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## Problems of Industrial Hygiene

THE annual reports of the director of the International Labour Organisation cover an extensive field, all the more because the boundaries between social and economic questions have been largely obliterated by the recent economic depression. Hitherto, the main work of the Organisation has lain in the field of protective labour legislation. In this field its activities have already been of direct concern to professional workers, whether in science or elsewhere; and apart from the actual conventions already adopted by the International Labour Conference, a notable amount of research work has been carried out in subjects of direct interest to scientific workers, such, for example, as its studies on the operation of the radius clause, and the problem of the salaried inventor, industrial relations between staff and management, hours of work of professional workers, the status of engineers and chemists, and similar topics.

The extent to which an international labour code has been established has led to the suggestion that the goal of the legislative effort of the Organisation is in sight and that its remaining tasks are secondary. To the examination of this contention, Mr. H. B. Butler devotes a concluding chapter in his recent report (Geneva: International Labour Office, 1935) which is of particular interest to the scientific worker. At the outset, Mr. Butler rightly points out that social legislation is not static but dynamic. Already some of the conventions adopted are becoming out of date. Notably is this true of those bearing on questions of hours of work, in which the growing acceptance of the necessity for some further and wise distribution of employment or leisure is obviously a disturbing factor. Only as proposals are con-

tinuously put forward based on assiduous research can we hope to approximate to solutions of such problems which will offer the minimum of distress and the maximum satisfaction of man's needs. There are still important fields for scientific investigation which demand investigators of high quality. Such, for example, are the questions of training for industry, including vocational guidance, apprenticeship and technical education, and the many problems arising out of leisure and the provision of facilities for recreation which were discussed at an international conference at Brussels in June. Besides these, the special problems of the professional worker require fuller consideration, and the fields of industrial hygiene and safety offer an immense scope for future action.

Since the publication by the International Labour Office in 1928 of a report and a supplementary report giving a concise analysis of laws and regulations of all the great industrial countries, as well as a survey of the organisation and activities of safety associations in various countries, and the adoption at the Conference of June 1929 of a draft recommendation concerning the question of industrial accidents, the problems of industrial safety and hygiene have received a growing share of attention in Great Britain and elsewhere. Apart from the purely professional problems of the scientific worker, the work of the International Labour Organisation touches him at no point so closely as at this. Upon his co-operation the success of almost all its efforts in this field finally depends.

The prominence of these questions should not of course be wholly attributed to the influence of the International Labour Organisation. Quite

independently, the Association of British Chemical Manufacturers has already done a great deal to promote safety and hygiene in chemical industry by means of its model safety rules for chemical works, its safety circulars with their particulars of various accidents and their causes, its 'Safety Summary' of information on accidents and their prevention. The annual reports of H.M. Chief Inspector of Factories record the way in which such matters are receiving increased attention in industry generally, and the success of the Industrial Museum at Horseferry Road, Westminster, and the illustrated descriptions of industrial accidents issued quarterly by the Home Office, afford further evidence, if such be needed, of the widespread desire to make conditions in industry as safe and healthy as possible.

Whether we approach the subject from the point of view of the dissemination of information or of that of securing effective action, the part of the scientific worker is equally important. Both in the preparation of summaries or abstracts of safety information, or of such monographs as "Occupation and Health", issued by the International Labour Office, and in their use, his participation is essential if the information provided is first to be accurate and then to be used effectively. There is still need for much wider use and more effective co-ordination of available information, so that experience gained in one firm or industry at the expense of human suffering may be freely available to prevent a similar occurrence elsewhere. Few industries are served so efficiently in this matter as the chemical industry, and the very circulation of such a publication as the *Journal of Industrial Hygiene* indicates the need for development in this respect.

Again, the participation of scientific workers in the publication of notes on accidents and hazards, their cause and prevention might well be more widely encouraged. Much valuable work is being carried out by various firms, but not all of this is published and made generally available. Moreover, the whole field of industrial hygiene offers opportunities for research which are far from being fully explored. Much work of this type is pre-eminently suited for co-operative effort, and from this point of view the influence of the International Labour Organisation is highly important. While undoubtedly the actual investigations will best be carried out through national organisations, an international organisation can do much to delineate the problems and supply the stimulus

where required, as well as secure co-ordination and avoid overlap.

Research work in industrial hygiene demands a high degree of co-operation between various classes of scientific and other professional workers. The annual reports of H.M. Chief Inspector of Factories afford continual evidence that failure to observe the provisions already laid down in the Factory Acts, and consequent industrial accidents, are due to the absence of skilled and qualified supervision, such as that of a chemist or engineer. Still more is it impossible to take adequate precautions and safety measures in the event of unforeseen contingencies, which can scarcely be entirely excluded from some processes or stages of development, in the absence of those who are able to bring a trained mind and expert knowledge to bear on any emergency.

There are welcome signs that this responsibility is now widely recognised among scientific workers, and that those occupying positions of responsibility are resolved to do all in their power to guard the worker in industry from risks of which he is often unaware and which only the scientific worker can appreciate. Certain professional organisations, such as the British Association of Chemists, have set themselves definite aims in this matter, and the Association of British Chemical Manufacturers is already carrying out a large amount of valuable work. The proposals of the new Poison Rules in regard to the supervision of the manufacture of pharmaceutical preparations will certainly be closely scrutinised from this point of view.

There are, however, many industries where a great deal more remains to be done, where scientific and professional workers are isolated and few in number. To raise the standard of industrial hygiene and safety in such industries demands all the support which they can receive from their professional and scientific colleagues and from the investigations and general efforts of such organisations as the International Labour Office. Only as the technical staffs are inspired by the consciousness of high professional traditions and solidarity in this matter of industrial safety, and as the work of the factory inspectors is continually reinforced by educational and research work stimulated by an international organisation pooling knowledge for the common benefit, can we hope to see the minimum standards of the law exchanged for those guaranteeing the maximum security of life and health.

## Kenya: The Settler's Story

### White Man's Country: Lord Delamere and the Making of Kenya

By Elspeth Huxley. Vol. 1: 1870-1914. Pp. xiii + 315 + 12 plates. Vol. 2: 1914-1931. Pp. vii + 333 + 12 plates. (London: Macmillan and Co., Ltd., 1935.) 2 vols., 25s. net.

THE author of this most interesting book is the daughter of a Kenya settler, reared and educated in Kenya. It is perhaps the most comprehensive account of the pioneer activities in farming and politics of European colonisation of those highlands in east equatorial Africa that has yet appeared. It is written round the life of that father of his adopted country, Lord Delamere, the ablest and most intelligent leader that the settlers have produced.

Kenya has, in the forty years of its history under British administration, been the centre of acute controversies, all of them raising issues that have reached far beyond its frontiers, affecting race relations and Imperial policy throughout the whole world. Kenya, owing to its geographical position, its unique climate, and the curious make-up of its very varied population, has always been, and will always remain, the focus, if not the storm centre, of a complex of difficult problems. It is not a normal land, and, like Ireland, it excites a romantic and even an emotional sentiment of intense affection, or intense antipathy, in all who have anything to do with it. That people 'fall in love' with Kenya is not surprising. The admirable photographs in this book will give some idea of the attraction of its spaciousness and beauty.

It has been said that Kenya is inhabited by the most difficult Europeans, the most difficult Indians, and the most difficult African natives in the Empire, all seeking livelihood in what is economically, and, from the point of view of the human species and his domestic animals, a most difficult country to harness to man's use. That the fair highlands of Kenya were so sparsely populated when less than forty years ago Europeans began, with official encouragement, to colonise it, was not due solely to the warlike proclivities of the nomadic Masai. Almost every known form of mycological, protozoan, helminthic and insect pest formed the flaming swords of death that guarded and still guard an apparent garden of Eden. Wheat rust, malaria, red water fever, rinderpest, worm-infested herds of zebra, tsetse fly, and last but not least, swarms of locust of more than one

variety contend with man for the domination of the land; and the fight is not won yet.

Lord Delamere was a romantic figure, part politician, part farmer and part Puck. Born in 1870, the only son of the second Lord Delamere, he was taken away from Eton at the age of sixteen, and, at seventeen, succeeded to the title and responsibilities of a feudal family estate in Cheshire. Civilisation, and the accidents of his birth and circumstances in England, for a young man of his temperament, were soon found to be constricting, and early he sought to escape from their toils. At the age of twenty-five he wandered through the port of Zeilah, that has recently become famous on account of the Italo-Abyssinian controversy, and through the semi-arid hinterland of Somali country into the country round Mount Kenya, and thereafter he devoted his remaining thirty-six years of life whole-heartedly to Kenya. His patrimony in England became but the milch cow from which the last possible drop was extracted for financing his very varied pioneer experiments in Kenya. Family, financial interest or motive, comfort, everything in life, he sacrificed on the altar of his passion for the colony.

By inheritance and upbringing, Lord Delamere was an eighteenth century aristocrat for whom there were three proper occupations—sport, agriculture and politics. But to inheritance and upbringing was added a personal individuality such as was possessed by the pioneer explorers of history, coupled with a very penetrating, if impish, intelligence, and a natural liking for and understanding of the African native, especially of the more primitive tribes. His personal handling of his favourite Masai in the troublous times of the War stands out as perhaps his most remarkable achievement.

Lord Delamere had inevitably an almost complete disregard of money and economics. He was recklessly generous and grandiose as regards the former. For himself, he lived hard and simply, but in his pioneer experiments in new agricultural introductions he was lavish, and the few successes had to compensate the bankers responsible for his overdrafts for many inevitable failures. The end of scientific experiment had to justify the means. Like many another English country gentleman who devotes his energy and substance to the tradition of agriculture, he always hoped but never really expected that the 'Home' farm would pay! Though Kenya owes a tremendous debt to Delamere for his farming experiments—

wheat, the introduction of Merino sheep, pedigree cattle, all of which he was the first to try out—it is not as an agriculturist but as a man of affairs that he made his greatest contribution.

Mrs. Huxley has given us on page 88 of the second volume the following admirable description :

“On many matters Delamere’s advice was of great value to the Government. It was easier to deal with a man of his calibre than with eleven discordant elected members. He was willing to help as well as to harry. But he could be a dangerous opponent. He was always on the alert. Outwardly he was urbane, charming and courteous ; ready, at any conference or interview, to voice an opinion in the most conciliatory, almost deprecating, fashion. But little escaped him ; and at the first error of fact or flaw in argument he would pounce quickly, still with unruffled courtesy, his blue eyes twinkling as he puffed a large cigar, his head cocked on one side like a sparrow. On occasions he had a keen appreciation of the dramatic effect of sudden outbursts of temper, to be followed by a complete withdrawal and an apology so charmingly delivered that offence had to be forgotten.”

This is an almost perfect picture of the man, whose sense of humour was never failing and whose mental resource was like a rapier. He did not suffer fools—especially official fools—gladly, and, like an African native he was a quick judge of both character and wits. Everyone official and unofficial knew that he was by ability and experience the outstanding figure in Kenya. Most people, especially his own native personal servants, loved him. A few people hated him.

Mrs. Huxley has written a faithful story of his adventurous life, and it needed to be told as she has told it. Of course, Delamere was the centre of all the storms and escapades of Kenya’s eventful history. She has inevitably written of the controversies from the settlers’ point of view. She is not always quite fair to the poor old Colonial Office, thousands of miles away in Downing Street. She is fully aware that the pro-Indian and pro-native enthusiasts have hitherto had most of the publicity, and she has fearlessly entered the lists. Her book is not always strictly impartial or objective, and doubtless it is the more stimulating and readable for that reason. Occasionally guilty of *suppressio veri*, she is very rarely, if ever, guilty of *suggestio falsi*. The book is remarkably free from any errors of fact—but, on page 224 of the second volume, Sir George Schuster, who had been financial adviser in the Sudan, was then financial adviser to the Colonial Office, and was later to become Finance Member of the Viceroy’s Council, is wrongly described as an Indian Civil Servant.

The book contains all the essential quotations from official sources as to the origin and development of the official policy of European settlement, and from the all too numerous Commissions which have wrestled with constitutional problems in East Africa. It is cleverly and attractively written, and admirably produced. On page 83 of the first volume, Mrs. Huxley has penetrated very deep into the root causes of our Imperial difficulties over Kenya.

“This loss of faith is perhaps”, she writes, “at the root of the misunderstanding and the bitterness that has grown up, since the war, between the settlers and their English rulers. For the colonists have in the main retained their old philosophy and preserved their faith. Economically they have believed, blindly like all producers, that the time will come when more raw materials will be needed. The intellectual isolation of colonial life has to a large extent cut them off from the influences which have brought about a change of philosophy in England. . . . To the gulf of distance, therefore, between the settler and the British voter who rules him, has been added a still deeper and more difficult gulf—the gulf of outlook. The colonist does not realise why the Englishman has apparently lost all sympathy with him. Inwardly he feels betrayed. The Englishman does not see that the colonist is guilty not of oppression but of consistency. So the settler stands marooned, cut off by the tide of post-war disillusion from the shore which he so confidently left, and gazing with a puzzled and aggrieved expression at the unfamiliar and defeatist sea.”

This is a true picture of what all too many settlers feel, not in Kenya only. But, while it is true that for economic and political, and even deeper reasons, there has been a great and subtle change in English views on racial questions, it is wrong to describe this new attitude as one of ‘defeatism’. It is by no means certain whether it is not the ‘die-hard’ who is the more guilty of defeatism, than the man who adjusts his point of view and his methods to an ever-changing world, and retains his faith in the ideals of British freedom, initiative and adaptability, finding new methods—often merely new forms and phrases—to continue that leadership and influence which will carry us even further to success as the people who have shown the greatest genius for colonisation in human history. The die-hard is the defeatist because he thinks we can only succeed on the basis of the old pre-War conditions, and in the pre-War environment. Nobody so young and so intelligent as Mrs. Huxley need really despair of our Imperial future.

W. ORMSBY-GORE.

## Atmospheric Physics

Vorlesungen über Physik der Atmosphäre  
Von Prof. Alfred Wegener und Prof. Kurt  
Wegener. Pp. xii+482. (Leipzig: Johann  
Ambrosius Barth, 1935.) 36 gold marks.

IN 1911 there appeared an attractive and highly individual book by Alfred Wegener, entitled "Thermodynamik der Atmosphäre". Under this somewhat forbidding title a wide range of atmospheric topics was discussed, with originality and insight if not always with adequate critical judgment. The book met with a favourable response, and was reprinted without alteration in 1924 and 1928, circumstances preventing the author from making the changes and extensions called for by the advance of knowledge. Meanwhile Wegener achieved world-wide fame as the author of the hypothesis of continental drift, which he expounded in a well-known and much discussed book; he also led a number of scientific expeditions, and unfortunately, in the last of these, to Greenland, he met his death.

Wegener had planned to expand his "Thermodynamik der Atmosphäre" into a more comprehensive book on the physics of the atmosphere, and among his papers the preface to this proposed work was found, of date 1928-29; it is a modest statement of his aim to produce not a detailed treatise but an introduction to the subject, individual in outlook. His brother, Kurt Wegener, who took up the leadership of the ill-fated Greenland expedition and published its results, undertook also, as a pious obligation to his brother's memory, to execute the transformation of the "Thermodynamik" into a "Physik der Atmosphäre".

This book is now issued, under the joint names of the two brothers. The author has evidently found the writing of the book a long and arduous task, as is really inevitable from its wide scope. Much of the original work is retained, including about half of the 143 illustrations in the original, supplemented with others to a total of 192 in the new book; the old illustrations, many of them very attractive pictures of clouds, waterspouts and other such phenomena, are indeed better reproduced now than before. The old material has, however, been much rearranged, and the original book is increased in size by about fifty per cent (from 331 to 481 pages) by the addition of new matter.

The new material includes a lengthy account—of about 35 pages—of the Milankovitch theory of solar radiation in the earth's atmosphere, and

extended treatment of friction (eddy viscosity) atmospheric optics, atmospheric electricity and other topics. The author in his preface expresses his dissatisfaction with the chapters on radiation and on friction: the inclusion of the theory of Milankovitch in the former chapter certainly seems out of line with the general plan of the book, which is elsewhere substantially non-mathematical.

The task which the author has attempted is one of considerable difficulty, and perhaps one not intrinsically congenial, being undertaken mainly out of respect and affection for the memory of a brother. It is therefore with both sympathy and regret that the reviewer feels constrained to express an adverse opinion on the execution of the task; the more so since the book shows a commendable lack of national bias in its choice of matter and of references to authors. The inadequacy of the book in its new form lies in its undue retention of old points of view, and the lack of mention of very much new work done since 1911. It is true that there are a few references of very recent date, including the 1934 paper of Götz, Meetham and Dobson on the mean height of the ozone layer; but the author does not seem really familiar with several of the advances made in atmospheric physics during the last quarter century. A few illustrations of these statements may be cited.

One of the individual peculiarities of Alfred Wegener's "Thermodynamik" was his postulation of a hypothetical element, geocoronium, as constituting, with hydrogen, the upper layers of the atmosphere, from about 100 km. upwards; an atomic weight of 0.4 was suggested for this element—a value which the subsequent progress of physics has wholly ruled out. It is astonishing to find A. Wegener's original height-composition diagram, including this element, reproduced in 1935, even though the anachronism is mitigated by the (inadmissible) suggestion that geocoronium may now be identifiable as electron gas, or may not exist at all. The few pages of discussion of the composition, pressure and temperature of the atmosphere at great heights are in part incorrect, and generally inadequate. The works of Jeans, Milne and Lennard-Jones on the escape of atmospheres, and those of Lindemann and Dobson on the temperature as indicated by meteor observations, are not mentioned; nor is the possibility, now widely favoured, that mixing keeps the composition uniform up to about 100 km. (except as

regards water and ozone). The few pages devoted to planetary atmospheres are also rendered out of date by later work of Slipher, Russell, and of the Mount Wilson Observatory.

Similar criticisms may be made of the treatment of the auroræ and of iridescent and of luminous night clouds. Størmer's recent important work on these two types of high cloud, in which he has measured their height and motion by the methods long successfully applied to the aurora, is not cited: nor is his important discovery that very high auroræ lie in the high sunlit region of the atmosphere. The account of the present state of knowledge as regards the auroral spectrum is likewise unsatisfactory.

Turning to the more generally studied fields of meteorology, examination of the chapters on the mechanics of the atmosphere, in which air waves and clouds of wave-like form are discussed, shows that the Helmholtz theory of these clouds is described, without reference to the work of Rayleigh, Bénard, Idrac and G. T. Walker and his school, on vortical and shear motion in unstable layers of fluid; yet this work seems to offer a more satisfying explanation of a wide variety of cloud forms.

The chapter on radiation, which contains a long account of the theory of Milankovitch, makes no reference to the important work of Simpson, based on Hettner's study of the spectrum of water vapour; likewise the work on lightning, due to Simpson, C. T. R. Wilson and, in Africa, by Schon-

land, is not cited in the chapters on atmospheric electricity. It is, of course, impossible to deal in detail with a wide variety of topics in a book of this size, but to the reviewer it seems that some brief account of such recent advances should have taken the place of out-of-date or less important matter that is included.

This general criticism can be illustrated also by the results of an examination of the author's index. The name of Fabry, for example, is naturally looked for, not least on account of his very important work on atmospheric ozone: the one reference to his name is found, however, to be to a determination by Fabry and Perot of the viscosity of air—for which, surely, the most recent value, taken from one or other of the most modern tables of physical constants, should have been cited. Perhaps the strangest feature of the name index, however, is that Isaac Newton is quoted only as the author of the notation  $\dot{x}$  for Leibniz's  $dx/dt$ , while his formula for the velocity of sound, and his law of friction, are attributed to H. A. Newton, a writer on meteors! The date of the latest reference to meteors seems, by the way, to be 1893.

These illustrations of points of criticism necessarily refer only to a fraction of the book; but they seem to the reviewer to be too typical of the whole. The high purchase price might certainly be laid out to better advantage by seekers after knowledge of atmospheric physics.

S. CHAPMAN.

## Through Einstein's Eyes

### The World as I see It

By Albert Einstein. Translated by Alan Harris. Pp. x+214. (London: John Lane, The Bodley Head, Ltd., 1935.) 8s. 6d. net.

THIS book ought to be entitled 'The World as I feel It', so suffused is it with a deep sincerity and a passion for justice. To Einstein the world is a painful place, not merely because of the suffering that abounds but also because of the latent possibilities for good that man creates and ignores. Jews are persecuted, driven and hunted from the lands of their adoption to which they have contributed so generously in art, in science and in literature. Einstein sees the dignity of civilised human beings humiliated, and their bodies physically maltreated for their political views or racial descent, and as a sensitive human being he suffers with them in shame. Art slips into decadence,

science is circumscribed, political leaders lose their independence of spirit and the ordinary citizen his sense of justice. Masses, worked into fury by unscrupulous newspapers, don uniforms to kill or be killed for worthless aims, and nations arm for war on a colossal scale, while their leaders chatter of peace. All this Einstein sees and it tortures him.

Whatever coherence this book possesses is of an emotional or an aesthetic nature; no attempt is made by the distinguished author to construct a consistent sociological background against which to view the multitude of problems that arise on every page. He stresses the contradiction in social organisation, that machinery should intensify rather than moderate the struggle for existence, that science should be used for war and destruction, and he pleads for a planned subdivision of labour as the solution. Coupled with this he would make a call to the economically stronger members of

the community to arrest the threatening decay of scientific life; but there is no discussion of the obstacles in the way of such a simple solution. It is an emotional rather than an intellectual analysis. Such questions occupy four of the five parts into which the book is divided.

It is in the last part that Einstein turns to matters more specifically scientific. Here he discourses very briefly on a variety of methodological and philosophical topics: scientific truth, methods of theoretical physics, various aspects of relativity; Kepler, Newton, Clerk Maxwell, Bohr, Planck, and many others. Many parts of it were delivered as lectures to various bodies. Here again the transparent sincerity of the man shines through everything he writes.

Experience, according to Einstein, is the alpha and omega of all our *knowledge* of existence, but the reasoning mind makes its specific contribution in the logic of science, and that contribution lies in the basic concepts of mechanics. Every attempt at a logical deduction of these basic concepts from elementary experience, he argues, must be doomed to failure; they are creations of the imagination,

not given realities. Pure thought nevertheless can grasp reality, but in the last resort experience must always remain the sole criterion of the utility of any such mathematical construction. The mind grasps this reality that exists outside it, and creates in addition basic concept by means of which it organises and understands that experience. The mind is thus a creative force in Nature, but there must exist an external reality upon which it must operate.

The treatment at this level would have been complete, in broad outline at any rate, had Einstein recognised the significance of the question suggested by the evolutionary outlook, namely, how far the mind of man is itself restricted and conditioned historically by the objective world, and thus how far the validity of the logic of science is affected by the fact that the reasoning capacities of man, although presumably ever-sharpening are nevertheless never perfect. In this way would the problem have been raised whether these basic mechanical concepts that serve in science to unify experience are indeed 'free' creations of the imagination.

H. L.

## Ideal and Real Crystals

### Ideal- und Realkristall

(Sonderheft der Zeitschrift für Kristallographie, Band 89, Heft 3-4.) Pp. 193-416. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1934.) 17.60 gold marks.

WHEN one of the editors of the *Zeitschrift für Kristallographie* received almost simultaneously two papers on the above subject, it occurred to him that a valuable opportunity had arisen of securing an adequate review and discussion of this important topic by devoting to it a separate issue of the *Zeitschrift*. As a sequel to this happy inspiration, a double-number has now appeared, which contains an introduction by Prof. Niggli himself, followed by thirteen papers and one shorter note on the same subject. The papers are all printed in the language in which they were written, with the result that half of them are in English and half in German.

The series of papers opens with an important contribution by Prof. Buerger, from the Massachusetts Institute of Technology, on "The Lineage Structure of Crystals", in which he demonstrates the widespread occurrence of a phenomenon analogous to dendritic or arboraceous growth, giving rise in massive crystals to a structure

which appears as a 'mosaic' when viewed only in two dimensions, but is often a complex three-dimensional structure of nearly parallel branches springing from a single stock or nucleus. The impression thus created, that crystal structures are predominantly tangled, is happily corrected by a final brief note by Dr. Buckley, from Prof. W. L. Bragg's laboratory in Manchester, in which he shows that crystals of potassium sulphate, grown in a thermostat in presence of a dye-stuff, and allowed to dry without the assistance of filter or blotting paper, can be obtained in a state of such perfection that magnificent interference patterns between parallel faces can be observed with monochromatic light. Many other examples of a similar character are cited, and it is clear that the imperfections, which formed the original subject of discussion, are far from being universal, and that real crystals can in fact approach very nearly to the ideal.

Limitations of space forbid any reference to the other papers of the series, but it is to be hoped that the unfavourable rate of exchange, which increases the price to English readers to about thirty shillings, will not prevent them from being widely read and studied in Great Britain.

T. M. L.

**Paläogeographie: mit besonderer Rücksicht auf die Fehlerquellen**

Von Dr. Fritz Kerner-Marilaun. Pp. viii+410. (Berlin: Gebrüder Borntraeger, 1934.) 30 gold marks.

As palaeogeography is a composite science which serves to co-ordinate stratigraphy, palaeontology and tectonic geology, the palaeogeographer must be conversant, not only with the aims and methods of these branches of geology but also with the possible sources of error which may arise. We already possess several excellent standard treatises on palaeogeography, such as the classical works of Arldt and Dacque, which follow more or less conventional lines. The author of the present book, however, approaches his subject from an entirely different point of view by discussing the problems with special reference to the possible sources of error.

The book is divided into four parts. Part 1 deals with the sedimentary rocks and the criteria to be applied in determining the conditions under which they were formed. It provides an up-to-date discussion of the problems of sedimentation, and a most instructive section is that dealing with the many errors possible in the recognition of desert deposits. Part 2 is devoted to correlation and the use of fossils both in the correlation of beds and in the determination of sedimentary environment. Part 3 is a modern presentation of the various theories of mountain building, including a discussion of Wegener's theory of continental drift.

Part 4 includes about one third of the entire book and is devoted to palaeocartography. The author here stresses the importance of distinguishing clearly between palaeogeographic investigations in unmoved areas in which the palaeogeographic lines can be projected, without error, on to the present maps, and investigations in areas which have suffered lateral translation by folding or thrusting. In the first case the sedimentary rocks occur in the areas in which they were originally deposited but, in the second case, their original regions of deposition lie at a greater or lesser distance from their present position. This movement factor is one which often escapes recognition, and the author has performed a great service in directing attention to it.

Altogether the book should prove of great use and value to geologists working in many different fields, but it is of an advanced nature more suited to the needs of the research worker than those of the student.

**The Handbook of Palestine and Trans-Jordan**  
Edited by Sir Harry Luke and Edward Keith-Roach. Third edition. Pp. xvi+549+1 map. (London: Macmillan and Co., Ltd., 1934.) 16s. net.

CONDITIONS change with such rapidity in modern Palestine that it is not surprising that very considerable revision has been necessary in the preparation of the new edition of "The Handbook of Palestine and Trans-Jordan". Information and statistics have been brought up to date, and, to quote Sir Arthur Wauchop's introduction, it now "gives a full account not only of the country's past, but of the achievements and changes of the last four years".

In view of the interest of Palestine's prehistory, it is a pity that the section dealing with this subject has not been more adequately revised. Miss Garrod's more recent discoveries are not completely covered, though, presumably, the final revision of the text had not been made before some, at least, were available for inclusion, while Sir Flinders Petrie's work in the neighbourhood of Gaza is barely mentioned. The important results obtained at Tell Duweir do not appear at all. Hence the largest Tell of archaeological importance in Palestine does not appear on the map, while its identification with Lachish, now certain, entails correction of both map and text.

These, however, are perhaps minor blemishes, where so much ground is more than satisfactorily covered. The handbook continues to be a never-failing source of information on the geography, history and social and economic conditions of the country.

**Hutchinson's Technical and Scientific Encyclopædia: Terms, Processes, Data, in Pure and Applied Science, Construction and Engineering, the Principal Manufacturing Industries, the Skilled Trades; with a Working Bibliography, naming Three Thousand Books and other Sources of Information, under Subjects.** Edited by C. F. Tweney and I. P. Shirshov. In 3 vols. Vol. 2: Direction of Rotation to Hydrogen-Ion Concentration. Pp. ii+673-1344. (London: Hutchinson and Co. (Publishers), Ltd., 1935.) 28s.

MUCH credit is due to the editors of this "Encyclopædia" for the design and execution of their work. So many subjects may be regarded as "technical and scientific" that to endeavour to afford appropriate information upon all matters pertaining to them, not only for scientific workers and technologists, but also for intelligent inquirers among the general public, would seem almost an impossible task. So far, however, as is practicable within the limits of three volumes, and judging by the contents of the two volumes already published, the editors will achieve their purpose. In the present volume, for example, sixty-seven pages are devoted to electrical subjects from "Electric Cables" to "Electrostatic Units". Glass and glass manufacture occupy twenty pages; dyes, eight pages; hormones, four pages (we note, by the way, that the word endocrine is not indexed); glucosides, eight pages; furnaces, nine pages; gemstones, six pages; and geophysics, four pages. We have tested the volume for many words and terms used in various branches of science and technology, and have rarely been disappointed. Many biological terms are included but no attempt is made to cover this whole field, though "commodities of botanical and zoological origin are named and described". This accounts, perhaps, for the omission of 'gene' and 'genetics'.

No work of the same scope and standard has been issued in England for many years; and we congratulate the editors and publishers upon their production, which should find a place in every reference library.



## Continuity of the Solid and the Liquid States

By Prof. J. Frenkel, Physico-Technical Institute, Leningrad

IT was believed until quite recently that liquids were in all respects—save their density—more similar to gases than to solid bodies. This belief was strengthened by the van der Waals' theory of the continuity between the liquid and the gaseous states, the sharp transition between them (corresponding to the boiling or condensation point) being replaced by the hook-like portion of the ( $p$ - $v$ ) curve, representing unstable intermediary states.

Recently, a number of new facts have corroborated the view that liquids—at least in the vicinity of the melting point—are much more similar to solids than to gases, not only with regard to density, but also with respect to the character of the *heat motion and structure*. As I pointed out ten years ago<sup>1</sup>, the heat motion in simple liquids consists of vibrations about an equilibrium position which after an average time  $\tau = \tau_0 e^{U/kT}$  ( $\tau_0$  is vibration period,  $T$  is temperature,  $U$  is activation energy) is shifted through a distance  $\delta$  comparable with the interatomic distances. Under the influence of alternating forces with a period  $\tau'$  much larger than  $\tau$ , the liquid behaves in the ordinary way, displaying a viscosity coefficient  $\eta = N\tau$ , where  $N$  is a constant which can be defined as the rigidity modulus displayed by the same 'liquid' when subject to alternating forces with a period  $\tau'$  much smaller than  $\tau$  (amorphous solids are rightly denoted as super-cooled liquids with a very large 'relaxation time'  $\tau$ ).

Still more recently, it has been pointed out (for the first time by Pauling) that the molecules in a crystalline solid can rotate more or less freely—just as has been assumed for liquids and gases; while Debye has shown<sup>2</sup> that both in liquids and solids there is actually no *free* rotation, but a sequence of rotational oscillations about an equilibrium orientation which is changed abruptly from time to time<sup>3</sup>.

Finally, it has been shown—for the first time by Stewart—that the X-ray diagrams of liquids, especially in the vicinity of the melting point, are very similar to those of a microcrystalline solid. The process of melting, therefore, cannot be conceived as a sharp transition from the crystalline to the amorphous state: the liquid near the melting point is still to a great extent crystalline and becomes gradually more and more amorphous as the temperature is raised. On the other hand,

a solid crystalline body, especially in the vicinity of the melting point, is no longer exactly crystalline, but contains a number of 'dissociated' atoms or ions which are irregularly distributed in the 'interstices' of the crystal lattice, and form the beginning, as it were, of the amorphous phase within the crystal. This 'dissociation' process explains diffusion in solids and the electrical conductivity of ionic crystals<sup>4</sup>.

Thus we see that the usual conception of the existence of a fundamental difference between the solid and the liquid states is incorrect. I wish to put forward the contrary view, namely, that *the solid and liquid states are connected with each other in a continuous way, just as are the liquid and the gaseous states*. The fact of the existence of a sharp transition point between the solid and the liquid states does not in the least contradict this conception—just as the existence of a sharp boiling (or condensation) point does not contradict the continuity between the liquid and the gaseous states. It simply indicates that, just as in the latter case, a continuous transition from solid to liquid, corresponding to a gradual increase of volume and of the degree of amorphism, must go through a sequence of unstable states, characterised by the same hook-like shape of the pressure ( $p$ )-volume ( $v$ ) curve, as that occurring in van der Waals' isotherms below the critical temperature. Hertzfeld and M. Göppert-Mayer<sup>5</sup> have indeed shown that the  $p$ - $v$  curve for a number of crystals displays a minimum of pressure, which they interpreted as corresponding to the melting point. They were led to this interpretation—or rather misinterpretation—by the fact that solids cannot be superheated, in contradistinction from liquids. This law of analogy between the melting and the boiling process can, however, be very naturally explained by the fact that small liquid drops formed inside the solid cannot rise to the surface, as do the gas bubbles formed in a boiling liquid. Melting can therefore begin effectively at the surface only.

A more exact theory of the  $p$ - $v$  isotherm for a crystal shows that the minimum of  $p$  discovered by Hertzfeld and Göppert-Mayer is followed by a *maximum*, so that we actually find a condition quite similar to that which is described by van der Waals' theory of the amorphous state. In order to build up an exact theory of fusion, it is necessary not only to consider the dependence of the vibration

frequency of the atoms (or molecules) on their mean distance apart more exactly than this has been done by the above authors, but also to take into account the *gradual amorphisation* of the body, which begins long before the melting point is reached. This 'amorphisation' can be regarded as the result of a large number of *local and temporary ruptures of the body*, due to the increase of the interatomic distances. To make this point clear, let us imagine that three atoms are put in a line and the distance apart between the two end atoms is gradually increased. Then the middle atom, which in a state of lowest energy should at the beginning lie just midway its neighbours, will finally move towards one of them, since the middle position, which initially corresponded to a minimum of the potential energy, will finally correspond to its maximum. The same result as that due to external forces, pulling the end atoms in opposite directions, must be produced by heat motion. To compare the two effects, however, we must consider not the *average* distances between the atoms as determined by the thermal expansion, but the maximum distances connected with thermal oscillations. It can thus easily be shown that a one-dimensional crystal with increase of temperature will not 'melt' but will break up into a number of small pieces (single atoms and doublets). In a two- or three-dimensional solid, a local 'rupture', however, will not lead to a breaking up of the whole body, thanks to the existence of lateral bonds between the atoms.

Although such local and temporary ruptures must take place also in a solid body, their number and importance greatly increase on melting, which accounts for the very much larger degree of 'amorphisation' which is found in the liquid state. This explains also the fact, first noticed by Rashevsky<sup>6</sup>, that the latent heat of fusion is of

the same order of magnitude as the elastic energy of the corresponding body strained to its theoretical breaking point at the zero point of temperature.

We thus see that the three states of aggregation of matter—the solid, liquid and gaseous—must be regarded as forming *one continuous sequence*, the sharp transition points—melting or boiling—being simply substitutes for continuous transitions through unstable intermediate states, corresponding to the hook-like parts of the  $p$ - $v$  curve. At ordinary temperatures there are two such hook-like portions, the first one (for smaller  $v$ 's) corresponding to the melting, and the second to the boiling point. Above a certain temperature  $T_1$ —the ordinary critical temperature of the substance—the second hook disappears, whereas the first one remains, since, as has been shown by Bridgman, and especially by Simon, it is possible to obtain under sufficiently high pressure a substance in the solid state above its critical temperature. A critical temperature  $T_2 > T_1$  for which the first hook should also disappear does not exist (according to Bridgman the melting temperature displays a monotonic rise with increasing pressure). It is, however, very probable that there exists a critical temperature  $T_0 \leq T_1$  (connected with a strongly *negative* value of the pressure) at and *below* which the first hook should disappear—corresponding to the fusion of the solid and liquid states into a single 'condensed' state.

A detailed mathematical treatment of the above questions will appear shortly elsewhere (in the *Jour. Phys.*, or the *Acta Physicochimica USSR*).

<sup>1</sup> J. Frenkel, Über die Wärmebewegung in festen und flüssigen Körpern, *Z. Phys.*, p. 1, 1926.

<sup>2</sup> P. Debye, *Z. Phys.*, Feb. 1, 1935.

<sup>3</sup> A similar view has been expressed by the writer in a book on the "Theory of the Solid and Liquid States" (in Russian).

<sup>4</sup> cf. J. Frenkel, *loc. cit.*

<sup>5</sup> *Phys. Rev.*, Dec. 1934.

<sup>6</sup> *Z. Phys.*, 1927.

## Human Origin and Christian Doctrine

By Dr. W. D. Lang, F.R.S.

THE late Bishop Gore remarks, in his "Belief in God", that it is not so much about the existence of God that men dispute, as the nature of the God in whom they can believe. Sir Ambrose Fleming, in the second published edition of his presidential address to the Victoria Institute, on "Modern Anthropology *versus* Biblical Statements on Human Origin", takes a less tolerant view. In his belief, as he states it, that "adherence to the doctrine of [organic] evolution is entirely incon-

sistent with belief in the fundamental doctrines of Christianity . . .", he appears rather to embrace in one atheistical category all who do not subscribe to this belief; such, at least, is the irresistible impression one receives on reading his address. This premise, which at best can have but an individual, and not a general, application, will be further considered: but first, all who admit the transmutation of species—and they are a heterogeneous assemblage, and must include, besides

modernist churchmen, churchmen as orthodox as Bishop Gore, educated laymen, Christian and non-Christian, agnostics, atheists, and even early churchmen like St. Augustine—must settle down together and consider the rest of Sir Ambrose's discourse.

Two main themes, like the narratives in the early chapters of *Genesis*, run through the thesis, namely, the inadequacy of palæontology in general, and of anthropological palæontology in particular, to prove the transmutation of species; and the inadequacy of natural selection as a means of transmuting species. It is clear that, if the first point is admitted and the transmutation of species is thereby considered as disproved, it is meaningless to labour the second; yet both points are laboured, though somewhat intermingled, in a series of arguments, from which, perhaps, one on each point stands out more emphatically than the rest. If, says Sir Ambrose, in effect, transmutation of species has taken place, transitional forms would be commoner than they are; and he points especially to the few known remains of supposed man more primitive than *Homo sapiens*. It is probable that those who have had most experience of fossils, both in the field and in the study, would say that, considering the long succession of fauna after world-wide fauna presented to palæontologists, considering the comparatively few accessible exposures of rocks of any one age in the world, considering the small chances of any organism of any given age being preserved as a fossil, and, comparatively speaking, the very small amount of intensive and extensive collecting that has been done, it is wonderful how notably fossil species are found to intergrade; and they would probably agree that all the evidence points to there having been a transmutation of species. The chances against any organism, and especially a bony organism, being preserved as a fossil, also tells against Sir Ambrose's contention that the associated remains of *Pithecanthropus* and *Eoanthropus* do not belong, respectively, to one individual.

Again, Sir Ambrose argues that the apparent rate of increase in the population of the world is a datum for estimating the age of the human species; and he holds that thus it can be proved that the inconceivably long periods demanded by the Darwinians for the evolution of man are impossible. He does not accept the contention of Malthus and Darwin that populations are equilibrated by their environment, and that once the bands of a controlling environment are loosed, even the slowest-breeding species will increase by leaps and bounds—a supposition which is corroborated by observing the sudden and immense fluctuations in some recent animal populations,

human races included, the causes of which, if not understood, are almost certainly environmental in the widest sense of that term. Were this not so, the whole world must have been filled with human inhabitants again and again, even in the comparatively short time allowed by Sir Ambrose Fleming since man's creation.

This ground has, however, been gone over many times; nor does it go to the root of Sir Ambrose Fleming's difficulties, as is clear from the following passage:

"In rejecting the idea of Creation by Divine Will and Power, the evolutionist then claims that the only kind of beginning which can be accepted as true is one which appeals to his own finite intelligence. He is prepared to accept the Darwinian hypothesis because it is intelligible to him. . . . He rejects as untrue any statements about Nature which lie outside the limits of present human understanding and experience. . . . Thus, said an eminent naturalist, . . . 'the theory of evolution was a theory universally accepted, not because it could be proved to be true but because the only alternative, special creation, was clearly incredible'".

Surely this passage goes to the heart of the matter, and reveals a misappreciation both on the part of Sir Ambrose and of his supposed opponents of the self-limitation of science. If it is true to say that a science is a marshalling of observed facts (a natural science, of observed physical facts) with the view of drawing logical inductions from them, it is clear that a natural science is self-limited, in its material (observed facts), in its method (logic), and in its standards (physical values). It must proceed from immediate effects to proximate causes, and so feels its way back to origins. It 'explains' the end by the beginning. It is otherwise with philosophy, which has its scientific aspect, and in this light might be called the science of significancies; but its material is all experience, and its standards are metaphysical values. It does not 'explain' the end by seeking its origin, but believes that the end 'explains' the beginning.

It is clear that, in the passage quoted above, Sir Ambrose Fleming is standing on metaphysical ground, and when he complains that his opponents reject "any statements about Nature which lie outside the limits of present human understanding . . ." he is really expecting them, as natural scientists, to go beyond the limits imposed by their system. They should answer that they must play the game, and seek proximate causes before they can feel back to ulterior causes, least of all adduce an ultimate cause. When, moreover, he points out that their arguments do not prove an anthropoid origin for man, they would answer

that such a biological theory, by its very nature, is incapable of mathematical proof, but must depend, like most such questions, on a balance of probabilities; and that is what Prof. Watson meant, in the passage quoted by Sir Ambrose, in saying that special creation was incredible. On the other hand, Sir Ambrose would be right in claiming that, as natural scientists, they are incompetent, through the very limitations of their method, to disprove the existence of God. In other words, Sir Ambrose and his opponents speak different languages, and on terms on which agreement is impossible.

We are thus brought back to Sir Ambrose's premise, that the acceptance of the doctrine of organic evolution is entirely inconsistent with the fundamental doctrines of Christianity. But, in complete sympathy with his ultimate conclusions, with genuine respect for his courage in upholding them, and in no self-complacent or dogmatic spirit, a Christian may yet ask what clause in the Christian creeds forbids him to be an evolutionist? Why may not a Christian believe, with the early Church, that the story in *Genesis* of man's creation is focused upon the spiritual truth that God created man, and is not to be regarded as a scientific account of the process? Why, if he honestly

follows intellectual truth, may he not trust God not to lead him to intellectual confusion; and, although he cannot expect to solve all his intellectual difficulties, just because, as Sir Ambrose insists, his mind *is* finite, why may he not hope, like Job in similar circumstances, ultimately to gain a vision of God?

After all, what differentiates a Christian is what he thinks of the person of Christ, and this seems to bear but remotely upon the physical processes of creation. On this criterion, it must be admitted that the greatest evolutionist cannot be claimed as a Christian—"I gradually came," Darwin said, "to disbelieve in Christianity as a divine revelation"; on the other hand, he repudiated atheism. His life, however, largely belied the statement just quoted. For the Christian's God is also eminently expressed in all that is beautiful, good and true. Now, on his own showing, Darwin gradually lost his æsthetic faculty, as he gradually lost his Christian faith; but every page of his writings expresses that wide charity which is the hall-mark of goodness; while his life was a single-minded pursuit of truth. Surely, Sir Ambrose will allow that such a man, although an evolutionist and in spite of his disavowing Christianity, is yet not far from the Kingdom of God.

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## Poison Gas

THE menace to civilisation of attacks on cities from the air is naturally perturbing all the peoples of Europe, for it is generally agreed by those best able to judge that there is no effective means of defence, so that the attacked country would be obliged to retaliate on the cities of the aggressor. It is true that the use of gas in war was prohibited by the Geneva Gas Protocol of 1925, to which most of the principal powers of the world subscribed; but in view of the failure to effect general disarmament there is even less confidence in the protocol now than there was in 1925. The attack might be made by dropping bombs filled with high explosive, or incendiary composition or with gas, or gas might be sprayed. In the Great War gas was not used in this way, and consequently it is not possible to say from actual experience whether it would be more effective than high explosive.

Against troops who had been trained in the use of gas masks and other protective measures the statistics, so far as they go, indicate that gas shells cause about as many casualties as the same number of H.E. shells, but that they kill far fewer.

The civilian population of a city could not be trained in protective measures to the same extent, and a large proportion would not have gas masks; but, on the other hand, they can take refuge in the houses, and so it should be possible to restrict the casualties. So far as can be judged in the absence of actual experience, these should be considerably less than those which would be caused by an equal weight of H.E. bombs. Probably the greatest damage, both physical and moral, would be done by squadrons of low-flying planes spraying gas followed immediately by others dropping H.E. bombs. If such an attack were delivered on a day when there were low clouds above which the approach could be made, and into which the attackers could dash again after the assault, it would not be possible for the defending fighting planes and anti-aircraft guns to accomplish much against them. If air raids should be made again in the future, they would, of course, be on a vastly greater scale than in the War. Consequently, it would be more possible to produce a lethal concentration of gas over such a large area as is needed for a decided military effect.

Hence the importance of educating the public in measures which would reduce the casualties to a fraction of the figure they might otherwise assume.

At the annual meeting of the British Science Guild held on June 12, a lecture<sup>1</sup> on gas defence was given by Mr. Davidson Pratt, general manager of the Association of British Chemical Manufacturers, and formerly an official in the Chemical Defence Research Department. Mr. Pratt dealt at fair length with the question of gas-protected rooms, of which he considers there should be one in every house or building, preferably situated on an upper floor. The preparations advocated would be decidedly troublesome and expensive, as they would involve not only closing all cracks and chinks with putty or mud, but also boarding up the windows outside and covering them inside with stout material such as wetted blankets or linoleum; also laying in a store of provisions, water and other necessities. It is evident that it would be difficult to do all this even in the houses of the well-to-do, and would be practically impossible in those of the poor. We should like to know whether these recommendations are based on actual experiments, and whether it would not be possible to make a room reasonably safe without rendering it useless for any other purpose than a refuge in emergency. If such experiments have not been carried out they should be put in hand, and the results published.

As regards gas masks, Mr. Pratt recommends that a type should be developed less expensive than the service one but sufficiently efficient for the needs of the general population. It is unsatisfactory that so little appears to have been

done yet in this direction. The problem of clothing that will protect against mustard gas and lewisite is more difficult. Other subjects dealt with briefly in the lecture were the detection and diagnosis of gas and decontamination; but apparently, from what Mr. Pratt said, the methods and organisation required have not yet been worked out.

An anonymous pamphlet on this subject has also been issued by the Union of Democratic Control<sup>2</sup>. Considerable industry has been shown in collecting statements, but the comments of the writer are mostly misleading, so obviously misleading that they tend to produce in the reader a prejudice against pacifists rather than a hatred of war, which is the natural attitude of most Britons.

The chapter dealing with Mr. Davidson Pratt's lecture is headed "The Great Defence Hoax", and the general thesis is indicated by the statement on p. 60: "The authorities hope to succeed in rousing enough fear amongst people to persuade them to acquiesce in an armaments race, to make the danger of air attacks seem real and to encourage them to believe that the precautions against them will be effective". More agreement will be felt with the following sentence, which occurs almost at the end of the pamphlet: "The plain fact is that the only defence against air attack is the absolute prevention of war". Similarly the only real defence against burglary is the absolute abolition of burglars, but pending that our front doors are provided with latches.

ARTHUR MARSHALL.

<sup>1</sup> "Gas Defence." By J. Davidson Pratt, O.B.E. Pp. 14. (London: The British Science Guild, 6 John Street, Adelphi, London, W.C.2, 1935.) 1s.

<sup>2</sup> "Poison Gas." Pp. 63. (London: Union of Democratic Control, 34 Victoria Street, London, S.W.1, 1935.) 6d.

## Obituary

Prof. J. B. Cohen, F.R.S.

**I**N the old organic chemistry laboratory at the University of Leeds there was a life-size bust of Liebig. It was perched high up on the top of some reagent shelves and it seemed as if the great 'master' of organic chemistry looked down and said, "All is well here". In many ways that bust was symbolic of the sway exercised in the laboratory by J. B. Cohen. He would have wished no better thing to be said of him than that he had tried to carry on the traditions made by Liebig for organic chemistry in the eighteen-fifties. Nicknames are often given to professors by their students as a sign of affection, but Cohen never received one from his. He was a little too austere for that. Instead he was usually called "Julius"—his first name. In a sense this was a greater sign of affection. It struck a deeper note of regard.

Cohen was born in Manchester in 1859 and lived almost the whole of his life in the north of England. Except for a couple of years in Munich in Baeyer's laboratory, he spent all his active scientific life in the Owens College and the Yorkshire College (later the University of Leeds). He went to Leeds in 1890. Previously, he was a demonstrator of chemistry at Owens College. His title at Leeds was lecturer in organic chemistry, and in 1904 he was appointed to a chair. Twenty years later he retired, having reached the age limit. He was made a fellow of the Royal Society in 1911. But when he retired he did not give up active work. During the next eight years he occupied a small suite of laboratories in the Leeds Medical School, and carried out a most laborious investigation on the antiseptic and trypanocidal activity of a large series of synthetic compounds, many of which he prepared himself. This was done

under the auspices of the Medical Research Council. When the last-named body decided to discontinue this line of work, Cohen really did retire, and he and his wife left Leeds and went to live at their country cottage near Coniston Lake. It was there amidst the beautiful surroundings which he loved that he passed away on June 14, after a few weeks' illness. He was then seventy-six years of age.

Cohen taught by example rather than precept. His research students will always retain ineffaceably in their minds a picture of his amazing industry, his high technical standards, his almost woman-like gentleness in dealing with their early errors, his reticent smile at anything which amused him and his abhorrence of anything which savoured of showmanship or attaining ends by any but transparently honest means. Those who came less closely into touch with him will remember his clarity as a lecturer, his great interest in the welfare of students and especially foreign students of the University, the Working Men's Club which he founded and personally conducted in one of the least attractive parts of Leeds, and not least his attempts by direct investigation to show the great evils wrought by the smoke-laden atmosphere of our industrial towns.

Cohen was an artist to his finger tips. A lover of music, he was no mean performer on the violin. He and his wife often gave delightful musical evenings to their friends both in the University and outside it. He painted well in water-colour and got great enjoyment in trying to put on paper in this medium his impressions of many parts of his beloved Lake District. With such a temperament his likes and dislikes were often very clear cut. They were sometimes an enigma to those who did not know him, but never to his friends. Few men are so honest and live their lives with such simplicity and dutiful routine as Julius Cohen did, and none can have tried more faithfully or wholeheartedly than he to serve his fellow men.

As a chemist Cohen did a considerable amount of valuable and fundamental work, but he did not make the kind of outstanding discoveries that open up new fields of activity. He was, however, very versatile, and from the titles of his published papers it may be seen that he covered a wide field. He was one of the old school of organic chemists who were mainly interested in the structure of carbon compounds and its influence on their properties and reactions—what may be called molecular architecture and its significance. The principal province of his work was that of aromatic substitution, especially of benzene compounds, and the laws which govern it. But he was also intensely interested in the problems of optical activity, and almost the last paper he ever wrote was on "Asymmetry and Life".

It was this mystery of the optical activity of naturally-occurring organic compounds, together with his great appreciation of the work of Pasteur, that probably directed Cohen's attention to the wide scope for chemical investigation provided by the activities of living organisms. This led him to advise many of his research students—the first being H. D. Dakin—to take up the study of what was then called

physiological chemistry and is now named biochemistry. None who were so advised can have regretted their choice, and the enormous development of biochemistry during this present century proves how right Cohen was in his appreciation of the contributions that the chemist could make in the biological field.

Organic chemists owe a great debt to Cohen because of his books. The smallest of these was probably the most important—his little "Practical Organic Chemistry". There was no book anything like as satisfactory when it was first published, and it has guided innumerable students in their first steps in the subject. Indeed it is still widely used. His greatest production was the three-volume "Advanced Organic Chemistry", and it is a tribute to his industry and wide reading that he could write such a book and yet carry out his normal day's work at his bench in the laboratory. Organic chemistry is now almost getting beyond the compass of a one-man book, but this "big Cohen" is still one of the books which are highly valued by advanced students in Great Britain. To many, Cohen's books will be his most lasting memorial, but those who had the privilege of his friendship will always in addition be grateful for the virtue they derived from the man himself.

H. S. R.

#### Prof. Max Cremer

ON May 22, a few weeks only after celebrating his seventieth birthday, Max Cremer, emeritus professor of physiology in the University of Berlin and formerly head of the Physiological Institute of the Veterinary College, Berlin, died in Munich. He was one of the last representatives of the classical German school of physiologists who mastered both biochemistry and biophysics.

Cremer started his scientific career as a pupil of Carl Voit and Soxhlet by investigating animal metabolism, particularly the formation and utilisation of carbohydrate in the body. He succeeded in proving that the organism is able to synthesise glucose and glycogen from certain breakdown products of organic matter, for example from glycerine. Although he maintained a fruitful interest in these problems, he soon turned his main activities to electrobiology, a field very congenial to his talents in mathematics and physics. In 1906, he discovered the existence of considerable potential differences between suitable watery electrolytes separated by a phase immiscible with water (glass, nitrobenzene). This fact formed the basis of the present view of electrical phenomena in living matter, and on the practical side, of the use of the glass electrode for hydrogen ion measurements.

Regarding the electric change in nerve as the essential factor concerned in the origin and propagation of the impulse, Cremer combined physico-chemical and physiological terms in an ingenious manner which culminated in a formula for the velocity of the impulse and in a mathematical expression for the processes preceding excitation. He also promoted the technique of recording the rapid

potential changes occurring in tissues (the invention of a string electrometer; the first physiological application of the cathode ray tube and the loop oscillograph in 1907 and 1912).

Although Cremer was extremely critical and even sarcastic in the scientific sphere, he was humorous and cheerful in ordinary life. This mixture in his imposing personality was very manifest in speech and discussion, and will not be forgotten by his pupils and friends.

H. ROSENBERG.

WE regret to announce the following deaths:

Mr. C. T. Kingzett, one of the founders of the Institute of Chemistry, and author of the "Chemical

Encyclopædia", and other books on chemistry, on July 29, aged eighty-two years.

Prof. W. R. Sorley, Knightsbridge professor of moral philosophy in the University of Cambridge, author of many well-known works on ethics, on July 28, aged seventy-nine years.

Mr. C. E. Stromeier, chief engineer of the Manchester Steam Users' Association, president of the Manchester Literary and Philosophical Society in 1929-31, on July 23, aged seventy-nine years.

Prof. F. A. F. C. Went, For.Mem.R.S., extraordinary professor of botany in the University of Leyden, and emeritus professor of botany in the University of Utrecht, on July 24, aged seventy-one years.

## News and Views

### Dr. Griffith Evans

WE extend our congratulations to Dr. Griffith Evans, who will attain his hundredth birthday on August 7. Dr. Evans was a pioneer in the study of protozoology in connexion with infections, and the first man to associate trypanosomes with the production of disease. He was born at Tymawr, near Towyn, Merionethshire. After studying medicine for a short time with a medical practitioner at Towyn and Aberdovey, he entered the Royal Veterinary College, London, where he qualified as M.R.C.V.S. In 1877, he was sent to India in the Army Service Corps. It was there that his great work on blood parasites was carried out. On arrival in India, he was appointed to investigate an endemic disease which for many years had been fatal to cavalry and artillery horses; by microscopic examination of the blood, which revealed the specific bacillus in the blood of every patient, Evans at once proved the disease to be anthrax fever.

In 1880, Dr. Griffith Evans's work on surra began; and upon studying the reports which had already been made upon the disease he at once reached the opinion that it was due to some parasite of the blood. His first act was to examine microscopically the blood of a surra patient: it was swarming with parasites. Though Koch had not yet made his classical postulates, and though Evans was ignorant of the nature of the microbes revealed to him, he immediately associated them with the production of the disease. They were the parasites which, at first called *Trichomonas evansi*, are now known as *Trypanosoma evansi*. Official opinion was strongly against him, but the Government printed his reports, and he had the gratification of knowing that his statements spurred on a number of younger men to continue investigations along lines which he had laid down. He returned to England in 1885, and after further work in Crookshank's

laboratory, King's College, London, retired from the army in 1890. In 1917 he was awarded the Mary Kingsley Medal by the Liverpool School of Tropical Medicine, in recognition of his distinguished scientific work, and on that occasion he wrote a short autobiographical memoir, which was published in vol. 12 of the *Annals of Tropical Medicine and Parasitology*.

### Alcohol and Road Accidents

EARLY this year, the Minister of Transport asked the British Medical Association whether it could usefully make any observations in the place of alcohol in the causes of road accidents, in the light of existing knowledge and experience. The Association thereupon appointed a special committee to consider the subject and the report of this committee has just been published (*Brit. Med. J.*, Suppl. July 27, 1935; p. 57). The committee confined itself to an examination of the scientific evidence on the effect of the consumption of alcohol on the functioning of the body, especially of amounts insufficient to produce the state commonly recognised as drunkenness. The Alcohol Committee of the Medical Research Council concluded that the direct effect of alcohol upon the nervous system is, in all stages and upon all parts of the system, to depress or suspend its functions; it is, in short, simply a narcotic drug. The earliest effects are an impairment of the faculties of judgment, concentration, self-criticism and the power of estimating risk, which are often accompanied by a sense of well-being and of self-satisfaction. At the same time, the power of making movements dependent on rapid and accurate co-ordination is adversely affected; the rapidity and accuracy of neuro-muscular co-ordination are diminished. The report reviews the experimental evidence on which the above statements are based, and points out that as little as three ounces of whisky produces these effects. The experiments were of course made in other connexions to determine the effects of alcohol upon the nervous and neuro-muscular systems; but

are applicable to motorists, whose movements are dependent on rapid and accurate co-ordination between the eyes, hands and feet. The committee also emphasises that the elimination of alcohol from the body is a slow process: 10–12 c.c., or the equivalent of one ounce of whisky, can be oxidised each hour, and the rate is not increased when the concentration in the blood is raised by drinking larger quantities. The committee concludes that the driving capacity of a driver, who has taken even small amounts of alcohol, must frequently be adversely affected, even when it has been consumed some hours before driving, and especially if taken in the absence of food.

#### Production of Oil in Great Britain

ONE of the most striking characteristics of the times is the tendency of man to make himself less dependent on the circumstances imposed by geographical conditions. Formerly it was necessary to settle, and for industries to develop, where sources of food and raw materials were readily accessible. Now the tendency is for these things to be done just where man chooses—but at a certain price. Modern civilisation demands oil and oil products, and our need is being in part met by the treatment of coal. In the House of Commons on July 24, the Secretary for Mines (Captain Crookshank) reported that the plant at Billingham for coal-hydrogenation is now working and will, when at full output, produce 45,000,000 gallons of motor spirit yearly—3½ per cent of our annual consumption. By August, the total production—including that from distillation of oil shale and coal—will reach 60,000,000 gallons, increasing to 90,000,000 gallons when the Billingham plant attains full output. Although petroleum can be got from the earth for relatively slight efforts, one of the chief merits claimed for coal-hydrogenation is the magnitude of the labour it requires and the employment it gives. This, however, is small in comparison with the size of the coal industry. The present Billingham output employs 1,900 miners and 1,000 plant employees, and it does not seem probable that the process can restore the former prosperity of the mining industry. Capt. Crookshank also stated that 43 applications had been received to prospect and work for oil in Great Britain.

#### Mr. Lloyd George's Scheme of National Reconstruction

MR. LLOYD GEORGE'S scheme of national reconstruction is outlined in a pamphlet entitled "Organizing Prosperity" (Ivor Nicholson and Watson. 6d.). His main thesis is that our economic system can be amended without being scrapped, and that the immense advantages of individual enterprise, energy and initiative which our present economic system fosters are not to be lightly sacrificed. They must rather be controlled and cultivated so that they may yield an ordered harvest for the nation. He gives first place to the land as a means of finding not only temporary employment during a period of exceptional trade depression, but also permanent employment for our surplus population. Other projects advocated include

housing and slum clearance, electrification of suburban railways, improvement of ports and docks, extension and improvement of electrical supply, road developments, water supply, telephone extensions and financial assistance for development of overseas markets. These various schemes would be financed by a 'prosperity loan', while the carrying out of the programme would be entrusted to a National Development Board consisting of a small body of persons of distinguished competence drawn from industry, commerce, finance, workers and consumers who would be appointed for a definite term and would be responsible to the Cabinet. But since a Cabinet of about a score of Departmental Ministers is an unsuitable body to give full and dispassionate consideration to bold schemes of national reconstruction, Mr. Lloyd George advocates a reversion to the War-time arrangement of an executive consisting of the Prime Minister and four or five Ministers without departmental duties.

#### Science and Vocational Advice

IN a Friday evening discourse delivered at the Royal Institution on May 10, and now available as a pamphlet, Dr. C. S. Myers discussed the "Scientific Approach to Vocational Guidance". He compared the giving of vocational advice with the giving of medical advice. Each is an art, yet each depends on the use of scientific knowledge and methods. The individual must be studied with regard to every relevant aspect of himself and his environment. In vocational guidance, the part played by psychological tests is essential, although relatively small. It is now possible to estimate intelligence fairly accurately, by means of 'verbal' and 'practical' tests, and as the degree of intelligence required varies in different groups of occupations, this is one very important deciding factor. But tests for character and temperamental qualities are not yet sufficiently reliable; and the chief contribution of the psychologist in this direction has been in the introduction of improved and systematic methods of assessment. Other qualities necessary for success in certain occupations are mechanical ability and manual ability. Tests for these abilities and others, based on a detailed study of some one occupation, can be applied in vocational *selection* where the problem is one of selecting the best person for a particular job. The co-operation of parents, teachers, school authorities and juvenile employment officers provides a necessary contribution to the data on which the vocational adviser's advice is based. The follow up of advised cases, and comparison with the results obtained from a control-group are now recognised parts of the experimental procedure. During the past nine years, the number of cases dealt with in Great Britain by the two bodies responsible for most of such research was 6,751; in 1925 the number of vocational guidance cases was less than 100.

#### T. A. Coward Memorial Sanctuaries

ON July 22, the Earl of Crawford and Balcarres opened the Nature sanctuary at Cotterill Clough.



Cheshire, formed by public subscription in memory of the late T. A. Coward, sometime lecturer in the University of Manchester and author of "The Birds of Cheshire", "The Fauna of Cheshire", etc. The deeds were handed over to the Society for the Promotion of Nature Reserves. The Earl of Stamford, chairman of the memorial committee, said 1,570 people from all parts of the world had subscribed £925 to save this well-known haunt of fauna and flora, and also a second memorial sanctuary at Marbury Mere, and subscriptions coming from so far apart as Canada and Hong-Kong showed the wide appreciation of Mr. Coward's work. The sanctuaries were chosen not only for their own particular appropriateness and value for study, but also because Coward himself studied in them so often. One part of the sanctuary will be permanently closed as a true Nature sanctuary for wild life, but a public right of way will exist at another part where visitors can see down the sanctuary and hear the bird songs. A bronze memorial plaque on a glacial boulder brought from the Bollin Valley is inscribed: "In Memory of Thomas Alfred Coward, M.Sc.,—1867-1933—Cotterill Clough and Marbury Reed Bed were purchased by public subscription to remain for ever undisturbed Nature reserves as a memorial to his great services to natural science". Already studies have been made in the sanctuary by the Manchester branch of the British Empire Naturalists' Association and the Altrincham Natural History Society. The opening ceremony in the Clough was attended by delegates from natural history, scientific, rambles, and other bodies chiefly from the north of England.

#### Recent Archæological Discoveries in Crete

OPPORTUNITY for further study of the archæological material found in a cave at Arkalokhori in Crete (see NATURE, July 6, p. 15) has led to some modification of opinion as to its character, though not as to its importance. Sir Arthur Evans, in a communication to *The Times* of July 29, states that as a result of comparative study of the hieroglyphic inscription in three vertical lines on the votive bronze double axe, he has arrived at the conclusion that it does not, as at first supposed, represent an exotic script. He finds that while one or two new forms appear, nearly all the signs have close parallels in the Cretan series, while two recur in the same collocation on a faceted hieroglyphic cylinder in his possession. He is, therefore, of the opinion that the language is identical, though the new inscription, from its associations with material belonging to Late Middle Minoan, must be regarded as late in its class, dating from about 1600 B.C. From one of the lairs of a badger, from which animal the locality takes its name, a fairly complete series of potsherds, covering most of the Minoan periods, was recovered. Sir Arthur, passing on in the same communication to recent work at Knossos, chronicles an exploration of Minoan deposits, in which the most remarkable discovery was a small limestone head. This was of a markedly dolichocephalic early Egyptian type, though associated with relics of the closing Middle

Minoan age. Mosaics of Hadrianic age from a villa recently found in the vineyard of the Villa Ariadne, in which the heads of Dionysiac figures in medallions are the recurring subject, have been pronounced to excel any Roman specimens of the kind yet found in Greece.

#### Origins of Man in America

SEARCH for evidence bearing on the problem of early man in America, which has been carried on in New Mexico during the past five years by Mr. Edgar B. Howard under the auspices of the Academy of Natural Sciences and the University Museum, Philadelphia, is now to be extended farther afield. When it was announced a few years ago that the stone implements of a type hitherto unknown in America, but now known as 'Folsom points', had been discovered near Folsom, New Mexico, by Prof. E. B. Renaud, of the University of Denver, a new orientation was given to the study of American archæology, more especially in the attitude towards alleged associations of artefacts with the bones of extinct or presumed early fauna. An antiquity for man in America greater than that generally admitted seemed a possibility. Mr. Howard's explorations in New Mexico, of which an account is to appear in the *Museum Journal* (Philadelphia), and especially his discoveries in a cave west of Carlsbad and in old lake beds near Clovis, New Mexico, at a depth of eight feet, of artefacts and traces of camp fires in association with the remains of extinct fauna—camels, wild horse, elephants—indicate that Folsom man had penetrated to the south-west in Pleistocene times, when the Wisconsin ice-sheet was waning, a period of climatic change tentatively fixed at 10,000 years ago. No contemporary human remains have been found. Mr. Howard is of the opinion that further evidence must be sought in Asia, and is now on his way, with the assistance of the Philadelphia Academy of Natural Sciences, to Russia, where he proposes to study the archæology of Siberia and hopes to enlist the co-operation of the Soviet authorities in further exploration. In the meantime, Dr. F. de Laguna, also on behalf of the Philadelphia Academy of Natural Sciences, has resumed her researches in Alaska—on this occasion in the Yukon Valley and with the object of tracking Folsom man on his way to the south-west.

#### Marriage Hygiene

A NEW quarterly journal, *Marriage Hygiene*, with a strong editorial board consisting, for the time being, of a number of prominent Indian medical men, has recently appeared from the *Times of India* Press, Bombay. Its objects are to secure for the science of conjugal hygiene a proper place in preventive medicine, to publish contributions which are believed to be necessary for scientific, sane sex teaching, and to bind its readers together into a brotherhood of clean thinkers and bold fighters against prejudice and taboos; and it is intended, by additions to the editorial board, that the journal should become an international one. The first number consists of

articles published elsewhere by Havelock Ellis, Julian Huxley, Norman Himes and others, and includes several pages of abstracts and reviews of books. In the second number there is an excellent article by Norman Himes on contraceptive technique in Islam and Europe in the Middle Ages. The articles so far published indicate the scope of the journal and the quality of its contributors. It promises well, and should receive a welcome from all who are interested in those problems which arise from the relation of male to female and of parent to offspring. The price of a volume is 18s., and the address of the managing editor is Kodak House, Hornby Road, Bombay. Surely it is a matter of profound significance that such a journal should have had its origin in India, particularly when it is learned that, associated with the journal, there is a eugenic clinic. It would seem that this journal intends to deal frankly and scientifically with a number of topics that are not usually encountered in the ordinary medical journals.

#### Recent Acquisitions at the British Museum (Natural History)

THE Zoological Department has received, as a donation from His Excellency the Governor of Sierra Leone, the skull and tusks of a young specimen of the forest elephant, from the Gola Forest, Sierra Leone. This specimen is of exceptional importance as it is accompanied by two complete tusks which are in every way similar to the tusks hitherto accepted as belonging to the so-called 'dwarf' elephant. The skull and teeth of this specimen prove it to be quite a young individual and therefore it is reasonable to conclude that the so-called 'dwarf' elephant ivory is merely the ivory of young elephants. 135 mammals, 144 birds, 9 reptiles, and 500 fishes from Ashanti have been collected for the Museum by Mr. Wilmoughby P. Lowe and Miss Waldron, and about 200 birds collected in southern Asia Minor by Mr. Charles Bird have been purchased. The important collection of British Lepidoptera formed by the late Robert Adkin, who died at Eastbourne on May 21, has been bequeathed to the Department of Entomology. This collection consists, at an estimate, of about 50,000 specimens, and embraces the microlepidoptera as well as the larger kinds to which most collections are confined. The Trustees approved the purchase for the Department of Geology of an important collection of some two thousand Australian fossils, including fishes, representatives of most of the invertebrate groups, and plants. It is particularly valuable on account of the large number of Permian and Triassic insects, including more than 100 types, which it contains. An interesting and valuable gold nugget from Morro Velho, Minas Geraes, Brazil has been bequeathed to the Department of Mineralogy, by the late Mrs. M. A. Bushnan, of Kew. The nugget, which weighs 119.3 grams, or nearly 4 ounces troy, consists entirely of native gold, all the original quartz having been removed, leaving a cellular structure. Among the purchases may be mentioned: a splendid scissor-cut yellow scapolite, weighing 12.3 carats. The rough stone was from Serra da Chibita, Minas

Geraes, Brazil. Scapolite of gem quality is not common, and this specimen is larger and of better colour than any other in the National Collection.

#### A Disease-Resistant Red Currant

A SHORT note issued by Science Service of Washington, D.C., announces the discovery by Dr. G. G. Hahn of a new variety of red currant resistant to the uredo- and teleuto-spore stages of *Cronartium ribicola*, the white pine blister rust fungus. This organism is heteroecious, spending its life-history on two distinct host plants. Currants and gooseberries are the summer hosts, whilst the aecial stage is spent upon white pine (*Pinus strobus*) in the winter. Many districts in America regard the white pine as their principal source of wealth, and so both wild and cultivated currants and gooseberries were eradicated completely. This caused much grief and expense to gardeners, but removed the necessary summer hosts of the fungus, and effectively controlled the disease on white pine. The new disease-resistant red currant is known as 'Viking'; it provides fruit of good quality, and promises to withstand drought as well as to resist disease.

#### Centralisation of Scientific Publication

IN an address on "The Dissemination of Science" before the American Association for the Advancement of Science at Minneapolis on June 26, Mr. Watson Davis, director of Science Service, reiterated a plea for the co-operative centralisation of some scientific publication functions in a Scientific Information Institute. It was suggested that manuscripts which could not be published promptly or in full should be sent to the Institute and prepared by typing or otherwise for photographic publication. The existence of the paper or monograph would be made known through the publication of the abstract in the scientific journal, and the paper could be obtained on request, each copy being made to order. The same system could be utilised for supplying to members the scientific papers delivered at a meeting. The photographic procedure might also be utilised for loans between libraries. In regard to bibliography, Mr. Davis suggested the operation by the Scientific Information Institute of a bibliographical file and production service to absorb existing bibliographical schemes in all branches of science and provide bibliographical material in fields of science which are at present not easily accessible. A fund of approximately 20,000 dollars would enable these projects to be initiated.

#### The National Central Library

THE nineteenth annual report of the National Central Library, Malet Place, London, W.C.1, directs attention to the difficult financial problems which at present confront the Committee. These are due partly to the inadequacy of its income to meet the growing demands made upon the Library and partly to the termination of the annual grants received from the Carnegie Trustees, from whom a final grant of £4,000 has now been received. The annual grant

of £3,000 from the Treasury has again been reduced by 10 per cent, and it has only been possible to spend £2,337 on books, the smallest expenditure for seven years. The financial difficulties are the more unfortunate when the work of the Library in tracing out-of-the-way books and acting as a clearing-house for the entire library system of Great Britain and a chief source of all bibliographical information is becoming more widely known and appreciated. The report contains references to the 'outlier libraries'—which now number 149, including those of a number of research associations, the regional library systems, the university libraries, and the foreign libraries—which will probably surprise the average scientific worker in the extent to which they reveal the co-ordination of effort in this field. Moreover, as the regional system grows, the work represented by each book issued by the Central Library continues to increase, as although the number of books issued may decrease the percentage of books difficult to trace and obtain becomes higher. Of particular interest is work on Union Catalogues, and the Union List of Periodicals in the University Libraries has been of the greatest service in locating periodicals. The report also refers to a Union List of Scientific, Technical and Commercial Periodicals in the Public, the University and all the Technical Libraries in Sheffield. A total of 61,187 books was issued by the National Central Libraries and 11,231 by the outlier libraries, which contain 5,846,000 volumes; 2,409 books were lent to university libraries, 1,233 of which were supplied from the Library's own stock.

#### Thermo-couple Standardisation

THE use of thermocouples for the measurement of temperature has become so customary in industry that the issue by the Bureau of Standards of the United States of a pamphlet of 36 pages by Messrs. W. F. Roeser and H. T. Wensel on the methods of testing them and the materials of which they are constructed will be welcomed by many workers in industry. It is Research Paper 768 of the Bureau, and is issued at the low price of 5 cents. It deals with the best materials to use for a given range of temperature, how to secure that they are pure and how to standardise the couples when constructed. On the whole, the authors prefer a freezing point rather than a boiling point for a standard temperature when each is available, but instructions are given for carrying out standardisations in each way and also for comparisons with working standards of the thermo-couple type. The best methods of interpolating for temperatures between the standard temperatures are also dealt with. Some idea of the accuracy to be expected from observations with various types of thermo-couples over different ranges of temperature is also given.

#### The World Power Conference

At the annual meeting of the International Executive Council of the World Power Conference, held at the Royal Netherlands Institute of Engineers, The Hague, Sir Harold Hartley, chairman of the British National Committee, was elected by the

Council as its chairman, in succession to the late Mr. D. N. Dunlop, who died on May 30. The choice of Sir Harold is peculiarly appropriate, since as a vice-president of the London Midland and Scottish Railway Company, and director of research of that great transport system, he is in close touch with industrial problems, while as chairman of the Fuel Research Board and a research fellow of Balliol College, Oxford, he is also conversant with the more academic aspects of scientific progress. The Conference owes to Mr. Dunlop, its founder, a happy combination of the practical with the ideal. Under Sir Harold Hartley's guidance it should continue to progress and to play an increasingly influential rôle throughout the world.

#### Dovedale

MR. ROBERT McDUGALL, of Manchester, has presented to the National Trust further sections of Dovedale. The dale lies partly in Derbyshire and partly in Staffordshire, and it was recently announced in Parliament that steps were being taken by the local authorities concerned for the planning of the whole area. This announcement was warmly welcomed by the National Trust. Now Mr. McDougall has added to his previous gifts 52 acres in Biggin Dale which joins Wolfscote Dale—as the upper part of the Dove valley is called—on the Derbyshire side some way above the land recently given by Imperial Chemical Industries, Ltd. Biggin Dale is a dry limestone gorge of great beauty. The new property, on its north-western side, consists of steep grass slopes with picturesque screes and some timber and hawthorn bushes, and from it there are arresting views down the Dove valley. There are also fine views across to the Staffordshire side of the Dove valley where the Peasland Rocks stand out boldly. Above the property is Wolfscote Hill (1,272 ft.) which, with its long ridge, is a great landmark in the neighbourhood.

#### Italian Council of Research

THE recent activities of the Italian National Council of Research, which is directed by the Marchese Marconi, are described in an official publication dealing with investigations which the Council has handed over to the universities, higher teaching centres and experimental stations in Italy. During the years 1933 and 1934, researches were carried out in the problems of nutrition in the laboratories and institutes of physiology and biochemistry at Naples, Padua, Genoa and Rome, as well as investigations on the etiology, epidemiology and prophylaxis of typhoid fever in the institutes of hygiene at Bologna and Genoa.

#### Toxicity of Industrial Solvents

At the request of the Home Office, the Medical Research Council has undertaken to promote investigation into the question whether various volatile substances might injure the health of workers using them under industrial conditions. The Council has appointed the following special committee to assist and advise in this matter: Sir Joseph Barcroft

(chairman), Mr. J. C. Bridge, Prof. A. J. Clark, Prof. A. G. Green, Prof. J. A. Gunn, Prof. E. H. Kettle, Dr. H. B. Morgan, Mr. J. Davidson Pratt, Mr. D. R. Wilson and Sir David Munro (secretary).

#### International Office for the Protection of Nature

THE Dutch and French Governments have now officially recognised the International Office for the Protection of Nature at Brussels and have appointed the following delegates to be their representatives on the general council of the Office: *Netherlands and Dutch East Indies*: Dr. P. G. van Tienhoven, president of the Society for Nature Protection in Netherlands; Dr. W. A. J. M. van Waterschoot van der Gracht, chief engineer of mines; Prof. L. Ph. le Cosquino de Bussy, director of the Colonial Institute, Amsterdam; Dr. J. C. Koningsberger, former Minister of Colonies. *France and Colonies*: M. M. Bolle, conservator of forests, Ministry of Agriculture, Paris; Prof. A. Gruvel, general secretary of the National Committee for the Preservation of Fauna and Flora in the Colonies; M. Raoul de Clermont, president of the Section for Nature Protection of the Société Nationale d'Acclimatation de France.

#### Speleological Research in Great Britain

At the meeting of representatives of associations interested in the exploration of caves from Yorkshire and Lancashire, Derbyshire and Staffordshire, Somerset and Devon, South Wales and Ireland (see *NATURE*, July 20, p. 98) held at Derby on July 27, over which Prof. L. S. Palmer (Hull) presided, it was resolved to form a British Speleological Association to serve as a clearing house for the co-ordination of the hydrological, geological, geographical, archaeological and biological aspects of cave exploration, and for the dissemination of information relating thereto. In the course of the discussion which preceded the carrying of the resolution, stress was laid on the damage done by promiscuous and uninstructed digging in caves, Mr. A. L. Armstrong (Warrington) in particular urging the need for training before any attempt is made to carry on the work of excavation. The meeting also adopted a proposal that Sir Arthur Keith should be invited to become the first president of the Association.

#### Awards of the Royal College of Physicians

At a meeting of the Royal College of Physicians of London held on July 25, the president announced the award of the Baly medal to Dr. F. H. A. Marshall, as a pioneer in the experimental investigation of sexual physiology and the relation of hormones to it; and the award of the Bisset Hawkins medal to Sir George Newman, for his distinguished services to public health, and more particularly for the leading part played by him in the institution of social medical services. Leverhulme scholarships were awarded to Dr. R. L. Noble and Dr. C. C. Ungley; and a grant from the same fund to Dr. Janet Vaughan to continue the work on which she was engaged before relinquishing her scholarship. Dr. E. G. L. Bywaters and Dr. L. C. Bousfield were re-appointed for six months

as Mackenzie Mackinnon scholars. The Murchison scholarship was awarded (by the University of Edinburgh) to W. M. Wilson.

#### Announcements

THE twelfth International Congress of Zoology will be held at Lisbon in September under the presidency of Prof. Arthur Ricardo Jorge, Jr. Further information can be obtained from the general secretary, Congrès international de Zoologie, Faculté des Sciences, Lisbon.

A CONFERENCE on academic freedom will be held in the University Museum, Oxford, on August 14-15. It will be divided into three sessions, namely: academic and professional freedom; international professional relief; and the utilisation of science. Among the speakers will be Bertrand Russell, G. D. H. Cole, Prof. N. Bentwich, Miss J. Thomas, Prof. H. Levy, L. J. Hodgson. Further information can be obtained from C. R. Morris, Balliol College, Oxford.

THE tenth and eleventh reports of the Committee on Contact Catalysis, Division of Chemistry and Chemical Technology, have been issued together by the National Research Council, Washington. They deal with general aspects of catalysis, activated adsorption, the nature of chemical binding, interchange of energy in molecular collisions, chain reactions and some technical applications of catalysts.

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

A temporary assistant lecturer in applied mathematics in the University of Liverpool—Registrar (Aug. 10).

A biochemist (part-time) for the Pathological Department, Manchester Northern Hospital—The Secretary, J. C. Daniels, 38 Barton Arcade, Manchester (Aug. 10).

A lecturer in botany in the United College, St. Andrews—Secretary and Registrar (Aug. 10).

An assistant (Grade III) and a temporary assistant (Grade II) in the Admiralty Compass Department, Slough—Secretary of the Admiralty (C.E. Branch), London, S.W.1 (Aug. 10).

A veterinary research officer to the Government of Burma—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Aug. 14).

An assistant lecturer and demonstrator in engineering in University College, Cardiff—The Registrar (Aug. 19).

Two assistant keepers at the Victoria and Albert Museum—Director and Secretary, South Kensington, London, S.W.7, marked "Assistant Keeper" (Aug. 31).

City microbiologist to the Municipal Council, Colombo, Ceylon (candidates to be from the United Kingdom)—Messrs. John Pook and Co., 68 Fenchurch Street, London, E.C.3 (Sept. 30).

A lecturer in geography and mathematics in St. Hild's College, Durham—The Principal.

## 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. 187.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

### The Fundamental Paradox of the Quantum Theory

UNDER the above title, Prof. G. Temple<sup>1</sup> deduces the paradox from the general principles of the quantum theory, that any two operators representing physical variables must commute. If this conclusion be correct, it would involve fatal consequences; therefore we should like to point out that the commutability of operators does not follow from the general principles, but only from the particular and rather arbitrary principle of symmetrisation, which Prof. Temple claims to have deduced, but which is a new hypothesis in reality.

It is generally accepted that "physical variables  $a, b, c, \dots$  are represented by symmetric linear operators  $A, B, C, \dots$  in Hilbertian space; and the representation satisfies the following conditions:

$$a^2 \rightarrow A^2, \lambda a \rightarrow \lambda A \quad (\lambda \text{ being an ordinary number}) \\ a + b \rightarrow A + B."$$

Furthermore, it is also admissible to conclude from the relation  $ab = \frac{1}{2}(a+b)^2 - \frac{1}{2}(a-b)^2$ , which is also a  $c$ -number relation, that  $ab \rightarrow \frac{1}{2}(AB+BA)$ . This way of symmetrisation is unique, if products of only two physical variables are considered. In the case, however, of using products of more than two physical variables, this symmetrisation can no longer be derived uniquely from a  $c$ -relation. For then it is possible to convert artificially the case of two variables into the case of three variables, having then several possibilities of symmetrisation.

We put, for example,  $A = (FF^{-1})A$ , where  $F$  is an operator and  $F^{-1}$  its reciprocal. Assigning  $F^{-1}A = D$ , then evidently  $ab = fdb$ .

According to Temple's symmetrisation

$$fdb \rightarrow \frac{1}{4}(FD + DF)B + \frac{1}{4}B(FD + DF).$$

Here, and in the general case of three variables, we will choose, however, in a more symmetrical way the sum of all six permutations of the three variables.

All the different possibilities of symmetrisation give the same result only then, if the variables commute. Hence we cannot conclude that all variables must commute because a special prescription of symmetrisation does not exist in quantum mechanics.

*Note added in proof.*—Further consideration shows that, starting from the above representation of physical variables by linear operators as assumed by Prof. Temple, the correct symmetrisation of products of physical variables should be made by forming the sum of all the permutations of the variables.

A detailed report on the question of symmetrisation will be published later.

H. FRÖHLICH.  
E. GUTH.

Institut für theoretische Physik,  
Universität,  
Wien.  
June 15.

<sup>1</sup> G. Temple, *NATURE*, 135, 957, June 8, 1935.

To remove any possible misunderstanding, let me say explicitly that the argument of my previous letter was not intended as a serious demonstration that any two operators representing physical variables must commute, but as a definite proof of the existence of some serious and fundamental defect in the form of modern quantum theory. The criticisms to which the argument has been subjected have concerned either the conditions which were assumed to be satisfied by the representation of variables by operators, or the method by which the representation of a triple product was obtained.

With regard to the first group of criticisms, it is sufficient to reply that the assumed conditions are universally accepted, and that the denial of any one of them is as fatally destructive of the present form of the quantum theory as is the acceptance of the commutability of any pair of physical operators. To say that the same variable need not always be represented by the same operator renders it impossible to interpret any operational formula: to deny that  $a + b \rightarrow A + B$ , unless  $A$  and  $B$  commute, makes it impossible to construct any Hamiltonian operator as the sum of the operators representing the kinetic and potential energies: to deny that  $a^2 \rightarrow A^2$  invalidates the whole theory of the momentum operators.

Criticisms of the second kind have usually taken the form of the assertion that the operator representing  $abc$  is

$$\frac{1}{24}\{(A+B+C)^3 - (-A+B+C)^3 - \\ (A-B+C)^3 - (A+B-C)^3\}, \\ \equiv \frac{1}{6}(ABC + BCA + CAB + CBA + ACB + \\ BAC).$$

Certainly, this is a legitimate deduction from the premises, but it is not the *only* possible deduction. I agree with Messrs. Fröhlich and Guth that in the case of triple products a unique form of the representation cannot be derived from  $c$ -relations between variables. But I deny that I have employed a "particular and rather arbitrary principle of symmetrisation . . . which is a new hypothesis in reality". I have based my deduction on the three premises admitted by Messrs. Fröhlich and Guth, and I challenge them to point out at what stage in my argument any further assumption has been made. Any triple product  $abc$  is also a double product of  $a$  and  $bc$ , or of  $b$  and  $ca$ , or of  $c$  and  $ab$ , and its representations are therefore deducible by the recognised rule for all double products, that is, that

$$xy \rightarrow \frac{1}{2}(XY + YX).$$

This is the gist of my argument, and *qua* argument it is invulnerable.

What, then, is the origin of the paradox? It can only arise from the fundamental concept of the representation of the variables of classical physics by the operators of quantum theory. The assertion that such a representation exists is the form taken

by the Correspondence Principle in modern quantum theory, and the paradox to which I have directed attention is a definite proof that, in this form, the Correspondence Principle is false. It is false for the obvious reasons that physical characteristics cannot be simultaneously describable by classical variables and by quantum operators, and hence that there cannot be any rigorous one-one correspondence between these two systems. Trivial though this conclusion appears, it is sufficient to require the complete revision of the greater part of the quantum theory, which at present still leans heavily on the crutches of the Correspondence Principle.

G. TEMPLE.

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July 1.

### Isotopic Constitution of Uranium

THE analysis of uranium rays from the volatile hexafluoride by Dr. Aston<sup>1</sup> has shown a single line at atomic weight 238. The element appeared to be simple to at least two or three per cent, but its properties were not favourable for study in the gas discharge. As uranium is of great importance for the subject of radioactivity, the spark source described in NATURE of April 6 (135, 542) was tried with uranium metal and gold as electrodes, and also with an electrode made by packing a nickel tube with pitchblende. It was found that an exposure of a few seconds was sufficient for the main component at 238 reported by Dr. Aston; but in addition on long exposures a faint companion of atomic weight 235 was also present. With two different uranium electrodes it was observed on eight photographs, and two photographs with the pitchblende electrode also showed the new component. The relative intensity could be only roughly estimated on account of the irregularity of the spark, but it appeared to be less than one per cent of the intensity of the main component.

This faint isotope of uranium is of special interest as it is in all probability the parent of the actinium series of radioactive elements. In discussing Dr. Aston's analysis<sup>2</sup> of the isotopes in lead from radioactive minerals, Lord Rutherford<sup>3</sup> pointed out that the lead isotope of atomic weight 207 is probably the end product of the actinium series, so that the atomic weight of protoactinium would be 231,  $(207 + 6 \times 4)$ . This value has been verified by the recent chemical determination of the atomic weight by v. Grosse<sup>4</sup>. Protoactinium itself may be formed by  $\alpha$ - and  $\beta$ -ray transformations from a hypothetical isotope of uranium, actino-uranium, with an atomic weight of 235 or 239<sup>5</sup>. The relative amount of actino-uranium at present on the earth would be 0.4 per cent of the uranium according to a recalculation by Dr. v. Grosse<sup>6</sup>. The present observations thus support this theory, with the atomic weight of 235 for the isotope actino-uranium. A third isotope, uranium II, of atomic weight 234 amounts theoretically to only 0.008 per cent of the uranium, and would be too faint for observation by the mass-spectrograph.

A. J. DEMPSTER.

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July 12.

<sup>1</sup> Aston, NATURE, 128, 725; 1931.

<sup>2</sup> Aston, NATURE, 123, 313; 1929.

<sup>3</sup> Rutherford, NATURE, 123, 313; 1929.

<sup>4</sup> A. v. Grosse, Proc. Roy. Soc., 150, 363; 1935.

<sup>5</sup> A. v. Grosse, Phys. Rev., 42, 565; 1932.

<sup>6</sup> A. v. Grosse, J. Phys. Chem., 38, 487; 1933.

### Intensity of Polarised X-Rays

To obtain a pencil of plane-polarised X-rays as free as possible from unpolarised radiation, Barkla's original method is still the standard. The resulting beam produced by scattering an ordinary X-ray beam through 90° from its original direction is always very weak. Partial polarisation of the direct beam from an X-ray tube was found by Barkla, and Kulenkampff<sup>1</sup> found strong polarisation near the short wave-length limit in the general radiation. Mark and Szilard<sup>2</sup> found no polarisation in the fluorescent radiation even at 90°. In the scattering method some increase of intensity is found when the scatterer will give a 'powder' line for which the Bragg angle, for the strongest component of the incident radiation, is 45°.

The polarised beam got by any of these methods proved too weak for use in some experiments on the interaction of polarised X-rays and crystals. A serviceable polariser for  $\text{CuK}_\alpha$  radiation was made by using a single crystal as the scatterer. The most intense beam was got from a single crystal of copper cut parallel to the 311 planes ( $2\theta = 90^\circ 10'$ ). Serious reduction in reflecting efficiency due to distortion can be avoided by the use of a special technique for preparing the section. The results of a comparison of intensity of the beam of polarised X-rays given by such a polariser and by the standard methods are shown in the table. As an ionisation spectrometer was not available, a photographic method had to be used. An attempt was made to produce the same blackening of photographic film by each of the methods in turn under similar conditions of working of the X-ray tube and of photographic development. Each film was then measured on a Moll microphotometer and the blackening expressed as  $\log_{10} (I_0/I)$ , where  $I_0$  is the galvanometer deflection when the unblackened film is before the thermopile and  $I$  is the corresponding deflection for the blackened film. The value 0.301 is for a film transmitting one half of the light incident upon it normally.

Scatterer	Density of blackening of film	Time of exposure (sec.)
Section of single crystal of copper	0.441	5
Copper powder (foil)	0.301	900
Carbon block	0.344	3,600
Wax block	0.414	4,800

Since photographic blackening by X-rays is a function of the product of the incident X-ray intensity and the time of exposure<sup>3</sup>, the results show that the increased efficiency got by using the single crystal polariser is of the order 100 to 1000 fold. Since the polarised beam from the crystal is a directed beam, greater accuracy of setting of the apparatus is needed than for the standard methods, but the routine accuracy of X-ray crystallography suffices. With this more powerful beam, advantage can be taken, in the study of the interaction of X-rays and matter, of the vectorial properties of polarised X-rays. In one such experiment now in progress it was found that an exposure of 24 hours was necessary with polarised X-rays when an exposure of 5 min. with ordinary X-rays sufficed. Without the thousand-fold increase of efficiency the experiment was impracticable, needing apparently an exposure of nearly three years.

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Research Fellow).

<sup>1</sup> Phys. Z., 30, 513; 1929.

<sup>2</sup> Z. Phys., 35, 743; 1926.

<sup>3</sup> Bouwers, Z. Phys., 14, 374; 1923.

### Extreme Infra-Red Absorption of D<sub>2</sub>O, Ice and D<sub>2</sub>O in Dioxane

THE broad absorption band observed in liquid water at about 160 cm.<sup>-1</sup> might be attributed to a free rotation of individual molecules, a combination frequency of near infra-red bands, or to a quasi-crystalline structure. The difference between the absorption of H<sub>2</sub>O in the liquid and vapour states suggests the latter, and we can attribute it to either (1) hindered rotation or (2) hindered translation. This frequency being strongly infra-red active I interpreted it as due to a hindered rotation of the molecules<sup>1</sup>. Bernal and Tamm<sup>2</sup>, using the model described by Bernal and Fowler<sup>3</sup>, predict a fundamental frequency of hindered translation near 160 cm.<sup>-1</sup> and a fundamental frequency of hindered rotation at 480 cm.<sup>-1</sup>. Measurements on D<sub>2</sub>O permit us to decide between phenomena (1) and (2): for hindered rotation the frequency should be shifted by  $\sqrt{2}$ , for hindered translation by  $\sqrt{20/18}$ , or about 5 per cent.

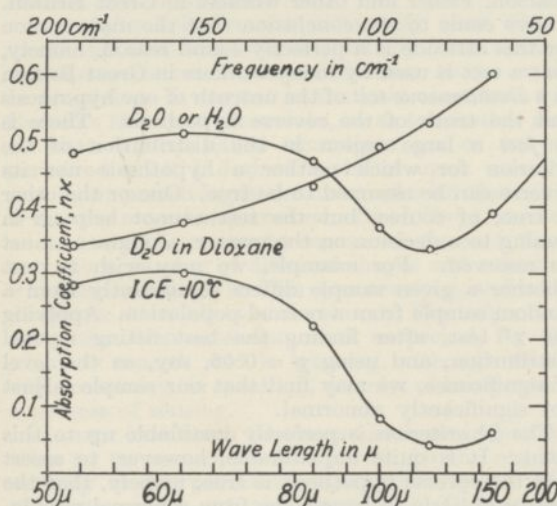


FIG. 1.

Within our experimental limits, D<sub>2</sub>O and H<sub>2</sub>O had the same absorption between 60 cm.<sup>-1</sup> and 200 cm.<sup>-1</sup>. The absorption band near 160 cm.<sup>-1</sup> can therefore be assigned to a hindered translational frequency of D<sub>2</sub>O or H<sub>2</sub>O molecules as predicted by Bernal and Tamm. However, if this frequency were due only to a vibration of water molecules in a quasi-crystalline structure, it should be neither infra-red active nor Raman active. The difficulty might possibly be removed (using the model proposed by Bernal and Fowler<sup>3</sup>) by assuming that some of the four surrounding molecules are forced to follow the vibrations of the molecule at the centre by turning. This could in effect make a hindered translational motion infra-red active and also weakly Raman active, as is observed<sup>4, 5</sup>.

The existence of the 160 cm.<sup>-1</sup> band in ice at -10° C., as shown in Fig. 1, is additional evidence for a quasi-crystalline structure in water, and indicates that the intermolecular forces are about the same in water and ice. As is also shown in Fig. 1, the 160 cm.<sup>-1</sup> band disappears for water dissolved in dioxane, which confirms that its presence was due to a structure in water rather than to the individual molecules. The absorption of dioxane has been subtracted in calculating the curve in Fig. 1.

Bolla<sup>4</sup> reports a feeble Raman band near 60 cm.<sup>-1</sup>. If this frequency is infra-red active, it is masked by the absorption due to the orientation of the permanent dipoles, as is best seen for water dissolved in dioxane. The absorption coefficient of water increases<sup>5</sup> to a maximum of 2.7 at 0.6 cm.<sup>-1</sup>.

Absorption measurements of the hindered rotation band predicted by Bernal and Tamm<sup>2</sup> at 480 cm.<sup>-1</sup> would be experimentally difficult, but the measurements of the reflecting power<sup>7</sup> show a distinct maximum about 500 cm.<sup>-1</sup> (much stronger than that for the 160 cm.<sup>-1</sup> band). This frequency, if it were due to a hindered rotation, should indeed be strongly infra-red active; however, an accompanying distortion of the configuration of the surrounding water molecules seems necessary to explain the feeble Raman band observed in this region<sup>4, 5</sup>.

I wish to thank Prof. E. K. Rideal for kindly supplying the D<sub>2</sub>O used in these experiments.

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Brussels.  
June 4.

<sup>1</sup> C. H. Cartwright, *NATURE*, **135**, 872, May 25, 1935.

<sup>2</sup> J. D. Bernal and Ig. Tamm, *NATURE*, **135**, 229, Feb. 9, 1935.

<sup>3</sup> J. D. Bernal and R. H. Fowler, *J. Chem. Phys.*, **1**, 515; 1933.

<sup>4</sup> Bolla, *Nuovo Cimento*, **10**, 101; 1934.

<sup>5</sup> Magat, *J. Phys.*, **5**, 347; 1934.

<sup>6</sup> H. Rubens, *Verh. d. phys. Ges.*, **17**, 315; 1915.

<sup>7</sup> H. Rubens u. E. Ladenburg, *Verh. d. phys. Ges.*, **10**, 226; 1908.

### Molecular Polarisation of Solutes and Dielectric Constant of Solvents

EXPERIMENTALLY it is indicated that the different total polarisations shown by the same solute when dissolved in different solvents are to be related to alterations in the orientation polarisations ( ${}_0P$ ) caused by replacement of one dielectric environment by another, the atomic and electronic polarisations being constant throughout such changes. Therefore the expression given by Raman and Krishnan<sup>1</sup> for the volume polarisation of a dielectric, namely:

$$\frac{\epsilon - 1}{\epsilon + 2} = v \left( \frac{4\pi}{3} \frac{\alpha_1 + \alpha_2 + \alpha_3}{3} + \frac{\epsilon - 1}{\epsilon + 2} \psi \right) + \frac{v}{3kT} \left( \frac{4\pi}{3} \mu^2 + \frac{\epsilon - 1}{\epsilon - 2} \Theta \right)$$

(cf. reference for definition of symbols) can be rewritten to show the molecular orientation polarisation ( ${}_0P_{\text{sol.}}$ ) of a polar solute at infinite dilution in a non-polar medium of dielectric constant  $\epsilon$  as:

$${}_0P_{\text{sol.}} = \frac{N}{3kT} \left( \frac{4\pi}{3} \mu^2 + \frac{\epsilon - 1}{\epsilon + 2} \Theta \right).$$

Now, dividing throughout by the true orientation polarisation as observed in the gaseous state ( ${}_0P_{\text{gas}} = 4\pi N\mu^2/9kT$ ) we have

$${}_0P_{\text{sol.}}/{}_0P_{\text{gas}} = 1 + 3 \Theta/4\pi\mu^2 \frac{\epsilon - 1}{\epsilon + 2}.$$

We wish to direct attention to two points of interest which arise from this result:

(1) The sign of  $\Theta$  being inversely that of the Kerr constant for the substance, this quantity is for most substances negative, and therefore their polarisations in solution should be, and in many instances have

been found to be, *less* than in the vapour states. Further, in many cases  $\Theta$  can be considered as approximately equal to  $-4/3\pi\mu^2$ , whence, by substitution,

$$P_{\text{sol.}}/P_{\text{gas}} = 1 + \frac{1 - \epsilon}{\epsilon + 2} = 3/(\epsilon + 2),$$

which is identical with the purely empirical result discussed and illustrated previously<sup>4</sup>.

(2) The minority of compounds—for example, chloroform, ether and certain amines—which have negative Kerr constants<sup>3</sup>, are particularly significant because *they should exhibit larger polarisations in the dissolved than in the gaseous condition*. Such experimental evidence as is available (cf. ref. 2) appears to support this. One extreme case can be quoted as an example: chloroform (Kerr<sup>3</sup>  $B = -3 \times 10^{-7}$ ) at 25° has an apparent orientation polarisation in the liquid (bulk) state of 23.7 c.c. whilst the highest recorded value in the vapour state, calculated from the results of Sircar<sup>2</sup>, is only 22.8 c.c.

Fuller information regarding the orientation polarisations in the gas phase of substances with negative Kerr constants is eminently desirable at the present time.

R. J. W. LE FÈVRE.

University College,  
London, W.C.1.  
June 11.

<sup>1</sup> Raman and Krishnan, *Proc. Roy. Soc., A*, 117, 589; 1927.

<sup>2</sup> *Trans. Far. Soc.*, 1934, Appendix.

<sup>3</sup> Briegleb and Wolf, *Fortsch. Chem.*, 21, Pt. 3; 1931.

<sup>4</sup> Le Fèvre, *Chem. and Ind.*, April 5, 1935, p. 316; and *J. Chem. Soc.*, June, 1935, p. 773.

### Coalescence in Stages between Two Drops of a Liquid

A DROP of benzene introduced into a vessel of water through a capillary tube spreads to a limited extent over the surface of galena that has been coated by any of the compounds known in flotation as collectors<sup>1</sup>. If now the tube be raised slowly, the benzene drop becomes elongated and then ruptures. The angle of contact being greater than 90°, a portion of the benzene remains on the mineral surface, the greater part contracts into a nearly spherical pendent drop at the end of the capillary tube, and the small portion that formed the 'waist' before breaking becomes a minute drop that rises slowly through the water. It does not immediately coalesce with the pendent drop when they meet. After a variable induction period, a very rapid change occurs, as the result of which the small drop may disappear altogether or may merely decrease in size. On occasions there may be four such diminutions in size before the drop disappears, the induction period for each being several seconds. Other organic liquids behave similarly.

A similar phenomenon has been observed with water. Small drops directed obliquely on to the surface of tap water do not immediately coalesce with it. It is presumed that the surfaces are contaminated by a thin film of grease or dust. Again, coalescence sometimes occurs in stages.

The probable explanation of these facts is that when true contact first establishes itself between the liquid in the small drop and that in the larger surface, spreading occurs so rapidly that the bubble does not fall (or rise) so quickly as its contents drain

away; a waist is formed and rupture occurs before the complete drop has been absorbed. It is suggested that these phenomena would repay investigation in a laboratory equipped with a high-speed cinematograph.

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Carlton, N.3.  
May 11.

<sup>1</sup> Wark and Cox, "Milling Methods", *Trans. Amer. Inst. Min. and Met. Eng.*, 112, 189; 1934.

### Statistical Tests

IN discussions on statistical tests with various Continental statisticians and users of statistical methods, I have been struck by their universal mistrust of modern statistical tests as developed by Pearson, Fisher and other workers in Great Britain. I have come to the conclusion that the main reason for this attitude is a perfectly sound reason, namely, that a test is used by many workers in Great Britain as a *simultaneous test* of the untruth of one hypothesis and the truth of the reverse hypothesis. There is *in fact* a large region in the distribution of the criterion for which neither a hypothesis nor its reverse can be assumed to be true. One or the other *is* true, of course, but the test cannot help us in coming to a decision on the matter. Judgment must be reserved. For example, we may wish to test whether a given sample differs significantly from a random sample from a normal population. Applying the  $\chi^2$  test, after finding the best fitting normal distribution, and using  $p = 0.05$ , say, as the level of significance, we may find that our sample is just not significantly abnormal.

The  $\chi^2$  criterion is perfectly justifiable up to this point. It is quite unjustifiable, however, to assert that the reverse hypothesis is true, namely, that the sample *is likely* to have come from a normal population, unless we have other reasons to believe this, in which case, of course, the  $\chi^2$  test is not used as a criterion of the truth of the reverse hypothesis. Given an equal *possibility* of an infinite variety of populations, the most likely group of distributions to have given it contains all those which will give the *modal*  $\chi^2$  value for the appropriate number of degrees of freedom. All these and an infinite number of others may be considered as *likely* to have given the sample, compared to the best-fitting normal distribution, which has indeed comparatively a very small likelihood. This likelihood is sufficient, however, to prevent our assuming abnormal distribution.

It is often of scientific and practical interest to investigate whether Gauss's law or other simple laws of distribution apply to a sample. There is no doubt that the  $\chi^2$  test, as usually applied, is quite useless for this purpose, though it may be most useful as a test of *significant heterogeneity*, using a low value of  $P$  as a criterion. It seems only reasonable that but a small part of the centre of the  $\chi^2$  distribution should be used as a test of *fit*.

I believe the mistrust of British methods on the part of the statisticians of other countries to be due partly to their failure to realise that the word 'normal' is usually employed to cover samples which are likely to have arisen from populations the estimates of the mean and other parameters of which have distribu-



tions very similar to those of the corresponding normal parameters. The fact that British methods 'work' is due to the prevalence in Nature of distributions *similar* to the Gaussian rather than to any peculiar virtue in the methods themselves. I am writing this in the hope that some statistician of international repute will be tempted to treat the matter fully in some publication such as NATURE available to statisticians of all countries.

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### Philosophy and Modern Science

I do not know whether in a brief compass I can say anything useful in regard to Dr. Jeffreys's letter in NATURE of July 20. Yet it seems a pity that the cardinal psychological distinction upon which I was laying stress<sup>1</sup> should be obscured by mere misapprehension and confusion.

I thought I had made sufficiently clear what I meant by the term *sensum*, namely, *that which is sensed or perceived*, in contradistinction to the *sensing or perceiving*. I was not in the least concerned with Russell's theory of sense-data, or as to whether most of what Russell called sense-data are or are not perceived. All I desired to insist upon was that sensing or perceiving is not identical with that which is thereby sensed or perceived. Dr. Jeffreys now tells us that what he means by sensations are such things as various patches of different shapes and colours of which he is aware when his eyes are open, and which disappear when his eyes are closed. Precisely; he is using the term sensation, as I suspected, for that which is sensed, and is ignoring, although all the while assuming (in speaking, namely, of being aware), a process of sensing.

He now maintains that sensations, so understood, seem to be immediate and not to be the result of activity on the part of the conscious subject. With the latter part of this statement I thoroughly concur; but when I am further told that sensations, or *sensa*, "just happen", I feel bewildered. Surely, patches of various shapes and colours do not "happen"; they simply are; what "happens" is the state or condition of being aware of them. The latter is the mental act; and it is, of course, wholly different from a bodily activity, such as that of "opening my eyes". Whether there be any process rightly describable as "merely having a sensation" is more than doubtful; but most certainly if there is, it is a case of mental activity. Not even the crudest, the most indefinite, *awareness* of a sensuous content is conceivable which does not involve the functions of discriminating and comparing, which functions, as the result of development, ultimately assume the highly evolved form of mental activity we call thinking.

Again, the statement in my letter that a concept, psychologically considered, is a way in which universals are cognised presupposes by no manner of means the existence of universals. We cognise numerous entities—numbers, for example—which are not existents. Indeed, the point I was urging was that an individual existent, such as the planet Neptune, is obviously neither a universal nor a concept. Dr. Jeffreys now informs us, "It is only when many observations are available that we can form the idea of a single body moving in a definite way; generalisa-

tion has already been applied in thinking of Neptune at all". Quite true; but what has that to do with the matter? Generalising is, in fact, involved in every act of mature perception, in my perception, for example, of the table at present in front of me; but it does not follow that the object perceived is, on that account, itself a generalisation. Dr. Jeffreys further informs us that what he calls a percept is substantially what Pearson called a construct. Well, I suppose a writer is at liberty to use a term in any sense he chooses. But it is, to say the least, unfortunate when a term with a well-recognised connotation is employed in a manner altogether contrary to its ordinary meaning. Even in popular language, the term 'concept', according to the "Oxford Dictionary", signifies "idea of a class of objects, general notion". The "idea of a single body moving in a definite way" is doubtless an idea of a highly complex object; but it is not, as such, an idea of a class of objects.

G. DAWES HICKS.

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July 22.

<sup>1</sup> NATURE, 135, 1035, June 22, 1935.

### The Carr and Price Reaction of the Fatty Acids of Cod Liver Oil after Vigorous Saponification

It has been demonstrated<sup>1-5</sup> that prolonged and vigorous saponification of the mixed free acids of fish-liver oils causes remarkable changes in their chemical structure and in the absorption in the ultra-violet. When saponifying the acids of cod liver oil in this way, I observed a remarkable change in the Carr and Price reaction of these acids.

Cod liver oil was saponified for 10 minutes with ethyl alcoholic potash, and the unsaponifiable fraction extracted with ether. The fatty acids were distilled (at 0.2 mm.). They were pale yellow in colour and gave with antimony trichloride in chloroform only a yellow colour. The acids were saponified for six hours in nitrogen under reflux with an excess of amyl alcoholic potash. (The amyl alcohol was previously distilled over potash.)

The regenerated acids gave with the Carr and Price reagent a relatively strong and rapidly decreasing violet colour with absorption at 600–620 m $\mu$  and at 530–550 m $\mu$ . Measured with the Lovibond tintometer, these acids contained per c.c. 300 L.U. (Wolff) = blue value 60. The cod liver oil itself contained 70 L.U. (Wolff) = blue value 14. The substance responsible for the reaction was purified by dissolving the acids in light petroleum and filtering through a Tswett column with activated aluminium oxide. A yellow coloured zone was visible at the top, unaltered even after washing with ethyl alcohol. The pigment was eluted with dilute ethyl alcoholic potash, regenerated by acidification and taken up in ether. After evaporation *in vacuo*, a pale brown-coloured semi-solid substance was obtained. Addition of light petroleum caused a yellow precipitate and removed soluble substances, which gave a reddish brown Carr and Price reaction. The precipitate was washed several times with light petroleum and dissolved in a small quantity of acetone or chloroform. So a colourless impurity which is insoluble in acetone and chloroform could be removed. After evaporation and drying *in vacuo*, a yellow amorphous powder was obtained.

The substance possessed acid properties, a dilute solution in chloroform was yellowish green-coloured and showed by itself no definite absorption bands (absorption from  $\pm 470$  m $\mu$  down to the lower part of the spectrum). With the Carr and Price reagent a violet colour developed with absorption bands at 525–535 m $\mu$  and at 590–620 m $\mu$ . The 525–535 m $\mu$  band rapidly decreased, the reaction mixture turned blue to greenish blue and a band at 670–690 m $\mu$  became visible. The bands at 590–620 m $\mu$  and at 670–690 m $\mu$  and also the blue colour are relatively stable. The Lovibond value of the yellow substance was 75,000 (Wolff) or blue value 15,000. From 15 gm. of fatty acids a few milligrams of the yellow product were obtained.

Different samples of cod liver oil and halibut liver oil acids showed this reaction with the antimony trichloride reagent. It was not observed with the acids of butter fat or arachis oil, or with carotene, cholesterol or ergosterol.

Further investigations are in progress.

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June 20.

- <sup>1</sup> Dann and Moore, *Biochem. J.*, **27**, 1166; 1933.  
<sup>2</sup> Dann, Booth, Golding and Kon, *Biochem. J.*, **29**, 138; 1935.  
<sup>3</sup> Edisbury, Morton and Lovern, *Biochem. J.*, **27**, 1451; 1933.  
<sup>4</sup> Edisbury, Morton and Lovern, *Biochem. J.*, **29**, 899; 1935.  
<sup>5</sup> Gillam, Heilbron, Hilditch and Morton, *Biochem. J.*, **25**, 30; 1931.

### The Metabolism of Retina

SIGNIFICANT differences of the normal metabolism of tissues either in Ringer bicarbonate or in phosphate solution have so far not been reported<sup>1,2</sup>. On the other hand, the contradictory results obtained by Dixon and Elliot<sup>3</sup> and Alt<sup>4</sup> respectively concerning the hydrogen cyanide stable residue of the respiration of liver slices have been explained by the use of different media. Nearly complete inhibition occurs in Ringer bicarbonate while a considerable residue remains in phosphate solution or in Ringer without bicarbonate.

The study of the metabolism of retina and tumours has shown the following results:

The respiration of rat's retina and Crocker mouse-sarcoma 189 in bicarbonate Ringer is about twice as high as in phosphate Ringer.

	$Q_{O_2}$ in bicarb.	in phosphate
Retina	32	17.5
Tumour	12-18	6-9

While the respiration of the tumour is inhibited in both media by about 90 per cent by hydrogen cyanide  $n/1,000-n/500$ , the respiration of retina is inhibited by

Retina, hydrogen cyanide  $n/1000$

	$Q_{O_2}$	$Q_M^{O_2}$	$Q_M^{N_2}$
Bicarb.	32-35	88	88
Phosphate	3	—	—

the same hydrogen cyanide concentrations *only in phosphate Ringer but not inhibited at all in bicarbonate Ringer*. The Pasteur reaction in this case is

completely inhibited, the aerobic glycolysis becomes equal to the anaerobic. Hydrogen cyanide, therefore, in bicarbonate media acts on retina as ethyl-carbylamine<sup>5</sup> on other glycolysing tissues. The anaerobic glycolysis is not affected. The inhibiting effect of phosphate and of hydrogen cyanide in phosphate on the respiration is reversible.

The natural thickness of the retina allows the measurement of its respiration at very low oxygen tensions. In nitrogen with 5 per cent oxygen, the respiration in phosphate remains still normal ( $Q_{O_2} = 17.5$ ) and under our experimental conditions 95 per cent carbon monoxide with 5 per cent oxygen leads to no inhibition of the respiration of the retina.

H. LASER.

Molteno Institute,  
University of Cambridge.  
June 30.

<sup>1</sup> O. Meyerhof, "Die chemischen Vorgänge im Muskel", p. 53. (Springer, Berlin, 1930.)

<sup>2</sup> F. Dickens and F. Simer, *Biochem. J.*, **25**, 985; 1931.

<sup>3</sup> M. Dixon and K. A. C. Elliot, *Biochem. J.*, **23**, 812; 1929.

<sup>4</sup> H. L. Alt, *Biochem. Z.*, **221**, 498; 1930.

<sup>5</sup> O. Warburg, *Biochem. Z.*, **172**, 432; 1926.

### Coagulation of the Blood as a Chain Reaction

WITH reference to the letter of Dr. Albert Fischer published in NATURE of June 29 (135, 1075), readers of this journal may be interested to be reminded of the following quotation from a paper by C. Delezenne, published in *Ann. de Physiol. et de Physicochim. biologique* (2, 537; 1926):

"Outre la faculté essentielle qui le définit, le fibrin ferment possède encore la curieuse propriété, découverte par BORDET et GENGOU, de faire lui-même naître le fibrin ferment, ou tout au moins d'en accélérer considérablement la production, lorsqu'on l'ajoute à un milieu qui en renferme tous les générateurs."

This sentence and what follows it fully substantiate the theory of blood coagulation as a chain-reaction described by Dr. Fischer.

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June 29.

### Fish and Rabbit Liver Glycogens

LIVER glycogen from fish of the genus *Gadidae*, first isolated and described by Bell and Young<sup>1</sup>, was subjected to methylation by the procedure of Haworth and Percival<sup>2</sup>. The product showed a methoxyl content of 45.5 per cent (maximum) and was identical with the corresponding derivative from highly purified rabbit liver glycogen in all its properties including  $[\alpha]_D$  in water +208° and in chloroform +209°. Hydrolysis with a mixture of aqueous hydrochloric and acetic acids, followed by separation of the cleavage products, yielded an amount of analytically pure tetramethylglucopyranose corresponding to 9.1 per cent of the starting material, while control experiments on methylated rabbit liver glycogen gave 9.5 per cent. Both these values correspond to a molecular magnitude of 12 glucose units for the glycogen molecule, and are in agreement with the findings of Haworth and Percival for commercial rabbit liver glycogen. The methylated glycogens are

further identical with respect to the colour developed with iodine, a deep red-brown, although, as Bell and Young found, the parent substances differ in this respect.

Results recently obtained by Bell and Kosterlitz<sup>3</sup> reveal further identity by examination of acylated derivatives of the two glycogens, and of the glycogens regenerated from these derivatives. It is therefore concluded that fish and rabbit liver glycogens are very probably chemically identical.

These results will be communicated fully through the usual channels.

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June 28.

<sup>1</sup> *Biochem. J.*, **28**, 882; 1934.

<sup>2</sup> *J. Chem. Soc.*, 2277; 1932.

<sup>3</sup> In the Press.

### Homology of the Female Periurethral Glands and the Prostate

So early as 1853, Virchow assumed, on the evidence of histological similarity, that the minute periurethral glands, found in the human female in the neighbourhood of the urethra, are homologues of the male prostate.

The following experiments made by us give experimental confirmation of this and some similar observations, and of the homology of the periurethral glands in the female rat with the ventral lobe of male prostate. The diol of androsterone ( $C_{19}H_{32}O_2$ , a derivative of male sexual hormone) prepared by Ruzicka was injected into ovariectomised rats for three weeks in doses of 175–700  $\gamma$  a day. On dissecting the vagina and uterus of these rats, glands, not normally seen in the rat, were found on the vagina, at the base and in front of the bladder. Macroscopically, these glands had the appearance of the ventral lobe of the male prostate. The largest gland measured 6 mm.  $\times$  4.2 mm.  $\times$  2.2 mm. The addition of oestrone to diol injections did not prevent the development of the 'female prostate'. Microscopical examination revealed a structure typical of the normal ventral lobe of the prostate of the male. This glandular tissue was found in some of the normal and ovariectomised uninjected rats, but only on histological examination; it was in a rudimentary condition, with atrophic cells.

Thus the name 'female prostatic gland' could be used instead of 'female periurethral glands', in order to emphasise the homology of these glands in the male and female, in the same way as the name 'utriculus masculinus' is used to show that this gland is homologous with the uterus of the female.

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### Depigmentation, a new Dietary Deficiency Disease, cured by Copper

IN a preliminary communication<sup>1</sup> a short description and two figures were given of a peculiar deficiency disease, involving depigmentation and occurring in young, pigmented rats. The only author who has, so far as I know, published a description of the same manifestations in rats, is Hartwell<sup>2</sup>. She

attributed these symptoms to deficiency of tryptophane and tyrosine in the diet.

Hitherto I have succeeded in producing a similar syndrome in young as well as in adult rats, young cats and young or adult rabbits. In my opinion, young rats are most susceptible to depigmentation; furthermore, they are susceptible during the whole year. Hartwell, however, could not produce depigmentation in rats during the winter season.

The influence of the feeding of many vitamins and minerals (Cu, Fe, Mn, Zn, Co, Ni, Na, K, Ca, Mg, F, Cl, I, P, S) was tested, separately and together: copper appeared to be the only active principle required for prevention or cure. The dosage must be much higher than for cure of anæmia, namely, 0.02–0.12 mgm. per diem for prevention, and 0.07–0.24 mgm. per diem for cure of the depigmentation. The minimum dosage required may thus vary considerably within these limits, in consequence of its availability and of the anti-copper effect of certain (growth-promoting) food-factors, which should always be present to some extent in a satisfactory diet.

Growth in itself may also promote depigmentation.

Loss of fur bears no relation whatever to the onset of depigmentation. It is cured by entirely different dietary factors (vitamin B<sub>2</sub> complex, cystine, residue factor of yeast or liver) and does not occur in rats fed on rations which are deficient in copper only. On the other hand, bald and depigmented rats may be cured by addition of copper so far as their colour is concerned, and the bald areas do not recover in this way.

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June 11.

<sup>1</sup> Gorter, *NATURE*, **134**, 382; 1934.

<sup>2</sup> Hartwell, *Biochem. J.*, **17**, 547; 1923.

### Vitamin C in Lower Organisms

THE vitamin C staining reagent (acetic acid – silver nitrate) has been applied to certain protozoa, bacteria, moulds, lichens and algæ.

Various ciliates and *Chlamydomonas* were concentrated by centrifuging, washed with distilled water, and then fixed with the acetic acid silver nitrate solution of Giroud and Leblond. Sections of these protista showed the presence of small black granules scattered in the cytoplasm without exhibiting any association with formed elements of the cell, such as the nucleus, chloroplasts, etc. The granules were rounded and each one was approximately one fifth the size of a single chloroplast in *Chlamydomonas*. Five or six granules occurred in each individual, both *Chlamydomonas* and the ciliates. In some of the latter, it was noticed that there was a tendency for the granules to aggregate round certain vacuoles. The culture medium in which these organisms had grown was tested with the indophenol reagent to ascertain whether vitamin C was being synthesised and excreted by them. No appreciable quantity of vitamin C either in the reduced or in the reversibly oxidised condition could be detected, however, in the medium.

Of the large numbers of *Bacillus coli communis* to which the vitamin C reagent was applied, a considerable percentage showed the presence of a single black granule at one end. No specimens were seen which showed more than one granule. Specimens

of *Mucor* and the blue-green mould *Penicilium* were also examined using the same solution for impregnation, and black granules were found in the mycelium and in the spores. The protoplasm in various types of Algae, for example, *Spirogyra* (Chlorophyceae) and *Oscillatoria* (Cyanophyceae) was seen to contain varying numbers of fine granules. In *Oscillatoria* at the growing tip the granules were orientated in lines radiating backwards from the tip. The granules in the segments farther back were scattered irregularly in the centre of the segment. In specimens of lichen examined, the algal cells contained only a few granules, but the fungal element of the lichen possessed a greater number of granules, aggregated chiefly in the centre of the hyphae.

It is apparent, then, that in these lower forms of life there is a substance capable of reducing a reagent which in higher forms of life is specific for vitamin C. It is suggested, therefore, that this reducing substance in these lower organisms is vitamin C, in which case it may be that the very existence of living protoplasm is dependent upon the presence of this vitamin. It has been shown in Eutherian mammals, and more recently in the marsupials also, that vitamin C occurs in all the organs of the body, although varying considerably in concentration in the different tissues. It is present in high concentration in the pituitary and adrenal glands, the corpus luteum and interstitial gonadial cells, and, to a lesser extent, in the liver. It is also present in the adreno-cortical homologues of certain fishes.

The suggestion is that vitamin C is essential for the existence of living protoplasm, probably as an integral part of an oxidation reduction system. Its high concentration within certain organs may indicate a non-specific catalysis of the manufacture of the hormones of those organs.

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#### Plural Nature of Vitamin B

ONE group of rats was supplied with vitamin B carriers that had been subjected to intense ultra-violet irradiation. The animals developed a severe dermatitis and died. A second group received tikitiki, an alcoholic extract of rice polishings, as the sole source of vitamin B. After some ten or twelve weeks these rats became denuded, assumed a very miserable appearance, and finally they died also.

Wheat germ oil and flavines have unique properties in treating these abnormalities. The denuded condition is healed by either hepatoflavine or lactoflavine, and the rats grow rapidly on the combination of tikitiki and flavine. Wheat germ oil is ineffective. The dermatitis is not relieved by flavines, but is healed by wheat germ oil. Growth will not be sustained unless the irradiated supplement is fortified both by wheat germ oil and flavines. Ultra-violet irradiation destroys two vitamins. One is flavine, the other is the unidentified factor required to prevent dermatitis.

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#### Rarity of the Archaic Arachnids, *Podogona* (Ricinulei)

THE writer of the review in NATURE of June 29 of Mr. Savory's book on Arachnida refers to a statement made by that author with regard to the number of specimens of *Podogona* or Ricinulei known to exist. The number of specimens representing the thirteen living species of *Podogona* was estimated at thirty-two.

This figure was correct when Kästner wrote his monograph on the group in Kükenthal and Krumbach's "Handbuch der Zoologie" (1932), but in the summer of the year 1933, Mr. Ivan T. Sanderson presented a collection of no less than three hundred and seventeen specimens of *Cryptostemma sjöstedti* to the British Museum (Natural History). These *Podogona* were collected by Mr. Sanderson on the Percy Sladen Trust Expedition to Nigeria and the British Cameroons, 1933. Only seventeen specimens were adult, the rest being nymphs except for one six-legged larval form. Mr. Sanderson also managed to bring back twenty living specimens, which were kept alive for twelve months in an incubator in the Museum. During this time they were exhibited at the Royal Society soirée in June 1934 and at the Linnean Society, and Mr. Sanderson had a very interesting film made showing their curious gait, and the cataleptic state induced by sudden intense light or slight movement.

The acquisition of this valuable collection and the light it has helped to throw on this obscure group tempt one to quote further from Mr. Savory's book and say it "... is a challenge to those collectors fortunate enough to find themselves in the right neighbourhood".

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#### Surface Tension of Heavy Water

SELWOOD and Frost<sup>1</sup> obtained for mixtures of varying proportions of ordinary and heavy water different values of surface tension, the surface tension becoming smaller as the D<sub>2</sub>O concentration increased. These authors compute by extrapolation that pure heavy water has a surface tension of 67.8 dyn./cm. at 20° C. No other data can be found in literature, especially no direct measurements of surface tension of pure heavy water.

When dealing with another problem, there arose a necessity of carrying out such a measurement with 99.2 per cent D<sub>2</sub>O obtained from the Norsk Hydro-elektrisk Kvaestofaktiebolaget, of Oslo, Norway.

Radius of the capillary bore (cm.)	Surface tension or ordinary water (dyne/cm.)	Surface tension of heavy water in dyne/cm.		
		I <i>d</i> = 1.1053	II <i>d</i> = 1.1048	III <i>d</i> = 1.1049
0.013526	73.0	72.7	72.6	72.6
0.019503	72.0	72.1	71.5	71.2
0.025364	72.4	—	71.8	72.0

Preliminary experiments carried out by means of the du Noüy precision tensiometer gave for this water a surface tension value of 72.6 ± 1 dyne/cm., the corresponding value for ordinary water being 72.8 dyne/cm. More accurate measurements were made by the ascension method at 20° C., all usual

precautions being taken. The results obtained in three capillary tubes of different radii show, for three samples (I, II and III) of more than 99 per cent heavy water obtained at different periods, a surface tension of  $72.2 \pm 0.5$  dyne/cm. As may be seen from the accompanying table, this value does not differ from that known<sup>2</sup> for ordinary water, within the limits of our experimental error.

Measurements have been made also with 96 per cent and 94 per cent D<sub>2</sub>O, the figures obtained being almost the same as those previously stated; densities and ascensions compensate each other similarly as in the case of 99 per cent heavy water.

On the basis of these preliminary measurements, we are inclined to believe that the values of surface tension of heavy and ordinary water most probably are equal or, in any case, the difference is very small.

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June 15.

<sup>1</sup> *J. Amer. Chem. Soc.*, **55**, 4335; 1933.

<sup>2</sup> cf. H. Freundlich, "Kapillarchemie", vol. 1, p. 30; 1930.

### Points from Foregoing Letters

H. FRÖHLICH and E. Guth claim that Temple's paradox (that if physical operators commute, Planck's constant is equal to zero), which would invalidate the greater part of the quantum theory, is due to the arbitrary way in which he chooses the product of three physical variables. Prof. Temple, while agreeing that in the case of triple products a unique form of representation cannot be derived, maintains that his deduction is as legitimate as that of Fröhlich and Guth. The paradox, he considers, really indicates that physical characteristics cannot be simultaneously described by classical variables and by quantum operators.

Prof. A. J. Dempster reports the observation by the mass-spectrograph of a uranium isotope of atomic weight 235, which is probably actino-uranium, the source of the actinium series of radioactive elements.

An X-ray polariser in which a cut section of a single crystal is used as scatterer is reported by Dr. W. H. George to give a beam of intensity 100-1000 times that of the standard methods.

Observations on infra-red light absorbed by ice, by water, and by heavy water dissolved in an organic liquid (dioxane) bring additional support, according to C. H. Cartwright, for a quasi-crystalline structure of water. The evidence favours a hindered translational frequency of D<sub>2</sub>O or H<sub>2</sub>O molecules, together with a turning of the four molecules surrounding the central vibrating molecule.

From a formula derived by Raman and Krishnan, relating optical and electro-magnetic properties of substances with molecular behaviour, Dr. R. J. W. Le Fèvre deduces that the polarisation of most substances in solution (as shown by the effect on the dielectric constant) should be less than in the vapour state; only those with a negative Kerr (magneto-optic) constant would show greater polarisation when dissolved than in the gaseous state.

Dr. I. W. Wark and Alwyn B. Cox describe instances of drops, apparently with contaminated surface, coalescing in several stages; they consider that the phenomena would repay study by means of a high-speed cinematograph.

Many British statisticians, Mr. H. J. Buchanan-Wollaston writes, assume that a test may be used simultaneously to show the untruth of one hypothesis and the truth of the reverse hypothesis. The reasoning employed, though often giving useful results, is open to objection and has apparently led to mistrust of these methods on the part of Continental statisticians.

The blue colour given by fish liver oils with antimony trichloride in chloroform solution has been used by Carr and Price as a rough indication of the

amount of vitamin A, though it is also produced by other constituents of the oils. A. Emmerie shows how the colour reaction is affected by saponification of the oils and describes a method used to obtain in concentrated form the constituents responsible for the Carr and Price reaction.

Dr. H. Laser describes how the respiration of the retina tissue of rats, and of mouse-cancer tissue, differs in phosphate and in bicarbonate media. Small amounts of hydrocyanic acid inhibit the respiration of retina tissue in presence of phosphates, but do not affect it in bicarbonate solution.

Chemical investigation of glycogen obtained from fish liver indicates that its molecule contains 12 glucose units and, according to Dr. David J. Bell, is identical with the glycogen obtained from the liver of rabbits.

Dr. V. Korenchevsky finds that, by the injection of a derivative of male sex hormone (androsterone) into female rats from which the ovaries have been removed, certain vestigial organs (periurethral glands) are stimulated to develop into a structure typical of the ventral lobe of the prostate of the male. He suggests that the two organs are homologous in the male and female.

Depigmentation in young rats described by Dr. F. J. Gorter is prevented or cured by addition of copper to the diet. He finds that the dosages required vary considerably in consequence of the availability of the copper fed to the rats and of certain dietary factors, which are always present to some degree in well-balanced rations and counteract the copper.

Vitamin C (ascorbic acid) appears to be a constituent of every living cell, according to experiments by Dr. Geoffrey Bourne and Russell Allen. Using acetic acid-silver nitrate reagent, which gives a black stain with vitamin C, they find small black granules scattered in the protoplasm in the cells of even the lowest organisms.

Further light on the plural nature of vitamin B is thrown by experiments, briefly reported by Prof. Albert G. Hogan and Luther R. Richardson, showing that alcoholic extract of rice, wheat germ oil and flavines, differ in their ability to cure dietary deficiency diseases in rats.

Dr. Susan Finnegan recalls the unique collection of 317 specimens of the rare African arachnid *Cryptostemma sjöstedti* presented to the British Museum by Mr. I. T. Sanderson and directs the attention of suitably placed collectors to the need of further specimens representing the thirteen living species of the order Podogona.

## Research Items

### Eskimo Migrations

THE bearing of recent researches on the vexed problem of Eskimo migration and cultures is discussed by Dr. T. Mathiassen in an article in the *Geographical Review* of July. He regards the Thule culture as originating in Asia and representative of the first Eskimo migration from west to east across Arctic America and into Greenland by Smith Sound. The Bering Sea culture of St. Lawrence Island he believes to be older than the Thule culture, and puts the Eskimo settlement of Alaska much further back than was previously assumed. Dr. Mathiassen disagrees with Mr. Birket-Smith's theory of the first peopling of Alaska from the east by Palæo-Eskimo who were derived from the primordial Eskimo on the Barren Grounds of Canada. The Caribou Eskimo are not the last survivors of these primordial Eskimo whose descendants adopted a sea culture, but rather a residual offshoot of a coastal people. The Cape Dorset culture of Labrador and the eastern shores of Hudson Bay, described by D. Jenness, would seem to be derived from the Thule culture and not from the Caribou Eskimo, but the question arises whether the people who left this culture in Labrador were not Indians rather than Eskimo.

### Mixtec Indian Manuscript

MISS EMMA REH, the Washington archæologist, whose recent investigations of Mexican antiquities have aroused considerable interest, has brought to light a Mixtec manuscript, which holds out the prospect of an interpretation of the Mixtec system of picture-writing. The manuscript is now in the National Museum, Mexico City. It came originally from the State of Oaxaca in southern Mexico. According to a report issued by Science Service, Washington, D.C., it is of deerskin and is in the form of eleven folds or pleats, reading from back to front. The contents are in black and consist of pictures, glyphs and writing in the European script, the last-named feature, obviously, giving the manuscript its special value, as it is hoped that it may thereby be possible to effect a translation of the writing in pictures and glyphs. The picture-writing suggests that the manuscript is a family chronicle of a chiefly house. It opens with a picture of three figures, who evidently, to judge by their dress, are of high rank. Their names are indicated as "Two Alligator", "Four Deer" and "Nine Dog". The story begins in the Indian year "Three House" and on the second page the date 1300 appears in European figures. Up to the eighth page the names are given in hieroglyph, but on the ninth page, Spanish names, and even Spanish clothes, appear as well as the Christian cross. This change is dated 1610, and may coincide with the adoption of the Spanish honorific 'Don' and 'Doña', a privilege granted to the Indians by the Spanish crown. The record ends in 1684. It has been suggested that it may be something in the nature of a "proof of nobility", or a document similar in purpose to the 'maps' or agreements defining boundaries, some of which are known still to be in use in Oaxaca. They are never seen by any but the Indian elders.

### Marquesan Shell Coronet

A PECULIAR type of head-dress from the Marquesas Islands has been presented to the British Museum by the Christy Trustees (*Brit. Mus. Quart.*, 9, 4). It resembles a coronet, and is composed of thin plaques of conch-shell and turtle-shell arranged alternately. These are attached by threads of coconut fibre to a 'woven' band of the same material. The shell plaques are left plain, but those of turtle-shell are ornamented with figures carved in low relief in the conventional style typical of Marquesan art. The main design consists in each case of a central full-faced figure, flanked by two smaller inward-facing figures in profile. Originally there should probably have been three rows of pearl-shell discs with turtle-shell rosettes attached as an additional ornament to the surface of the sennet band. These head-dresses (*paekaha*) were formerly worn on festive occasions by both sexes. Their manufacture probably originated in Fatu Hiva in the southern islands of the group. The coronets were worn in historic times with the sennet band uppermost, so that the shell plaques formed a kind of eye-shade. The carved figures were thus worn the wrong way up, which suggests that the original method of wearing was the reverse. Good early examples are difficult to obtain, and this is the first complete specimen to appear in the Museum collections. The modern degenerate version of the coronet has celluloid or vulcanised rubber in substitution for the turtle-shell, and porcelain buttons for the pearl-shell discs.

### Daylight and the Feeding of Birds

THE relationship between the coming and departing of daylight and the feeding of some common birds has been discussed by George Marples (*British Birds*, 29, p. 45, July 1935). He shows that the habit is a tolerably regular one, and that amongst the birds which begin to feed before sunrise (the time antecedent sunrise by from 42 minutes to 5 minutes) are the song-thrush, mistle-thrush, redbreast, barn-owl, backbird, wren, blue tit, great-tit, chaffinch, house-sparrow; while such as begin to feed after sunrise include only the goldfinch, coal-tit and spotted flycatcher. A regular cessation of feeding in relation to sunset was also observed. A peculiarity brought out by comparison of the times recorded is, that almost invariably blue-tits commence to feed before great-tits and finish feeding later, notwithstanding that they eat the same sort of food and the great-tit has a larger body to nourish.

### Crustacea of Porto Rico and the Virgin Islands

Two important papers have recently been published by the New York Academy of Sciences on the "Scientific Survey of Porto Rico and the Virgin Islands"; these deal with the Crustacea Macrura and Anomura by Waldo L. Schmitt, and the amphipods by Clarence R. Shoemaker (New York, Jan. 1935). An endeavour is made in both papers to include every species known from these two regions including St. Croix, and a brief description of generic or specific characters is given in most cases. When many species represent a genus,

useful keys are employed and at least one species of each genus is figured. 142 species, 68 genera and 24 families of macruran and anomuran Crustacea are listed, a very large number of these having been collected by the expedition, which only undertook shore and shallow-water marine and fresh-water collecting. The amphipods are not so well known; fourteen families, twenty-one genera and twenty-four species are recorded. A revision of the genus *Emerita* with a new species (the only one found in Porto Rico) has resulted in Dr. Schmitt recognising seven species, four of which are found on the Atlantic coast of America, and two on the Pacific coast, whilst he finds that the Indo-Pacific form known as *Emerita asiatica* was first named by Linnæus as *Cancer emerita*, and should now be called *Emerita emerita*.

#### North American Callianassas

DR. WALDO L. SCHMIDT, in his paper "Mud Shrimps of the Atlantic Coast of North America" (Smithsonian Miscellaneous Collections, 93, No. 2, 1935), describes three new species of *Callianassa* and a new variety of one of them, proposes a new name for a specimen that had been assigned to an old, inadequately described species, and gives a general survey of all species occurring on the Atlantic coast of North America, with a useful key. One of the new species, *Callianassa (Callichirus) islagrande*, somewhat resembles *C. major*, Say, but differs in the eye stalks, telson and the remarkably elongate larger chela of the male. The genus *Glypturus*, as de Man has already suggested, is shown to be so similar to *Callianassa* that the present author now no longer separates it, placing *Glypturus acanthochirus*, Stimpson, in the sub-genus *Callichirus*, which shows a number of species having the third maxillipeds approaching the *Glypturus* type, the generic characters being based on these appendages. The paper is illustrated with photographic plates showing the dorsal front view of the various species and some of the more important limbs.

#### Marine Worms from Hawaii

IN Bulletin 129, Bernice P. Bishop Museum, Honolulu, 1935, M. Holly describes a collection of polychætes most of which are pelagic forms of *Nereis* captured on the surface of the sea, especially by night. All the nereids except one known species are represented by epitokous forms, all of relatively small size—3–20 mm. long—which are placed in ten new species. A detailed account of their characters is given. In *Occasional Papers*, 10, No. 18; 1934, from the same Museum is a brief note by Prof. W. R. Coe on new nemertean worms from Hawaii, in which he points out that the tropical and subtropical coasts bordering the Pacific Ocean have a sparse representation of nemertines as compared with the coasts of more northern latitudes. The specimens here described, collected in the intertidal zone, include three species of the genus *Baseodiscus*, one of which is described as new. In two of the species some of the efferent ducts of the nephridia lead to the cavity of the foregut and others open on the dorso-lateral surfaces of the body.

#### Aquatic Hemiptera of the Family Helotrephidae

THE family Helotrephidae is one of obscure affinities and shows the very exceptional character, among adult insects, of the head and thorax being closely fused together. Mr. W. E. China has published an

important paper wherein some new or little-known species are described and figured (*Ann. Mag. Nat. Hist.*, June, pp. 593–614). At the same time the taxonomy of the family is reviewed, and stress is laid upon those characters which are of special generic and specific value. These features are listed, and will serve as a guide to future workers, and so avoid the use of lengthy, detailed descriptions which may include the enumeration of characters devoid of real diagnostic value. The paper concludes with a key to the known genera and species. This small and peculiar family, it may be added, is only known from the Orient and Central Africa.

#### A Disease of Coniferous Trees

EXOTIC conifers have been imported into New Zealand for half a century. They have been acclimatised, and have usually formed healthy forests of valuable timber trees. It is scarcely a matter of wonder that one or two fungus diseases have also been imported inadvertently, but these have largely been controlled by avoiding unsuitable sites and high altitudes. A rather more severe disease made its appearance in 1929, and has been studied in detail by Mr. T. T. C. Birch ("A Phomopsis Disease of Conifers in New Zealand". N.Z. State Forest Service Bulletin No. 7. Govt. Printer, Wellington, N.Z. 1s. 9d. net. Pp. 30. 1935). The causal fungus, *Phomopsis strobil*, produces a canker upon the stems and makes the terminal shoots wilt. Young trees of *Pinus radiata*, *P. muricata* and *P. canariensis* are the hosts, but infection only occurs in late winter when unseasonable frosts overlap the growing season of the susceptible species. Cultural and morphological characters of the fungus have been investigated, and conditions of infection have been demonstrated by extensive experiment. Eighteen half-tone illustrations elucidate the structure of the fungus and portray the symptoms it produces.

#### Pests and Diseases of Sugar-Beet

THE Ministry of Agriculture and Fisheries has added another volume to its series of monograph bulletins on plant diseases ("Pests and Diseases of the Sugar Beet", Bulletin No. 93, pp. 58, April 1935, 1s. 6d. net. H.M. Stationery Office). The insect and other pests have been described by Mr. F. R. Petherbridge, whilst the fungus and virus diseases are treated by Mr. H. H. Stirrup. These two workers made an extensive tour of the chief sugar-beet growing areas in most of the countries of central and northern Europe, and the bulletin describes the information they collected. Most of the Continental pests are also troublesome in Great Britain, but the beet leaf bug (*Piesma quadrata*), the meadow moth or webworm (*Loxostege sticticalis*), sugar-beet weevils (*Bothynoderes* sp. and *Otiorrhynchus ligustici*) and the beet eelworm (*Heterodera schachtii*) have not yet appeared here. The virus diseases known as 'yellows' and 'crinkle' also seem to be mainly of Continental occurrence. An exhaustive list of English diseases and pests is given, each malady being described in detail. One of the most pleasing features of the volume is the publicity given to various Continental methods of control. English readers will be interested in a machine furnished with four rotary brushes which gently remove the eggs of the beet fly (*Pegomyia betae*) from their intended victims. Twenty-six half-tone illustrations help to render the bulletin an attractive and clear exposition of the subject.

### The Photographic Objective

AN interesting account of the development of the photographic lens was given recently as an address to the Physical Society by W. Taylor and H. W. Lee (*Proc. Phys. Soc.*, May). The ordinary photographic lens has employed exclusively spherical surfaces, and successive improvements have removed one after another of the aberrations. The article describes the achromatic doublet, Lister's combination of doublets to correct coma, the Wollaston meniscus construction to correct astigmatism, and the combination of meniscus lenses to correct distortion. It next became necessary to increase the aperture of the lens, and the Petzval portrait lens appeared, followed by the 'rapid rectilinear' and the anastigmats using the new Jena glasses. H. D. Taylor in 1893 broke away from the traditional line of development and introduced an anastigmat with only three lens elements. Modern lenses are descended either from the Jena anastigmats, the Petzval lens or the H. D. Taylor lens. Diagrams of a number of modern lenses are given, including the Zeiss  $f/0.85$  lens (derived from the Petzval), various British lenses working up to  $f/1$ , and special variable focus and telephoto lenses. There is a list of references to patents.

### Molecular Polarisation in Solution

IT is now known that the dipole moment of a substance measured in solution is influenced by the nature of the solvent, and some empirical rules have been proposed with the object of correcting for the solvent effect. By the examination of a number of experimental results, R. J. W. Le Fèvre (*J. Chem. Soc.*, 773; 1935) concludes that the expression  ${}_0P_1/{}_0P_2 = K(\epsilon_2 + 2)/(\epsilon_1 + 2)$ , where  ${}_0P_1$  and  ${}_0P_2$  are the orientation polarisations of a solute molecule in two media of dielectric constants  $\epsilon_1$  and  $\epsilon_2$  respectively, appears to be valid over a wide range of  $\epsilon$  values. It satisfactorily includes the polar solvents chloroform, aniline and chlorobenzene, whilst a rule previously given by Jenkins that the total polarisation is inversely proportional to  $\epsilon$  fails in this respect. A rule proposed by Müller, that  ${}_0P_{\text{soln.}}/{}_0P_{\text{gas}} = 1 - k(\epsilon - 1)^2$ , is found to hold only for solvents of low dielectric constant, for which  $k = 0.075$ ; it fails for chloroform ( $k = 0.032$ ) and chlorobenzene ( $k = 0.035$ ). The recorded data show that a non-polar solute has much the same molecular polarisation in all solvents: only polar solutes exhibit appreciable alterations. Since the sum of the atomic and electronic polarisations of a substance is usually practically independent of its state of aggregation, these differences are wholly referable to the orientation polarisation, the variations of which are now shown to be simply related to the dielectric constant of the medium (see also p. 181 of this issue).

### Action of Calcium Carbide on Methyl Alcohol

STATEMENTS occur in chemical literature to the effect that, when free from water, alcohols do not react with calcium carbide. So far as methyl alcohol is concerned, this seems to be erroneous. The results of experiments by Prof. A. Contardi and Dr. B. Ciocca (*Rend. R. Ist. Lombardo Sci. e Lett.*, 68, parts 1-5) show that absolute methyl alcohol acts readily on powdered calcium carbide. The reaction begins even at the ordinary temperature and gives rise to calcium methoxide and acetylene, no homologues of which are formed. It is, therefore, evident that the determination of water in mixtures of hydro-

carbons and alcohols by measuring the acetylene formed by their interaction with calcium carbide will not give trustworthy results unless methyl alcohol is absent. The reaction described furnishes a simple means of obtaining calcium methoxide, the preparation of which is otherwise a laborious operation.

### Carob Flour as a Foodstuff

IN parts 1-5 of vol. 68 (1935) of the *Rendiconti of the Reale Istituto Lombardo di Scienze e Lettere*, Prof. Adriano Valenti, of the University of Milan, gives the results of experiments in which rats and dogs were fed with carob germ flour, either raw or roasted, and in some cases boiled with water. The flour, prepared by grinding finely the germs of the carob seeds, has a sweetish taste and adheres to the palate like a gummy material. Its percentage composition was found to be: water, 8.95; proteins, 55.30; fats, 5.21; lecithin, 1.34; ash, 6.70; cellulose, 2.32; carbohydrates, 20.18. It thus appears to be richer in protein than any other food of vegetable origin. The biological experiments show, nevertheless, that it is tolerated perfectly as a food by animals. With none of the rats (26) was any ill-effect observed, and regular increase in weight occurred, particularly with young, growing animals. The rats compared well with those of a second group fed on a diet of bread and milk. Similar results were obtained with two dogs, one of which was fed, first on bread and water, then on the carob flour, and later on bread and water again; with the other dog, part of the bread in the initial and final stages was replaced by horseflesh.

### Lunar Heights and Topography

MESSRS. McMATH, Petrie and Sawyer have developed a new technique for investigating lunar topography at the McMath-Hulbert Observatory of the University of Michigan (*Publications Obs. Mich.*, 6, No. 8). They find that an isolated determination of the height of a lunar peak, derived from a measured shadow length, is of little significance, on account of the rugged nature of the country over which the shadow is passing. The Michigan workers investigate the variation of these relative altitudes with changing shadow lengths, and so determine the topography of the neighbouring peaks and crater walls and secure the average elevation of such points above the surrounding country. Motion picture negatives are used; these are exposed in a modified motion picture camera attached to the 10½ in. Cassegrain reflector. A typical set of exposure times runs from 24.0 sec. to 17.9 sec. with an interval of 4.0 sec. between exposures. After development, the negative is run through a projector which magnifies the picture to a scale of 1.15 mm. per second of arc on the moon. A profile of a section through the crater Theophilus is given by the authors. The outer ramparts are 15,000 ft. and 14,000 ft. and the central peak 7,500 ft. above the adopted datum level, below which the floor of the crater sinks 1,000 ft. in places. This section through the crater is 65 miles from rampart to rampart. The uncertainty is given as being  $\pm 125$  ft. for the elevation of a peak 16,000 ft. above the average of the terrain in its vicinity.

ERRATUM: Referring to the paragraph entitled "Sex and Cultural Status" in NATURE of July 27, p. 149, Dr. J. D. Unwin informs us that the word "zoostic" should read "zoistic" throughout.



## The Origin of Optical Rotatory Power

By Prof. T. M. Lowry, C.B.E., F.R.S.

PROF. MAX BORN'S paper on the "Theory of Optical Rotatory Power", which was read at the Royal Society on February 7 and is published in the *Proceedings* for May 1, 1935, is of first class interest and importance, since it provides an adequate solution of one of the most difficult problems in optics.

More than a century ago, Fresnel suggested that optical rotatory power was caused by the unequal velocities of transmission of circularly polarised light of opposite signs; and by a brilliant piece of experimental work he established the real existence of *circular double refraction* in quartz; but his tentative suggestion that the optical rotation of rock crystal "cannot be reconciled with complete parallelism of the molecular lines", and must therefore depend on a spiral arrangement of these layers, cannot be extended to optically active liquids. It was therefore left to Pasteur to recognise in the phenomenon of *dissymmetry* (that is, the inability of a figure to be superposed on its image in a mirror) the characteristic feature of right-handedness and left-handedness, which determines the existence of optical rotatory power in crystals and in liquids, and finds its simplest expression either in a spiral or screw-like structure or alternatively in an irregular tetrahedron.

Equations expressing the influence of wave-length on rotatory dispersion were developed in 1900 by Drude; but these were based primarily on an intuitive recognition of the correct mathematical form of the equations; and, although Drude pointed out that "a dissymmetrically isotropic medium would result if all the molecules were irregular tetrahedra of the same kind", he made no attempt to prove that his conception of *ions vibrating in helical paths* would actually give rise to optical rotation. So recently as 1916, therefore, Gray was justified in complaining that the chemical and physical theories of optical rotatory power "have not been tied together; it has not been shown why the asymmetric molecule should give rise to these particular equations".

The missing link was supplied in 1915 by Born's theory of *coupled vibrators*. The form of *coupling* suggested by Born is of the simplest and most inevitable character, and has been adopted almost universally by subsequent workers in the same field. It is merely an application of the phenomenon of electrical resonance, and implies that, when an electrically charged particle is set in vibration, for example, by an incident light-wave, it sends out a secondary wave, which acts upon neighbouring particles in just the same way as the original light-wave. The difficulty of the problem of optical rotatory power arises from the fact that rotation of the plane of polarised light is a *third-order effect* which does not appear until *four* particles have taken part in this process of resonance. No rotation is therefore produced until the original vibration has been handed on from *A* to *B*, *C* and *D*; and even then the effect is a precarious one, which vanishes if the four particles lie in the same plane, or if in any other manner a plane or centre of symmetry is created,

for example, by making two of the particles identical. In these circumstances the calculation of optical rotatory power proved to be such a formidable task that it was only attempted twice in a period of twenty years; and even then one of these laborious calculations of the rotatory power of a *crystal* was vitiated by a numerical error, which has not yet been put right.

The four coupled vibrators of Born's theory obviously correspond closely with the four dissimilar radicals which give rise to optical rotatory power in the simplest optically active molecules, namely, those molecules which contain an asymmetric carbon atom of the type *CR'R''R'''*; but the calculations of the rotatory power of an asymmetric *molecule* on the basis of Born's theory are so difficult that they have never even been attempted. Two attempts have been made, however, to simplify this extremely complex problem. Thus S. F. Boys, by ignoring the characteristic frequencies of the vibrators, was able to calculate the rotatory powers of four simple alcohols and amines, from the radii and the refractivities of the radicals; and values of these quantities were

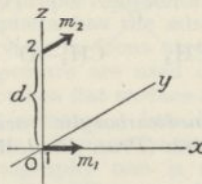


FIG. 1.\* Kuhn's simplified model of a dissymmetric molecule.

found which, when inserted in an extremely complex function of the linear dimensions of the molecule, and multiplied by a simple product of the refractivities and other appropriate constants, gave a remarkable concordance between the observed and calculated specific rotations. On the other hand, Werner Kuhn, in 1929, applied Born's theory of coupling to a simplified molecular model consisting of two *linear vibrators*, moving at right angles to one another (Fig. 1). Optical rotatory power then occurs as a *first order effect* and can therefore be expressed by much simpler formulæ. He showed that his model gave the formulæ for rotatory dispersion which had already been developed by Drude and Natanson, and that these formulæ then had a self-consistent basis, whereas the spiral vibrators, which Drude suggested as a justification of his formulæ, do not actually give rise to any rotatory power at all.

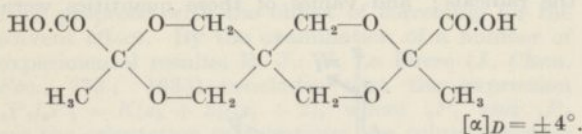
The postulate of a linear vibrator implies that the ellipsoid of elasticity is reduced to a straight line, so that the particle is able to move to and fro in one given direction, but is so rigidly confined to this linear path that no polarising force, however powerful, is able to make it move in any other direction. Such a conception differs very widely from the relatively flexible electronic systems which are found in chemical

\* Figs. 1, 2 and 3 are reproduced by courtesy of Messrs. Longmans, Green and Co., Ltd., from Lowry's "Optical Rotatory Power" (1935).

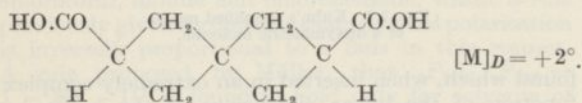
molecules. It is perhaps approached rather remotely in substances like benzoquinone, the crystals of which contain giant molecules of indefinite extension in one dimension, along which they exhibit abnormally high refractivities; but substances like amyl alcohol give no hint of any similar strong anisotropy. Moreover, the presence of *four* dissimilar radicals appears to call inexorably for a system of *four* vibrators; and calculations based upon a model containing only *two* vibrators can only have a remote relation to the properties of real molecules of this type. Whilst, therefore, Kuhn's simplified model has provided a new basis for the dispersion formulae of Drude and Natanson, it does not appear to be capable of direct application to the asymmetric carbon atom, the rotatory power of which must still be treated as a third-order effect in accordance with the original conceptions of Born.

More favourable conditions occur in certain spiro-compounds, which are not asymmetric (since they possess a two-fold axis of symmetry) and do not contain an asymmetric carbon atom, but which can nevertheless be prepared in optically active forms, since they possess the essential property of molecular dissymmetry, that is, the molecule can exist in two mirror image forms which are not superposable on one another. Three such molecules have been studied in this connexion.

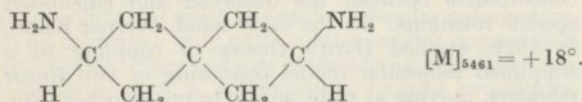
I. *Erythritoldipyrvic acid*, resolved by Boeseken and Felix (*Ber.*, 56, 1855; 1928).



II. *Spiroheptanedicarboxylic acid*, resolved by Backer and Schurink (*Proc. Akad. Wiss., Amsterdam*, 31, 370; 1928).



III. *Diaminospiroheptane* resolved by Pope and Jansen.



In each of these compounds the two halves of the molecules are crossed, that is, if the right-hand ring is in the plane of the paper, the left-hand ring is in a plane at right angles to it, since the central carbon atom has a tetrahedral and not a planar configuration. The planes which contain the terminal radicals COOH and CH<sub>3</sub>, COOH and H, or NH<sub>2</sub> and H, are therefore also at right angles to one another. These two rectangular planes can be compared with the directions of the two linear vibrators in Kuhn's original model, and on this basis he has made a detailed study of Boeseken's spiro-acid I. For this purpose he has considered the two —CO.OH groups as linear vibrators, displaced from the central axis of the molecule in directions at right angles to one another (Fig. 2), and has thus been able to calculate the rotatory power of the molecule.

This figure has the demerit of dealing with only one of the two radicals in the system CH<sub>3</sub>—C—CO.OH, the 'crossing' of which produces the dissymmetry of the molecule. Born, on the other hand, has deduced a formula for the rotatory power of a system of four vibrators, *A, B, A, B* (Fig. 3), in which *both* radicals play a part and neither of them need be assumed to be strongly anisotropic. This formula has been applied to the spiro base of Pope and Jansen, where there are good reasons for thinking that spacial dissymmetry, and not the anisotropy of the H and

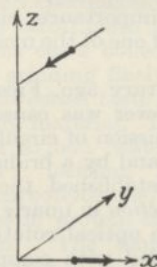
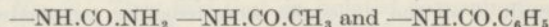


FIG. 2. Coupled vibrators in a dextrorotatory molecule.

NH<sub>2</sub> radicals, is the principal factor in producing the optical rotatory power of the molecule. Results of the right order of magnitude have been obtained; but these are merely guesses, and the principal importance of the formula lies in its application to the *relative* magnitudes of the rotatory power of related compounds, rather than in attempts to predict the *absolute* rotatory power of any of them. The latter must always be difficult, since the formula involves the *eighth power* of the distance between the two vibrators, the *sixth power* of their frequencies and the *square* of the strengths of their absorption bands. On the other hand, if we compare a series of spiro-compounds containing, for example, the radicals



we can now recognise that their rotatory powers are definite functions of three well-defined properties of

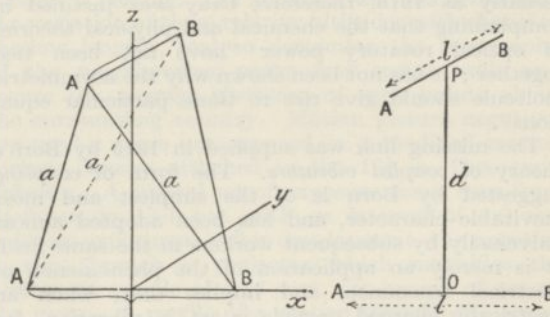


FIG. 3. Born's molecular model.

the radical, and their correlation becomes an experimental problem of very great interest. Unfortunately, the frequencies of the simplest compounds lie in the Schumann region, for which very few data are yet available; but no great increase of complexity is needed in order to bring the frequencies within the range of easier experimental observation; and, on the other hand, the Schumann region is rapidly being opened up to research, so that progress on the lines suggested by Born's theoretical work need not be long delayed.

## A Note on Stereoscopic Photography

By Dr. John R. Baker, Department of Zoology and Comparative Anatomy, Oxford

IT is sometimes stated that in the stereoscopic photography of near objects it makes no difference at all to the images whether the cameras are placed parallel to one another, or convergent upon the object.

In Fig. 1 the object to be photographed has three distinct points upon it,  $A$ ,  $B$  and  $C$ . The thick black

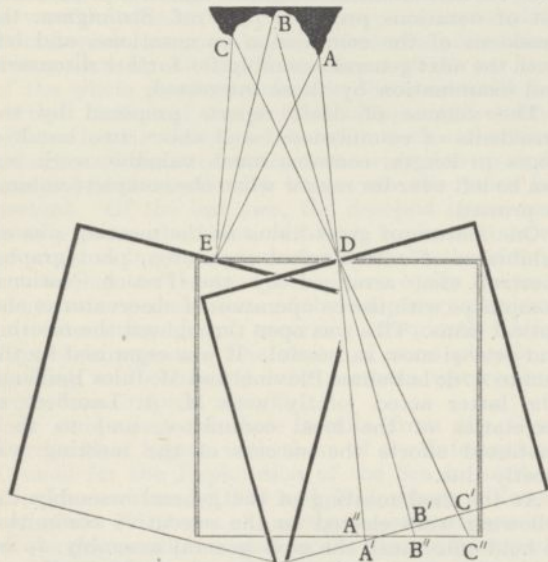


FIG. 1.

lines indicate the outlines of the camera in its two positions for obtaining convergent views of the object. (The angle of convergence shown in Fig. 1 is purposely made greater than the greatest angle of convergence possible with normal vision, so as to exaggerate the point that is to be made.) An exactly similar camera is also shown in the position it would occupy for the right-eye view, if photographs were

going to be taken with parallel cameras. The outline of this camera is indicated by dots between lines. For the sake of simplicity pin-hole cameras are represented. The apertures of both pairs of cameras are at  $D$  for the right-eye view and at  $E$  for the left-eye view.

The right-eye convergent camera produces images of the points  $A$ ,  $B$  and  $C$  at  $A'$ ,  $B'$  and  $C'$ . The right-eye parallel camera produces the images at  $A''$ ,  $B''$  and  $C''$ . Now  $A'B'$  exactly equals  $B'C'$ , while  $A''B''$  is less than  $B''C''$ . Therefore the view obtained with the convergent camera is not the same as that obtained with the parallel camera.

Which is the proper position of the camera for the representation of normal binocular vision as closely as possible? Imagine an eye situated at  $D$ . The owner of the eye would notice that the angle subtended between  $A$  and  $B$  was exactly equal to the angle subtended between  $B$  and  $C$ . In making an accurate drawing of the appearance of the object from his viewpoint, he would therefore make  $AB$  exactly equal to  $BC$  on his sheet of paper. This is what the convergent camera does. The convergent camera therefore gives the proper representation of the object.

The parallel camera has the advantage of giving a larger field of view in focus at the same time, if lenses of wide aperture are used and if the object presents a more or less flat surface at right angles to the axis of the cameras; but its image is not absolutely accurate. It must be remembered that in stereoscopic photography one is relying for one's effects upon minute differences between the two prints, and extreme accuracy is therefore important if a truthful appearance is to be given.

The facts stated in this note give support to the tilting-stage method of stereo-photomicrography, for in this method the two views are convergent. The other method, in which the object is photographed first at one side of the field of view and then at the other, and the two photographs treated as a stereoscopic pair, is equivalent to the use of parallel cameras.

## International Co-operation in Astronomy

THE International Astronomical Union held its fifth general assembly at Paris on July 10-17, at the Centre Marcellin Berthelot, when nearly three hundred astronomers were gathered together from twenty-seven different countries. The President of the French Republic was present at the opening ceremony, when addresses of welcome were given by the Minister of Public Instruction, the president of the French National Committee of Astronomy (M. de la Baume Pluvinel), the director of the Paris Observatory (M. Esclanon) and replied to by the president of the Union, Prof. F. Schlesinger. During the meeting the admission of three new countries,

U.S.S.R., China and Yugoslavia, was announced; with the growing number of countries supporting the Union it was found possible substantially to reduce the unit of subscription from the different countries, without hindering the work which the Union has already undertaken to support.

A great part of the value of the meeting lies in the informal discussions between small groups which were possible at some of the social gatherings organised by the generously hospitable French hosts, such as the visits to the observatories at Meudon and Paris. But the work of the Union is done mainly at the meetings of thirty-one committees which

examine schemes of co-operative work in the different branches of astronomy. One of the features of the present meeting was the number of joint meetings of commissions, which after dealing with their own special work, discussed jointly borderline problems where their common interests were concerned. Thus the commissions on ephemerides, meridian astronomy, and the movements and positions of planets, asteroids and satellites combined to discuss and press for further experimental work—to be followed later by international co-operation schemes for the determination of systematic corrections to star positions from observations of minor planets. To the commissions on notations and ephemerides were referred two resolutions on the symbols at present in use for time, which had been sent in by two national committees on astronomy. They recommended, and the Union adopted their point of view, that the symbol G.C.T. for Greenwich mean time reckoned from midnight should be dropped and that the symbol U.T. (Universal Time) should be used instead.

A move of the Bureau of Latitude Variation from Mizusawa to Naples on the coming retirement of Dr. Kimura was decided upon. Special tributes were paid to Kimura's work and he was made a *Président d'Honneur* of the commission on latitude, a similar compliment being paid to Sir Frank Dyson by the commission on meridian astronomy. The commission on spectrophotometry directed attention to the fundamental importance of producing photographic plates of uniform sensitivity over the surface, and urged further work on this point at the research laboratories of the various plate manufacturers. The physical study of comets was removed from the commission on planets and satellites, and in a general rearrangement of subjects the zodiacal light, the night sky and related subjects were grouped with meteoric astronomy, while novæ were given a special sub-commission in the commission on stellar spectra. The commission on lunar nomenclature, which has completed its work and published a map of the moon with a list of lunar formations, has been replaced by a new commission on the moon to deal also with occultations and physical researches.

Among the resolutions adopted on the recommendations of the committee on stellar statistics we may mention a definite choice of the galactic pole at  $\alpha = 12^{\text{h}}40^{\text{m}}$ ,  $\delta = +28^{\circ}$  (1900.0), the position used in Ohlsson's tables of galactic co-ordinates. In solar physics resolutions were adopted for co-operative work on line profiles, for the publication of characteristic solar numbers of the sun separately for the four quadrants, N.E., N.W., S.E. and S.W., and for observations of active prominences at short intervals by a number of different methods. A number of technical resolutions on star positions cannot very well be given here but mention may be made of a resolution to issue a supplementary list of observatories and astronomers, of alterations in the cipher code for astronomical telegrams and of a preliminary list of notations prepared by Prof. Strömgren, the president of the commission on notations, and left until the next general assembly for further discussion and examination by those interested.

The volume of draft reports prepared by the presidents of commissions, well above two hundred pages in length, contains much valuable work but can be left over for review when the complete volume is printed.

One feature of great value at the meeting was an exhibition of astronomical apparatus, photographs, spectra, etc., arranged by the French National Committee with the co-operation of observatories and optical firms. This was open throughout the meeting and proved most successful. It was organised by the Comte A. de la Baume Pluvinel and M. Jules Baillaud. The latter acted jointly with M. A. Lambert as secretaries of the local committee, and to their unstinted efforts the success of the meeting was mostly due.

At the final meeting of the general assembly the following were elected as the executive committee to hold office until the next general assembly, to be held at Stockholm in 1938: *President*: M. Esclangon (France); *Vice-Presidents*: Dr. Adams (U.S.A.), Prof. Banachiewicz (Poland), Prof. Bergstrand (Sweden), Prof. Bianchi (Italy) and Dr. Spencer Jones (Great Britain); *General Secretary*: Dr. Oort (Netherlands).

## Zooplankton of the Great Barrier Reef

A NOTABLE addition to the reports of the Great Barrier Reef Expedition has recently appeared\*. In the first part the validity of the collecting methods is discussed, the effect of the transparency of the water and the relative abundance and composition of the zooplankton, with a comparison of temporary and holoplanktonic animals. Oblique hauls were made to ensure large enough catches to give significant results, and vertical hauls through a water column of known depth were made to give information directly comparable with data obtained elsewhere. The methods used are shown to be reliable.

\* British Museum (Natural History). Great Barrier Reef Expedition, 1928-29. Scientific Reports, Vol. 2, No. 6: The Zooplankton. (2): The Composition of the Zooplankton of the Barrier Reef Lagoon, by F. S. Russell and J. S. Colman; (3): A Comparison of the Abundance of Zooplankton in the Barrier Reef Lagoon with that of some Regions in Northern European Waters, by F. S. Russell. Pp. 159-201. (London: British Museum (Natural History), 1934.) 7s. 6d.

Curves of the average catches of all animals for each month in the coarse silk net oblique and vertical hauls at a position three miles east of Low Isles in the Barrier Reef Lagoon agree well on the whole. Taking the copepods alone, the agreement is even closer, the month of January being the only one where there is any considerable disagreement, when many more copepods occurred in the vertical hauls. Daylight samples compare with those taken by night in a very similar way to those taken at Plymouth. The transparency of the water, which has already been shown to have a direct connexion with the wind (Orr, Vol. 2, No. 3 of these Reports), has a considerable effect on the numbers of animals caught, the curves of abundance in both oblique and vertical hauls, of copepods, decapod larvæ and chaetognaths following closely the curve of transparency. There seems to be practically no seasonal variation in

numbers of copepods and decapod larvæ although there is one in the chaetognaths.

Copepods, as is the case throughout the world, are the most abundant animals in the plankton. Here they form 71 per cent of the zooplankton in the vertical hauls, and this is supported in the oblique hauls, where they form 69.1 per cent. Other animals of importance were tunicates (Appendicularians and Thaliacea), chaetognaths, molluscs (Pteropoda, Heteropoda and larvæ), echinoderm larvæ (November and December), ostracods (March and July), decapod larvæ and Siphonophora. Sudden increases and certain seasonal changes in echinoderm larvæ, ostracods and salps will be discussed in a later report.

It is estimated that the temporary planktonic animals, consisting of medusæ, coral planulæ, the larvæ of polychætes, cirripedes, decapods, euphausiids, stomatopods, gastropods, lamellibranchs and echinoderms, and larval fish, form about 10-15 per cent of the whole plankton taken in the coarse silk net vertical hauls and coarse mesh oblique and stramin oblique hauls. Gastropod, lamellibranch and echinoderm larvæ (the last restricted to a very short period), decapod and euphausiid larvæ are the most important. Of the last two, the decapod larvæ were usually more abundant, although euphausiid larvæ occurred in large numbers at times. In the stramin net catches the decapod larvæ were easily the most abundant representatives of the temporary plankton, an interesting form occurring frequently being *Leptochela pugnax*. The rarity of coral planulæ is striking, and compared with northern waters there were few cirripede nauplii.

A comparison of these results from the Great Barrier Reef lagoon with those of the International Council for the Exploration of the Sea in northern European waters in 1910 and 1911, where a Nansen net of silk No. 3 was of exactly the same dimensions as the coarse silk net used for the above experiments, is of great interest. Also more recent catches off Plymouth are compared. It was found that the Barrier Reef zooplankton is as rich numerically when averaged over the year as that of the northern regions compared. The great seasonal changes in the latter show much larger increases and decreases in the individual months. Comparisons in volume show that the Barrier Reef samples have more volume but fewer animals, to be accounted for by the greater compactness of the northern plankton.

Temperature must be taken into account in these comparisons, and the much higher rate of metabolism probable in warmer waters; also that there is apparently no surplus plant life at any time as there is in colder seas after diatom outbursts. The hydrographical and weather conditions are such that the diatoms are continually in a state of suspension and do not sink. It seems probable that throughout the year the animal plankton population is the maximum that the plant crop can support and that there is a comparatively rich supply of plankton animals available as food. Is there enough for the huge number of animal eating corals? It would seem that there are fewer plankton-eating fishes than in northern waters, where clupeoids and mackerel prey to such an extent on the animal plankton, and that the bottom life in these regions is poor compared with that in northern waters. Thus more food is available for the plankton-eating invertebrates. The corals are night feeders and there is an enormous plankton life at night in this vicinity. The inference is that the planktonic life is sufficient to support the corals.

## Science News a Century Ago

### The Entomological Society

At a meeting of the Entomological Society held on August 3, 1835, Mr. J. F. Stephens (1792-1852) being in the chair, "Various curious and remarkable insects were exhibited, amongst them the Indian leaf insect (*Phillium siccifolium*) in its different stages, from the collection of Mr. Saunders. A living capricorn beetle was exhibited by Mr. Desvignes, which had been reared in a piece of furniture nearly ten years old. Specimens of the vegetation wasp, horse tick, spider silk, etc., from the island of St. Domingo were exhibited by Mr. Hearne. The chairman also exhibited a specimen of the very rare and singular bee parasite, *Elenchus tenuicornis* Kirby, recently captured by himself, and made some observations on its peculiarities."

"The memoirs read consisted of a note upon the insects found in unrolling a mummy at Belfast, by Mr. Patterson, president of the Natural History Society of that city; an account of the *Poma Sodomitica*, or Dead Sea apples, a production respecting which travellers and botanists have been greatly at issue, but which has lately been ascertained to be a vegetable gall of a very large size, by Walter Elliot, Esq., by whom these productions were discovered growing in Palestine, and who has reared the insects which produce them". (*Athenaeum*.)

### Experiments with the Lime Light

On August 5, 1835, *The Times* gave an account of the experiments with the limelight made on the top of the Colosseum in London by Mr. Alexander Gordon. Gordon employed four jets of oxy-hydrogen gas impinging on a cylinder of lime and an arrangement of lenses which caused the light to pass out in a sheet or fan. "It is a very simple, though excellent invention, and appears capable of being applied to lighthouses and similar buildings with great efficacy. . . ."

### Reappearance of Halley's Comet

No astronomical event of 1835 was looked forward to with greater interest than the reappearance of Halley's comet, last seen in 1759. As early as 1817, its motion and perturbations since 1759 were proposed by the Turin Academy of Sciences as a subject for a prize, which was awarded to Baron Damoiseau. The Paris Academy of Sciences adjudged a similar reward to Pontécoulant in 1829, while Rosenberger's calculations won for him the Gold Medal of the Royal Astronomical Society. The comet was first seen on August 6, 1835, by the astronomers at the Jesuits' College at Rome as "a nearly circular misty object" and it was afterwards watched by astronomers in various countries. The error of Rosenberger's ephemeris was only seven minutes of arc, and the perihelion passage took place on November 16, five days after the predicted time. Owing to its southern declination, it was seen to greatest advantage at the Cape of Good Hope by Maclear and Sir John Herschel, who continued to observe it until May 5, 1836, when it finally ceased to be visible. Reviewing the calculations made regarding the comet, Grant said: "The fidelity with which it responded to the deductions of the geometer on the occasion of its last appearance forms one of the many magnificent triumphs which adorn the history of the Theory of Gravitation".

## The British Association at Dublin

THE Dublin correspondent of *The Times*, writing on August 7, 1835, said: "A considerable number of distinguished literary visitors are already in this city, for the purpose of attending the meetings of the British Association, which commence on Monday. The *William Penn*, from Liverpool, with a great many more, is expected at Kingstown this evening. Many curiosities are looked for during this eventful week in Dublin; but Lord Brougham is expected as the 'great lion'. I am sure his Lordship will feel quite at home in Ireland". Writing again on August 9, the correspondent said: "Up to 5 o'clock yesterday evening the council of the Association was occupied with the admission of members. Mr. Thomas Moore, accompanied by Dr. Lardner, arrived in town yesterday. On Friday evening the *William Penn* reached Kingstown from Liverpool, freighted with scientific visitors amongst whom were Dr. Babbage and Sir John Ross. The same vessel is expected this evening with a similar cargo. There are several foreigners in town as delegates from various parts of the continent. Many are the 'lions' we have already, but alas! Lord Brougham is not to be amongst us, and the lovers of curiosities are mortified accordingly".

## Societies and Academies

## EDINBURGH

Royal Society, July 1. ALAN W. MOZLEY: The freshwater and terrestrial mollusca of Northern Asia: A critical and detailed study of sixty-seven species and sub-species of non-marine mollusca from Siberia, fifty being aquatic and seventeen terrestrial. They are of four categories: (i) those common to Europe and Asia; (ii) those that are circumboreal; (iii) those common to north-east Asia; and (iv) those endemic to Siberia. The various habitats are described. From the point of view of molluscan distribution, four faunal regions are recognised: (i) the great Siberian region; (ii) the Baikal region (this is rich but so peculiar and specialised that it falls outside the scope of the present paper); (iii) the far eastern region; and (iv) the Chuckchee-Kamchatka peninsula. S. M. K. HENDERSON: Ordovician submarine disturbances in the Girvan district. The Ardwell Beds, a series of greywackes of Lower Caradoc age in the Girvan district of Ayrshire, contain intraformational breccias and slip-bedding; grading, with accompanying minor current bedding, is common throughout. The disturbed bands rarely exceed three inches and show an eroded upper surface, especially clear in examples of slipping. In the case of breccias, submarine earthquakes loosened and broke up the sea floor sediment; resultant tsunamis tore up and distributed the debris. Sediments of a more plastic nature slid down submarine slopes. A boulder bed has likewise been attributed to the slipping of sediment down a submarine slope. MARY G. CALDER: Further observations on the genus *Lyginorachis*, Kidston. Three new species of the fossil genus *Lyginorachis* are described, namely, *L. Waltoni*, *L. Brownii* and *L. trinervis*. The specimens are all from rocks of Calciferous Sandstone age in the west of Scotland, *L. Waltoni* being from Arran and *L. Brownii* and *L. trinervis* from the Kilpatrick Hills. Some additional notes are also made on

*Lyginorachis taitiana*, from specimens in the Kidston Collection of Fossil Plant Slides. STEWART MACLAGAN and EDWARD DUNN: The experimental analysis of the growth of an insect-population. Experiments with the rice weevil (*C. oryzae*) have shown that a population of these beetles offers a certain internal resistance to its own growth. This is effected through a decrease in the copulation frequency, fecundity and fertility of the adults, with increasing density; and an increase in larval mortality. The behaviour of the beetles is entirely irrational, the limitation of population growth being brought about by influences which are primarily thigmotropic. So precise is the relationship between the population density and the copulation frequency of the beetles that it can be described by the equation  $Y = aX^b$ , where  $Y$  represents copulation frequency and  $X$  the population density (see also NATURE, Jan. 5, p. 33). T. M. MACROBERT: Some series and integrals involving associated Legendre functions, regarded as functions of their degrees. Legendre functions and products of Legendre functions in finite integrals and series are replaced by the corresponding Mehler-Dirichlet integrals; the resulting formulae are then expressed as Dirichlet integrals, and the limits of these integrals give the values of infinite integrals and series.

## PARIS

Academy of Sciences, June 17 (*C.R.*, 200, 2045-2128). AUGUSTE LUMIÈRE and Mlle. SUZANNE SONNERY: Variations in the leucocyte formula produced by intravenous injections of carbon. CHR. PAUC: The resolution of abstract equations by a method of iteration. FRÉDÉRIC ROGER: The relation between the tangential and metric properties of certain sub-ensembles of Jordan curves. JEAN FAVARD: The polynomials of Tehebiecheff. D. MICHNEVITCH: Functional groups and their applications. GEORGES VRANCEANU: The unitary theory of fields and non-holonomic hypersurfaces. PIERRE VERNOTTE: Sketch of a theory of reactivity. BENJAMIN DE JEKHOWSKY: The number of asteroids and their effective mass. FRANÇOIS LINK: The eclipses of the satellites of Jupiter. D. G. DERVICHIAN: Correction to the constant of Eötvös reducing it to two distinct values. JEAN URBANEK: Form and symmetry of the electromagnetic equations: the equivalence of energy and mass. EMILE SEVIN: The levels of the neutron. PIERRE MESNAGE: The molecular emission spectra of some metallic salts. The spectra produced by the high-frequency discharge without electrodes were studied in the cases of silver chloride, zinc chloride and nickel chloride. RENÉ BERNARD: Production of the Vegard-Kaplan bands by the electronic bombardment of a mixture of argon and nitrogen. The spectrum as a whole showed a striking analogy with that of the night sky, owing to the presence of the Vegard-Kaplan bands. CASIMIR JAUSERAN: The action of aqueous solutions on latent photographic images of different ages. MME. IRÈNE CURIE, HANS VON HALBAN, JR. and PIERRE PREISWERK: The radioactive elements formed during the irradiation of thorium by neutrons. One of the elements produced is an isotope of radium, another is an isotope of protactinium. HENRI MULLER: Hydrofluoric acid. WILFRIED HELLER: The spontaneous formation of definitely arranged aggregates in solids containing non-spherical particles. JULES GUÉRON and MARCEL

PRETTRE: The complexity of the reaction between ozone and potassium iodide. When ozone acts on potassium iodide, two reactions occur simultaneously, one giving iodine, the other iodate. PIERRE CARRÉ and DAVID LIBERMANN: The alkyl- and aryl-sulphinic esters. RENÉ RAMBAUD: The action of sodium ethylate on the  $\gamma$ -halocrotonic esters. JEAN JUNG: The recrystallisation of the diorites and quartz diorites of the Manson (Puy-de-Dôme) plateau under the influence of granite contact metamorphism. STOYAN PAVLOVITCH: The amphibolites of the Zlatibor massif (western Serbia). GEORGES DENIZOT: The tectonic of the massif of Allauch, near Marseilles. GEORGES CORROY: The bases of the Jurassic link of Roquefortcade-Nans to the north-west of Sainte-Baume. GEORGES CLAUZADE: The bases of the link of Roussargue-Liquette, to the west of Sainte-Baume. PAUL DELEAU: The presence of the Lias at Djebel Nador (Department of Oran). JEAN DRESCH: The structure of the Haouz of Marrakech. J. LACOSTE and C. BOIS: Remarks concerning the first movements of the soil during earthquakes affecting some European regions. ADOLPHE LÉPAPE and GEORGES COLANGE: The presence of water vapour and carbon dioxide in the air of the stratosphere. The proportions of moisture and carbon dioxide in the air of the stratosphere, altitude 9-16 kilometres, is unexpectedly high. The carbon dioxide is about double that found at the surface, and the moisture much higher than corresponds to the temperature. CAMILLE ARAMBOURG: Observations on some fossil fishes of the order Halecostomes and on the origin of the Clupeids. MARCEL ABELOOS: The larval diapause and eclosion in the Coleoptera *Timarcha tenebricosa*. JEAN GIAJA and STEFAN GELNEO: The resistance of some homeotherms to low temperatures. Various animals and birds were submitted to temperatures ranging from  $-35^{\circ}\text{C}$ . to  $-160^{\circ}\text{C}$ ., for short periods without injury. A dog after remaining in a chamber for five hours at  $-160^{\circ}\text{C}$ . was uninjured. HENRI BIERRY and BERNARD GOUZON: The fluorescence spectra of hepatoflavin before and after irradiation. ÉTIENNE WOLFF and ALBERT GINGLINGER: The experimental production of intermediate sex forms by the injection of folliculin in the embryo of the fowl. In the embryo of the fowl intersexuality can be regularly obtained by injecting genetically male individuals with folliculin, on condition that the injections be made before the seventh day and the dose about 100 international units. VICTOR PLOUVIER: Contribution to research on amygdonitrileglucoside and amygdaloside in plants. YERVANTE MANOUELIAN: Experimental syphilis. Lymphatic ganglia. Minute forms of *Spirochæta pallida*, syphilitic spirochæto-gen. LEDOUX-LEBARD, LONG and SAGET: Radioscopic examination in a lighted room.

## MELBOURNE

Royal Society of Victoria, May 9. LEO STACH: Victorian Tertiary Catenicellidæ (Bryozoa), (3). This paper concludes a study of the systematics of the Tertiary Catenicellidæ, with a revision of members of the sub-families Catenicellinæ and Ditaxiporinæ. Notes on Scuticellinid gonocæcia, the species incorrectly relegated to Catenicellidæ, and extra-Australian Tertiary species, are appended. A new genus, *Chelidozoum*, of the family Savignyellidæ is erected for *Claviporella vespertilio*, Macgillivray.

## WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 21, 235-299, May 15). H. C. SHERMAN and H. L. CAMPBELL: Rate of growth and length of life. Rats of the same heredity, initially in good health, living in the same environment and subsisting on one or other of two normal diets, both of which were adequate to maintain growth and health although one was better balanced quantitatively, show different rates of growth, those on the better diet growing faster. Growth rate and length of life, however, vary independently of one another. CHARLES E. DECKER: The graptolites of the Simpson group of Oklahoma. VIRGINIA H. RHOADES: The location of a gene for disease resistance in maize. Plants susceptible to physiological form 3 of *Puccinia Sorghi* were pollinated with material from a plant, homogeneous for the dominant factor for resistance, which had been irradiated with X-rays. Irradiation produces a chromosomal deficiency, and in susceptible offspring, the deficiency appeared in the short arm of the tenth and shortest chromosome of the haploid complement. Breeding experiments confirmed this finding. FRANK H. CLARK: Linkage relations in 'Zavadskaiia shaker' in the house mouse (*Mus musculus*). This character is distinct from and is not linked with the characters 'ordinary shaker' and 'waltzing'. Linkage tests suggest that it is located in chromosome 14; and possibly the gene for hydrocephalus lies in the same chromosome. DONALD L. WEBB: Generation of any  $n$ -valued logic by one binary operation. W. E. SEWELL: Generalised derivatives and approximation. MARSTON MORSE and GEORGE B. VAN SCHAAACK: Abstract critical sets. CHARLES N. MOORE: On convergence factors for series summable by Nörlund means. EDWARD V. HUNTINGTON: Effective equality and effective implication in formal logic. S. LEFSCHETZ: A theorem on extremals (1). ALONZO CHURCH: A proof of freedom from contradiction. JENNY E. ROSENTHAL: Intensities of vibration rotation bands. A theoretical discussion in which an exact expression for the probability of any transition  $v' \rightarrow v''$  is derived for the case of a Morse potential function between the nuclei. It gives results in good agreement with experimental values for HCl. G. H. PARKER: What are the resting and the active states of chromatophores? The chromatophore systems of different animals are very differently organised so far as nerves are concerned, but all appear to be subject to neurohumoral control. Experiments on *Fundulus* in which bands across the tail were completely denervated by section of the nerves, showed that the melanophores of these bands were still active. It is concluded that pigment immobility in a melanophore defines the resting state. Brownian movement is greatly reduced in such a state, suggesting that the active and resting phases are characterised by the protoplasm of the melanophore being in the sol and gel states respectively. J. VAN OVERBEEK: The growth hormone and the dwarf type of growth in corn. The dwarf type *nana* differs from the normal race by a single gene. Coleoptiles are equal in length, but the mesocotyl of *nana* is shorter than the normal, due to decreased extension. Less growth substance (auxin) is given off by *nana* than normal corn, and less growth occurs for a given amount of auxin. It is concluded that more auxin is destroyed in *nana*, due to a change in oxidation-reduction properties, thus causing inhibition of growth.

## Forthcoming Events

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

Sunday, August 4

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—  
Miss M. R. J. Edwards: "Seashore Life".\*

WORLD FEDERATION OF EDUCATION ASSOCIATIONS,  
August 10-17. Conference to be held in Oxford.

## Official Publications Received

## Great Britain and Ireland

The Institution of Gas Engineers. Publication No. 105: Education Regulations, 1934 Revision: Regulations for the Education and Certification of those engaged in the Technical Work of the Gas Industry and for the Award of Certificates in Gas Works Practice, Gas Supply Practice and Gas Fitting of the City and Guilds of London Institute. Pp. 84. Publication No. 106: 72nd Annual General Meeting, London, 4th to 7th June 1935; Official Programme. Pp. 16. Publication No. 107: 72nd Annual Report and Accounts of the Council of the Institution of Gas Engineers to be presented at the 72nd Annual General Meeting to be held at the Institution of Civil Engineers, on the 4th, 5th and 6th June 1935. Pp. 40. Publication No. 108: Presidential Address (72nd Annual General Meeting) by Charles Valon Bennett. Pp. 16. Publication No. 109: National Policies governing the Testing of Gas Appliances. By Stephen Lacey and C. A. Masterman. Pp. 44. Publication 110: Problems and Answers in the Reconstruction of Manufacturing and Distribution Plant, Nottingham. By George Dixon. Pp. 80+3 plates. Publication No. 111: The Gas Account. By W. B. McLusky. Pp. 44. Publication No. 112: Development of Gas Sales; Policy and Performance. By Samuel B. Chandler. Pp. 48+6 plates. Publication No. 113: Waste Heat Recovery from Retort Settings. By Major W. Gregson. Pp. 40+1 plate. Publication No. 114: The Preparation, Marketing and Utilization of Coke. By W. L. Boon. Pp. 88+2 plates. (London: Institution of Gas Engineers.)

Observations of Stellar Parallax, Vol. 2. From Photographs taken and measured at the Royal Observatory, Greenwich, under the direction of Sir Frank Dyson. Pp. 158. (London: H.M. Stationery Office.) 12s. net.

Observations made at the Royal Observatory, Greenwich, in the Year 1933, in Astronomy, Magnetism and Meteorology, under the direction of Sir Frank Dyson and Dr. H. Spencer Jones. Pp. viii+A74+B4+Cx+C52+D66+E46+22+4 plates. (London: H.M. Stationery Office.) 22s. 6d. net.

The Economic Proceedings of the Royal Dublin Society. Vol. 2, No. 33: On the Biological Condition of Relaid Oysters, 1935. By Dr. J. H. Orton. Pp. 533-540. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6d.

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1934. Pp. 312+9 plates. (Bristol: The University.)

Apples and Pears: Varieties and Cultivation in 1934. Report of the Conference held by the Royal Horticultural Society at the Crystal Palace, Sept. 19-21, 1934. Edited by F. J. Chittenden. Pp. 1v+216+23 plates. (London: Royal Horticultural Society.) 7s. 6d.

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 25: Reports of the Irish Radium Committee for the Year 1934, including Reports by Oliver Chance, Dr. W. G. Harvey, Oswald J. Murphy. Pp. 231-242. 1s. Vol. 21 (N.S.), No. 26: Note on the Effect of Storage on the Colour and on the Free Fatty Acid Content of a Commercial Sample of Veterinary Cod-Liver Oil. By E. J. Sheehy. Pp. 243-245. 6d. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

The Hannah Dairy Research Institute. Annual Report for the Year ending 31st March 1935. Pp. 16+4 plates. (Kirkhill: Hannah Dairy Research Institute.)

The Medical Research Council: What is it and how it Works. By Norah Dacre Fox. Pp. 12. (London: London and Provincial Anti-Vivisection Society.)

Technical College Buildings: their Planning and Equipment. A Report by a Joint Committee of the Association of Technical Institutions and the Association of Principals of Technical Institutions with Representatives of the Royal Institute of British Architects and the Institute of Builders and a Member of the Staff of the Board of Education. Pp. xii+144+20 plates. (London: Association of Technical Institutions and the Association of Principals of Technical Institutions.) 3s.

## Other Countries

Pasteur Institute of India, Kasauli. The thirty-third Annual Report of the Director of the Institute for the Year 1933, Part 2. Pp. 44. (Kasauli: Pasteur Institute of India.)

Ministério da Educação e Saúde Pública. Anuário, publicado pelo Observatório Nacional do Rio de Janeiro para o Ano de 1935. (Ano 51.) Pp. xiii+460. (Rio de Janeiro: Observatório Nacional.)

Ministério da Educação e Saúde Pública: Observatório Nacional do Rio de Janeiro. Taboas das Marés para o Ano de 1935 nos Portos do Rio de Janeiro, Belém, S. Luiz, Amarracao, Camocim, Fortaleza, Natal, Cabedello, Tambahú, Recife, Aracajú, Bahia, Ilhéos, Victoria, Santos, Paranaguá e Itajahy. Pp. 209. (Rio de Janeiro: Observatório Nacional.)

General Catalogue of Stellar Parallaxes. Compiled at Yale University Observatory by Frank Schlesinger with the collaboration of Louise F. Jenkins. Second edition, containing all Determinations available in January 1935. Pp. x+196. (New Haven, Conn.: Yale University.)

Tenth and Eleventh Reports of the Committee on Contact Catalysis, Division of Chemistry and Chemical Technology. By Guy B. Taylor and Robert E. Burk. (Contribution No. 124 from Experimental Station, E. I. du Pont de Nemours and Co.) Pp. 181. (Washington, D.C.: National Research Council.)

U.S. Department of the Interior: Geological Survey. Bulletin 856: Geology of Big Horn County and the Crow Indian Reservation, Montana; with Special Reference to the Water, Coal, Oil and Gas Resources. By W. T. Thom, Jr., G. M. Hall, C. H. Wegemann and G. F. Moulton. Pp. vii+200+15 plates. 60 cents. Water-Supply Paper 744: Surface Water Supply of the United States, 1933. Part 4: St. Lawrence River Basin. Pp. v+159. 15 cents. Water-Supply Paper 747: Surface Water Supply of the United States, 1933. Part 7: Lower Mississippi River Basin. Pp. v+121. 10 cents. Water-Supply Paper 749: Surface Water Supply of the United States, 1933. Part 9: Colorado River Basin. Pp. v+119. 10 cents. Water-Supply Paper 751: Surface Water Supply of the United States, 1933. Part 11: Pacific Slope Basins in California. Pp. xi+376. 30 cents. Water-Supply Paper 753: Surface Water Supply of the United States, 1933. Part 12: North Pacific Slope Basins. B: Snake River Basin. Pp. vii+197. 15 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 87. Zoological Results of the Third De Schauensee Siamese Expedition. Part 6: Fishes obtained in 1934. By Henry W. Fowler. Pp. 89-163. (Philadelphia: Academy of Natural Sciences.)

Western Australia: Geological Survey. Bulletin No. 95: The Physiography (Geomorphology) of Western Australia. By J. T. Jutson. Second edition, revised. Pp. xvi+366. (Perth: Government Printer.)

Report of the First Scientific Expedition to Manchoukuo under the Leadership of Shigeyasu Tokunaga, June-October 1933. Section 5, Division 1, Part 12, Articles 66, 67: Insects of Jehol (VIII), Order Hymenoptera (II). By Keizō Yasumatsu. Pp. 27+47+11 plates. Section 5, Division 2, Part 3: Birds of Jehol. By Prince N. Takatsukasa, Marquis M. Hachisuka, Dr. N. Kuroda, Marquis Y. Yamashina and S. Uchida. Pp. 91+23 plates. (Tokyo: Waseda University.)

Cornell University: Agricultural Experiment Station. Bulletin 619: Classification and Agricultural Value of New York Soils. By Frank B. Howe. Pp. 83. Bulletin 620: Marketing and Distribution of certain Perishable Farm Products in the Lower Hudson Valley. By W. C. Hopper and C. W. Pierce. Pp. 37. Bulletin 621: Effects of Modifications of the Potato-Spray Program. By E. O. Mader and F. M. Blodgett. Pp. 34. Bulletin 629: The Alfalfa Snout Beetle, *Brachyrhinus linguistica* L. By Charles E. Palm. Pp. 47. Memoir 170: Ecological Problems of the Humus Layer in the Forest. By L. G. Romell. Pp. 28. Memoir 171: A Study of Selected Factors in Family Life as described in Autobiographies. By Mildred B. Thurou. Pp. 52. Memoir 172: Ionic Exchange of Peat Soils. By B. D. Wilson and E. V. Staker. Pp. 13. Memoir 174: Certain Rarer Elements in Soils and Fertilizers, and their Role in Plant Growth. By R. S. Young. Pp. 70. (Ithaca, N.Y.: Cornell University.)

U.S. Department of Agriculture. Circular No. 351: Notes on the Habits of certain Coprophagous Beetles and Methods of Rearing Them. By Arthur W. Lindquist. Pp. 10. 5 cents. Technical Bulletin No. 467: The Crested Myna, or Chinese Starling, in the Pacific Northwest. By Theo. H. Scheffer and Clarence Cottam. Pp. 10. 5 cents. (Washington, D.C.: Government Printing Office.)

Annual Report of the Board of Regents of the Smithsonian Institution: showing the Operations, Expenditures and Condition of the Institution for the Year ending June 30, 1933. (Publication 3260.) Pp. xiv+476+56 plates. (Washington, D.C.: Government Printing Office.) 70 cents.

The Indian Forest Records. Vol. 20, Part 15: Illustrations of Indian Forest Plants. Part 3: *Dipterocarpus macrocarpus* Vesque, by R. N. Parker; *Anisoptera oblonga* Dyer, *Scapula glabra* Parker, *Hopea wightiana* Wall., and *Hopea glabra* Wight and Arn., by C. E. Parkinson. Pp. 18+plates 11-15. (Delhi: Manager of Publications.) 14 annas; 1s. 6d.

Canada: Department of Mines: Mines Branch. The Canadian Mineral Industry in 1934. (No. 760.) Pp. ii+119. (Ottawa: King's Printer.)

Annual Report of the Royal Alfred Observatory for the Year 1934. Pp. 8. (Mauritius: Royal Observatory.)

Danish Eel Investigations during 25 Years (1905-1930). By Johs. Schmidt. Pp. 16. (København: Carlsberg Foundation.)

Government of Northern Rhodesia. A Report on a Faunal Survey of Northern Rhodesia, with Especial Reference to Game, Elephant Control and National Parks. Pp. xii+500+xxii+11 maps. (Livingstone: Government Printer; London: Crown Agents for the Colonies.) 7s. 6d. net.

Union of South Africa: Department of Mines: Geological Survey Geological Map of the Klerksdorp—Ventersdorp Area. By Dr. Louis T. Nel. Surveyed in 1931-1934. 2 sheets, each 45 in. x 29½ in. (Pretoria: Government Printer.)

Federated Malay States. Report on Forest Administration for the Year 1934. Pp. 81+4 plates. (Kuala Lumpur: Government Printer.)

## Catalogues

Ergometrine B.D.H.: the Quickly-acting Water-soluble Alkaloid of Ergot. Pp. 6. (London: The British Drug Houses, Ltd.)

Time Base Apparatus for Synchronous Electric Time Deflection for use with Cathode Ray Oscillographs. Pp. 8. Hochvakuum-Elektronenstrahlröhren mit elektronenoptischer Strahlkonzentration. Pp. 12. Manfred von Ardenne's Cathode Ray Oscillograph for Measuring Purposes. Pp. 8. All-Mains Apparatus for Manfred von Ardenne's Cathode Ray Oscillograph. Cathode Ray Tube for Television. Pp. 6. (London: W. Edwards and Co.)

Zeiss Nachrichten. Heft 8, Januar 1935. Pp. 40. (Jena and London: Carl Zeiss.)