fig. 1). The first fortnight was spent settling in, arranging laboratory

accommodation, and transporting all our numerous cases of apparatus and equipment out from Puno, a four-hour trip by motor launch. During this time a good deal of miscellaneous collecting was done in the ponds and streams of the peninsula, but it was not until the beginning of May that work on the lake could be started in earnest. Since then routine hydrographical and chemical observations

\* See also the article by Prof. J. Stanley Gardiner in NATURE of Feb. 27, 1937, p. 353.



have been made at a station about four miles out from the anchorage, besides numerous trips farther afield. An intensive faunistic and ecological study has been made of the anchorage and neighbouring bays, also supplemented by expeditions to other shores of the lake.

The hydrography of the lake is somewhat complicated, and no certain conclusions as to the water movements can be drawn from our work as yet. It can be seen from Fig. 2, which shows temperature profiles for the same station at different dates, that during the two and a half months of our observations there has been a steady loss of heat from the lake as a whole. At the same time the thermocline has moved down from 60 metres to 100 metres and its temperature difference has decreased. The causes of these two changes are presumably to be found in the considerable radiation which occurs during the nights, which are almost always clear at this season, and in mixing by the wind. The latter has not been strong, averaging 9.4 m.p.h. in May, 8.8 m.p.h. in June, and 9.5 m.p.h. in the first half of July, but higher velocities have probably been reached for short periods in July than in the preceding months.

The lake water is distinctly alkaline, the *pH* varying from about 8.5 in the surface layers to 7.75 at the bottom. It has a comparatively high content of solutes, the chloride alone ranging from 245 to 250 parts per million. The alkali reserve shows small variations about 0.0023 *N*, being generally rather lower in the illuminated zone. Of the nutrient salts, silicate ranges from 300 mgm. to 800 mgm. Si per cubic metre in the photosynthetic zone, and rises to 2,000 mgm. Si in the

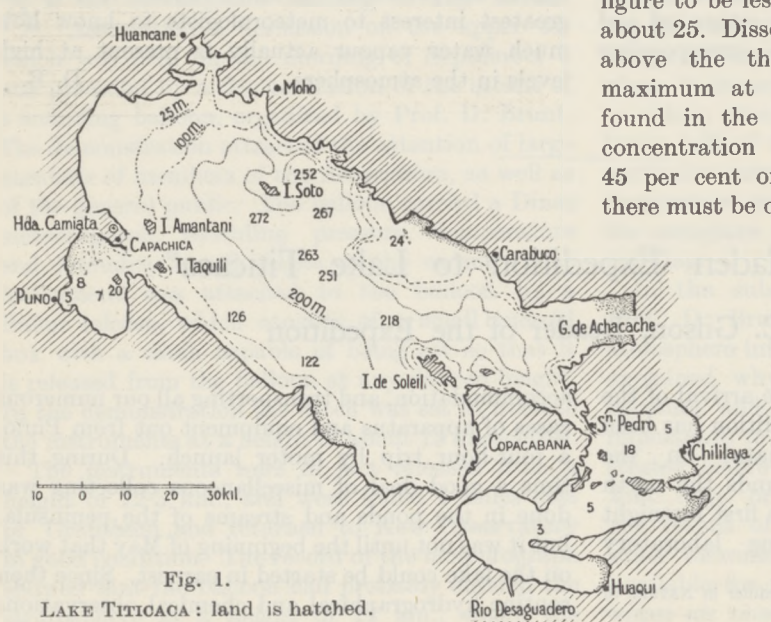


Fig. 1.

LAKE TITICACA: land is hatched.

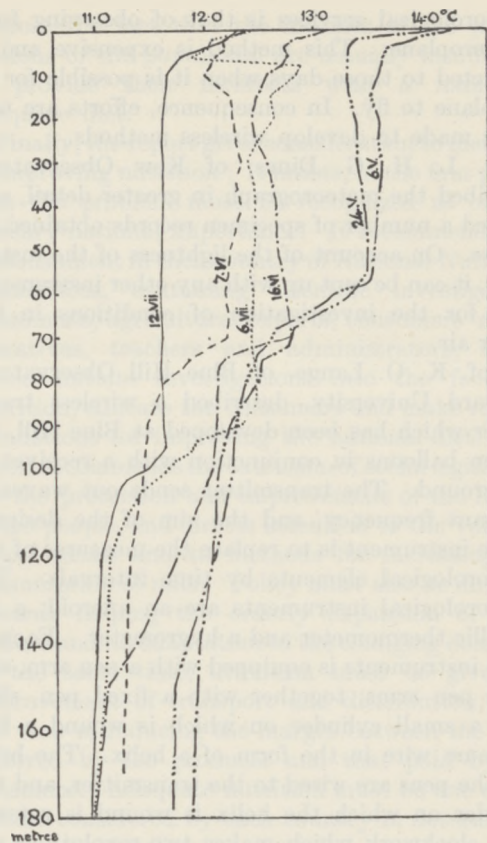


Fig. 2.

TEMPERATURE PROFILES AT A STATION IN LAKE TITICACA.

depths; phosphate shows a similar reduction in the surface layers where it never exceeds 15 mgm. P/m.<sup>3</sup>, but depletion by the plankton is by no means complete, as we have never found this figure to be less than 7; in deep water it rises to about 25. Dissolved oxygen approaches saturation above the thermocline, frequently showing a maximum at 5 or 10 metres, as is commonly found in the sea. Below the thermocline the concentration is lower but never falls below 45 per cent of saturation, which suggests that there must be complete circulation at some time of the year. An experiment with raw plankton gave the 'compensation point' at 13 metres, but the true level is probably somewhat lower.

Plankton is abundant, the principal plankton animal being a species of *Diaptomus*. Early in the season a daphnid was also present in considerable numbers but later gave place to a small chydorid. Several species of rotifer are also common. The dominant phytoplankton forms



are a diatom and a colonial green alga resembling *Dictyosphaerium*. The latter is abundant at all depths down to 50 metres; the diatom is found alive down to 15 metres, but below this there are only dead shells. The less common forms show an interesting vertical distribution. Thus from 10 to 20 metres *Lagerheimia* sp. (Chlorococcales) and *Chlamydomonas* sp. occur; from 20 to 30 metres *Oocystis* sp. (Chlorococcales) is found and *Peridinium* sp. in small numbers; from 30 to 40 metres the *Peridinium* is common with *Staurastrum* sp. (Desmidiaceæ); from 40 to 50 metres there is little alive except the *Dictyosphaerium* and *Peridinium*.

Round the shores the rooted vegetation varies considerably with depth, exposure and type of bottom. In all sheltered places where the depth is between 1 and 4 metres, such as the major part of Puno Bay, there is a thick growth of "tortora" (*Scirpus riparius*). Underneath this and elsewhere is a mixed smaller vegetation which shows a marked zonation with depth. Thus in moderate shelter from 0.2 to 0.5 metre *Zannichellia* sp. is dominant; from 0.5 to 8 metres there is a mixed vegetation of *Potamogeton*, *Elodea* and *Myriophyllum*; from 8 to 13.5 metres *Chara* sp. is dominant; from 13.5 to 17 metres this is replaced by a moss. With greater exposure the zones tend to be shifted downwards, perhaps owing to the harder bottom and consequently clearer water found there.

The fauna of the lake is rich in individuals, but species are not numerous. No Isopoda, Neuroptera, Plecoptera, Hydrometridæ or Gerridæ have been found.

In the "tortora" swamp occur *Notonecta* and the water beetles *Agabus* and *Trophisternus*. The same species of these genera are also present in ponds near the lake. In the belt of low-growing weeds which fringes the shores down to a depth of about 10 metres, the most abundant animals are several species of *Hyaella* (Amphipoda) and *Littoridina* (Mollusca). Besides these, *Turbellaria*, *Oligochæta*, *Platyaphius* (a ramshorn snail), *Ancylus* (a freshwater limpet), *Pisidium*, *Sphaerium*, leeches, water mites, Corixidæ and the larvæ of caddis flies, Chironomidæ and dryopid beetles are usually found. A green sponge is common, growing on plant stems. A similar fauna is present in the shallow lagoons near the north end of the lake.

On bare stony bottoms *Hyaella* is dominant, as many as 1,500 having been counted to the square foot. Below the 10-metre line the bottom is usually muddy and contains *Platyaphius* and *Hyaella* (different species from those in the weed), *Pisidium*, leeches, chironomid larvæ and sponges.

There are in the lake a number of species of

*Orestias* (a Cyprinoid fish), a large catfish, and an aquatic frog (*Cyclorhamphus*). The catfish is also found in the larger rivers which run into the lake, and in these it is fished commercially.

In the smaller streams near the lake and the headwaters of the rivers are numerous beetles, larvæ of dragonflies and mayflies, *Planorbis*, *Sphaerium* and *Hyaella*. The same species of *Planorbis* has been found near Cuzco in the Amazon basin; and the same, or a closely related, species of *Hyaella* as far down as Quillobamba

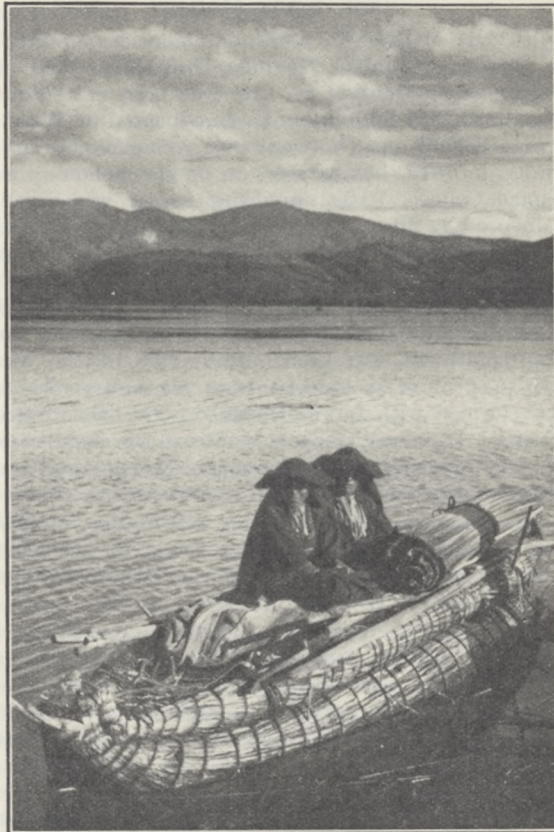


Fig. 3.

NATIVE BOAT WITH WOMEN WEARING A TYPE OF HAT COMMON IN COUNTRY DISTRICTS NEAR LAKE TITICACA.

(3,600 feet) in the Amazon basin, as well as at San Antonio (15,500 feet) in the Pacific drainage area. In some of the temporary ponds near our base a species of *Estheria* (Conchostraca) was abundant until they dried up.

Besides the field work, the results of which are very briefly summarized above, a good deal of laboratory work has also been done. Hinton has worked out the life-histories of nearly all the important insects, besides making extensive collections of the terrestrial insect fauna. Collections have also been made of many of the birds and their parasites.



I am much indebted to all my colleagues for their wholehearted co-operation in all the work of the Expedition and for much of the information contained in this article. We are also indebted to Señor Carlos Landaeta B. for allowing us to

use the Hacienda Camjata as our base, and to the officials of the Peruvian Corporation in Puno and Arequipa for arranging our food supplies and helping us in innumerable other ways. We gratefully acknowledge the help thus afforded the Expedition.

## Obituary Notices

### Prof. Frank Morley

**FRANK MORLEY**, professor emeritus of mathematics at Johns Hopkins University, died at Baltimore on October 17. He was born in 1860 at Woodbridge in Suffolk, and was educated at Woodbridge School until he went into residence at Cambridge in 1879, having won an open scholarship at King's College. His university career was sorely hampered by illness. He did not graduate until 1884, a year later than the normal date, eighth in the list when G. B. Mathews was senior wrangler and A. N. Whitehead fifth. Ill-health beyond all doubt had prevented him from doing himself justice, but the disappointment was keen. In middle life he was loth to speak of his student days, yet the friendships then formed with Lowes Dickinson and others were lasting. It is saddening to contrast the conditions of sixty years ago with the encouragement and the opportunities that are offered to a clever boy to-day.

For three years after leaving Cambridge, Morley was a master at Bath College. Then, by the good offices of Dr. Rendel Harris, Morley (whose parents were Quakers) became professor at the Quaker College of Haverford, Pa. From then onwards his home was in America. The hardships of his earlier years were behind him; his health no longer caused him anxiety, though he was always cautious; he married, feeling that his position was assured, and lived in Haverford for twelve years, years of great happiness, during which his powers and his reputation steadily increased. His closest mathematical associations were with two Cambridge professors at the neighbouring college of Bryn Mawr, Charlotte Scott from Girton College, one of the foremost of the younger geometers, and James Harkness of Trinity College, who collaborated with him in his first book, a treatise on the theory of functions published in 1893, and reissued six years later in a shortened and much improved form as an introduction to that subject.

In 1900, Frank Morley accepted the professorship of mathematics at Johns Hopkins University, Baltimore; this he held until he reached the age of retirement nearly thirty years later. His election to this famous chair, always associated in Britain with the name of J. J. Sylvester, was an honour that could scarcely be surpassed. Other honours were bestowed upon him as the years passed by; they will not be catalogued here. He filled his high office and performed its duties with dignity and distinction.

At Johns Hopkins the work was more onerous and the responsibilities were greater than at Haverford; it is not unreasonable to feel regret that Morley's output of original papers was thereby lessened, for it is in these that his most characteristic work is to be found. As a boy and a young man Morley had shown exceptional promise as a chess-player; throughout his life he could grasp the possibilities of a position at chess or of a hand at cards with astonishing ease and certainty. He had something of the same power in discussing a geometrical configuration, for he proved, not once but many times, that he could penetrate more deeply into its inner significance than the rest of us.

There can be no doubt that the life Prof. Morley loved best was the quiet life of the student, a simple home life with friends near at hand. His elevation to the prominence of the professorship at Johns Hopkins University was a well-deserved honour, but whether it added to his happiness is doubtful. He never allowed himself to lose touch with England; it was his habit to come in alternate years, but after his retirement in 1928 he came every year; always if possible making a stay at both Woodbridge and Cambridge. A few years ago he was stricken with a serious illness while at sea on the way to England, and never wholly recovered his strength. This year he had a heart attack at sea while returning to America, and died peacefully soon after reaching his home at Baltimore.

Prof. Morley leaves a widow and three sons, all of whom were Rhodes scholars at Oxford.

HERBERT W. RICHMOND.

### Prof. H. Jacobi

THE death is reported of Prof. Hermann Jacobi, emeritus professor of Sanskrit in the University of Bonn, which took place at Bonn on October 20 at the age of eighty-seven years.

Jacobi's early researches relating to Indian culture and religion dealt with the then little understood cult of Jainism. When quite a young man he accompanied Dr. Buhler, who was a member of the Bombay Educational Service, to Jaisalmer and other centres of Jain learning. He then made a profound study of the cult; and in consequence it was he who was mainly instrumental in securing the recognition in Europe and America of Jainism as an important religious system quite independent of Buddhism, of



which it was then supposed erroneously to be a mere offshoot. His translation of the Jain Sutras appeared in the Sacred Books of the East edited by Max Müller; and in 1879 he published an edition of the Kalpa Sutra, the recognized manual of the community, with an English introduction. He also edited three important Prakrit texts, which appeared at intervals between 1883 and 1923 in the "Bibliotheca Indica". He was the first to give Apabhramsa texts, which mark the transition from Prakrit to modern languages. His collection of Jain tales (1930) is in general use as a text-book. In 1913 Jacobi revisited India to lecture before the University of Calcutta on Indian rhetoric. His reception by Jain pandits on that occasion not only threw open to him material usually not accessible to foreigners, but also manifested the high esteem in which he was held in the Jain community.

Jacobi's contributions to Sanskrit learning were no less important and covered a wide field, including the study of the Indian doctrine of poetics, the Ramayana and Mahabharata, to which he is the most authoritative guide, and Indian chronology, a subject in which his studies in the *Indian Antiquary* of 1888 and *Epigraphica Indica* of 1892, with further tables published two years later, are the fundamental calculations for all later work. In comparative philology he developed important theories as regards the characteristics of certain Asiatic languages as compared with the Indo-European group. He was also an authority of the first rank on Indian philosophy, an important study being "The Origin of Buddhism from the Sankhya Yoga" (1896).

Jacobi's eminence as an Oriental scholar was recognized on the occasion of his seventy-fifth birthday, on February 11, 1925, when he was the recipient of a volume of contributions from forty-seven prominent Orientalists, among whom Britain was represented by Sir George Grierson, Dr. F. W. Thomas and Prof. R. L. Turner.

#### Mr. A. B. Brewster

WE regret to record the death of Mr. A. B. Brewster, formerly Governor's Commissioner of Colo, North and East Fiji, which took place at Bath on October 13 at the age of eighty-two years.

Adolph Brewster Brewster was born in Melbourne and educated in England. On his return to Australia, with his father in 1870 he took up a land grant in Fiji from the Polynesian Company, which had acquired a large concession of land around Suva from King Cakobau (Thakombau). On the failure of his venture in cotton and sugar planting, he entered the Fijian Civil Service in 1884, and served until his retirement in 1910.

Later, as Governor's Commissioner of the mountain provinces of Vitilevu, Brewster acquired an intimate and sympathetic knowledge of the wild mountaineers and their customs, of which he gave a vivid and detailed account in his book "The Hill Tribes of Fiji". He was also the author of "King of the Cannibal Islands", which appeared recently. It was through

a letter written by him to *The Times* that the war club presented to Queen Victoria by King Cakobau was returned to Fiji in 1932 to serve as the mace of the Legislative Council. A further service to Fijian studies, for which posterity will be grateful, was the compilation of a manuscript record of a native version of the organization of Fijian society, which was undertaken at his request by a native clerk, preserving a tradition which otherwise would have died out.

#### Mrs. F. Ll. Griffith

WE regret to record the death of Mrs. Griffith, widow of the late Francis Ll. Griffith, professor of Egyptology in the University of Oxford, which took place at Oxford on October 21 at the age of sixty-four years. Mrs. Griffith became interested in Egyptology after a visit to Egypt in 1906, and studied under Prof. Griffith, whom she married in 1909. From that time onward she was closely associated with her husband in his archæological and linguistic studies, and accompanied him on his expeditions of archæological investigation in Egypt, Nubia and the Sudan in 1910-13, 1923, 1929 and 1930. After his death in 1934, she devoted herself to superintending and herself working at the numerous undertakings which he had planned, but had left uncompleted. She had already published two volumes of the "Demotic Graffiti in the Dodecaschœnus", of which the seventy plates were prepared by herself. She also actively supported by the expenditure of time and money the further excavations at Firka and Kawa in the Sudan in connexion with the Oxford Excavations in Nubia, a trust which had been founded by her husband in 1910.

MR. HERBERT WILLIAM ENGLAND, who died at the age of fifty-five years on October 30, had for nearly forty years been in charge of the departmental library of the Zoological Department of the British Museum (Natural History). Mr. England possessed an unrivalled knowledge of zoological literature and will be greatly missed by the many zoologists at whose disposal his knowledge and his ability in tracing obscure references were freely placed. He entered the Museum service as a boy attendant in February 1898 and attained the rank of higher grade technical assistant in 1932. Among his colleagues his kindly, helpful and generous character was well known, and the high regard in which he was held in the Museum is illustrated by the fact that he was one of the three recipients among the Museum staff of the King's Coronation Medal.

WE regret to announce the following deaths:

Sir Joseph Isherwood, Bt., who devised the longitudoal framing method for the construction of cargo boats and tankers, on October 24, aged sixty-seven years.

Prof. J. B. Senderens, *correspondant* of the Section of Chemistry of the Paris Academy of Sciences and honorary fellow of the Chemical Society, aged eighty-one years.



## News and Views

### Nobel Prize for Physics

THE formulation of de Broglie's wave-particle theory in 1924 and its experimental verification in 1927 by Dr. C. J. Davisson at New York and Prof. G. P. Thomson at Aberdeen mark an outstanding epoch in the history of physics. With the award of the Nobel Prize for Physics for 1937 to Dr. Davisson and Prof. Thomson just announced, all three are now in the select ranks of Nobel prize winners. The scattering of an electron beam was first studied by Campbell Swinton so far back as 1899, and had it not been for the fact that he used a polycrystalline instead of a single crystal reflecting surface, he might well have discovered the wave-like interaction of electrons with matter. The results of the many further observations on the scattering of electrons were all found to be in accordance with classical or quantum mechanics until, in 1921, Davisson and Kunsman recorded directions of preferential scattering of an electron beam from a polycrystalline surface which, however, they explained in terms of pure particle mechanics. Although L. de Broglie had formulated his theory associating wave systems with moving particles in 1924, it appears to have been rather the stimulus of an accidental observation which led C. J. Davisson and L. H. Germer to study the scattering of slow electrons from the surface of a single nickel crystal, and in March 1927 they gave a preliminary summary of their results. This was followed in December of the same year by a more complete account, which established for the first time the wave properties of moving electrons, in agreement with de Broglie's theory.

MEANWHILE, in Aberdeen, G. P. Thomson and the late A. Reid, unaware of Davisson and Germer's experiments, had been studying the scattering of fast electrons by thin films, and in May 1927 they published an account of the diffraction of cathode rays by a thin film of celluloid, illustrated by a photographic record of the distribution of the scattered electrons. It is interesting to note that here again, although he was acquainted with de Broglie's theory, it was not so much this as certain anomalous results relating to the scattering of electrons in helium observed by Dymond, and Thomson's own experiments on the scattering of positive rays in gases, which afforded the main stimulus to the carrying out of his experiments. Shortly afterwards, Thomson published the results of further experiments on the diffraction of fast electrons by thin metal films which quantitatively confirmed de Broglie's relationship. Since 1928, Davisson and Thomson have, with their respective collaborators, greatly extended their epoch-making researches, and to Thomson is due the merit of having early recognized the outstanding possibilities in the study of surface problems of electron diffraction by fast electrons with photographic

recording of the scattering angles. To-day the electron diffraction camera ranks with the microscope, the spectrograph and X-rays as an indispensable unit in the well-equipped chemical or physical laboratory.

### Nobel Prize for Chemistry

Prof. W. N. Haworth, of Birmingham, and Prof. Paul Karrer, of Zurich, have been awarded jointly the Nobel Prize for Chemistry for 1937. Prof. Haworth is Director of the Chemistry Laboratories of the University of Birmingham, now provided with the most modern chemistry department in Great Britain through a generous benefactor who has recognized the value and possibilities of Prof. Haworth's investigations. He is a Davy medallist of the Royal Society and Longstaff medallist of the Chemical Society. For many years his name has been associated with outstanding results obtained in his laboratories in the elucidation by chemical and physical methods of the constitution of substances of biochemical importance, particularly the sugars and polysaccharides and, more recently, as the notice of the award indicates, with the synthesis and determination of the constitution of the antiscorbutic vitamin C to which he assigned the name of ascorbic acid. With this later work, other names are also associated, particularly those of Prof. A. Szent-Györgyi, who has received the Nobel Prize for Medicine, and Prof. E. L. Hirst, of Bristol, who has long been associated with Prof. Haworth. Prof. Haworth's name will remain outstanding in classical organic chemistry. The success of his work is due in no small measure to his great ability in organizing and leading a team of loyal collaborators, which call forth qualities as necessary in modern chemical investigations as those required for carrying out the investigations themselves. Of this loyal collaboration Prof. Haworth has never ceased to express his appreciation whenever he has had occasion to describe the results of investigations in laboratories of which he has had charge.

Prof. Paul Karrer has published many papers on vitamins A and B and related compounds; he also confirmed the constitution ascribed to ascorbic acid by Szent-Györgyi. Karrer is perhaps best known for his investigations on the carotenoids, of which  $\beta$ -carotene acts as the chief precursor of vitamin A in the animal body, although  $\alpha$ - and  $\gamma$ -carotene and cryptoxanthine can also act as pro-vitamins to a certain extent. More recently he has turned his attention to vitamin B<sub>2</sub> and the chemistry of the flavins, one of which, lactoflavin, is a part of the complex originally described as vitamin B<sub>2</sub>, and also a part of the yellow oxidizing enzyme, in which, as the phosphate, it appears to be combined with the colloidal carrier of the enzyme. Finally, in one of his most recent papers, he and Soloman describe the



isolation of some new sterols from the unsaponifiable matter of wheat-germ oil by fractionation by adsorption on a column of aluminium oxide; the fraction of unsaponifiable matter used was assumed to contain vitamin E.

#### Prof. Charles Fabry, For.Mem.R.S.

AFTER fifty years devoted to teaching and research, Prof. Charles Fabry is retiring from the chair he has held in the Sorbonne, Paris. In his scientific career, Prof. Ch. Fabry has been pre-eminent for his work in optics. His interferometric work, with his determination (with Pérot and Benoit) of the length of the standard metre in wave-lengths of the monochromatic radiation of cadmium, has long been classical. His studies on the spectrum of the iron arc, his pioneer work on the mercury arc lamp, and on the application of interferometry to spectroscopic research must also be recalled. To a somewhat later period belong his researches in photometry and astrophysics. The microphotometer he designed with Prof. H. Buisson, and his studies on photographic density also represent pioneer work in a field which has since seen a wide development along the lines he predicted. During recent years, Prof. Fabry's interest has turned towards meteorological optics. Under his direction, researches on the composition of the upper atmosphere and its ozone content are being carried on by a group of his pupils. Soon after the Great War, Prof. Fabry founded in Paris the Institut d'Optique, of which he is still director. The activity of this institution has been devoted to industrial optics as well as to scientific investigation, to teaching and to the designing of optical parts as well as to research. The *Revue d'Optique*, also founded by Prof. Fabry, is published by the Institut d'Optique.

PROF. FABRY is also a brilliant writer and a lecturer of no ordinary skill. His text-books on electricity, thermodynamics, photometry, written in an exceptionally lucid style, are classics in the French universities. As a lecturer he was, at the Sorbonne, unrivalled; generations of students have listened to his witty and genial lectures and marvelled at the clarity and directness of his exposition. He is also well known in English-speaking scientific circles and is a foreign member of the Royal Society. He has delivered the Guthrie Lecture and Thomas Young Oration before the Physical Society; he is an honorary member of many scientific bodies, and recently has been elected president of the International Council of Scientific Unions. The scientific jubilee of Prof. Fabry will be celebrated by a meeting to be held at the Sorbonne some time between November 23 and December 5, and the committee dealing with the arrangements has also approved the design of a Fabry Jubilee Medal, a replica of which can be obtained from the Secretary and Treasurer of the Committee, Prof. G. A. Boutry, Conservatoire des Arts et Métiers, 292 rue St.-Martin, Paris (3ème). It is also hoped to be able to publish in volume form some of Prof. Fabry's works, selected from his classical memoirs and from his unprinted researches.

#### Dr. Eric Ashby

DR. ERIC ASHBY, reader in botany in the University of Bristol since 1935, has been appointed to the chair of botany in the University of Sydney, Australia, in succession to Prof. T. G. B. Osborn. After leaving the City of London School, Dr. Ashby entered the Imperial College of Science in 1923, graduating in 1925. From this time dates the origin of his original investigations, which have been pursued steadily along two main lines: a quantitative study of the effects of the environmental factors and their interactions on the growth of *Lemna*, and the analysis of hybrid vigour. Papers on both these topics have appeared in the *Annals of Botany*. In 1929 he secured a Commonwealth fellowship and widened his scientific outlook by two years work in the United States. Shortly after his return he was awarded the D.Sc. of the University of London. Dr. Ashby has played a prominent part in the development of a quantitative ecology and has surveyed this subject in botanical reviews. His highly individual view on the nature of heterosis has aroused general interest if not general approbation. His point of view is succinctly expressed in a contribution to the Royal Society on the theory of heterosis. Dr. Ashby has served botanical science in various capacities on the councils of the Linnean and Ecological Societies, and as the joint secretary of the Society of Experimental Biologists. His great talents and enterprise have gained due recognition in securing at the early age of thirty-three years an appointment of such distinction.

#### Geological Society: Foreign Fellows and Correspondents

AT its meeting on November 3, the Geological Society of London elected as Foreign Fellows, Dr. W. A. J. M. van Waterschoot van der Gracht, Dr. W. J. Jongmans, Dr. A. Renier, and Dr. F. E. Wright, and as Foreign Correspondents, Prof. N. L. Bowen, Prof. R. M. Field, Baron F. von Huene, and Prof. H. Stille. Dr. W. A. J. M. van Waterschoot van der Gracht, of Heerlen, has made important contributions to our knowledge of the underground geology of the Netherlands, and has also published papers on economic geology, including coal and petroleum. More recently he has devoted attention to tectonic geology with special reference to North America. His review of the theory of continental drift formed the introduction to a symposium on that subject which was published by the American Association of Petroleum Geologists. He was director of the Rijksopsporing van Delfstoffen until 1917, and has been a Fellow of the Geological Society of London since 1898. Dr. W. J. Jongmans, director of the Geological Bureau of the Netherlands at Heerlen, has added much to the knowledge of Carboniferous stratigraphy. His publications on Carboniferous plants are well known, particularly those dealing with the genus *Calamites*. He is editor of the botanical section of *Fossilium Catalogus*, and was responsible for the volumes in that series dealing with the Equisetales and Lycopodiales. Dr. A. Renier, director of the Geological Survey of Belgium, has



also made numerous contributions to the stratigraphy and palæontology of the Carboniferous rocks, particularly of Belgium. His published works deal with, among other subjects, fossil plants, coal resources and tectonics. Dr. F. E. Wright of the Geophysical Laboratory, Carnegie Institution, Washington, has investigated the optical properties of minerals, including variations due to changes of temperature. He has also written on the petrological microscope and the surface features of the moon.

COMING to the new Foreign Correspondents, Prof. N. L. Bowen, of Chicago, formerly a member of the staff of the Geophysical Laboratory, Washington, is an authority on the crystallization of magmas and the evolution of igneous rocks. His work is widely known, and has had considerable influence in Great Britain. Prof. R. M. Field, of Princeton University, has carried out researches upon marine sediments, particularly of the West Indies, and has described the geology of the Bahamas. He has also compared the Ordovician succession in Great Britain and America. Baron F. von Huene, professor in the University of Tübingen, is well known for his studies of fossil reptiles, particularly those of the Trias and Lias. He has described forms from Central Europe, South Africa, North and South America, India, and Great Britain. His larger works include monographs on the dinosaurs and ichthyosaurs. Prof. H. Stille, of Berlin, is the author of numerous papers on the geology of Westphalia, Hanover and other parts of Germany, many of them dealing with the Cretaceous system. He has also made a special study of tectonic geology, both in its broader aspects and in relation to particular areas, such as the western Mediterranean.

#### The Royal Veterinary College and Hospital

THEIR MAJESTIES THE KING AND QUEEN opened on November 9 the new buildings of the Royal Veterinary College, Great College Street, Camden Town, London, N.W.1. A brochure issued to commemorate this event gives a brief history of the College, and an account of its reconstruction, with a description of the new buildings and of the work that will be carried on in them. The brochure is sumptuously produced, and is illustrated with a portrait of Charles Vial de St. Bel, the first principal (1791-93), as frontispiece, three views of the old College buildings, and a plan of the reconstructed College with views of some of its chief features. The old College has been demolished, and the new College block is rectangular in shape, with projecting wings facing Great College Street, the various departments being grouped around two internal courts separated by a central assembly hall. The Beaumont Hospital for Sick Animals and the Canine Hospital are situated to the west, and the Pathological Museum and Pathological Research Institute to the east, of the main block. Behind the Canine block are a reception stable, harness room, garage and workshop. Along the north-east boundary is the Ride in which horses are tested for soundness, horse-boxes, stores and

quarters for attendants. The post-mortem building with cold store, preparation room and laboratories adjoins the Ride. Future extensions planned when funds permit are the Large Animals' Hospital and a field station.

#### Society of Glass Technology: Twenty-first Anniversary

THE Society of Glass Technology began a two days' anniversary meeting on November 9 to celebrate its Coming of Age. The proceedings opened with a luncheon that was attended by the vice-chancellor of the University of Sheffield and Mrs. Pickard Cambridge, Mrs. F. Wood, Lord Cozens-Hardy, Mr. Geoffrey Pilkington, Mr. W. L. Chance and many other prominent glass manufacturers. In addition, the Society had as its guests four foreign delegates from the Continent, namely, Prof. A. J. de Artigas (Spain), Prof. G. Keppeler (Germany), Dr. B. Long (France) and Dr. H. Maurach (Germany). Of the eighteen original members who still retain their connexion with the Society, thirteen attended. The toast of the Society was proposed by Dr. A. W. Pickard-Cambridge, who spoke of the good effect of such scientific societies internationally and said he looked forward to a time when the University could do more towards developing the artistic side. He concluded by thanking the Society for its generosity in promising to contribute £2,500 towards the Elmfield Fund. The toast was supported by Prof. Keppeler (representing the Deutsche Glastechnische Gesellschaft) and Mr. S. B. Bagley, president of the Glass Manufacturers' Federation.

In the evening the presidential address to the Society was given by Prof. W. E. S. Turner, who reviewed the progress in the glass industry during the past twenty-one years. He showed how the development of machine methods, for which we have largely to thank America, has resulted everywhere in the displacement of skilled labour, so that the craftsman has been fighting a losing battle. On the following day a number of technical papers were read. The morning session was opened by the reading of congratulatory messages from members and friends from Germany, Belgium, Denmark, Italy, United States, Canada, and Africa, after which the status of honorary fellow of the Society was conferred upon Dr. H. Maurach of the Deutsche Glastechnische Gesellschaft (Germany) and Dr. Ross C. Purdy of the American Ceramic Society. Dr. Maurach, who with Prof. G. Keppeler represented the German Society then presented a congratulatory address, after he and a number of ordinary fellows had signed the roll. The address was contained in a magnificently engraved cylinder of glass mounted in silver at the ends of the work of Prof. von Eiff of Stuttgart, and was enclosed in a casket.

#### New Buildings for Glass Research at Sheffield

ON Tuesday, November 9, a ceremony having an element of novelty took place in connexion with the new buildings at present being erected for the Department of Glass Technology of the University of Sheffield. This was the laying of a foundation



block made of glass, weighing approximately four hundredweight. Mr. Geoffrey Pilkington, of Messrs. Pilkington Bros. Ltd., who cast the block, performed the ceremony in the presence of a distinguished gathering of civic and university authorities and prominent glass manufacturers. He said that he thought he must be the first to lay such a block, and referred to the considerable technical difficulties involved in its manufacture. Immediately previous to the laying of the block, Prof. W. F. S. Turner placed a glass casket containing appropriate records in a cavity in a wall of the building. He said, however, that as the Glass Research Delegacy was quite sure that the list of donors to the Building Fund enclosed was not yet complete, it was not proposed to seal either the casket or the cavity as yet. The pro-chancellor of the University, Lieut.-Colonel Sir Henry Stephenson, sketched the development of the Department from its birth in 1916, and Mr. Bagley, chairman of the Glass Delegacy, announced that of the sum required for the operations, only a further £7,000 now remains to be raised.

FOLLOWING the laying of the foundation 'stone' for the new buildings, the Wood Memorial Library was declared open by Mr. Bagley who, after a prayer of dedication from the Bishop of Sheffield, spoke in moving terms of the work of the late Mr. Frank Wood for the Department of Glass Technology, through the Glass Research Delegacy, of which he was chairman from 1923 until his death in 1934. A beautiful memorial window in stained glass executed by Messrs. James Powell and Sons to the design of Mr. J. Hogan, was then unveiled by Mr. Haslam Wood, son of Mr. Frank Wood. A portrait of Mr. Wood in the centre is supported on the left by scenes illustrating glass manufacture and on the right by others showing research and control. Above are the shields of the Universities of Leeds, London and Sheffield, with a glass furnace below them.

#### Sir Aurel Stein in Southern Persia

SIR AUREL STEIN described his latest and final journey of archæological reconnaissance in southern Persia before the Royal Asiatic Society and the Royal Central Asian Society on November 11. In recording his farewell to Iran, Sir Aurel mentioned that in five years he had covered close on five thousand miles on camel, horse and foot—a considerable achievement for any explorer, in view of the difficulties of climate, country and the dangers of tribal interference, but for a veteran past his eightieth year a feat of remarkable endurance. This last expedition, taking up its work where the expedition of exploration in Fars had come to an end in 1934, started from Shiraz in November 1935 and lasted until the autumn of 1936. Its itinerary included the plateau of Ardakhan, the Bakhtiari Mountains, Susa, the Saimareh River, to which four months was devoted, the little explored Pish-i-koh portion of Luristan, Kermanshah, the high mountain valleys of Persian Kurdistan, where an attempt to reach the border was unsuccessful, and the province of Urumiyeh,

where in the country between Zagros and the salt Lake Urumiyeh, prehistoric remains in the form of mounds, both great and small, far exceeded in numbers any encountered in previous stages of the journey. Here burials in abundance belonging to the second millennium B.C. were found; but difficulties of labour, of which the supply was permanently depleted during the Great War, prevented any extensive investigation. The expedition came to an end at an interesting point, when the reconnaissance was being carried out in the valleys leading down from Kermanshah to the Mesopotamian plains. Orders from Teheran, due to the possibility of difficulties with the tribes, and the incipient illness of the leader, prevented the completion of the programme as planned. Sir Aurel, however, has no ground for dissatisfaction in what had been accomplished. A notable tale of archæological discoveries of every period from prehistoric to early Mohammedan has been added to his laurels.

#### Archæological Exploration in Arabia

MR. H. ST. JOHN PHILBY opened up an attractive vista for archæological exploration in an account of his recent journey through Arabia before the Royal Geographical Society on November 15, when he suggested that the Sheban country might be the original homeland of the Phœnicians whose place of origin has not yet been determined. In the summer and autumn of last year Mr. Philby traversed Arabia from north to south, from the Mediterranean to the Indian Ocean, a journey of which there is no previous record, although he himself considers that it may have been a route followed at times in the days of the old spice trade. To the archæologist, the most interesting part of Mr. Philby's lecture dealt with his visit to the ancient Himyaritic capital of Shabwa, where, however, he found no evidence to support Pliny's statement, if the identification of that writer's Sabota with Shabwa be accepted, that it had contained sixty temples. The remains of one outstanding temple of supreme magnificence was found, with two ruin heaps within the walls, which one day may be found to contain temples. At the same time there is a possibility, in Mr. Philby's view, that Pliny may have been referring to the whole district of the 'two Shebas', which might well have possessed sixty temples in the days of its prosperity. In the heart of the desert two necropolises were discovered, forty miles away from the nearest wells to-day. Here there were thousands of circular tombs built up of untrimmed slabs of local limestone. The largest tomb was ten feet high and twenty-five feet in diameter. All the tombs had been rifled of their contents and in no instance was evidence of human burial discovered. Judging from the inscriptions, these tombs date from Himyaritic times or earlier. Similarities with cemeteries at Bahrain and in the central Arabian provinces point to Phœnician affinities; while certain signs among the inscriptions and rock engravings seem to stand half-way between pictographs and letters, recalling the reputed relation of the Phœnicians with the origins of the alphabet.



### Problems of Soil Erosion

FOR his Friday evening discourse at the Royal Institution, on November 12, Sir Daniel Hall took as his subject "Soil Erosion: the Growth of the Desert in Africa and Elsewhere". Soil, far from being stable, is easily set in motion by wind or rain if the cover of vegetation and the binding supplied by its roots and humus are unduly disturbed. Deforestation about the headwaters of the streams, followed by grazing by goats which prevent natural regeneration, has brought about the denudation of the hillsides in Levantine countries, has turned the river valleys into malarious swamps and choked the harbours at their mouths. Of recent years the duststorms that have swept across the United States represent the removal of the fertile soil from farming land west of the Mississippi, in many cases to such an extent as to cause the abandonment of the farms. It is not so much agriculture that is to blame, as the continuation of a wasteful system of farming and the breaking up of the sod on soils only fit for regulated grazing. Such wind destruction extends into Canada and has become serious in parts of Saskatchewan and Alberta.

IN Africa the problems of erosion by washing are becoming insistent. The native forms of agriculture are wasteful and depend upon moving on to fresh land every few years. With the growth of population that has followed the Pax Britannica, land is becoming insufficient for shifting cultivation, giving rise to land hunger and political unrest. Still more destructive is the custom, among the Bantu tribes in particular, of maintaining excessive numbers of cattle, sheep and goats, which are not used for food. Livestock has increased far beyond the capacity of the grazing grounds, and, with overstocking, erosion sets in. So far from affording opportunities for colonization, much of the best land in East Africa is rapidly wasting and leaving its inhabitants under a growing threat of famine. Sir Daniel exhibited photographs of the remedial measures that are being adopted, but it will be necessary to interfere somewhat drastically with tribal customs before the natives can be taught to practise a system of agriculture that will maintain the fertility of the land and allow of continuous production. Considerable expenditure is probably required in order to implement British trusteeship for the inhabitants of Africa who are now destroying their means of existence.

### Kashmir Earthquake of November 14

AN earthquake of some strength occurred on the afternoon of November 14 in north-western India, especially in the province of Kashmir. That it attained semi-destructive intensity (degree I of the Milne scale) is clear from the slight damage that occurred at Srinagar, Abbottabad, and other places. The earthquake is of interest chiefly from its association with more violent shocks in the same province. Within little more than a century, two earthquakes of Milne's highest order of intensity (III) visited Kashmir, one in 1828, the other in 1885. Another, of intensity II, occurred on December 4, 1865, in the district around Chamba (about 150 miles south-

east of Srinagar), and two others, of about the same intensity as the recent shock, in that near Srinagar on August 28, 1916, and January 20, 1931. Of these earthquakes, by far the most interesting is that of May 30, 1885, studied by Mr. E. J. Jones, of the Geological Survey of India, whose brief report is published in the *Records of the Survey* (18, 221-227). In the small meizoseismal area of this earthquake, containing about 47 square miles, the destruction of villages was complete and about 3,000 persons were killed. The next isoseismal includes Srinagar near its east end, and within it large portions of the towns and villages were thrown down. Abbottabad lies a short distance to the west of this isoseismal. Thus, it would seem that the origin of the recent shock may have been connected somewhat closely with that of its much stronger predecessor in 1885.

### Benefaction to Edinburgh Astronomical Association

THE Edinburgh Astronomical Association will shortly be in possession of about £25,000 under the will of the late Mr. J. H. Lorimer, the well-known artist. Mr. Lorimer had been a member of the Association since 1924, when the first general meeting of the Association was called. He served for a time as a member of council some years ago and later was elected vice-president. He was much interested in astronomy and in the Association, and regularly attended the Association's meetings. The Association has always had plans for development, but has been hampered in the past by the small income available. Now that this is to be much increased, the council is considering which in particular of the many possible schemes will best use the money for the benefit of astronomy. As yet the only decision made is to extend the Association's library. The objects behind further decisions are likely to be: to advance the science of astronomy and promote astronomical research, to circulate information on astronomical matters by publication and generally to encourage astronomical study and to increase popular interest in the science. Negotiations are being conducted with the view of using the Edinburgh City Observatory for research and education. This Observatory has not been in use since the death of the City Astronomer, Mr. J. McD. Field, in April of this year.

### Physical Fitness of University Students

THE University authorities at Leeds have introduced a scheme of medical examination and advice which should be of considerable assistance to students in the maintenance of their health while they are at the University. The scheme is on an entirely voluntary basis, but there is reason to think that it will be used extensively. A certain number of medical practitioners, resident in different parts of Leeds, are co-operating with the University for this purpose. A student who registers under the scheme (paying a nominal fee of half a crown) is entitled to go to one of these doctors, at his own choice, for examination and advice. The scheme is not intended to provide medical treatment for students, but rather to help them to avoid the necessity for treatment. In the past, members of the staff have always been ready



to advise and help students when any questions have arisen in regard to their health; the new scheme, however, by providing a simple form of machinery, will encourage students, whatever their present condition of health, to satisfy themselves of their physical fitness or be advised in good time of the measures they should take to become fit. Consideration is also being given by the authorities to the possibility of extending the facilities for physical training at the University. The students are naturally watching with keen interest these developments, which are taking place in consultation with the Union Committee.

#### Agricultural Marketing Policy

UNDER this head, Mr. A. N. Duckham, research officer to the Bacon Development Board, made a weighty contribution to the discussion on "State Intervention in Agriculture", which was held in Section M at the British Association meeting in Nottingham. In his view, recent marketing legislation is the offspring of the researches and inventions associated with the names of Liebig, Mendel, Faraday, Pasteur and others, and of the necessity for rectifying the imbalance between agriculture and manufacturing industries. The protective measures adopted by the marketing boards have helped to save British agriculture from chaos by reducing, through price stabilization, the speculative nature and insecurity of 40-50 per cent of home production, and by prompting improvements in agricultural business methods. Other beneficent activities of the boards have been the laying down of minimum quality standards, the standardizing of trade practices, and the institution of good market-intelligence services. Equally important have been the provisions made for controlling competition, for example, by limiting the number of sugar-beet factories, creameries, bacon factories, potato merchants and cattle markets. The savings effected by cutting out surplus capacity and operating the remainder at full load should, it is stated, reduce the price spread between farmer and consumer; and farmers should benefit by the practice of collective bargaining, which is one of the main objects of the Marketing Acts. A noteworthy feature of current policy is the statutory attempt to influence demand by 'consumption steering', that is, by means of differential prices and subsidies to consumers, by education, habit-changing and direct publicity. So far very little has been done in this direction, but, in the author's view, the success of current marketing policy will be largely governed by steering consumption more vigorously towards the produce of British soil. Planning and State intervention have come to stay, and their prospective effect will be to ensure stability of quality, supply and price.

#### Development of the Glasshouse Industry

A SERIES of papers delivered before Section M (Agriculture) of the British Association at Nottingham on September 6 dealt with the history and present-day practice of the growth of crops under glass. Mr. H. V. Taylor first indicated trends in the technique of plant forcing, from the early use of the cloche,

through the employment of frames and greenhouses, to the modern Dutch lights and 'aeroplanes' tomato houses. Dr. W. F. Bewley spoke upon "Science in Relation to the Glasshouse Industry". He showed how the increase in intensity of crop forcing, and the growth of produce out of its normal season, brings new problems of disease and of nutrition. Many examples of how these troubles have been overcome by the Cheshunt Research Station were given. Some of the investigations, as the work of Lloyd on control of the tomato moth caterpillar, and that of Speyer upon the control of white fly, are now classical, and the newer research maintains the high standard. A most welcome link with practice was provided by Mr. F. A. Secrett's paper on "The Production of Early Vegetables and Salads under Glass". The need for vegetables quickly grown on good soil, as a contribution to national health, was stressed. A suitable light soil, adequately manured, and a site with security of tenure and adequate water supply, are the first essentials. Heavy capital costs and labour charges are incurred, but Mr. Secrett's practical demonstration of commercial success is even more eloquent than his illuminating paper.

#### Fire-Immune Cable

A FACTORY, opened by Lord Ridley on October 12, for making fire-resisting cable called 'Pyrotenax', marks a new development which promises to be of far-reaching importance to the electrical industry. The insulating cover utilizes a new insulating material, magnesium oxide, the heat-resisting and other physical properties of which have been proved in connexion with boiling-plate elements, which are made of resistance wire embedded in the oxide. 'Pyrotenax' cable has a copper conductor, magnesia insulation, and copper sheath. The new technique enables continuous runs of this cable up to 300 yards to be produced. A piece of cable in series with a burning lamp can be hammered to the thickness of a sixpence without affecting the light. It is therefore mechanically robust. For all practical purposes the cable is immune from fire and would not contribute anything to a possible conflagration. Notable use has been made of 'Pyrotenax' cable in France. The Louvre, the *Normandie*, the Galleries Lafayette and the French railways use it. In Great Britain it has been adopted for the new lighting equipment of the Tate Gallery and for several industrial installations. The 'Pyrotenax' factory is practically 'all-electric' throughout, electric furnaces being used for all the annealing stages and for the dehydration of the magnesium oxide insulation. The rating of these furnaces is 250 kilowatts, and their temperature is controlled by a Cambridge thermostatic instrument. The factory is situated at Hedgely Road, Hebburn-on-Tyne. A full illustrated account appeared in the *Electrical Times* of October 21.

#### Electrical Accidents and their Causes

In a pamphlet issued by the Home Office (London: H.M. Stationery Office, 1937, 6d.) and written by H. W. Swann, H.M. Inspector of Factories, a report of electrical accidents for the year 1936 is given. The



report deals not only with accidents that have actually occurred but also with the large-scale methods for preventing danger and damage which have been discussed with the electrical industry. The total number of fatal accidents reported, 112, is satisfactorily small, and comparing it with previous years it indicates no marked variation from a steady mean. The variations in the numbers reflect the periods of industrial activity and depression. It is noted that there has been an increase in the number of accidents to male persons less than twenty-one years of age during the last five years. A feature of the electrical accidents is the large percentage (55 per cent) in which the injury was due to burns alone. Joining of metal by arc welding is rapidly becoming popular. Practically all the welding accidents (57) are cases of conjunctivitis (eye-flash) and none of them was fatal. Stress is very properly laid on the provision of suitable goggles for workers liable to be exposed to radiations from the arcs.

#### Vehicle Tests on Motor Roads

HIGHWAY engineers are interested in tests recently made by the German road authorities on the comparative efficiencies of motor roads and ordinary roads. An abstract of a paper on the subject is given in *Roads and Road Construction* of August. The results of the driving efficiencies obtained in two approximately parallel roads joining Bruchsal to Bad Nauheim, a distance of about 91 miles, are given. One of these was an *autobahn* road and the other a State road specially constructed for long-distance journeys which had been greatly improved during the last four years. The latter road was comparable in layout and surface condition with a Class I road in Great Britain. The tests were made with an ordinary high-powered car. On the State road, the journey took 2½ hours at an average speed of 44 miles per hour. On the motor road it took 1½ hours at an average speed of 74 m.p.h.; on the State road the average speed was only 56 per cent of the maximum speed of the car; on the motor road it was 92 per cent. On a second journey undertaken on the motor road at the same average speed as that attained on the ordinary road, the petrol consumption dropped from 5.5 to 3.1 gallons. Considering that on the ordinary road 351 cars were met and 158 overtaken, exclusive of bicycles and pedestrians, the feeling of safety is much greater on the motor road as there are no oncoming cars to avoid. The tests were made with a 3.21 Mercedes car. It is concluded that on the motor road you always arrive quicker at your destination than is possible on the ordinary road and consume less fuel. On this road also the safety is greater and the stress to which the driver and car are subjected is much less. Further experimental results are to be carried out on speed trials with other cars.

#### Kelvin and the Atomic Theory

IN his tribute to Lord Rutherford in *NATURE* of October 6, Prof. A. S. Eve states that Lord Kelvin died in unbelief of Rutherford's atomic theory. Mr. C. Turnbull, 21 Percy Park, Tynemouth, North-

umberland, has pointed out that this is incorrect. In his presidential address to the Physical Society (January 1936), Lord Rayleigh (p. 221) states that Kelvin argued emphatically with Rutherford and himself against the atomic origin of the energy. Rayleigh asked him to make a bet of five shillings that within three (or six) months he would admit that Rutherford was right. Within the allotted period Kelvin came round, and at the British Association he made a public pronouncement in favour of the internal origin of the energy of radium. He also produced the five shillings in settlement of the bet.

#### Announcements

THE Right Hon. Lord Riverdale has been appointed chairman of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research in succession to the late the Right Hon. Lord Rutherford of Nelson. Sir William H. Bragg has been appointed a member of the Advisory Council.

THE following have been elected as officers of the Cambridge Philosophical Society for 1937-38: *President*: Sir F. Gowland Hopkins. *Vice-Presidents*: Dr. C. G. Darwin, Mr. F. P. White, Prof. J. Gray. *Treasurer*: Dr. J. D. Cockcroft. *Secretaries*: Mr. A. H. Wilson, Dr. O. M. B. Bulman, Mr. J. A. Ratcliffe. *New Members of the Council*: Dr. N. Feather, Dr. C. F. A. Pantin, Mr. E. N. Willmer.

At the anniversary meeting of the Mineralogical Society held on November 4, the following officers were elected: *President*: Dr. L. J. Spencer; *Vice-Presidents*: Prof. P. G. H. Boswell and Prof. C. E. Tilley; *Treasurer*: Mr. F. N. Ashcroft; *General Secretary*: Lieut.-Colonel W. Campbell Smith; *Foreign Secretary*: Prof. A. Hutchinson; *Editor of the Journal*, Dr. L. J. Spencer.

At 6.57 p.m. (G.M.T.) on November 16, Flying Officer Clouston and Mrs. Kirby-Green arrived at Capetown from London, having flown the distance in 45 hours 2 minutes. The route taken was through Cairo, Khartoum, Broken Hill and Johannesburg. They have thus beaten the record set up by Miss Amy Johnson by 33 hours 23 minutes.

FOR the first time in history, a medical man in the person of Dr. Roussy, dean of the Paris medical faculty and well known for his researches on the nervous system, endocrinology and cancer, has been elected rector of the University of Paris.

THE Francis B. Garvan Gold Medal established by the American Chemical Society to honour outstanding women chemists has been awarded to Dr. Emma R. Carr, head of the Mount Holyoke Department of Chemistry. Dr. E. Bright Wilson, jun., assistant professor at Harvard University, has received the one thousand dollar award from the Society for his experimental work in physical chemistry.



## 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. 897.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## The Kinetics of Polymerization

A RECENT paper<sup>1</sup> on the kinetics of gaseous polymerization reactions appears to lead to some doubts concerning the interpretation of experiments in the liquid phase. It is now found that gaseous styrene is stable at temperatures up to 400° C., a result which seems inconsistent with the published data on the rate of polymerization of liquid styrene. The results of Schulz and Husemann<sup>2</sup> can be expressed by means of a unimolecular constant, given by

$$k_1 = 1.1 \times 10^7 e^{-21,000/RT} \text{ sec.}^{-1},$$

while Suess, Pilch and Rudorfer<sup>3</sup> find a bimolecular constant,

$$k_2 = 2.5 \times 10^6 e^{-21,500/RT} \text{ mol./l./sec.}$$

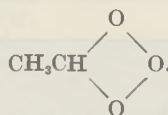
Further, Wassermann<sup>4</sup> has shown that the rates of a number of diene additions are the same in the gas phase and in solution, so that we can with some confidence employ the expressions above to calculate the rate of the gaseous polymerization.

At sufficiently high temperatures, the reverse process of depolymerization will become sufficiently important to mask the forward reaction. According to Blyth and Hofmann<sup>5</sup>, polystyrene is depolymerized on heating above 300° C., and up to this temperature the above formulæ should therefore hold. The calculated half-lives for the reaction at 300° C. and atmospheric pressure are 6 sec. and 46 min., and it is clear that there is a very large discrepancy between these figures and the results of Kistiakowsky. It is suggested in explanation that the liquid phase results refer to a catalysed reaction, the catalyst being in all probability a peroxide which may initiate chains by the formation of a complex<sup>6</sup>.

Definite evidence has been obtained that this is the case for vinyl acetate, which Kistiakowsky also found to be stable up to 360° C. in the gas phase. Starkweather and Taylor<sup>7</sup> found that the polymerization of liquid vinyl acetate at 101° C. could be represented by a first order constant,  $k = 5.0 \times 10^{-3} \text{ min.}^{-1}$ . Breitenbach and Raff<sup>8</sup> were unable to obtain consistent results in glass vessels, and Breitenbach<sup>9</sup> has attributed this difficulty to the presence of traces of moisture which react with the alkali of the glass to give sodium hydroxide. When the ester was dry, Breitenbach found that its rate of polymerization at 98° C. was only one hundredth of that found by Starkweather and Taylor. We have found that pure vinyl acetate does not polymerize measurably at 100° C., and believe the rates measured by the former authors to be due to the presence of peroxides.

Commercial vinyl acetate may contain a small amount of acetaldehyde<sup>10</sup> which in the presence of air

forms a peroxide, probably of the formula



Samples of vinyl acetate capable of polymerizing at 100° C. always gave a peroxide test, and the rate and extent of polymerization were found to be associated with the amount of peroxide present. It is perhaps significant that this substance can be eliminated by distillation with an efficient fractionating column but is by no means completely removed by careful vacuum distillation. It is probable that the role of the sodium hydroxide produced when the ester is moist is to saponify some of the vinyl acetate yielding vinyl alcohol, which is tautomeric with acetaldehyde. We may note further that aldehyde-free vinyl acetate does not polymerize at 100° C. even in the presence of oxygen: samples were shaken with air or oxygen for two weeks but remained stable when afterwards heated to 100° C. Identical results were obtained from supplies of vinyl acetate from two sources.

The study of the initiation of polymerization by aldehydes and oxygen is being continued and fuller details will be published in due course.

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- <sup>1</sup> Harkness, Kistiakowsky and Mears, *J. Chem. Phys.*, **5**, 682 (1937).
- <sup>2</sup> Schulz and Husemann, *Z. phys. Chem.*, **36**, B, 104 (1937).
- <sup>3</sup> Suess, Pilch and Rudorfer, *Z. phys. Chem.*, **179**, A, 361 (1937).
- <sup>4</sup> Wassermann, *Farad. Soc.*, General Discussion, September, 1937.
- <sup>5</sup> Blyth and Hofmann, *Ann.*, **53**, 315 (1845).
- <sup>6</sup> Gee and Rideal, *Trans. Farad. Soc.*, **32**, 666 (1936).
- <sup>7</sup> Starkweather and Taylor, *J. Amer. Chem. Soc.*, **52**, 4708 (1930).
- <sup>8</sup> Breitenbach and Raff, *Ber.*, **69**, 1107 (1936).
- <sup>9</sup> Breitenbach, *Z. Elektrochem.*, **43**, 323 (1937).
- <sup>10</sup> Blaikie and Crozier, *Ind. Eng. Chem.*, **28**, 1155 (1936).

## Phase Transformation in Locusts in the Field

IN 1921 Uvarov<sup>1</sup> enunciated the 'phase theory' to account for the swarming of locusts, a theory which postulated post-embryonic divergences in the pigmentation, structure and behaviour of members of the same species. This theory has since been proved by field observations and by experiment to be correct in a number of locust species, and in breeding experiments the changes were found to be due to the density of population of locusts<sup>2</sup>.



The question which has so far remained unanswered, however, is how the individuals of a population of solitary locusts in the field, less numerous than gregarious locusts, and without the 'gregarious instinct' of the latter, could encounter one another with sufficient frequency to bring about the change of the phase *solitaria* through *congregans* to *gregaria*. My investigations of the behaviour of the solitary phase of *Schistocerca gregaria* Forsk., on the Red Sea coast of the Sudan during last winter, have thrown some light on the mechanism by which this transformation occurs in the field.

For various reasons, the solitary 'hoppers' of the 4th and 5th instars tend to concentrate into patches of dense but uneven vegetation, which is usually unweeded millet cultivation. One of the most



Fig. 1.

A 'BASKING-PLACE' OF SOLITARY LOCUSTS AMONG UNWEEDDED MILLET CULTIVATION. A THERMOMETER WITH BULB EXPOSED TO THE SUN (APPEARING AS A WHITE LINE), AND A SMALL SCREEN SHADING ANOTHER THERMOMETER AND AN EDNEY PAPER HYGROMETER (TO THE LEFT OF THE FIRST THERMOMETER), ARE LYING ON THE BARE SAND OF THE 'BASKING-PLACE'.

interesting reasons for this is the existence of a visual attraction to the millet stands (probably perceived as dark objects), which I was able to demonstrate experimentally. Within the 'concentration zones' the absence of wind permits the sun's radiation, in conjunction with vegetation of very uneven height (Fig. 1), to produce a close 'patchwork' of different temperatures, humidities and light intensities. Small patches of bare ground, such as that shown in Fig. 1, constitute the warmest and driest situations available. Solitary hoppers are not as inactive as formerly supposed, and at certain times of day

they form loose basking groups on the bare patches. I was able to demonstrate that the formation of such groups must largely be attributed to the separate reactions of each individual to the temperature stimulus, as presented in the 'patchwork'. Without any gregarious instinct, the solitary hoppers are forced into association, simply because their numbers are large in relation to the number of bare patches available in the vicinity. This crowding of hoppers may have the same effects as breeding in densely populated cages, namely, changes in coloration, morphology and in the inter-reactions of individuals, so that the bare patches may be regarded as the birth-places of gregariousness, for without them the change of phase would probably be impossible, however numerous the locusts became.

It was also found that gregarious hoppers, whose cohesion in bands is maintained by some form of inter-attraction which is perhaps visual, were too active to remain together on the bare patches, so that the bands tended to break up in unweeded cultivation. Such vegetation is, therefore, on one hand indispensable to the production of phase *gregaria*, but on the other hand, fatal to the continued existence of this phase. The survival of the hopper bands and adult swarms of this phase is only made possible by their 'breaking out' of the environment which has engendered them.

Another interesting result, partly of field observations and partly of rough experiments, was that the direct relation between activity and temperature in temperature-adapted hoppers, is reversed in hoppers not adapted to temperature. Over a certain range, temperature-adapted hoppers are, of course, more active at higher than at lower temperatures, but the effect of sudden increase of body temperature is temporarily to depress activity, while sudden temperature decrease temporarily accelerates activity. This principle may have much wider applications.

A detailed account of these investigations will be published elsewhere.

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Oct. 17.

*Bull. Entom. Res.*, 12, 135-163 (1921).

<sup>2</sup> Faure, *Bull. Entom. Res.*, 23, 293-405 (1932).

#### Nomenclature of the Seasons

ONE frequently hears it said that the swallow passes the winter in South Africa, though a moment's reflection shows that it is summer in South Africa when the swallow is there. There appear to be no words for times of year, longer than a calendar month, applying to the whole world. Again, when one is trying to analyse periodic phenomena among organisms in the tropics, one is continually hampered by the lack of words denoting the seasons; for spring, summer, autumn and winter are meaningless near the equator. One may speak of the rainy and dry season or seasons, but the periods are often ill-defined. If one extends the words for the temperate seasons into the tropics, one cannot escape such absurdities as saying that in south-west Ceylon the winter is the hottest season. Such considerations as these have driven me, despite an aversion from all unnecessary complications of nomenclature, to suggest a series of eight new words.



Each of the first four words is applicable (like a calendar month) to the whole world at the same date:

*Boredune.* March 22–June 21 (approximately): the time when the sun is in the northern hemisphere and going towards (δύνω) the north (βορέας).

*Borepheuge.* June 22–September 21: the time when the sun is in the northern hemisphere and going away from (φεύγειν) the north.

*Notodune.* September 22–December 21: the time when the sun is in the southern hemisphere and going towards the south (νότος).

*Notopheuge.* December 22–March 21: the time when the sun is in the southern hemisphere and going away from the south.

These words make possible such succinct statements as the following. The swallow breeds in Europe in the boredune and borepheuge and passes most of the notodune and notopheuge in South Africa. Very few species of birds breed in the southern hemisphere and pass the boredune and borepheuge in a non-breeding condition in the northern hemisphere. The Gouldian finch of Australia exhibits an internal rhythm in reproduction: for it breeds about the notodune in its native haunts, and individuals imported into the northern hemisphere tend to continue to breed in the notodune.

There is also a need for words which apply to the whole of one hemisphere (north or south), that is, words which extend the concepts of spring, summer, autumn and winter right through the tropics to the equator.

*Homodune.* The season when the sun is in the same hemisphere (north or south) as the place spoken of and going towards the pole of that hemisphere (ὁμός same). This word, applicable everywhere, is the same as spring in temperate latitudes, if one allows the official sense to the word spring. The days are lengthening during the homodune.

*Homopheuge.* The season when the sun is in the same hemisphere as the place spoken of and going away from the pole of that hemisphere. In temperate latitudes this is the same as summer. The days are shortening during the homopheuge.

*Heterodune.* The season when the sun is in the opposite hemisphere to the place spoken of and going towards the pole of that hemisphere (ἕτερος other). In temperate latitudes this is the same as autumn. The days are shortening during the heterodune.

*Heteropheuge.* The season when the sun is in the opposite hemisphere to the place spoken of and going away from the pole of that hemisphere. In temperate latitudes this is the same as winter. The days are lengthening during the heteropheuge.

The following are examples of the use of these four words in sentences which require considerable circumlocution without them. The blackbird starts laying about the beginning of the homodune in Britain and also in New Zealand, where the descendants of imported specimens have established themselves; in Ceylon it breeds about the beginning of the homodune and again about the end of the homopheuge. In Britain we have no species of bird with a special breeding season starting in the heterodune, but there are heterodune-breeders among tropical and southern hemisphere birds. Almost throughout their range most species of fruit-bats copulate in the heterodune, and there is thus a difference of about six months in their breeding seasons on the two sides of the equator. In the tropics the rainy season or seasons usually fall in the homodune and homopheuge: often there is a rainy season in each, separated by a short drier period.

I am greatly indebted to my friend, Mr. E. B. Ford, for translating my concepts into easily pronounced and intelligible words based on Greek. It may be remarked that the first 'o' of notodune and notopheuge is short.

It is hoped that students of migration and of seasonal phenomena in the tropics may consider the possibility of these eight new words being useful. The new knowledge of the relationship between light and reproduction may be thought to lend weight to a system of the seasons based on the apparent movement of the sun and therefore on the change in length of day.

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### Non-Specificity of the Trio Follicles in the Merino

I HAVE the privilege of collating the valuable notes of the late Prof. J. E. Duerden, having been his colleague and friend for the past two years. Prof. Duerden's recent work on the embryology of the fleece has important implications of both a fundamental and an applied character, and it is felt that the following advance note, indicating some of the results he obtained, approaches in some measure the type of communication which Prof. Duerden himself contemplated writing at the time of his death.

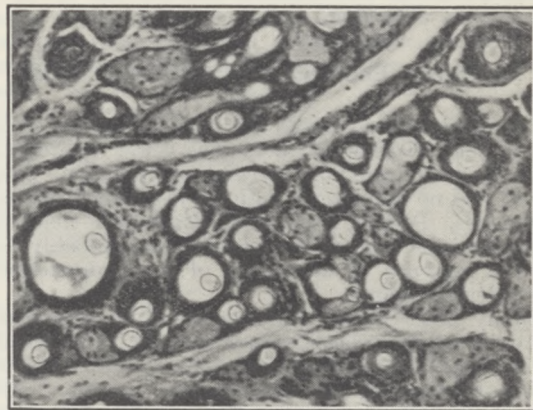


Fig. 1.  
Magnification  $\times 120$ .

Prof. Duerden's investigations were chiefly in the form of a comparative study of follicular arrangement in both foetal and post-natal stages of the Ovidæ, and also of many other mammals. He established the fact of the common and fundamental nature of the arrangement of the early follicles in trios, noted in some mammals by other workers, and also observed that these follicles produce coarse birth-coat fibres; he states in this connexion that "Production of the woolled fleece is by the loss of the coarse fibres grown by the trio follicles" and, I would add, of course, by the addition of finer fibres chiefly grown by later developing follicles.

With reference to this aspect of the developing fleece, Prof. Duerden has established the important point that a follicle which in the lamb produces a coarse, kempy birth-coat fibre may later produce a fine



non-medullated wool fibre. He has shown that this actually occurs in the South African Cape Merino lamb, and the photomicrograph (Fig. 1) reproduced here (magnification  $\times 120$ ) constitutes evidence supporting his view. This is a photograph of a horizontal section of skin from a four months' old Cape Merino lamb: so many new follicles and fibres have become differentiated that the early trio arrangement is somewhat obscured. Large birth-coat follicles, however, are clearly shown which have already shed their coarse birth-coat fibres, and in these same large follicles can be seen recently keratinized fine non-medullated wool fibres. Here again a note of Prof. Duerden's may be aptly quoted: "Changes in the arrangement and character of the fibres occur during the life of the sheep, especially as between the birth-coat and the adult fleece. The foetal distinction in size between the trio and the later follicles may be accentuated, as in the Somali and wild sheep, or may be reduced, as in the Suffolk and Leicester, and the fleece become more uniform; the coarse trio fibres may be shed and replaced by fine fibres (that is, in the same follicles), as in the fine-wooled Merino."

Prof. Duerden's work also suggests the importance of the follicle bundle as a genetic morphological unit, and how its nature may influence such fleece characters as type of staple formation, degree of sample uniformity in fibre diameter, and fleece density.

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#### Androgenic Endocrine Activity in the Female Mammal

PARKES<sup>1</sup> recently made the very important statement that ovarian extracts may show androgenic activity when tested on the comb of the capon. Since there was no androgenic activity in purified ovarian hormones, Parkes reasonably concluded that the androgenic activity of the extracts was probably due to the presence of substances of the androsterone-testosterone group.

Many observations demonstrate that androgenic activity can be induced experimentally in the female guinea pig by certain agents which act on the ovary without changing its microscopical aspect. The clitoris of the guinea pig offers a very convenient test for androgens; more than twenty years ago<sup>2</sup> I discovered its transformation into a penis-like organ under the influence of a testicular graft (in one of the experimental animals which Prof. Steinach generously put at my disposal). Sand<sup>3</sup> independently found a similar phenomenon in the rat. Since then, the transformation of the clitoris of the guinea pig into a penis-like organ has been seen by other investigators working with testicular grafts or testicular hormones.

Now a penis-like organ can also occasionally be found in untreated female guinea pigs which are otherwise normal<sup>4</sup>. A similar condition can be produced experimentally by exposing the ovaries to X-rays or by injecting gonadotropic extracts (Steinach and Kun<sup>5</sup>). A typical penis-like organ may grow in less than three months after 'partial castration', that is, when the quantity of ovary is diminished to a minimum by resection (in six out of twenty animals operated upon when adult<sup>6</sup>).

Steinach and Kun emphasized the extensive luteinization of the ovary seen in their successful experiments, but the ovaries in our guinea pigs with a spontaneous penis-like organ, and likewise the androgenic ovarian fragments, showed no excessive luteinization. Similar results were obtained in a new series of twelve guinea pigs, out of which again six revealed the penis-like organ. These animals were operated on when 4-28 days old, one ovary being removed and the other reduced to a minute fragment. The transformation of the clitoris became manifest only about eleven to twelve months later. The ovarian fragments were examined 32-33 months after operation, and showed cystic follicles and sometimes luteal cysts, but only twice in a total of twelve positive cases was I able to state with certainty that hypertrophy had taken place of those tubular structures of the ovarian medulla which may be considered as a masculine rudiment. One of the most interesting features of our experiments is the fact that the experimentally induced androgenic activity does not depend upon microscopical ovarian changes suggestive of gonadal intersexuality. This indeed does not exclude the possibility suggested by Parkes of androgenic male hormones being produced in the ovary.

An ovarian graft in a castrated male guinea pig may exceptionally maintain the seminal vesicles and the prostate in a normal condition<sup>7</sup>. This was recently shown also for castrated mice with ovarian grafts<sup>8</sup>. In our case, in which the graft was not examined until 34 months after transplantation, there was an enormous development of epithelial tissue due to proliferation of the medullary ovarian tubules; but in view of our microscopical results with ovarian fragments, the condition of this graft may be considered as exceptional and not necessarily related to the androgenic activity.

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<sup>1</sup> Parkes, *NATURE*, 139, 965 (1937).

<sup>2</sup> Lipschütz, *Anz. Akad. Wissensch. Wien*, No. 27 (1916); *Arch. Entw.-Mech.*, 44, 196 (1918).

<sup>3</sup> Sand, *Pflügers Arch.*, 173, 1 (1918).

<sup>4</sup> Lipschütz, *Brit. J. Exp. Biol.*, 4, 227 (1927).

<sup>5</sup> Steinach und Kun, *Pflügers Arch.*, 227, 265 (1931).

<sup>6</sup> Lipschütz, *C.R. Soc. Biol. (Paris)*, 112, 1272 (1933).

<sup>7</sup> Lipschütz, *Virchows Arch.*, 235, 35 (1932).

<sup>8</sup> De Jongh und Korteweg, *Acta Brevia Neerland.*, 5, 126 (1935). Hill and Gardner, *Anat. Rec.*, 64, Supp. 21 (1936). Hill, *Endocrinology*, 21, 495, 633 (1937).

#### Restropic Effects of Anterior Pituitary Extracts

SEVERAL authors have attributed endocrine functions to the reticulo-endothelial system (R.E.S.) and have employed, for various purposes, extracts prepared from its centres. But no link between endocrine glands and the R.E.S. has as yet been demonstrated. Recently, however, we have obtained evidence of pituitary control of the reticulo-endothelial system. The experiments were carried out on rabbits. A modification<sup>1</sup> of the Congo-Red method<sup>2</sup> was used in assessing the activity of the R.E.S. The rate at which the dye is eliminated from the circulation reflects the functional condition of the system, and the method which measures this rate thus yields an index of the activity of the R.E.S.



First the normal rate was determined in each animal. Injections of various pituitary extracts were then administered and the rate of elimination was again determined at regular intervals. Certain aqueous extracts produced a rapid rise in the activity of the system. The rise was noticeable 24 hours after the first injection but did not attain its maximum until some days later. Cessation of the injections resulted in a return to the normal level. Thus one rabbit showed an initial index (per cent of dye eliminated within one hour) of 45.7. After three daily injections of 1 mgm. each the index rose to 76.9; 10 days after the last injection the index had fallen again to 48.5. The treatment was not followed by any signs of damage to the R.E.S. These effects were obtained with extracts that did not contain the growth factor and were free of, or contained traces only of, gonadotropic and thyreotropic hormone. The active substance is highly soluble in water and can be extracted even with distilled water. A highly potent extract was prepared from fresh anterior lobes (cattle pituitaries) in a soxhlet worked under reduced pressure. Water was used as extractive and an alkaline reaction was maintained by repeated addition, to the gland material, of weak ammonia. The active substance is insoluble in acid 70 per cent alcohol but soluble in alcohol containing 3 per cent ammonia. It is precipitated by phosphotungstic acid, rapidly destroyed by boiling and unstable in solutions kept at room temperature.

Purified gonadotropic hormones prepared from the anterior lobe of cattle pituitaries, from human placenta or pregnancy urine, and from the blood of a menopausal subject failed to affect the R.E.S.-index significantly or even uniformly.

Strongly thyreotropic extracts, prepared from anterior lobe and containing a proportion of gonadotropic hormones, significantly and rapidly lowered the index. For example, 61 per cent of the dye was eliminated in an untreated rabbit within one hour after its injection. After three daily injections, the rate had fallen to 26 per cent. But the fall in the activity of the system persists for a few days only. A return to the norm takes place even when the injections are continued.

It thus seems likely that the anterior pituitary is involved in the regulation of the R.E.S. Presumably it influences, therefore, some aspects of immunity.

The influence of the gland may be complex since it yields at least two active derivatives. One type of extract increases the activity of the R.E.S.; in accordance with current terminology, we propose to refer to the active substance as the 'positively restropic factor'. Another type of extract, characterized by its thyreotropic activity, is negatively restropic; that is, it lowers the activity of the R.E.S. The positively restropic factor is manifestly not identical with the growth factor or the gonadotropic hormones. But it may be identical with one of the other anterior lobe hormones for which separate existence has been claimed.

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### Interpretations of Atomic Constitution

THE correspondence columns of NATURE are usually devoted to contributions from specialists, and for a layman to enter into them may be regarded as an intrusion. There must be, however, many readers who, unable to be advanced workers in any particular branch of science, try to follow current thought, especially in physics. They form the bulk of those who read and enjoy the more popular expositions of science by fellows of the Royal Society and others actually engaged in scientific work, and many look forward to the arrival of NATURE.

Could one of such interpreters give an explanation of the difficulties some of us find in the present contemporary picture of atomic structures? We know it is only a rough picture. A billiard ball model of the atom is, we know, impossible. Recent bombardment experiments bear out, however, the general rough scheme of things. Heisenberg, with his indeterminacy, certainly introduces anxieties. On the other hand, in the answers do not allow a shift to wave mechanics: we would look upon that as an unfriendly 'action'. Could NATURE, however, get some explanation given us of such difficulties as the following:

(1) No doubt in popular works it is difficult to express things correctly, but I notice reference frequently to the charge on the electron or proton. Surely these two elements are the charge and nothing else, even if they do differ in mass by a factor of 2000, or is the ephemeral positron now looked upon as the charge on the proton?

If, to account for isotopes, we must introduce neutrons, no difficulties present themselves if a neutron can be looked upon as a proton married happily to an electron in domestic bliss with no charge. Just mass. But we are told (see Prof. Andrade's article in NATURE of September 8, 1934) that we must not look upon the neutron as having within itself an electron. The consequence seems to lead to philosophical difficulties; for now the neutron is just a lump of matter, and the theory that matter is electrically built up, fails. Is this point conceded, or if not, why not?

(2) The nucleus in heavy atoms presents the most serious difficulties. Here, we are told for each atom, live concentrated together a group of protons, corresponding in number to the electrons in their orbits, plus some neutrons to account for isotopes and other things. Yet the protons, being positively charged, must dislike proximity with the same vehemence as the electron. How is it assumed that they can remain packed together? Prof. Andrade, in his attractive book "The Atom", page 71, envisages a scale model with the nucleus the size of a plum, with electrons occupying orbits two thousand feet across. If the nucleus is made up of protons, as bombardment apparently proves it to be, and if each proton has, or is, a positive charge, then such a picture is mathematically an absurdity. What is the force holding them together?

If I am told that under certain conditions two similarly charged protons can be made to unite to form a super proton of mass 2 and charge 2, or even more, but always in units of protons plus a neutron or two—rather like similarly charged blobs of mercury, sitting on a glass plate, disliking proximity, but by force made to amalgamate; if I am told that this super proton, now called a nucleus, is held together by a new sort of atomic 'surface tension'

<sup>1</sup> Adler, H., and Reimann, F., *Z. Exp. Med.*, 47, 617 (1925).

<sup>2</sup> Stern, K., and Wilhelm, R., *Z. Exp. Med.*, 97, 354 (1935).



but can be broken up by bombardment; if I am told that in such breaking up it may shed a proton or two which will change the chemical properties of the atom and that energy will be released; that is a story which anyhow accounts for the facts, and for Prof. Andrade's 'plum', although not really explaining them, but the trouble is no one mentions the difficulty of protons just living together, maintaining their individuality.

The above idea may be fantastic, but let us have some story; at present we have none. There may be answers, easy ones, to these difficulties, which are asked in all sincerity of those who have worked so wonderfully in this new entrancing wonderland of physics, and for whom no one has greater admiration than myself.

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At one time it was the fashion to ask "What is electricity?" and to taunt, or condole with, the man of science, because, said the questioner, he had no answer to offer. The question I always considered unreasonable, since we must take some fundamental entity, which we cannot explain in terms of other substances, as the basis of our theories, and electricity is an aspect of our fundamentals. It is not a kind of liquid, or a kind of gas, but something quite different from both. There should never be any question of calling electricity a fluid, and then expecting to deduce its complete behaviour from the known property of fluids. What we have rightly done is, rather, to find out by experiment what its actual properties are, and what general laws will cover them. It then proves that for certain limited purposes electricity can be considered as a fluid, but the limitations should always be borne in mind.

Colonel Moore-Brabazon, moving with the times, puts certain questions as to our fundamental entities of to-day, the proton and the neutron, and wants their properties explained in anthropomorphic terms of likes and dislikes, and so on, or at any rate, in terms of the behaviour of massive bodies, which they resemble as little as electricity in bulk does a material fluid. The problem is not to explain atomic and nuclear electro-dynamics in terms of macroscopic charges and their properties, because we know that this cannot be done, but to find out with what particles we can form a consistent scheme of action for the experimenter, and with what properties we must endow these particles.

Workers on nuclear problems have decided that they must have, among other things, protons and neutrons. Now, if I understand Colonel Moore-Brabazon, he wants to know how the neutrons and the positively charged protons can be packed together, because if they have the properties of macroscopic charges the assemblage will be unstable. We know, however, that they have not these properties, and our task is to form a consistent scheme which shall cover these properties and shall also cover other aspects of atomic electrodynamics. We may have to assume certain entities to help us along temporarily in our difficulties, such as the unsatisfactory neutrino, but the unsatisfactoriness of the neutrino is not that it has properties inconsistent with the laws of classical

electricity, but that it has no properties at all, except those assumed *ad hoc*.

We can get over Colonel Moore-Brabazon's difficulty about "the charge on the proton" by calling it "the charge of the proton", to which nobody will object. Whether we talk of the neutron containing an electron is to some extent a matter of words, just as whether we talk of a rocket as containing the stars is a matter of words. What we want to know is under what conditions the neutron can be transformed into, or replaced by, a proton and an electron. To explain this behaviour we have to resort to sets of rules evolved by studying atomic and macroscopic phenomena and to accept the "non-reasonable" conception of the quantum theory, in its modern wave-mechanical form. Thus I can tell Colonel Moore-Brabazon that it is held in some quarters that the proton and the neutron represent two different quantum states of one entity: I can talk to him of Fermi and of Bose statistics, and allied rules to help us to decide as to the structure of the nucleus—as to whether, for example, it contains electrons. This would, however, be to introduce difficult detail that he might regard as an attempt to throw dust in his eyes. I prefer to say, quite generally, that some sort of special rules are required, and that, whatever these are, they are to be obtained by generalizing certain experimental results, and not by reasoning from the classical laws of electricity. In Rutherford's words "the atomic nucleus is a *world of its own* [my italics. E. N. da C. A.] in which a number of particles like protons and neutrons are confined in a minute volume and held together by very powerful unknown forces. Vigorous attempts are in progress to adapt existing [that is, quantum-mechanical] ideas to explain the structure of atomic nuclei, and some success has been obtained in a few simple cases".

If Colonel Moore-Brabazon is still unsatisfied I beg him to cast his eyes back to Newtonian days. Would he in those days have wanted strings tied to the planets to pull them towards the sun, on the ground that a body cannot act where it is not? He cannot pull my nose (though perhaps he may pull my leg) at a distance; how then can the sun pull the planets? In fact, the conception of action at a distance gave much trouble to very acute brains\*. Jean Bernoulli, for example, never accepted it. However, quite apart from any speculations as to the nature of gravitational forces, such as Einstein's recent hypothesis, the laws of interplanetary force were worked out on the assumption that a body *could* act where it was not, with such satisfactory results that the hypothesis of universal gravitation now offers no trouble to anybody.

I cannot promise Colonel Moore-Brabazon that all men of science will share my views, but there they are, for what they are worth. Now, perhaps, in return, Colonel Moore-Brabazon will give me a logical statement of British foreign policy in the last ten years, which has puzzled me as much as the nuclear mechanics of the last ten years has puzzled him.

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\* The reader who wishes to see how slowly Newton's ideas penetrated may consult M. Brunet's learned "L'Introduction des théories de Newton en France au XVIII<sup>e</sup> siècle".



Internal Friction of Wires

WORKING with the transverse vibrations of wires of glass, steel, brass, aluminium and silver, Bennewitz and Rötger<sup>1</sup> have found that the internal friction has a maximum at a frequency  $f_0$  characteristic of each wire. They have found, in fact, that the internal friction varies with frequency  $f$  approximately as

$$A \frac{f_0 f}{f_0^2 + f^2} \quad (1)$$

The purpose of this letter is to point out that the internal friction measured by Bennewitz and Rötger is a direct consequence of the entropy increase associated with the flow of heat from the compressed to the extended side of the wire.  $f_0$  is interpreted as the reciprocal of the time of relaxation for the establishment of temperature equilibrium across the wire. The theory of this thermo-elastic internal friction has been discussed by me<sup>2</sup> for the case of a reed. An extension of the theory to wires is being published elsewhere. It is found that  $Q^{-1}$  for both reeds and wires (which is equal to the logarithmic decrement  $\lambda$  of Bennewitz and Rötger multiplied by  $\log_e 10/\pi$ ) is given by (1), with

$$A = (E_S - E_T)/E_S,$$

where  $E_S$  and  $E_T$  are the adiabatic and isothermal Young's moduli, respectively. In the case of wires,  $f_0$  is given by

$$f_0 = (q^2/2\pi)Da^{-2} = 0.539 Da^{-2},$$

where  $D$  is the thermal diffusion constant of the material,  $a$  the radius of the wire, and  $q$  the first root of the equation

$$(d/dx)J_1(x) = 0,$$

namely, 1.84.

Not only does the thermo-elastic effect give a satisfactory qualitative interpretation of the experiments of Bennewitz and Rötger, but also, as shown by the accompanying table, it gives good quantitative agreement.

Type of wire	Glass	Steel	Brass	Aluminium	Silver
$2a$ in mm.	1.25	1.0	1.25	1.5	1.01
$f_0$ , observed	0.66	25	40	83	240
$0.539 Da^{-2}$	0.5-0.7	27	45	84	350
$A \times 10^3$ , observed	8.7	2.6	4.4	5.2	6.0
$(E_S - E_T) E_S \times 10^3$		1.9	3.2	4.6	3.7

<sup>†</sup>  $A$  has been obtained by multiplying  $\lambda_{max}$  of Bennewitz and Rötger by  $2(\log_e 10)/\pi = 1.46$ .

It is of particular interest to note that the frequency,  $f_0$ , at which the internal friction has a maximum is not a constant of the material, but varies inversely as the square of the radius of the wire.

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<sup>1</sup> Bennewitz, K., and Rötger, H., *Phys. Z.*, **37**, 578 (1936).

<sup>2</sup> Zener, C., *Phys. Rev.*, **52**, 230 (1937).

Capture of Slow Neutrons in Light Elements

By means of a small boron-lined ionization chamber we have studied the density distribution of neutrons around a source (Ra + Be) placed in a large container filled with a hydrogenous liquid<sup>1</sup>. From the measured distribution the total number of neutrons present at any instant is obtained by integration. This figure does not depend on the scattering properties but only on the capture cross-sections of the

nuclei constituting the liquid. If a constant number of neutrons is emitted from the source, then the mean number present at any instant is inversely proportional to the total capture probability.

By using liquids containing the same constituents in different proportion we have been able to separate the capture effects due to the single constituents. First we compared benzene (C<sub>6</sub>H<sub>6</sub>) and liquid paraffin (CH<sub>1.87</sub>, according to chemical analysis). The numbers of neutrons in these two liquids were found to be inversely proportional to the respective hydrogen densities; it follows that the capture cross-section of carbon must be much smaller than that of hydrogen. A similar result was found for oxygen, on comparing benzene and water. Through the kindness of a loan of 60 litres of heavy water of 10 per cent deuterium oxide content, from the Norsk Hydro-Elektrisk Kvalstofaktieselskab, Oslo, we were enabled to include deuterium in our experiments; also in this case no measurable capture was detected. In a 7.6 per cent solution of ammonium nitrate in water, however, the capturing action of the nitrogen could be easily observed and measured.

We have also made measurements with aqueous solutions of boric acid and lithium hydroxide. Since the capture cross-sections of boron and lithium have been determined from experiments with beams of thermal neutrons, our measurements can be used to obtain absolute capture cross-sections for all the light elements quoted above. The results are collected below.

Capture cross-sections  $\sigma_c$  for neutrons of velocity  $2.2 \times 10^5$  cm./sec.

Element	H	D	C	N	O
$\sigma_c \times 10^{24}$ cm. <sup>2</sup>	0.27 ± 0.02	< 0.03	< 0.01	1.3 ± 0.3	< 0.01

Our value of  $\sigma_c$  for hydrogen is somewhat smaller than the value given by Amaldi and Fermi ( $0.31 \times 10^{-24}$  cm.<sup>2</sup>) which furthermore corresponds to a neutron velocity of  $2.5 \times 10^5$  cm./sec. and should therefore be increased by a factor of 1.13 to be compared with our value. On the other hand, from neutron beam experiments we get a somewhat larger value (48 instead of  $43 \times 10^{-24}$  cm.<sup>2</sup>)<sup>1</sup> for the scattering cross-section of hydrogen. For the mean number of collisions suffered by a slow neutron in paraffin before getting captured we find  $205 \pm 20$  (instead of 140)<sup>1</sup>.

Our value of  $\sigma_c$  for nitrogen agrees with the value found<sup>2</sup> by counting the protons emitted in the reaction  $^{14}\text{N} + ^1_0\text{n} = ^{14}\text{C} + ^1_1\text{H}$ .

We may mention another result of our investigations. We have compared the yield of photo-neutrons from beryllium and deuterium irradiated by gamma rays from radium, with the yield from a mixture of radon and beryllium. Assuming the latter yield to be 20,000 neutrons per second per milliecurie, we find for deuterium a cross-section of  $\sigma_{2.2} = 7 \times 10^{-28}$  cm.<sup>2</sup> for photo-dissociation by quanta of 2.2 Mev. energy. For beryllium, where two gamma lines of 1.8 Mev. and 2.2 Mev. are sufficiently energetic, we find  $\sigma_{1.8} + 0.3\sigma_{2.2} = 2 \times 10^{-27}$  cm.<sup>2</sup>.

A detailed account is to appear shortly in the *Proceedings of the Royal Academy, Copenhagen*.

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<sup>1</sup> Amaldi, E., and Fermi, E., *Phys. Rev.*, **50**, 899 (1936).

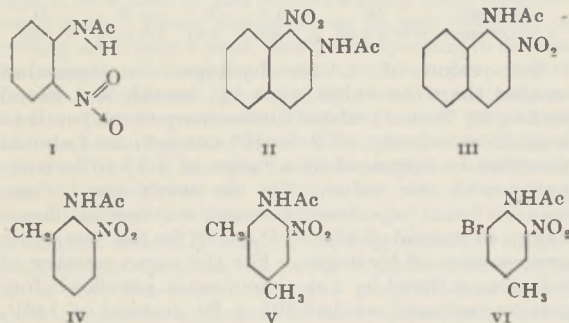
<sup>2</sup> Burcham, W. E., and Goldhaber, M., *Proc. Camb. Phil. Soc.*, **32**, 632 (1936).



### Evidence of Restricted Rotation about the N—C Bond in 2:6-Disubstituted Acetanilides

THE failure<sup>1</sup> to effect optical resolution of substituted anilines having two large *ortho* groups has left unconfirmed the theoretical possibility of restricted rotation about the nitrogen-nuclear single bond in such compounds. That such steric effects are indeed present in suitably constituted molecules is now proved by a method entirely independent of optical activity.

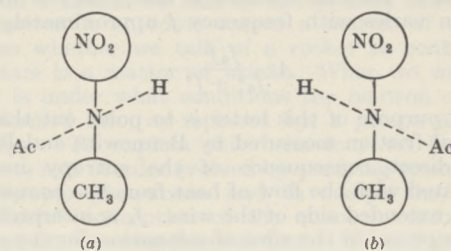
It has been shown<sup>2</sup> that the molecular association of amides is due to the bonding effect of the amide-hydrogen atoms, the complete replacement of which effectively checks association. Subsequent work has shown that, in the case of anilides, certain *ortho* substituents are effective in preventing association, and it is significant that such substituents are invariably hydrogen-acceptor groups such as  $-\text{NO}_2$ ,  $-\text{N}:\text{N}-$ ,  $-\text{COOEt}$ . In such compounds it is evident that the hydrogen atom responsible for association is no longer available for this purpose, it being engaged in chelate ring-formation, such as that depicted in *o*-nitroacetanilide (I). During these experiments an unexpected difference was revealed between the behaviour of 1-nitro-2-acetnaphthalide (II) and the isomeric 2-nitro-1-acetnaphthalide (III). The former is unimolecular, having a lower melting point and greater solubility in hydrocarbon solvents than the latter, which is associated. This led us to suspect steric influences, and to investigate other substances in which similar steric effects might be expected.



The results showed with surprising regularity that although *o*-nitroacetanilide (I) is unimolecular, the substitution of a second *o*-substituent in this compound (such as in IV, V and VI) restores the tendency to associate. The inevitable conclusion is that the amide-hydrogen atom in III, IV, V and VI is deflected by steric interference between the acetyl group and the methyl group (or the bromine atom) too far away from the neighbouring nitro-group to permit of chelate ring-formation, thus leaving the hydrogen atom free to exert its intermolecular bonding effect.

The sensitiveness of this method of detecting restricted rotation as compared with the classical method of optical resolution can best be explained by considering the example of 3-nitro-2-acet-toluidide (IV). A plan of this molecule as seen from a point above the nitrogen atom and remote from the benzene nucleus is shown in VII, the single line connecting the two *ortho* substituents ( $-\text{NO}_2$  and  $-\text{CH}_3$ ) representing the plane of the benzene nucleus. The size of the two *ortho* groups may be such as to limit, but not absolutely prevent, the rotation of the H—N—Ac axis from the position shown in VII *a* to that shown in the enantiomorph VII *b*. Any such rotation will

bring about a more or less rapid racemization. Nevertheless, only in a very small proportion of molecules intermediate between (a) and (b) is chelation between H and  $\text{NO}_2$  possible, with the result that the majority of the molecules show association.



VII

In other words, whereas the chance of resolving such a compound depends upon the non-conversion, or at least the slow rate of conversion, of molecules of type (a) into those of type (b), the test now applied is completely independent of such conversions, and depends solely on the inclination (in whatever direction) of the H—N—Ac axis to the plane of the benzene nucleus.

The degree of association of these compounds was measured cryoscopically in naphthalene, and the relevant figures will be published elsewhere.

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<sup>1</sup> Tuan, Hsü, and Hsü, *J. Chinese Chem. Soc.*, 4, 131 (1936).  
<sup>2</sup> Chaplin and Hunter, *J. Chem. Soc.*, 1114 (1937).

### Liver Extract and Hæmoglobin in Rats

RECENTLY Tschesche and Wolf<sup>1</sup> have stated that rats, made anæmic on a diet consisting wholly of milk, respond differently to iron and copper and to liver extracts known to be clinically active in the treatment of pernicious anæmia. According to these authors, erythrocyte and leucocyte counts and hæmoglobin are all increased by the metals, while cell counts but not hæmoglobin are increased by the liver extract.

Preliminary attempts in these laboratories to confirm the results of Tschesche and Wolf have led to the surprising result that liver extract produces an apparently significant increase in the hæmoglobin of rats with milk anæmia, while leaving the cell count as low as in untreated animals. It is proposed to publish fuller details of this investigation elsewhere.

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<sup>1</sup> Tschesche, R., and Wolf, H. J., *Z. physiol. Chem.*, 248, 21 (1937).

### Crystal Structure and the Magnetic Anisotropy of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

FROM a discussion of the magnetic susceptibilities of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  powder at different temperatures, Jordahl<sup>1</sup> concluded that the crystalline electric field acting on the  $\text{Cu}^{++}$  ion in the crystal should be predominantly cubic in symmetry, and further, from



the sign of the potential due to this field which fits the magnetic data, that the field should correspond to an octahedral distribution of six equal negative charges around the  $\text{Cu}^{++}$  ion. This result is not obvious from general structural considerations, since the crystal is triclinic, and there are five molecules of water and one  $\text{SO}_4$  group associated with each  $\text{Cu}^{++}$  ion. The result, however, has been beautifully verified by the X-ray studies of Beevers and Lipson<sup>2</sup> on the structure of the crystal. The  $\text{Cu}^{++}$  ion is found to be at the centre of an octahedron of six negatively charged oxygen atoms. Four of them belong to four water molecules, and they form a square with the  $\text{Cu}^{++}$  ion in the centre. The other two, which are contributed by two sulphate groups, are located centrally above and below this square.

Now this octahedron is only approximately regular, the oxygens of the water molecules being closer to the  $\text{Cu}^{++}$  ion than the other two. The crystal field acting on the  $\text{Cu}^{++}$  ion should therefore deviate considerably from cubic symmetry, and its intensity along the normal to the plane of the water molecules should be less than for directions in the plane. Now there are two such  $\text{Cu}^{++}$  ions in the unit cell of the crystal, and the two corresponding squares of water molecules make with each other an angle of  $82^\circ$ , which is nearly a right angle. One would therefore expect: (1) that the crystal should be magnetically anisotropic, which is a trivial result since the crystal is triclinic; (2) that two of the principal suscepti-

bilities of the crystal should be nearly equal, and greater than the third (that is, the magnetic ellipsoid should be approximately an oblate spheroid); (3) that the axis of this spheroid should lie along the line of intersection of the planes of the two squares of water molecules in the unit cell. All these conclusions have been verified experimentally<sup>3</sup>.

The directions of the two nearly equal axes of the ellipsoid can also be predicted from the fine structure of the crystal: the shorter of them should lie in the plane bisecting internally the two squares of water molecules. Since the angle between the two squares differs by only  $8^\circ$  from a right angle, this last conclusion cannot be accepted with the same confidence as the others. From a study of the magnetic anisotropy for a number of planes in the crystal, we have recently determined the directions of these two magnetic axes, and they too lie nearly as predicted from the structure.

Thus the magnetic data confirm in a striking manner the structure proposed by Beevers and Lipson for the crystal.

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<sup>1</sup> *Phys. Rev.*, **45**, 87 (1934).

<sup>2</sup> *Proc. Roy. Soc., A*, **146**, 570 (1934).

<sup>3</sup> Krishnan and Mookherji, *Phys. Rev.*, **50**, 860 (1936).

### Points from Foregoing Letters

Prof. A. C. Cuthbertson, Geoffrey Gee and Prof. E. K. Rideal find that pure vinyl acetate does not polymerize measurably at  $100^\circ\text{C}$ . even in the presence of oxygen. A peroxide derived from acetaldehyde, however, catalyses the reaction. The authors suggest that the discrepancy in the findings of various observers between the rate of polymerization of gaseous and liquid styrene may be likewise explained by the presence of a peroxide catalyst in the liquid phase.

J. S. Kennedy describes how solitary locusts belonging to the species *Schistocerca gregaria* on the Red Sea coast, crowd together into patches of dense but uneven vegetation, and this fortuitous concentration brings about the change from the solitary to the gregarious 'phase'.

A photomicrograph of a horizontal section of skin from a four months' old Merino lamb is submitted by Dr. A. B. Wildman in support of the late Prof. J. E. Duerden's view that the 'trio' follicles which at first produce the coarse birth-coat fibres may later produce a fine non-medullated wool fibre.

The appearance of male sex organs in female guinea pigs after the almost complete removal of the ovaries is described by Prof. A. Lipschütz. This, the author points out, does not exclude the possibility that male hormones are produced in the ovary.

Taking the elimination of Congo-Red dye from the body as a measure of the activity of the reticulo-endothelial system, C. Wetzler-Liget and Dr. B. P. Wiesner find that certain aqueous pituitary extracts stimulate the activity while other extracts of the anterior lobe of the pituitary having thyrotropic activity and containing a proportion of sex hormones lower the activity.

Following upon theoretical considerations of entropy increase, Dr. C. Zener calculates the frequency of transverse vibrations for which the internal friction is a maximum, in the case of wires of various materials (glass, steel, silver, etc.) from the known values of their Young moduli; he submits a table showing that the values obtained agree with those experimentally determined by Bennewitz and Rötger.

From measurements of the density distribution of neutrons around a source, in different hydrogenous liquids, Drs. O. R. Frisch, H. von Halban, jun., and Jørgen Koch have obtained values for the capture cross-sections of hydrogen and nitrogen, for neutrons of thermal energy; in the cases of deuterium, carbon and oxygen, upper limits for the capture cross-sections have been established. Furthermore, the cross-sections of deuterium and beryllium for photo-dissociation by the gamma rays of radium have been determined.

Whilst certain *o*-substituted acetanilides give indication of chelate ring-formation between the two neighbouring groups, Dr. L. Hunter and H. O. Chaplin find that substitution of a group in the second *ortho* position prevents chelation. This fact is interpreted as evidence of restricted rotation about the nitrogen-nuclear single bond in 2:6-disubstituted acetanilides.

From a consideration of the fine structure of the  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  crystal (triclinic) analysed by Beevers and Lipson, Prof. K. S. Krishnan and A. Mookherji locate the directions of the maximum and the minimum susceptibilities of the crystal, and further state that the intermediate principal susceptibility should be almost equal to the maximum. These results have been verified experimentally.



## Research Items

### Ethnography of the Tanaina

IN continuation of his research among the Northern Athapascan Indians, Dr. Cornelius Osgood spent the summer of 1931 and part of that of 1932 with the Tanaina of Cook Inlet (Yale Univ. Pub. in Anthropol., 16, 1937. Oxford Univ. Press. 13s. 6d. net). The Tanaina are a nation of related subdivisions or tribes, of which, broadly speaking, there are seven. The name means "the people", as distinct from either Eskimo or Europeans. Their culture has suffered much disintegration from European contacts during a period of one hundred and fifty years. Their language belongs to the Athapascan stock, being most closely related to that of their neighbours to the north-west, the Irgalik Athapascans. It is unquestionable that the neighbouring Eskimo have had some physical, cultural and linguistic effect on them. No anthropometric study of them has been made, but they are taller than the Eskimo. A full-grown man of less than five feet eight inches is rare. The nose is prominent, frequently aquiline, the lips full, the skin darker than the Eskimo. The most important article of diet is fish, especially salmon; but the Tanaina are unique among the Athapascans in having access to sea mammals, seal, sea lion, etc. The meat of the white whale is much relished, but as they have not the correct 'medicine' for its killing, they buy it with furs. Of land animals they hunt the forest fauna, mountain sheep and goats, bear, etc. For vegetable foods they eat a variety of berries, spruce buds, wild rice, wild 'peas', fern roots, and, most important of all, the *klila*, a parsnip-like root, which is obtained only from the North Inlet, but is the principal article of trade and transported as such from one end of the country to the other.

### Newfoundland Amphipoda and Decapod Larvæ

MISS NANCY FROST describes some interesting material collected by the S.S. *Cape Agulhas* in Newfoundland waters in 1931-35. The list of amphipods given includes a new species of *Hippomedon* (*H. stephensenii*) and a specimen of *Paramphithoe cuspidata* which differs considerably from the type. The decapod larvæ are numerous, the genus *Spirontocaris* being conspicuous and five species differentiated, although three of them could not be referred to distinct species. *Pandalus montagui* was the most abundant of all the larvæ and *P. borealis* fairly common. Two distinct megalopæ belonging to *Hyas* were found, one being *Hyas coarctatus*, and it is almost certain that the second is *Hyas araneus*, but this differs from *H. coarctatus* in having two small posterior dorsal spines on the carapace instead of one large one. If this identification be correct, this clears up much that was obscure in the previous descriptions. A young stage of *Latreutes fucorum* is figured, two specimens having been secured, and there is a post-larval (or young stage) of *Spirontocaris grænländica*, which fills a gap in the hitherto known life-history. Miss Frost finds that the mandibular palp is present in the post-larva of both species of *Pandalus*, which is very much earlier than it appears in some species of *Spirontocaris*.

### New Mutation in *Drosophila*

A MUTATION in egg-shape of *Drosophila funebris* described by Prof. F. A. E. Crew and Dr. C. Auerbach (*Proc. Roy. Soc. Edin.*, 57, Part 3) provides several points of interest. The eggs are shorter and broader than normal, and spheroidal in shape, the four attached filaments being very much shorter. The ability to produce these eggs is inherited as a recessive condition, and is found to be widespread in the wild population. The fecundity of females which lay spheroidal eggs is also very low. Whereas normal females lay more than 1,000 eggs, these lay mostly 30-50. The curve of egg production is also different and the spheroidal eggs are more variable. The correlation between length and width of the egg is positive in normal, negative in spheroidal eggs. This is the first mutation in egg-shape to be found in *Drosophila*, and as the females which produce these eggs are themselves normal in appearance, special tests are required to show the manner of inheritance.

### Cobalt Chloride Treatment of Sheep

IN an earlier paper it had been shown that a lamb sickness in Southland, New Zealand, known locally as Morton Mains disease, could be successfully controlled by the use of small quantities of cobalt chloride administered in drench form. While drenching is reliable as a research method, since it ensures that every animal gets its proper dose, it has disadvantages in farm practice owing to the time and trouble involved. J. K. Dixon, of the Cawthron Institute, has now been able to show (*N.Z. J. Sci. Tech.*, 18, 892-97) that a salt lick made by spraying a solution of 4 oz. of cobalt chloride on a ton of dairy salt can be successfully used as an alternative method. Ewes and lambs supplied with such a lick kept in perfect health, but the use of it during pregnancy only was not sufficient to maintain optimum growth of the lambs during the following summer. The cost is not likely to exceed 4d. per sheep per year and great saving in labour is attained.

### The Root-Knot Eelworm

MR. G. FOX WILSON has collected a large amount of information about the root-knot eelworm, *Heterodera Marioni* Goodey (*J. Roy. Hort. Soc.*, 62, Pt. 8, August 1937). The pest was formerly regarded as a pest of glasshouse plants, but it is now known to attack a wide variety of outdoor crops. It frequently appears on groundsel, chickweed and shepherd's purse, weeds which may spread the pest in unhygienic gardens. The life-cycle is described, and various methods of dispersal, such as the distribution of infected soil upon the gardener's boots or tools, and the return of greenhouse compost to the garden, are discussed.

### Heteroauxin and Cambial Activity

As foreshadowed in an earlier paper (A. B. Brown, *Canadian J. Res.*, 15, No. 1), an interesting series of experiments has been performed on the stimulation of the cambium of dormant branch segments of *Populus balsamifera* L., by the application of



heteroauxin (A. B. Brown and R. G. H. Cormack, *ibid.*, 15, No. 9). Bridged rings were cut in the bark in the middle of the segments, and the amount of new xylem cut off by the reactivated cambium was clearly visible on the surface of the old wood when the bark was stripped from the segment and the latter dried. In this manner xylem patterns were obtained showing that the induced activity was in all cases similar to that produced by wounding alone but more extensive. There was local activity at the three regions of wounding, namely, the ring and the top and bottom of the segments, in the controls; but there was a much greater, though still local, activity in the cases where heteroauxin had been applied. The influence of the latter was manifested at points some distance from the region of application, but without any renewed activity on the part of the intervening cambium.

#### Recent American Earthquakes

THE recent issue (July 1937) of the *Bulletin* of the Seismological Society of America contains several useful papers on recent earthquakes in North and South America. J. E. Ramirez (pp. 211-223) describes ten earthquakes in the department of Nariño, Colombia, within less than a year (1935-36), three of them of destructive strength. The region is one that has been visited by many great earthquakes (of which a list is given) since the Spanish conquest. A semi-destructive earthquake on July 15, 1936, with its origin near the boundary of the States of Washington and Oregon, is studied by B. H. Brown (pp. 205-209). Many tombstones in the cemeteries were rotated, about 70 per cent of them in the clockwise direction, but it is noted that some stones in close proximity were rotated in opposite directions. P. Byerly and J. T. Wilson (pp. 225-229) give a valuable list of 64 earthquakes in northern California in 1936. Many of the epicentres, as shown on the map, lie along well-known faults. The earthquakes of the New Madrid region (the scene of the great earthquakes of 1811-12) are receiving careful attention. F. Robertson (pp. 231-239) describes two slight shocks during the first half of the present year. The earlier (January 30) occurred, like a recent predecessor (May 12, 1929), at the height of the flood of the Ohio and St. Francis rivers. Its epicentre seems to lie on the edge of the Tiptonville dome, one of the largest areas partly uplifted during the earthquakes of 1811-12.

#### Secular Trends of Temperature

DURING the last few years, a number of investigators have discussed the secular trend of temperature over a long series of years at various places in Europe and America, generally with the aid of moving 20-year averages of mean temperature. In Prof. Note No. 77 of the Meteorological Office (London: H.M. Stationery Office), Miss L. F. Lewis gives a very thorough analysis of one of the best records for this purpose, that obtained at the Radcliffe Observatory, Oxford. The period covered is 1815-1934. The observations had been corrected for changes of instrument and exposure by certain of the trustees of the Observatory. The analysis covers the year and the four seasons separately, and brings to light a number of interesting facts. The annual curve of 20-year moving annual averages for the whole 120 years reveals three marked warm and two marked cold periods. The third warm period is the one that

we have been enjoying during the present century and is not very different in intensity from the two earlier ones; but when we come to the separate seasons it is seen that the mildness of the winters of the past forty years is without precedent. The summer and winter are the seasons which follow least closely the annual curve. The summers of the present warm spell have until the last few years been on an average decidedly cool, so that this latest warm spell is also one of notable equability. No previous 20-year means of the difference between mean summer and mean winter temperature have been so low as those for 20-year periods ending between the years 1912 and 1934. A definite answer to the question whether our climate is becoming milder cannot, of course, be obtained from these curves, but they certainly correct the impression of such a change given by a comparison between the latter part of the last century and the present century up to date.

#### Hydraulic Cements

IN a discussion on chemistry and building research in Section B of the British Association at Nottingham, Dr. F. M. Lea referred to some of the main problems met with in cement technology. He was dealing with hydraulic cements—those which set and remain permanent under water—and confined himself to Portland cement. From phase equilibrium studies of binary, ternary and quaternary oxide systems and from the application of microscopic, X-ray and other methods of examination the major crystalline compounds have been found to be  $3\text{CaO}\cdot\text{SiO}_2$ , which is mainly responsible for the development of strength in the early stages of hardening,  $2\text{CaO}\cdot\text{SiO}_2$ , which hydrates slowly and develops strength in the later stages,  $3\text{CaO}\cdot\text{Al}_2\text{O}_3$ , and sometimes  $5\text{CaO}\cdot 3\text{Al}_2\text{O}_3$ , and  $4\text{CaO}\cdot\text{Al}_2\text{O}_3\cdot\text{Fe}_2\text{O}_3$ . On hydration, it is probable that a hydrated dicalcium silicate or a  $3\text{CaO}\cdot 2\text{SiO}_2$  aq. compound is formed, free calcium hydrate being liberated, and a hydrated tri- or tetra-calcium aluminate produced. Calcium-sulpho-aluminate is also formed by reaction with the gypsum used to control the set. When, as in practice, a limited proportion of water is used, the hydration products appear to be mainly gelatinous, but the view that this gel has a microcrystalline structure is as yet unconfirmed. Heat of hydration is greatest for the compound  $3\text{CaO}\cdot\text{Al}_2\text{O}_3$  and diminishes in the order  $3\text{CaO}\cdot\text{SiO}_2$ ,  $4\text{CaO}\cdot\text{Al}_2\text{O}_3\cdot\text{Fe}_2\text{O}_3$ ,  $2\text{CaO}\cdot\text{SiO}_2$ . Moisture content considerably affects the physical properties of the set cement. Theories concerning volume changes were also discussed.

#### Polymorphism under Pressure

THE issue of the *Proceedings of the American Academy of Arts and Sciences* of July contains a paper of ninety pages by Prof. P. W. Bridgman of Harvard on the polymorphic transitions of thirty-five solid inorganic substances under pressures up to 50,000 atmospheres and at temperatures from  $-100^\circ\text{C}$ . to  $200^\circ\text{C}$ . The substance under test is placed in a cylindrical hole about 1 cm. long and 0.6 cm. diameter in a cylinder of 'solar' steel about 4 cm. long and 3 cm. diameter, and the pressure is applied by a 'carboly' piston forced into the hole by a hydraulic press. The pressure is determined from that in the press and the areas of the sections of the pistons of apparatus and press. To enable the cylinder to withstand the pressure without fracture, it is made slightly conical and the pressure applied



forces it into a wide collar of chrome vanadium steel in which a thermo-couple is placed to measure the temperature. The change of volume of the substance on transition is determined from the movement of the piston. The whole apparatus is surrounded by an oil bath. For the substances examined the transition of phase takes place in most cases at higher temperatures as the pressure is increased, but there are many exceptions. The change of volume may decrease or increase with increase of pressure, and Prof. Bridgman concludes that polymorphism is "an essentially haphazard phenomenon".

#### Densities of Mixtures of Light and Heavy Water

In many lines of investigation, the proportions of light and heavy water in a mixture are required, and the simplest method of finding these proportions is a determination of density. L. G. Longworth (*J. Amer. Chem. Soc.*, 59, 1483; 1937) has determined the densities of several mixtures of light and heavy water and finds that the two liquids mix without volume change, so that the volume of a mol of the solution may be expressed in terms of the mol fractions of the components by the formula  $V_a = N_1v_1 + N_2v_2$ , where the subscripts 1 and 2 refer to the light and heavy constituents. The actual molal volumes of the solutions are given by the relation  $V = (N_1M_1 + N_2M_2)/d$ , where  $M$  is the molecular weight and  $d$  the observed density. The expansions on mixing,  $V - V_a$ , were found to be zero within the limits of precision of the density determinations. The atomic weights used were O = 16.000, H = 1.00756, D = 2.01309, the atomic weight of hydrogen being given a correction for the deuterium normally present. If  $\Delta S$  is the value of  $1 - \frac{d_{25}^{25}}{d_{25}^{25}}$ , referred to the density of deuterium-free water, the two equations may then be combined to give a simple relation between  $ND_2O$  and  $\Delta S$ , namely,  $ND_2O = \alpha \Delta S / (1 - \beta \Delta S)$ , in which  $\alpha = 9.235$  and  $\beta = 0.0309$ . This equation makes it possible to determine the proportions of light and heavy water in mixtures of the two.

#### Uranium Dioxide Starting Resistances

In starting an ordinary d.c. motor, a 'starting' resistance is placed in series with it and this resistance is gradually diminished by hand as the speed of the motor increases, so as to maintain so far as possible a constant current through the motor. In the autumn issue of *AEG Progress*, a description is given of new starting resistances made of uranium dioxide (urdox). This material was discovered by two German engineering firms working in collaboration—the Allgemeine Elektrizitäts-Gesellschaft (AEG) and the Osram Gesellschaft. Unlike ordinary metals, its resistance diminishes as the temperature rises, and as this fall occurs rapidly, a 'resistor' of this material when placed in series with a motor keeps the current constant during the starting period. The long life of these resistors is due, among other things, to the fact that during operation they heat only a few hundred degrees and never become red hot. A usual value for the resistance of one type of these resistors is one ohm when hot and fifty ohms when cold. Their starting times vary between half a second and 30 seconds, whilst their cooling periods last for some minutes. These resistances can also be thermally and electrically balanced so as to become voltage regulators. The cost of installing them in existing installations is very low. It is practically only necessary to provide lamp-holders.

#### Service Area of a Radio-telegraphic Transmitter

THE July issue of the *Amalgamated Wireless (Australasia) Technical Review* contains a paper entitled "The Service Area of a Long Wave Telegraphic Transmitter" by A. L. Green. This paper discusses the factors of aerial efficiency, wave propagation and interference from atmospherics, which determine the delivery of a reliable day and night broadcast telegraphic service to all points within a radius of about 5,000 miles from the transmitter. In the study of this problem, a large amount of published data has been analysed and the results have confirmed two assumptions made in the author's calculations. The first of these relates to the use of Watson's propagation formula over a large range of wave-lengths, while the second is that the intensity of interference from atmospherics is directly proportional to the wave-length to which the receiver is tuned. As a result of the author's calculations, it is concluded that the optimum wave-length for the service contemplated is about 4,000 metres, and that the supply of 100 kilowatts of power to an aerial of an effective height 100 metres is sufficient. The use of a wave-length shorter than the optimum improves the service at the shorter distances; while a longer wave-length is necessary only if the service requires to be extended to very great distances. Under the conditions described above, the radiated field should provide a signal to noise ratio greater than unity at all points within a radius of 5,000 miles from the transmitter.

#### Geometry of Pipe Joints

SOME interesting geometrical problems arise in making neat and practicable bend connexions in sheet-material between one cylindrical pipe or duct and another. For those who are concerned with work of this kind or with analogous problems, a pamphlet by W. Sellar entitled "The Geometry of Conical Pipes, Bends and Joints" (London: The Draughtsman Publishing Co., Ltd. 2s. net) will be found of positive assistance. In a pipe of uniform diameter, the arrangement of elbows and bends of various degrees of smoothness presents no special difficulty, and several of the methods in use are described and illustrated. When, however, the pipes to be connected are of different size and meet at an angle, the choice of a wrapped surface to which a flat sheet can be bent and which will form a convenient and pleasing intersection with the given surfaces is distinctly more complex. The solution lies in making use of the property that the ellipse is a plane section both of the cone and of the cylinder. The appropriate ellipse is obtained by arranging that the cone and the cylinder are both tangent to a common sphere, and in the pamphlet it is shown how, in a number of different problems, one or two or even more spheres can be used to obtain connexions for complex systems of pipes and branches in such a form as to minimize loss of pressure. The basic principle of this method of construction is clearly explained but no geometrical proof is given—nor for the purpose in view is it required. It is not clear, therefore, why a long list of what are described as essential points is given for these, and the figures illustrating them tend rather to complicate than to clarify the apparent simplicity of the method. The explanations given of the solutions of the numerous problems dealt with are, however, concise and clear, and are illustrated by drawings which alone would form a sufficient guide to a draughtsman.



## The Mellon Institute, Pittsburgh\*

THE Mellon Institute of Pittsburgh has published in pamphlet form an account of the dedication of the new building on May 6-7, 1937 (*NATURE*, May 15, 1937). In the introductory address, the Hon. Andrew W. Mellon paid tribute to Dr. Robert Kennedy Duncan, who initiated the system of industrial fellowships; and to his book "The Chemistry of Commerce", from which Mr. Mellon derived his original interest in the scheme. Discoveries and inventions, rather than governmental or political action, he said, "increased production, lowered costs, raised wages, elevated the standard of living".

The addresses of Dr. Irving Langmuir, Dr. Harold C. Urey and Dr. William P. Murphy—all Nobel laureates—are reprinted. On the subject of chemical research, Dr. Langmuir said that it is a common experience of industrial laboratories that the cost of research on a problem, up to the point where a patentable invention is made, is only a small fraction of that required to make the invention commercially successful, and for this reason such laboratories cannot devote a large part of their effort to fundamental research. The application of modern physics to chemistry, he suggested, is receiving only a small fraction of the attention it deserves. The greatest field which would open itself within the next decade in chemical research would be in the application of the new physical methods to the study of the familiar properties of matter, which have been neglected by the physicist for many years.

"We need more fundamental knowledge, in terms of atomic structure, of the mechanical properties of metals, insulating materials, plastic materials, and in general, chemical substitutes of high molecular weights. The use of X-rays, electron diffraction, and electron optics . . . should open new fields to chemists."

Dr. Urey scheduled ten important technical processes developed in recent years. Two of fundamental importance, the fixation of atmospheric nitrogen and the hydrogenation of coal, are due largely to German men of science. As to the first, it is estimated that the I. G. Farbenindustrie has expended 150,000,000 gold marks in the development of the process. Synthetic woollen textiles are coming—already two Italian regiments are wearing imitation wool uniforms made from the casein of skimmed milk. Would artificial wools ruin sheep farmers? More thought should be given to such problems consequential on scientific discovery. The limitation of scientific progress is fixed by the number of men available. "Find the men! That is the problem."

Another serious problem is the dissipation of raw material. We may have to grow our fuel supply by plants specially developed for the purpose; but the replacement of metals presents greater difficulties, pending the conquest of Mars and Venus. Referring to the ideals of scientific men, he said:

"We wish to abolish drudgery, discomfort, and want from the lives of men and bring them pleasure,

comfort, leisure and beauty. Often we are thwarted and our efforts perverted to other ends, but ultimately we will succeed. You may bury our bodies where you will, our epitaphs are written in our scientific journals, our monuments are the industries which we build, which without our magic touch would never be."

Dr. Murphy, co-discoverer with Dr. George R. Minot of the liver treatment for pernicious anaemia, commented on a weakness of medical research—the lag between discovery and its application to the cure of disease. The medical researcher has no incentive for the wide dissemination of his work, the profession as a whole showing no interest in commercial exploitation or in ensuring that the best product is put on the market. Progress in medical research has consequently been retarded in contrast to industrial research.

On the second day, a symposium on recent progress in science was held, including contributions from Dr. Frank B. Jewett on "Communication Engineering", Dr. George O. Curme, jun., on "Recent Progress in Synthetic Organic Chemistry", Sir Frederick Banting on "Early Work on Insulin", and Dr. William W. G. Maclachan on "The Problem of Chemotherapy in Pneumonia". Dr. Curme said that the spectacular days of pioneering in the field of synthetic organic chemistry are passing, but the important task of its application to industrial and economic problems "is just getting under way". He instanced plastics as offering a wide field of work and regretted that "not one of our universities offers an adequate course of study, preparing students either for engineering application or research on plastic materials". Sir Frederick Banting said that the greatest advance in the treatment of diabetes since the discovery of insulin was due to Hagedorn and his colleagues, of Denmark, who in 1933-35 discovered that the addition of protamine to their insulin so delayed the action that the day's supply could be given in one injection. The presence of zinc was found by Scott to be necessary for this effect. It is estimated that more than a million people receive insulin each day. "Although much of the physiology is known, we do not yet know how insulin enables the body to utilize carbohydrates, nor do we know the cause of diabetes."

Dr. Maclachan gave an interesting account of the systematic research carried on in the Institute on quinine derivatives for the treatment of pneumonia, 76 having been prepared and tested, a laborious process requiring about 20,000 white mice and other subjects. "As to our results for the past two years, we can say that hydroxyethylapocupreine appears to be effective in a considerable number of cases", especially in cases of pure infection. The original discovery that ethylhydrocupreine possesses strong powers of destroying pneumococci was due to Morganroth, in Germany, in 1911; but this preparation had the serious defect of producing blindness if given in adequate dosage. The object of the Pittsburgh workers, as of other workers in Japan and Germany, was to produce a derivative without this defect.

\* Dedication of the New Building of Mellon Institute. Pp. 71. (Pittsburgh: Mellon Institute, 1937.)



## Reaction Kinetics

ON September 13-15 the Faraday Society met under the presidency of Prof. M. W. Travers in the University of Manchester to discuss the modern theories and selected experimental aspects of reaction kinetics. The meeting was attended by a very large number of foreign guests and visitors.

The first section of the discussion was devoted to the theoretical treatments of reaction kinetics and resolved itself into a critical examination of the transition state or activated complex method and a comparison of the value of this method with that of the collision theory. The service done by this discussion lay in the emphasis on the differences which exist in the conceptual approach to the problem between those using the transition state method and those using collision theory.

The transition state method consists of two steps: the first is the construction of the potential energy surface for all configurations of the reacting atoms, and the second the calculation of the number of representative points which pass in unit time from the region of the potential energy surface that represents the initial state to that representing the final state of the reaction. The first step in this problem has been successfully carried out in a number of simple cases by the application of the semi-empirical method, developed by Eyring and Polanyi from London's theory. It was shown how the London theory can be modified so as to allow of an extensive use of empirical information and afford an interpretation of chemical reactivity in terms of bond strengths and the repulsion forces acting between atoms and molecules. A chemical change of the type  $AB + C \rightarrow A + BC$  can be carried out by a complete dissociation of  $AB \rightarrow A + B$  and the subsequent union of the atoms  $B$  and  $C$ . This would lead to an activation energy for the reaction equal to the dissociation energy of  $AB$ , no use having been made of the forces between atoms  $C$  and  $B$ . If, however, the centre  $C$  can be made to approach  $AB$  without overcoming large repulsion forces, then the attraction forces between atoms  $C$  and  $B$  can be utilized to reduce the activation energy. The driving force of a chemical change arises from the resulting bond formation  $BC$ , whereas the chemical inertia arises from the energy expended in achieving a configuration of atoms such that the driving force becomes operative. To attain this configuration, it is necessary to overcome the repulsion forces between  $AB$  and  $C$  and also the extension forces of the molecule  $AB$ .

The second step requires the definition of an 'activation surface' such that representative points crossing this surface lead to reaction. The number of points crossing this surface in unit time (reaction rate) is simply the density of points on the surface multiplied by their mean velocity perpendicular to the surface. The number of points in the 'activation surface' has been calculated by statistical equilibrium theory. Two very fundamental points were brought out in the discussion of this method.

1. The activated complexes  $AB$  (systems the representative points of which lie in the activation surface) are formed from molecules  $A^1$  and  $B^1$  of the initial state which possess sufficient energy in excess

over the normal molecules  $A$  and  $B$ . The transition state method assumes that equilibrium exists at all times between normal molecules and activated complexes, and this implies equilibrium between normal molecules and the energy-rich species  $A^1$  and  $B^1$ . It was emphasized that it is an assumption that the equilibrium numbers of energy-rich molecules  $A^1$  and  $B^1$  are maintained and not a condition which is necessarily fulfilled.

In most chemical reactions this condition is fulfilled since the equilibrium constant for a reaction can be expressed as the ratio of the reaction velocity constants in the forward and the reverse directions. Whenever the kinetic mass action law can be applied, it is justifiable to assume that the equilibrium number of energy-rich molecules is maintained and that the same conditions obtaining at equilibrium also hold when the products of reaction are removed.

2. In calculating the velocity of a chemical reaction by the transition state method, it is necessary to assume the validity of classical mechanics for the activated complex. Difficulties arise in the quantum treatment because of the fact that one cannot speak of a mean velocity of the representative point in the activation surface (Heisenberg indeterminacy principle) and, moreover, in certain cases tunnelling through the potential energy barrier may play an important part.

The statistical method of treating the activated complex has been translated into thermodynamic nomenclature and one speaks of the equilibrium constant  $K^\ddagger$ , the entropy change  $\Delta S^\ddagger$  and heat change  $\Delta H^\ddagger$  between the initial state and the activated complex. The heat change is the activation energy and the entropy change is related to the factor  $A$  in the velocity constant expression  $k = Ae^{-Q/RT}$ . This method has been used to account for reactions with abnormal  $A$  factors. An association reaction involving complex molecules has an abnormally small  $A$  factor, which in this theory is to be accounted for in terms of a negative  $\Delta S^\ddagger$  between the initial state and the activated complex. The explanation in terms of the collision theory becomes identical with that of the transition state if the collision number is multiplied by a probability factor  $P$  which contains terms relating to the correct orientation, the correct 'internal phase' and the right internal energy distribution of the reacting molecules. These same factors appear explicitly in the partition functions which define the change entropy  $\Delta S^\ddagger$ .

The denaturation of haemoglobin and egg albumen are reactions where the breaking of many weak bonds leads to the formation of an activated complex in which there is a much greater randomness of motion than in the initial state. This leads to a large positive entropy change, which means an abnormally high  $A$  factor.

Of great importance to any treatment of reaction kinetics is the study of the changes in the factors  $A$  and  $Q$  (of the Arrhenius equation) in a series of related reactions. An adequate theory must be able to include and explain the regularities which exist between changes in  $\log k$ ,  $Q$ ,  $A$  and  $\log K$  ( $K$  is an equilibrium constant). When substituents are



introduced into, say, benzene derivatives, the velocity at which these compounds react is changed and these changes are nearly all due to changes in the activation energy. In other cases, however, superimposed on the changes in  $Q$  are variations in  $A$ , and frequently the two variations tend to compensate each other. The factor  $A$  shows marked variations due to changes of the solvent in which reaction occurs, and both  $A$  and  $Q$  have been found to vary with changes in the hydrostatic pressure. Changes in the velocity constants of a series of chemical reactions are often related to the changes in the equilibrium constants for the same or for a very similar series of reactions by  $\log k = \alpha \log K + \text{const.}$  This gives an important approach to the understanding of the reactivity of organic compounds. Although a quantitative explanation cannot yet be given, it is just beginning to be possible to connect some of these relationships with changes in bond strengths, repulsion forces and chemical driving forces.

The last section of the discussion dealt with ionic and proton transfer reactions. The mechanism of both types of change has been considered in terms of 'extension' and repulsion forces. In the field of negative ion reaction, it has been possible to trace a relationship between the mechanism on one hand, and the chemical structure of the reactants and the physical conditions of reaction on the other. This study is of great value to the understanding of organic reactivity and the nature of the factors influencing it.

In the proton transfer reactions the small weight of the proton and the comparatively short distances between centres make a quantum mechanical 'tunnel effect' possible, but the experimental evidence available does not directly demonstrate the presence or absence of this effect. The comparison of reactions involving deuterons with those in which protons take part has led to valuable information about the mechanism of acid-base catalysis and proton transfer reactions in general.

## Institution of Gas Engineers

### AUTUMN RESEARCH MEETING

THE ninth Autumn Research Meeting of the Institution of Gas Engineers in London on November 2 and 3 had an interest above the average. The Institution research organizations have hitherto concerned themselves with current technical problems. This year the fortieth and forty-first reports of the Joint Research Committee of the Institution and the University of Leeds deal with problems of the future, and offer a glimpse of a cherished ideal of the gas industry, namely, the complete conversion of coal into a gas suitable for general distribution. Seventeen years ago, at a meeting of the Institution, gasification with oxygen and steam was visualized as an approach to this problem. Cost of oxygen and unsuitability of composition of the gas offered obstacles then unsurmountable. In the meantime, the oxygen production has been improved and cheapened. High-pressure technique has also shown the possibility of synthesizing hydrocarbons. In Germany, the Lurgi Company has built and operated a high-pressure producer whereby the town of Hirschfelde is supplied with gas made from lignite. In the forty-first report, on experiments made by Dr. F. J. Dent, it is disclosed that solid fuel can be freely hydrogenated to gaseous paraffin hydrocarbons at quite moderate pressures.

After carbonization at low temperatures, a coke contains carbon in a condition very ready to take up hydrogen under pressure, giving gaseous hydrocarbons instead of liquids, but without requiring the very high pressures necessary to 'liquefy' coal. Indeed results quoted show that hydrogenation of the coke combined with gasification of the residue would enable a coal to be converted into a rich gas without exceeding steam boiler pressure, and with an efficiency of 80 per cent. Such a gas, made and purified under pressure, would probably be practically sulphur-free and ready for distribution over considerable distances. Such results would apparently

be attainable with almost any type of coal, whereas high-class coking coal must be used in current practice.

The transference of these results to an industrial scale may take time, but there is no reason to doubt its feasibility as the engineering problems involved have already been solved. There is thus in prospect a method of fuel distribution which should be kept in mind at a time when the future of the coal, fuel and power industries is the subject of repeated inquiry and comment.

The fortieth report, prepared by Mr. J. W. Wood, on the combustion characteristics of town gas, contains a review of the literature on the combustion of gas which is probably the most comprehensive available. It presents an attempt to ascertain the characteristic of a gas most suitable for general use, and is appropriately associated with the forty-first report, which suggests that a process of complete gasification might be capable of adaptation to suit the composition of the gas produced.

A paper on the ignition of gas by 'cold catalyst' by L. W. Andrew, A. B. Densham and E. W. Voice suggests that the time is approaching when gas burners may be ignited by the use of a switch only. H. Hollings, W. K. Hutchinson and R. H. Griffith read papers on the removal of sulphur from gas, showing a way to sulphur-free gas made by current methods. Towns gas is the purest commercial fuel—so far as sulphur is concerned—but the removal of the residual traces of sulphur has eluded the ingenuity of gas chemists for generations. Now several alternatives have appeared, and catalytic oxidation of sulphur compounds at 150° holds promise of almost complete removal. When the products of combustion of coal gas are free from sulphur, considerable expansion in the uses of gas can be envisaged, and the reports at this meeting show that this time is now in sight. H. J. HODSMAN.



## Science News a Century Ago

### Civil Engineering at the University of Durham

In the *Civil Engineer and Architect's Journal* for January 1838 is an article entitled "Regulations for Students in Civil Engineering of the University of Durham, passed by the Senate and Convocation, November 22, 1837". In commenting on the Regulations, the *Journal* said: "The engineer, to enter upon any task of magnitude, ought to bring to it natural talents, expanded by education, and strengthened by experience; he ought to combine the mind of the philosopher with the accomplishments of the mechanic; he ought to be a man of profound judgment; he ought to be able to decide not merely what to do, but what *not* to do; . . .

"A large proportion, in fact, the whole of the above-mentioned qualifications so far as education and a rigid academic examination can effect them, will be induced by the system of regulations and course of study prescribed by the Senate; and the practical application of the knowledge obtained at the College will be made most advantageously in the mining districts in the neighbourhood; without the combination of theory with practice, the student when he enters into the world will find himself loaded with a quantity of knowledge which he is more apt to forget than to seek out the opportunity of applying to the advancement of the arts."

### Advantages of Medical Botany

At a meeting of the Medico-Botanical Society on November 22, 1837, reported in the *Lancet* of December 2, Mr. Johnson read a paper on this subject. "The advantages of the study of botany," he said, "were not immediately felt by the majority of medical practitioners, who were satisfied with obtaining their drugs from a wholesale druggist, and such herbs as they might require from Covent Garden. The physician, too, went on his daily practice of prescribing remedies which he had been in the habit of employing for years, and never daring to employ new remedies. This was the cause of the indifference with which medical botany had been treated by the majority of the profession. The objects of the Society were, perhaps, not sufficiently understood; it was not established for the purpose of forwarding the knowledge of botany in the abstract, the locating of certain genera and species, but for the purpose of ascertaining and testing the effects of remedies. Among other reasons why medical practitioners should study botany he might mention that of the present general diffusion of knowledge; many persons studied botany as an amusement, and the medical man, who it was generally considered ought to be better informed than common, should not be behind-hand in this science."

### Magnetic Observations in America

At a meeting of the Royal Society on November 23, 1837, Francis Baily being in the chair, a paper was read entitled "Magnetical Observations made in the West Indies, on the Coasts of Brazil and North America, in the years 1834, 1835, 1836 and 1837". The author was Sir James Everard Home, Bt., Commander, Royal Navy, fellow of the Royal Society, and the observations had been reduced by the Rev. George Fisher, F.R.S.

"The observations of the dip were made with an instrument of modern construction by Dollond.

Each observation consisted of an equal number of readings of the position of the needle, before and after the inversion of its poles, and a mean of all the readings taken for the true dip. Tables are subjoined containing the dips observed at each place; the times of making a hundred vibrations of five horizontal needles, and the mean horizontal forces computed therefrom; and likewise the results estimated in the direction of the dipping needle, compared with direct experiments made with the dipping needle itself."

### A Simulated Fast

THE *Lancet* of November 25, 1837, describes the following remarkable case of simulation: "A woman was lately exhibited in Paris as a phenomenon on the ground that she had taken no food for the last twenty months; she was fresh and fat, and carried a healthy child, six months old, at the breast. Not consuming any food the woman could not be supposed to excrete; she accordingly passed no excretion, and the miracle was complete. She carried her folly, or her knavery, so far as even to enter the *Hôtel Dieu* and place herself under the *surveillance* of a physician, M. Caillard, whom she assured that God was the father of her baby, and that he had commanded her to commence a fast in 1836. She was placed in St. Benjamin's Ward, and for several days the history she gave of herself seemed true; the food and drink placed beside the bed had remained intact; no trace of excretion could be discovered. Determined to find an explanation, M. Caillard passed her over to the care of M. Magendie, who happened to have a small closet unoccupied attached to one of his wards. The woman was shut up in this apartment with some food; the quantity of which was accurately measured. She resisted the sense of hunger for eight days, but ate on the ninth. The excretions were found carefully concealed in the mattress, which she had sewn up again."

## University Events

BRISTOL.—Dr. Eric Ashby has tendered his resignation from the readership in botany as from December 31, on his appointment to the chair of botany in the University of Sydney.

CAMBRIDGE.—G. L. Clark, of Trinity College, has been elected to an Isaac Newton Studentship.

Dr. C. F. A. Pantin has been appointed reader in invertebrate zoology.

T. T. Paterson, of Trinity College, has been appointed curator of the Museum of Archæology and of Ethnology.

Dr. J. A. Ramsay, of Queens' College, has been appointed Harding lecturer in experimental zoology. Dr. G. S. Carter, of Corpus Christi College, F. R. Parrington, of Sidney Sussex College, and Dr. G. Salt, of King's College, have been appointed University lecturers in zoology.

LONDON.—Mr. J. D. Bernal has been appointed to the University chair of physics tenable at Birkbeck College. Since 1934 he has been assistant director of research and in charge of the Crystallographic Laboratory at Cambridge.

SHEFFIELD.—The following appointments have been made: H. J. Barrie, as demonstrator in pathology; R. B. M. Jenkins, as assistant lecturer in civil engineering.



## Societies and Academies

## London

Royal Society, November 11.

F. W. ASTON: A second-order focusing mass spectrograph and isotopic weights by the doublet method. Several improvements have been embodied in this instrument, including adjustable slits and second-order focusing. The instrument has a resolving power of 2,000 and an accuracy of measurement approaching 1 in  $10^5$ . By its means, a large number of natural doublets have been measured. In many of these, one member is a hydrocarbon molecule, hence the isotopic weight of  $^{12}\text{C}$  has been ascertained with particular care. From the results obtained the packing fractions and isotopic weights of more than twenty atomic species are tabulated, some for the first time.

J. E. BEST, F. T. FARMER and J. A. RATCLIFFE: Studies of the *E* region of the ionosphere.

## Paris

Academy of Sciences, October 4 (*C.R.*, 205, 549-584).

HENRI LAGATU and LOUIS MAUME: The chemical determination of the cultivated plant.

ARISTOTLE D. MICHAL: General conformal geometry.

M. and MME. LUCIEN D'AZAMBUJA: Monochromatic images of the sun obtained on the spectroheliograph with the  $\lambda 10830$  infra-red helium line, the violet hydrogen line  $\text{H}\epsilon$  and the infra-red lines of the same element  $\lambda 10938$  and  $\lambda 10049$ .

AUREL NICOLAU: The thermomagnetic study of two paramagnetic solutions. Details of measurements of solutions of nickel sulphate and ferrous ammonium sulphate. Both follow the law of Weiss.

MAURICE FALLOT: The magnetic properties of alloys of iron and rhodium. The results are given graphically. The magnetic properties of these alloys show one remarkable characteristic, the mean atomic moment increases with the percentage of rhodium.

GABRIEL BOSSCHETER and JACQUES ERRERA: Water, as ice, liquid water and in solution in dioxan studied in the near infra-red.

CHARLES DUFRAISSE and JEAN LE BRAS: Combustible substances, regarded as helping incombustible extinguishers, for the practical extinction of flames. Contrary to the usually accepted view, absolute incombustibility is not a necessary condition for fire extinguishers: partially combustible substances or mixtures may be more efficacious provided they do not form a true flame.

PAUL CHOVIN: Researches on Pechmann's colouring matter. The products resulting from the action of alkalis. Mechanism of their formation.

HENRI LONGCHAMON: The genesis of gneiss and granulites with sillimanite in the French Central Massif.

THÉODORE V. IONESCU: The calculation of the interval of time between two successive encounters of an electron with the molecules of the ionosphere.

ROGER GAUTHERET: New researches on the culture of cambium tissue. In an earlier communication, the author has shown the possibility of making true cultures of plant tissue. Details are now given of the effects produced by adding small proportions of

heteroauxin, cysteine hydrochloride and vitamin  $\text{B}_1$  to the culture media. All these stimulate the proliferation of cambium tissue of *Salix caprea*, cultivated *in vitro*. Of the three substances named, vitamin  $\text{B}_1$  gives the best results.

OCTAVE DUBOSQ, PIERRE P. GRASSÉ and MAURICE ROSE: The flagellæ of *Acanthotermes ochraceus* of South Algeria.

BRUNO MINZ and RENÉ AGID: The influence of vitamin  $\text{B}_1$  on the activity of acetylcholine.

GEORGES BLANC and MARCEL BALTAZARD: Crossed immunity between the pustular fever and purpura fever of the Rocky Mountains. Vaccination of the guinea pig against these two diseases by a living biliated virus of pustular fever. The immunity conferred by pustular fever against purpura fever is total. It is as strong in man as in laboratory animals.

RENÉ SALGUES: The wool of the osteomalacic sheep.

HENRI EMERY: Immunization of the rabbit against the experimental epithelioma of Brown Pearce.

## Cape Town

Royal Society of South Africa, September 15.

A. P. GOOSSENS: A study of the South African species of *Sporobolus* R.Br. with special reference to leaf anatomy. A historical account is given of the work done on the anatomy of grass leaves. The anatomy of the leaves of *Sporobolus* is discussed, and a key to the species is drawn up incorporating these anatomical features. The new species are described and the distribution of all South African species is given.

## Moscow

Academy of Sciences, *C.R.*, 15, No. 9, 1937.

J. A. MINDLIN: The boundary dynamic problem of the theory of elasticity for a circle with a given tension.

S. LECHNITSKY: Solution of the problem of elasticity of anisotropic bodies for the interior of an ellipse.

N. MOISEIEV: Periodic trajectories around the point of balancing  $L_1$  in the Copenhagen problem of three bodies.

S. A. BOROVIK and T. T. BOROVIK-ROMANOVA: Variations in the intensity of titanium and vanadium radiation on the introduction into the electric arc of salts of sodium and of potassium.

A. V. STEPANOV: The influence of surface state on the plasticity of crystals.

E. I. GUROVIČ: The problem of the presence of films on metals.

W. G. TRONEV: Solubility of noble metals at high pressure (1). The solution of metallic platinum in hydrochloric acid.

G. A. LEVITSKIJ: Genotypic control of structural chromosome changes.

K. SUCHORUKOV and B. STROGONOV: The activators of peroxidase in sick plants.

M. I. GOLDIN: So-called masking of virus diseases.

P. J. SCHMIDT: Two new species of *Arctediellus* Jordan from the Okhotsk Sea.

A. M. VASJUTOČKIN: Regeneration of the myoid elements of the thymus gland of amphibians.



## Forthcoming Events

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

### Monday, November 22

UNIVERSITY COLLEGE, LONDON, at 5.30.—The Very Rev. W. R. Inge, K.C.V.O.: "The Price of Progress" (Pickman Godlee Lecture).\*

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—J. Rymill: Film of the British Graham Land Expedition.

ROYAL SCHOOL OF MINES, at 8.—Prof. B. P. Haigh: "Metallurgy and Mechanics in the Design of Steel Pipes" (Armourers and Brasiers' Company's Lectures. Succeeding lectures on November 29 and December 6).\*

### Tuesday, November 23

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Prof. E. Rubin: "Experience and Perception, Thinking and Feeling" (succeeding lectures on November 24 and 26).\*

EUGENICS SOCIETY (at the Royal Society, Burlington House, W.1), at 5.30.—J. C. Trevor: "Some Anthropological Considerations of Race Crossing".\*

### Wednesday, November 24

BRITISH ASSOCIATION (at the Goldsmiths' Hall, Foster Lane, Cheapside, London, E.C.2), at 4.—Dr. R. E. Mortimer Wheeler: "Origins of Town Life in Britain" (Norman Lockyer Lecture).

SOCIETY FOR THE STUDY OF ALCHEMY AND EARLY CHEMISTRY (at University College, Gower Street, W.C.1), at 8.—Dr. D. J. Lysacht: "Hooke's Theory of Combustion".

### Thursday, November 25

ROYAL SOCIETY OF MEDICINE, at 3.—Prof. F. L. Golla: "Science and Psychiatry" (Eighteenth Maudsley Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. G. Stoney, F.R.S.: "Scientific Activities of the late Hon. Sir Charles A. Parsons, O.M., K.C.B., F.R.S." (Parsons Memorial Lecture).

INSTITUTE OF FUEL (at the Junior Institution of Engineers, 39 Victoria Street, S.W.1), at 6.—Symposium on "The Ignition of Fuel on Grates".

### Friday, November 26

PHYSICAL SOCIETY (at the London School of Medicine for Women), at 5.15.—Thomas Young Oration.

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS (at the Royal Society of Arts, John Street, Adelphi, London, W.C.2), at 5.30.—Brigadier M. N. MacLeod: "The Ordnance Survey and its Work".

BEDSON CLUB, KING'S COLLEGE, NEWCASTLE-UPON-TYNE, at 6.30.—Prof. J. R. Partington: "Chemistry in the Ancient World".

ROYAL INSTITUTION, at 9.—Prof. H. Dingle: "Science and the Unobservable".

## Appointments Vacant

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

SENIOR ENGINEER (short-wave and ultra-short wave systems) and ENGINEER (acoustics) in the Research Department of the B.B.C.—The Engineering Establishment Officer, British Broadcasting Corporation, Broadcasting House, W.1 (November 22).

ASSISTANT LECTURER IN MATHEMATICS in University College, Leicester—The Registrar (November 27).

LECTURER IN PHYSICS in the Leicester College of Technology—The Registrar (November 27).

LECTURER IN GEOGRAPHY AND GEOLOGY in Rhodes University College, Grahamstown—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (November 27).

LECTURER IN BOTANY (physiology or genetics) in the University of Bristol—The Registrar (December 2).

CHEMIST at the Rubber Research Institute of Malaya—The Secretary, London Advisory Committee for Rubber Research (Ceylon and Malaya), Imperial Institute, S.W.7 (December 31).

## Official Publications Received

### Great Britain and Ireland

Proceedings of the Royal Irish Academy. Vol. 44, Section A, No. 1: Precision Measurements with a Radial Deflection Cathode Ray Oscillograph. By John J. Dowling and Dr. Thomas G. Bullen. Pp. 10+1 plate. 1s. Vol. 44, Section A, No. 2: Some Electrical and Optical Properties of Iodine Vapour. By K. G. Emelius, E. B. Cathcart and C. M. Minnis. Pp. 11-18. Vol. 44, Section A, No. 3: On some Symbolic Formulae in Probability Theory. By T. S. Broderick. Pp. 19-28. 1s. Vol. 44, Section A, No. 4: The Zeros of Legendre Functions. By Dr. P. G. Gormley. Pp. 29-43. 1s. Vol. 44, Section B, No. 1: The Influence of Temperature on the Activity of the Kidney in relation to its Influence on Oxygen Consumption. By E. J. Conway, J. M. O'Connor and D. K. O'Donovan. Pp. 18. 1s. 6d. Vol. 44, Section B, No. 2: Structural Laws of the Mammalian Kidney, with a Theoretical Derivation from a Diffusion-Pressure Theory. By E. J. Conway. Pp. 19-28. 1s. Vol. 44, Section B, No. 3: A Map of the Glacier-Lakes and the Local Glaciers of the Wicklow Hills. By Prof. J. K. Charlesworth. Pp. 29-36+plate 2. 1s. Vol. 44, Section B, No. 4: Studies in the Synthesis of Flavonols—The Oxidation of Flavonodigenides. By Dr. Joseph Algar and Isabella P. Carey. Pp. 37-44. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [311]

### Other Countries

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 1936. (No. 776.) Pp. iii+204. (Ottawa: King's Printer.) [3010]

Meddelanden från Statens Meteorologisk-Hydrografiska Anstalt. Band 6, No. 6: Isförhållandena vid Sveriges Kuster under Vintern 1870-71—1934-35. Av C. J. Östman. Pp. 63+2 plates. 3.00 kr. Band 7, No. 1: Fyrisån. Av Ragnar Malin. Pp. 15+1 plate. 1.50 kr. (Stockholm: Statens Meteorologisk-Hydrografiska Anstalt.) [111]

Cornell University: Agricultural Experiment Station. Bulletin 673: Economic Studies of Vegetable Farming in New York. 2: Market-Garden Farms without Greenhouses, Rochester Area. By J. L. Paschal. Pp. 36. Bulletin 676: Tomato Fertilizer Experiments on Long Island. By J. D. Hartman, Paul Work and P. H. Wessels. Pp. 12. Memoir 199: Index Numbers of the Cost of Goods and Services bought by Farm Families in New York, 1920 to 1935. By Helen Canon and Mahel Rollins. Pp. 23. Memoir 200: Relation of Size of Community to Marital Status. By Dwight Sanderson. Pp. 74. Memoir 201: The Daily Rate of Photosynthesis, during the Growing Season of 1935, of a Young Apple Tree of Bearing Age. By A. J. Heinicke and N. F. Childers. Pp. 52. Memoir 202: Quantitative Determination of Lactic Acid in Butter. By H. C. Troy and Paul F. Sharp. Pp. 17. Memoir 203: Incidence of Fire Blight in Young Apple Trees in relation to Orchard Practices. By E. M. Hildebrand and A. J. Heinicke. Pp. 36. Memoir 204: The Reliability of Flavor Judgments, with Special Reference to the Oxidized Flavor of Milk. By G. Malcolm Trout and Paul F. Sharp. Pp. 60. (Ithaca, N.Y.: Cornell University.) [111]

II<sup>e</sup> Congrès Scientifique International de l'Alimentation organisé par La Société Scientifique d'Hygiène Alimentaire. La Science de l'Alimentation en 1937. Pp. A121+B72+C163+D73+E53+F90+iv. (Paris: Congrès Scientifique International de l'Alimentation.) [111]

Bulletin of the American Museum of Natural History. Vol. 74, Art. 1: New Fishes from the Continental Tertiary of Alaska. By Erich M. Schalkjer. Pp. 24. (New York: American Museum of Natural History.) [311]

### Catalogues, etc.

Allgemeine und angewandte Zoologie. (Antiquariats-Katalog Nr. 715.) Pp. 160. (Leipzig: Gustav Fock, G.m.b.H.)

Marmite (Yeast Extract) in Medicine and Dietetics. Pp. 24. (London: The Marmite Food Extract Co., Ltd.)

Books on Botany, Part 2. (New Series, Catalogue No. 46.) Pp. 44. (London: Wheldon and Wesley, Ltd.)

The Lovibond Comparator for Colorimetric Determinations. Pp. 36. (Milford, Salisbury: The Tintometer, Ltd.)

Vermes. (Catalogue No. 93.) Pp. 68. (Den Haag: Antiquariaat W. Junk.)

The Dextra Industrial X-Ray Unit. (Publication No. 257.) Pp. 9. The Spekker Minor Ultra-Violet Photometer. (S.B. 258.) Pp. 4. (London: Adam Hilger, Ltd.)

A Catalogue of Books Old and Modern, comprising Recent Second-hand Purchases, including Works on the Alps and Mountaineering, Architecture, Art, Topography, etc. (No. 485.) Pp. 30. (Cambridge: Bowes and Bowes.)

"Cressall" Dimming Resistances. (List No. 67.) Pp. 2. "Cressall" Electric Branding Iron. (Leaflet No. 66.) Pp. 2. (Birmingham: The Cressall Manufacturing Co., Ltd.)