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Peking Man: The New Skulls and the Evolutionary Problem

ALL but ten years have elapsed since the investigations initiated through the palæontological researches of Dr. J. G. Andersson of the Chinese Geological Survey culminated in the identification of Peking man. It was in 1927 that the late Dr. Davidson Black boldly, on the evidence of a tooth, differentiated a new genus of man, *Sinanthropus pekinensis*. His temerity was fully justified two years later when in December 1929, Mr. W. C. Pei found the first skull of Peking man in the cave of Choukoutien; but it is only now, after the discovery of the three new skulls in November last, which are described by Prof. Franz Weidenreich in this issue of NATURE (see p. 269), that it is possible to appreciate in something like true perspective the momentous character of Dr. Davidson Black's first diagnosis.

The early recognition of the distinctive character of the human relics from these Pleistocene deposits eliminated many possibilities of doubtful interpretation, and prepared the way for the pregnant studies of the bearing of this great discovery on the general problem of human evolution, by which the late Sir Grafton Elliot Smith, Sir Arthur Keith, and others have made Peking man a crucial point in discussion. Much, however, as they have rested their argument for the course of evolution by which modern man has appeared upon indications afforded by distinctive or rudimentary characters in *Sinanthropus*, it will be gathered from the description of the new skulls by Prof. Weidenreich, and from his comparative study of their morphology, that the interpretation of *Sinanthropus* in terms of the evolutionary process now involves a change even more fundamental than anthropologists had contemplated.

Great significance in an evolutionary context has been attached to the combination of primitive and modern, if rudimentary, characters exhibited in Peking man. Prof. Weidenreich himself in recent studies has extended and given greater precision to this diversity of character, more especially in his investigations of the teeth and the conformation of the jaw, suggesting not only that in these characters does Peking man tend to approach modern man, but also indicating specifically a resemblance to certain of the modern Mongols. He now argues that this resemblance is further emphasized in the recent discoveries, while the broad and flat nasal bridge in one specimen, immediately, if tentatively, institutes a further point of resemblance to the Mongol in the possession of the characteristic, flat nose.

One of the most remarkable characters to which attention is directed by Prof. Weidenreich is the conformation of the brain, as shown in the endocranial cast; but even more striking in this connexion is its remarkable size. In both male and female it is large for a primitive brain; but in the male it is placed at approximately 1200 c.c., which is within no very distant range from the capacity of the modern brain, especially in the female. We need, then, feel no surprise at the cultural development of this early and primitive type of man as it is to be seen in the artefacts and in the evidence for the use of fire found in the cave of Choukoutien.

It is, however, when Prof. Weidenreich turns to the comparative study of *Sinanthropus* that his conclusions attain their most startling character. For here he now finds that the new evidence definitely places *Sinanthropus* at a lower stage in development than *Pithecanthropus*, the ape-man

of Java, approximately in a geological sense his contemporary. Discussion, which hitherto has proceeded on the line that *Sinanthropus*, while standing in relation to *Pithecanthropus*, was definitely on the line of advance, is thus not a little confounded. On the other hand, Prof. Dubois, in his study of *Pithecanthropus* and early man in Java (see p. 294), offers a way out by removing *Pithecanthropus* from the human line and associating him with the gibbon, while in the recently discovered Solo man of Java—the *Javanthropus* to which Weidenreich and others see resemblances

in Peking man—he sees, not a line leading to the Neanderthal stock destined to die out, but a member of a group, including Rhodesian and Wadjak man, which is on its way to becoming modern man in the person of the Australian aborigine.

Anthropologists, while congratulating Prof. Weidenreich on this great discovery made under the auspices of his laboratory, are deeply indebted to him for the dispatch with which he has placed at their disposal the new material for further discussion of this intricate and fascinating problem.

The Agricultural Research Council

THE Agricultural Research Council took over, on its formation in 1931, the functions of the Development Commissioners' Advisory Committee on Agricultural Research, and was charged with the duty of organizing and developing research so that the resources available for that purpose should be used to the utmost advantage. The wisdom with which that committee had developed and guided research had won for it the admiration of farmers and scientific investigators alike, particularly of those who could recall the backward position of Great Britain in agricultural research in the early years of this century. Research had so developed, however, that a more comprehensive body was needed for its guidance, one with powers such as that of forming committees and sub-committees which could bring the experience of specialists to bear on the various problems.

While the Agricultural Research Council is analogous to the Medical Research Council, and to the Department of Scientific and Industrial Research, its administration is more complicated because it has not built up, nor does it control, its own research centres. The general relationship of the Agricultural Departments with the research institutes, university departments of agriculture and agricultural colleges remains unchanged, the Council giving criticism and advice on research programmes and grants; in 1934-35 the sum of £329,695 was included for research and advisory work in the estimates of the Agricultural Departments with appropriations in aid from the Development Fund. The Council has powers to initiate special services—a function eminently appropriate for a body having such a 'bird's-eye-view' of research and of the industry as a whole.

The second report of the Council* describes the continuation of a survey of agricultural research in Britain, but is devoted more particularly to those activities or institutions which have been the object of special inquiry during the period under review. Animal diseases continue to receive special attention, in accordance with a policy adopted by the Council early in its career—that of furthering work on certain diseases which might spread should the Government decide to encourage the live stock industry. The Council found that an increase in the number of trained investigators was one of the most urgent needs in this field of research, and took appropriate action.

Amongst the work of the specialist committees of the Animals Diseases Committee, that on braxy and braxy-like diseases may be noted; after reviewing the situation, it was decided that, as a foundation for further successful research in this field, more accurate information should be obtained on such questions as the incidence of infections of sheep by anærobic bacilli, and a special investigator was appointed to undertake a survey. As an example of research of special value to large tracts of the Empire, as well as to Britain, reference may be made to the work on sheep blow-flies at Bangor and at Aberdeen. Promising results have been obtained by studying separately the several factors involved in blow-fly attacks; thus, at Bangor, high humidity at the base of the wool was found to be one of the essentials for the eggs and larvæ of the fly, and work is in progress to investigate the conditions causing high humidity.

* Committee of the Privy Council for the Organisation and Development of Agricultural Research. Report of the Agricultural Research Council for the period October 1933—September 1935. (Cmd. 5293.) Pp. iv+130. (London: H.M. Stationery Office, 1936.) 2s. net.

The Agricultural Research Council performs an important function in serving as a link with other organizations interested in agricultural research. Thus, it was recognized early on that there was a common field in the study of human and animal nutrition in its bearing on health, and joint committees were formed with the Medical Research Council to investigate iodine deficiency and to co-ordinate work on tuberculosis in animals. Again, the Milk Marketing Board made a grant of £4,000 towards research on contagious abortion in cattle, and this was made to the Council.

As an example of the energetic action taken in

consequence of the recommendations of its committees, the instance may be quoted of the report of the special committee on *Brucella abortus* infection, recommending that the Council should investigate this problem at a centre of its own, possessing an adequate area of land. The additional powers necessary to carry this into effect were promptly sought and secured.

The promptitude and vigour evident throughout this report emphasize the fact that the creation of the Agricultural Research Council was an event of the first importance for the science and practice of agriculture in Great Britain.

Peary: The Man and the Explorer

Peary

By William Herbert Hobbs. Pp. xv+502+8 plates. (New York: The Macmillan Company, 1936.) 5 dollars.

THE appearance of yet another book on Peary would scarcely attract much attention were it not written by an author of international reputation, one who knew both Peary and Greenland. Prof. Hobbs gives a hint in his preface as to the reason for writing the book, namely, that Peary, for various reasons, has never had "the full acclaim that was his due". One of those reasons is the publication, in England and in America, of several books which, in no uncertain terms, pronounce that the claim of Peary to have reached the Pole was at least open to doubt, if not actually fraudulent. These books have had a vogue which must have deeply offended ardent supporters such as Prof. Hobbs. The real student of polar literature can have little regard for such books, and can only regret the existence of those writers to whom the phrase about by-gones has no meaning at all, and who delight in resurrecting distasteful controversies of the past.

The present book, therefore, is at once a biography of a man and a refutation of the slurs that have been cast upon the claims of that man; yet the friendly critic must deplore that the author took upon himself that dual task when the first alone would have been more effective. The word "claim", introduced into the literature of polar exploration by the American Press and, be it admitted, by Peary himself, should never appear in such a book as this. Prof. Hobbs would probably answer that it was through the false claims of Dr. Cook to have reached the Pole a year earlier

than Peary that the latter was put on the defensive; in other words, that it was not Peary who began the claiming.

It will be remembered that, owing to Peary's curious methods of navigation and the lack of witnesses on his final dash to the Pole in 1909, there was no decisive proof of his having been there, and his amazing rate of travel as soon as he left his last white companion gave his detractors the chance of beginning an undignified controversy. In the absence of documentary evidence, Peary's friends fell back on the argument that his character was such that he must have been where he said he had gone, upon which the scandal-mongers began to ferret out his past in an endeavour to bring to light circumstances which might give a contrary colour to his character. In the opinion of the writer they failed to do so, and the verdict should be that Peary reached the vicinity of the Pole as he said he did, but it seems an odd way of arriving at a valuation of such a deed.

The announcement of a new life of Peary, therefore, gave hopes that it would so portray the man that the world at large would see without a doubt that his character did not permit of the kind of subterfuge of which he was accused. The picture begins with great promise: we are introduced to a very pleasant boy in a small town in Maine in the mid-seventies of last century. We read his delightful letters to his mother, about his work and his play, his associates and his plans for the future. At his college he was a very hard worker, as indeed he was throughout his life, and he won the praise and the friendship of his professor, who on one occasion described his standard with the queer phrase of "at least 100 per cent".

Devoted to the study of birds and becoming an expert taxidermist, he yet found time for winter sports, for horse-breaking and for writing poetry; all these in addition to a close attention to his more direct profession of surveying and civil engineering.

From his letters at this time, it is obvious that Peary was very ambitious, anxious to become outstanding in some way or another, a hard but cheerful worker and a pleasant companion. In spite of his love of the open air, we find him, after a short period as a surveyor, becoming a draughtsman in the Coast and Geodetic Survey, from which he rises by sheer merit, through a severely competitive examination, to a junior post in the Civil Engineering Corps of the United States Navy. At thirty years of age he has won his spurs as an engineer, making reconnaissance surveys for the projected canal in Nicaragua, which was afterwards abandoned in favour of the Panama site. It was at this period that his attention was turned to the polar regions by reading a paper on the inland ice of Greenland. With characteristic energy he followed up that lead by going to Greenland in 1886, alone, to try conclusions with the inland ice. With no one except a Danish companion, and by man-hauling their sledges, he managed to penetrate 100 miles on the ice-cap, just three years after Nordenskiöld's somewhat similar journey and two years before Nansen's famous crossing. For a man without experience it was a real feat, and on his return he was obviously wavering between his old love of surveying in the tropics and the new one of journeying in the Arctic.

It is at this stage in the book that the reader feels, with regret, that he has parted with the man and has met the explorer, that he will henceforth read the records of deeds as presented to the world but not of the thoughts and aims which led to the doing of those deeds.

Peary was a good writer and a prolific one, and his descriptive pieces are simple and effective. In his later books a certain egotism tends to assert itself, an egotism which, if read from private letters, might be a pleasant enough revelation of the man, but which, in a published narrative, is apt to jar. The author of this biography missed a great chance, if indeed it ever presented itself, by not continuing to quote from Peary's private correspondence. If, for example, he could have had access to his letters to his faithful and adventurous wife, we might have had a far truer picture of the man, of his hopes and his fears and his faith, than we can ever get from numerous quotations from his published books. We believe that the child was really father of the man, and that somewhere there are private letters which reflect the writer faithfully as did his schoolboy letters to his mother.

In this book, however, Peary becomes a public man henceforth, and we have to judge him from his own public account of himself. With this limitation, the book deals so faithfully and meticulously with his career that certain attributes of the great traveller stand out more and more clearly as it proceeds. The first is his indomitable determination and fierce energy. Not once but a dozen times, failure, even ignominious failure, faced him, yet he persisted in overcoming the obstacle. Whether it is a broken leg or a lost depot, a lack of funds or frost-bitten feet, he goes steadily on with his plans and his journeys. One can have nothing but admiration for his will to succeed, and his persistent pursuit of his self-appointed goal.

It is interesting, also, to trace Peary's gradual evolution as a polar traveller. He sampled, in succession, nearly all the possible modes of polar travel. Beginning with man-hauling with a white man, he goes on to dog-sledging with white men; then he gradually introduces Eskimo into his parties until finally he trusts almost entirely to the natives for transport. This argues an ability to adapt himself to conditions which was singularly lacking in many of the explorers of last century, and still more does it point to a treatment of the natives which, whatever its principles, was extraordinarily effective in winning sterling service.

Most of the great polar travellers have had an outstanding physique, and Peary was well in the forefront in this respect, as witness many incidents on his journeys. Even the fact that, in his final journey to the Pole, at fifty-three years of age, he rode on the sledges a great part of the time, does not detract from his record as a man who could outlast most of his fellows, as he did often enough in his younger days.

Peary's contributions to the technique of polar transport must have been many, and the only cause for hesitation in making a fuller tribute to him on this account is that in his later writings he invariably claimed that tribute in full measure himself, and in so doing, tended to dim his own reputation by insistence on what was his due.

The concluding chapters of the book, on the great Cook controversy, are, in the main, disappointing. The biographer admits that Peary handled the matter badly, that he was no match for Cook as a student of mass psychology. The reader who has read the book with sympathy will welcome that admission, but at the same time he will feel aghast that an explorer should ever have to study the psychology of a public to whom he tells his story. One is tempted to a base parody in suggesting that he who lives by the Press shall fall by the Press, and that brings us to the chief

and, one hopes, sufficient excuse for the less pleasing aspects of Peary's life. He was, throughout his career, dependent on others for financing his expeditions; he was therefore living on his reputation, and forced by circumstance to bolster his own fame by his own writings, and to attack

any force that tended to dim it. This book has not given us the real Peary—perhaps it was impossible to do so—but it gives us a clearer view than any other biography of a man whose name is much too great to be affected permanently by the snappings of minor detractors. F. DEBENHAM.

Butterflies of the Genus *Erebia*

Monograph of the Genus *Erebia*

By B. C. S. Warren. Pp. vii+407+104 plates. (London: British Museum (Natural History), 1936.)

IT might be difficult to decide whether a description of much of the taxonomic work that has been and still is being done as merely careless can be regarded as lenient or just. It certainly would not be harsh. In the latter half of the eighteenth century it was not unusual for one author to tackle the whole of the natural world, and, considering the magnitude of the task and the degree of development of knowledge at the time, the result was at least comprehensive. Since that time, our knowledge has grown to such an extent that the size of the taxonomic group with which any single author can hope to grapple effectively has become more and more restricted, and the superficial character of much of the work that has been done has added so much to the labour involved in revising even a single genus, that the systematist confronted with the classification of a suborder no larger than the Rhopalocera may well stand dismayed at the prospect.

It is not surprising, therefore, to find a volume of some 400 pages and more than 100 plates entirely devoted to a revision of the genus *Erebia*, which comprises some 69 known species, represented by 225 subspecies (geographical races), in addition to which there are 90 named forms and nearly 280 aberrations. The task of dealing with the nomenclature alone is no light one, as the number of names involved exceeds 900, nearly 600 of which are actually used to designate species, subspecies, forms and aberrations.

In directing attention to the need for this revision, Mr. Warren points out that of the many systematic works which include a treatment of *Erebia*, Dr. T. A. Chapman's paper is the only one in which any attempt is made to study the structural characters of all the known species of the genus.

The author puts forward the following five points, which in his opinion "cover the essentials

of a genuine systematic work", and which have been aimed at in the production of this book:

"(1) To supply definite proof, on an anatomical basis, of the real affinities of every hitherto described species, subspecies, form and aberration of *Erebia*; (2) to establish the correct use of every valid name, and to eliminate those that are only synonyms or homonyms; (3) to provide reliable data for the identification of species; (4) to treat the variation of each species comprehensively, but at the same time in as simple a manner as possible; (5) to give the distribution of each race accurately, but not in great detail, avoiding long distribution lists which would encumber the work without being of compensating value."

It is becoming more generally recognized that many of the distribution lists published are based on identifications of questionable accuracy, and that they unnecessarily increase the bulk and cost of production of any taxonomic work.

There is great need for more treatises like the volume under review, monographs in which every effort is made to state and display facts with simplicity, but with absolute precision. In the matter of illustrations, Mr. Warren has not confined himself to a single aspect of a subspecies or form, either in displaying the facies of the insect or the structure of the genitalia, and a study of the figures of different specimens of the same subspecies, even from the same locality, indicates that the book is fully, though not in any way too lavishly, illustrated. There has been a good deal of controversy in the past over the respective merits of photographs and drawings, particularly in connexion with the figuring of genitalia. Mr. Warren has taken the trouble so to dissect and photograph these structures that it has been possible to give a perfectly satisfactory picture, admirably arranged for purposes of comparison.

An interesting feature of this valuable and beautifully produced monograph is an original discussion on the androconial scale and its development in the genus *Erebia*, which it may be hoped will encourage students to make a special study of these scales in other butterflies.

Stellar Constitutions and Systems

Five Halley Lectures

Pp. iv +30 +32 +32 +18 +30. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 8s. 6d. net.

THE Halley Lecture in the University of Oxford was founded by the late Henry Wilde, on the return of Halley's comet in 1910. The lecture is given annually on a subject connected with astronomy or terrestrial magnetism. The University by decree has defined astronomy to include astrophysics, and terrestrial magnetism to include "the physics of the external and internal parts of the terrestrial globe". Lectures under this benefaction have been given by many outstanding investigators in astronomy and geophysics. Most of the lectures have been of more than ephemeral value; though many of them have afterwards been published in booklet form, most of them are now out of print.

It was a happy idea of the Savilian professor of astronomy to endeavour to form a permanent record of the lectures. Of those already delivered, which had been printed by the Oxford University Press, only five were available in sufficient numbers to justify binding in a single volume. It so happened that these five lectures were on astronomical subjects. The volume under review will be, it is hoped, the forerunner of similar volumes to appear in the future.

The lectures included in this volume comprise "The Rotation of the Galaxy", by Sir Arthur Eddington; "The White Dwarf Stars", by Prof. E. A. Milne; "The Composition of the Stars", by Prof. H. N. Russell; "Red-Shifts in the Spectra of Nebulæ", by Dr. E. Hubble; and "Dimensions and Structure of the Galaxy", by Dr. J. S. Plaskett. In reading through these lectures again, one cannot but be impressed by the able manner in which the subjects were dealt with, and unsolved problems were discussed.

The problem that was uppermost in the mind of Sir Arthur Eddington was the bearing of the rotation of the galaxy on the time-scale of stellar evolution. "Geological time swallows up at least 1,500 million years; we must allow a reasonable margin beyond that for the evolution of the solar system, say 3,000 million years altogether. The minimum requirement of our model system is that it will keep going for that time without collapse. Actually we are hard put to it to invent a galaxy with even this limited degree of permanence, which shall at the same time embody

the main features of stellar motion and distribution enumerated on p. 6. As for those who dabble in the long time-scale of billions of years now fashionable (and I have to confess myself one of them) we must simply ignore them. Whatever the study of individual stars may bring forth in its favour, the evidence of galaxies and of systems of galaxies is dead against so leisurely a rate of progress. The problem of the galaxies is unapproachable except from the standpoint that the material universe is a much more evanescent affair". The lecture ended with these words: "Perhaps the lesson of the galaxies is to wake us from our dream of leisured evolution through billions of years. It is hard to credit our stellar system with so much age and endurance. It is more like a young man in a hurry". Since this lecture was delivered, astronomical opinion has been veering steadily in favour of the short time-scale for stellar evolution as opposed to the time of billions of years formerly current.

Prof. Milne discussed the white-dwarf stars and the nature of 'dense matter', sketched out his views on stellar evolution and described the relationship of novæ and of white dwarfs to his scheme. The recent appearance of two bright novæ, in addition to several fainter novæ, has given a great impetus to the study of the many complex problems that these interesting stars present. Milne's theory of the cause of a nova outburst, though not yet proved, still offers the most plausible working hypothesis. It may be mentioned that the large folding diagram (Fig. 3), which accompanies this lecture, has been omitted from the review copy of this volume. It is to be hoped that the omission is peculiar to this copy only, for without the diagram in question it is not possible to follow much of the argument.

In his lecture, Prof. Russell gave an admirable résumé of the present state of knowledge about the composition and physical conditions of the visible portions of the stars. The only stellar spectrum that has been studied in sufficient detail to permit a complete qualitative analysis is that of the sun. It is found that seven elements—magnesium, iron, silicon, sodium, potassium, calcium and aluminium—make up 96 per cent by weight of the solar metals, and these are the seven principal constituents of terrestrial rocks. The determination of the abundance of the non-metals is more difficult, as the lines in their spectra are faint and of very high excitation potential. The more conspicuous features of the distribution are

a general decrease in abundance for the heavier elements and a greater abundance of elements of even atomic number than of elements of odd number. This relation has been noticed in terrestrial data also, and attributed in some way to the constitution of atomic nuclei. Another result of interest, confirmed in other ways, is that hydrogen is of the order of 1,000 times as abundant, atom for atom, in stellar atmospheres as all the metals together. The complicating factor in these investigations is that the maximum intensity of the lines of one element depends more often than not on the degree of ionization of another element. Further progress in the detailed quantitative analysis of stellar atmospheres is dependent upon the more detailed investigation of stellar spectra. The great 200-inch telescope, with a focal length in the Coudé form of about 500 feet, will permit a more complete investigation of the spectra of the brighter stars than has hitherto been possible.

Dr. Hubble's lecture dealt with a problem the solution of which must also await the completion of the 200-inch telescope—the interpretation of the red-shifts in the spectra of the extra-galactic nebulae. "This telescope should penetrate to distances where the effects of red-shifts are so great that the requisite data will lie well above the threshold [of the photographic plate]. Such data will afford critical empirical tests of the interpretation of red-shifts as representing actual motion, and will establish the form of the velocity-distance relation in regions where the velocities, whether real or apparent, are considerable fractions of the velocity of light". The method of investigation is to examine the apparent departure of the distribution of the extra-galactic systems from statistical uniformity. This apparent departure from a uniform distribution is attributed to the reddening of the light from the systems, which increases with distance. The effect to be expected will differ according to whether the reddening is, or is not, interpreted as a velocity effect.

The remaining lecture, the most recent of the lectures on an astronomical subject, was given by Dr. J. S. Plaskett in 1935, and dealt with the present state of knowledge about the dimensions and structure of the galaxy. During the past twenty-five years there have been considerable changes in current ideas as to the dimensions of the galaxy. Eddington, in the first of the lectures in this book, when referring to some dynamical investigations that he made in 1913-15, remarks: "But when I turn to the efforts I then made to fit the theory to the observed properties of the system, it is like a glimpse of the middle ages. Is it possible that only fifteen years ago we thought the stellar universe was like that! With some misgiving I

found I must place the sun at least 500 parsecs away from the centre of the system; but I did not expect to be believed. Nowadays 7,000 parsecs is the minimum estimate".

The great expansion in the size of the system followed from Shapley's application of the luminosity-period relationship for the Cepheid variables to the estimation of the distances of the globular clusters. He gave the system a diameter of 260,000 light-years. The diameter of the largest known external systems, the Andromeda nebula, was later estimated by Hubble to be about 40,000 light-years, so that there seemed to be a great disparity in size between the galaxy and the external systems. Subsequent investigation has tended progressively to reduce this disparity. The revision of the zero-point of the Cepheid period-luminosity curve, and allowance for the presence of absorbing material within the system, which dims the light of distant stars and causes distances depending on any luminosity method to be overestimated, has reduced the dimensions of the galactic system. The distance from the sun to the centre of the galaxy derived dynamically from investigations of the rotation of the galaxy is now in good agreement with that deduced from the distribution of the globular clusters—about 10,000 parsecs or 32,000 light-years. The diameter of the system is of the order of 100,000 light-years.

Concurrently with the reduction in the size of our own system, the estimated dimensions of the Andromeda nebula have been enlarged. Hubble, in 1932, identified 140 nebulous objects in and near the Andromeda nebula as globular clusters, dynamically connected with the system. Many of these were outside the limits of the system shown on long-exposure photographs. In 1933, Stebbins and Whitford, from photo-electric measures, showed that faint nebulosity extended to much greater distances than had been supposed. These investigations have combined in showing that there is no great difference in size between the Galaxy and the Andromeda nebula. Dr. Plaskett ends his lecture, however, with a note of caution: "While the dimensions, structure and dynamical organization of the Galaxy have been here fairly definitely stated, the proposed model must be considered only as a preliminary attempt at the solution of this difficult but very important astronomical problem. In view of the changes that have occurred in our conceptions of the Galaxy during the past twenty years, one would be very rash to predict that even approximate finality had been reached. All that can safely be said at present is that the concept developed has a certain unity, completeness, and probability, and it can only be hoped that it makes a useful introduction to more complete knowledge". H. S. J.

Modern Sociologists

(1) Comte: the Founder of Sociology. By F. S. Marvin. Pp. 216.

(2) Veblen. By J. A. Hobson. Pp. 227.

(London: Chapman and Hall, Ltd., 1936.) 6s. net each.

(1) MR. MARVIN'S "Comte", notwithstanding the brevity of treatment imposed by the limitations of the series of which it forms part, is one of the best and most lucid expositions of the doctrines of the founder of 'sociology' extant. Its merits, however, are not confined solely to its treatment of the positive philosophy and the religion of humanity as originally formulated. The author, having in mind the aim of the series to bring the principles of sociological thinkers into relation with the problems of to-day, has essayed the by no means easy task of evaluating the position of Comtian theories at the present time. In so doing, Mr. Marvin has analysed current trends of modern society in thought, in scientific discovery, and in social development, with an acute perception and a sanity of judgment, which not only provide an efficient antidote to current moods of superficial pessimism, but also convey a gospel to scientific workers and practical sociologists.

(2) Veblen is a thinker of a very different order from Comte; and notwithstanding Mr. Hobson's acute and sympathetic analysis of his work, it is difficult to evade the conclusion that his sociological doctrines were little more than a sublimation of personal experience. His early life on a Middle-West farm and in Chicago at the close of the nineteenth century, when the corrupting influence of financial interests was at its height, fundamentally affected his reading of history and his view of the development of society. His interpretation of the evidence of anthropology, upon which much stress is laid by his admirers in the United States, is superficial and lacking in understanding. This view would probably not meet with the assent of the author of this exposition. The brief introductory sketch of the events of Veblen's life given here needs revision as to its dating.

Über Katalyse und Katalysatoren in Chemie und Biologie

Von Alwin Mittasch. Pp. vii+65. (Berlin: Julius Springer, 1936.) 3.60 gold marks.

A LIFETIME'S work on technical catalysts lies behind this little pamphlet. While Haber proposed and outlined experimentally the idea of nitrogen fixation, and Bosch developed the apparatus for it, Mittasch solved one of the main practical difficulties attached to the process, by the discovery of an iron catalyst of a certain composition.

Few people know more about technical catalysts than does the author; much of the existing knowledge has grown up under his direction and has never been published. It is astonishing how little all this important work has contributed to the elucidation of the principles of catalytic action. The pamphlet gives no scientific views on this subject. Besides reviewing the various aspects of chemical catalysis,

it surveys a great number of biological phenomena in which small quantities of substance have big effects: the action of enzymes, poisons, heredity are all spun together in a web of loose analogies. Some of the points referred to are of quite recent date and impress upon the reader the wideness of the author's knowledge. This factual survey may be of some use, even though there is no idea underlying it.

One is reminded of Gudden and Pohl's treatise on photo-electric conductivity which, when introducing the chapter on selenium, notes that this particular field is most obscure owing to the great amount of technical work done in it. It seems that technical research conducted under an employer's authority, in an atmosphere of secrecy, is far less effective in discovering the principles involved in a process than pure research open to world-wide discussion.

M. POLANYI.

Witches and Warlocks

By Philip W. Sergeant. Pp. 290+15 plates. (London: Hutchinson and Co. (Publishers), Ltd., 1936.) 12s. 6d.

DR. MARGARET MURRAY'S study of witchcraft in western Europe, which revived the theory of a Dianic cult and brought its manifestations into relation with modern ideas on the character of primitive religion, gave an orientation to the numerous studies of witchcraft which followed, and demanded from her imitators and successors something more than descriptive narrative to justify publication. Mr. Sergeant's claim to serious attention lies in his careful and detailed analysis of the evidence in the cases of the Lancashire witches, and the part played by the Mathers and others in the persecution of the Salem witches in America, as well as in his account of the Elizabethan Dr. Dee and his evil genius Kelly. On the theoretical side he is not equally happy. His knowledge of primitive religion is scarcely adequate to the demand—his reference to totemism seems particularly wide of the mark—nor does his knowledge of the literature of that subject appear to be extensive.

Aluminium-Legierungen

Von A. Grütznert. Unter Mitarbeit von G. Apel. Teil 1. Patentsammlung geordnet nach Legierungssystemen. Pp. vii+342. 35 gold marks. Teil 2. Patentsammlung. Nebst einem Markenverzeichnis bekannter Aluminium-legierungen, von Prof. Dr. A. von Zeerleder. Pp. iii+343-868. (Zugleich Anhang zu Aluminium Teil A in Gmelins Handbuch der anorganischen Chemie, Achte Auflage, herausgegeben von der Deutschen Chemischen Gesellschaft.) (Berlin: Verlag Chemie, G.m.b.H., 1936.) 54 gold marks. (Ausland preis, 40.50 gold marks.)

THE alloys of aluminium are so numerous that a complete table of them has been compiled, which runs to more than 800 pages and is issued in two parts. The table facilitates reference to the patent literature, and a further useful feature is a supplementary list of all the known alloys of the metal in the alphabetical (or numerical) order of their trade names, together with the names of patent holders and percentage compositions.

The New Discovery of Three Skulls of *Sinanthropus pekinensis*

By Dr. Franz Weidenreich,

Visiting Professor of Anatomy, Peiping Union Medical College, and Honorary Director of the Cenozoic Research Laboratory, National Geological Survey of China

FOLLOWING the recovery of several fragments of a very small adult skull of *Sinanthropus* from Locus I (Locality 1) in the latter part of our spring field season at Choukoutien, we had the good fortune during the fall season of this year to unearth three additional more or less well-preserved skulls, two of which were recovered on one day. All three skulls belong to adult individuals. The skull recovered first, and designated as Skull I of Locus L (Fig. 1), is the largest, with a cranial capacity of approximately 1,200 c.c. and with its coronal and sagittal sutures partly fused. The second skull (Skull II of Locus L, Fig. 2) is the smallest of the group, with a cranial capacity not higher than 1,050 c.c., and its coronal, sagittal and lambdoid sutures fused. This skull shows a clear indication of the persistence of a metopic suture. The third skull (Skull III of Locus L, Fig. 3) is smaller than Skull I, but larger than Skull II. The cranial capacity of Skull III is approximately 1,100 c.c. Although all the sutures of this skull are still patent, yet other characteristic features make it evident that we are concerned with a young adult individual. Parts of the face are preserved in all three skulls; thus, in Skull III both nasal bones and the entire lateral border of the orbit in

palate and ten teeth *in situ* (premolars and molars), which, however, are not connected with the skull. Belonging to Skull I are several teeth only. In addition, we have a great number

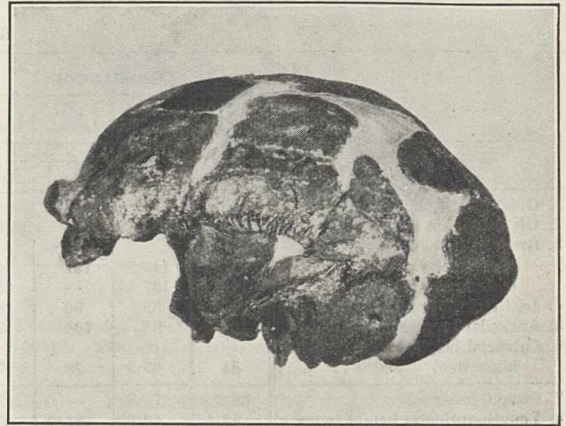


Fig. 2.

Sinanthropus pekinensis, SKULL II, LOCUS L, ADULT FEMALE. NORMA LATERALIS, LEFT SIDE. $\times \frac{1}{3}$.

of very small fragments apparently pertaining to the face, yet it is rather doubtful whether it will be possible to undertake even a partial reconstruction.

As has been noted in the case of all teeth of *Sinanthropus* recovered hitherto, it is also true for *Sinanthropus* Skulls I and II, namely, that they possess a large and a small type of teeth. I had previously arrived at the conclusion that the large teeth may belong to male individuals and the small to female individuals. This assumption has been confirmed by the fact that the large type of teeth pertain to the bigger skull (Skull I) while the small type of teeth is to be found in the small skull (Skull II, Fig. 4). Thus it seems quite certain that the latter represents the skull of a female individual, and the former that of a male individual.

Parts of the base are missing in all three skulls. Skull I is the most defective, with only the right temporal bone being preserved. In Skull II both temporal bones are present, but a great part of the supraorbital region is broken off. Skull III is the most complete one; the entire occipital bone with the posterior border of the foramen magnum is preserved. However, the right temporal bone has been lost.



Fig. 1.

Sinanthropus pekinensis, SKULL I, LOCUS L, ADULT MALE. NORMA LATERALIS, RIGHT SIDE. $\times \frac{1}{3}$.

complete connexion with the brain case; in Skull II the frontal process of the maxilla, the lower border of the orbit, the cheek-bone and fragments of the alveolar process of the upper jaw with

All three skulls have the same appearance as Skull I of Locus E described by Davidson Black (1931). However, since this skull belongs to a child of eight–nine years (cf. Weidenreich, 1935), the characteristics of the *Sinanthropus* type are much more pronounced in the recently recovered skulls such as, for example, the size and thickness of the supraorbital ridges and the occipital torus, the crest of the vertex and the muscle markings of the temporal bone. The greatest transversal diameter of all three skulls is represented by the biauricular breadth with the breadth decreasing gradually above the ear aperture. The accompanying table (see below) shows the results derived

Since the character of a type is not always defined by the general shape only but also by the feature of details, it deserves special attention here that the new *Sinanthropus* skulls completely agree with Skull I of Locus E in this respect. This is true, for example, in respect to the position and form of the ear aperture—with the exception of the cleft of the tympanic part of the temporal bone which is distinctly an infantile character in recent man and is missing in all adult *Sinanthropus* skulls—and in regard to the smallness and form of the mastoid process, as also the very narrow space between the temporal lines on both sides.

TABLE*

	Sinanthropus				<i>Pithecanthropus</i> ²	Neanderthal group				Recent man ³	Chimpanzee ³
	I Loc. L	II Loc. L	III Loc. L	I Loc. E ¹		Neanderthal	Spy I	La Chapelle	Rhodesia		
Sex	♂	♀	♂	♂ (child)	♀	♂	♂	♂	♂	♂+♀	♂+♀
1. Greatest length (g-op)	198	191	195	188	183	201	203	208	206		
2. Glabello-inion length (g-i) .. .	195	188	194	185	177	199	198	195	204		
3. Greatest breadth :											
a. auricular	148	145	147	144	140	—	—	144	142		
b. temporo-parietal	136	137	—	133	130	147	147	156	146		
4. Last frontal breadth	89	88	90	82	85	107	104	109	100		
5. Auricular-bregmatic height (po-b)	107.5	98	100	93	94	—	118	115	116		
6. Calvarial height (over glabello-inion line)	84	65.5	78	70	66.2	80.5	81	79	90		
7. Cranial index	68.7	71.8	—	73.6	71.0	73.1	72.4	75.0	70.9	—	—
8. Length-auricular height index ..	53.4	50.7	51.0	50.3	51.4	—	54.7	55.4	56.3	63.8	51.2
9. Calvarial height index	43.1	34.8	40.2	37.9	37.9	40.4	40.9	40.5	45.4	59.8	32.5
10. Bregmatic index (Schwalbe) .. .	39.5	44.2	39.2	39.5	40.9	38.4	34.5	36.5	36.4	28.0	50.0
11. Bregmatic angle (Schwalbe) .. .	47°	39°	44°	43°	42°	44°	46°	45.5°	48°	59°	39°
12. Superior inion angle (lig)	74°	60°	62°	64.5°	70°	66.5°	68°	68.5°	70°	84°	50°
13. Inion angle (lio)	—	—	96°	—	99°	118°	122°	113°	107°	119°	110°
14. Capacity (c.c.)	c.1200	c.1050	c.1100	914	1000?	c.1370	—	1620	1325	1325	410

* The figures in italic type represent limiting values of the individual groups, with the exception of recent man and chimpanzee. Measurements of Locus E skull not considered in limiting values on account of its immaturity.

¹ After Davidson Black's figures, but the position of inion has been rectified. ² Reconstruction after Weinert. ³ Average figures of all races.

from the more essential skull measurements in comparison with those available for *Pithecanthropus*, Neanderthal and recent man. The measurements 8–13 giving the corresponding ratios reveal that *Sinanthropus* as a whole occupies the lowest place in the order of all hominids in regard to those peculiarities which determine its position in the line of evolution. This is particularly true for Skull II of Locus L, while Skull I of Locus L in part falls within the range of variations of the Neanderthal group. However, Skull II apparently is even lower than *Pithecanthropus*, the difference being that the *Sinanthropus* skull shows a more pronounced frontal tuber than *Pithecanthropus*, the entire forehead of which is flattened. The smallness and lowness of *Sinanthropus* Skull II is all the more remarkable since the skull fragments recovered last summer and considered to pertain to an adult individual are still smaller in dimensions than the respective parts of Skull II of Locus L and *Pithecanthropus* (cf. Weidenreich, 1937).

As to the face, the parts preserved in Skulls II and III yield a rather good idea of the general structure, at least so far as the upper parts are concerned. The nasal bridge is broad and flat (the index of the inter-orbital breadth is 29.8 average); Neanderthal group: Spy I, 28.8; Rhodesia, 28.6; La Chapelle aux Saints, 26.8; recent man, 24.3 (average). There is no groove between the root of the nose and the forehead. The orbit is very low (orbital index of Skull III, 77.2; Rhodesia man, 75.5; La Chapelle, 81.9; Gibraltar, 91.1; recent Australian, 78.8 (average male); the lateral border recedes backwards below the frontal zygomatic suture. The lacrimal fossa is missing in all skulls. The orbit is deep and the superior orbital fissure very small. The cheek bone is remarkably high, as high as that of the Rhodesia skull. A canine fossa does not exist and the anterior surface of the frontal process of the maxilla is slightly convex and not depressed as in recent man. The upper jaw, therefore, must

have projected considerably. The palate is broad and high.

Earlier (1935) I was able to demonstrate that a close connexion between *Sinanthropus* and certain groups of the present Mongol race could be assumed. The occurrence of the so-called 'torus mandibularis' on the inner side of the mandible of some of the *Sinanthropus* jaws as well as on those of recent Mongols, especially Eskimos and Lapps, and furthermore the occurrence of shovel-shaped medial and lateral upper incisors in *Sinanthropus*, as also in modern Mongols, indicate some direct relationship between Peking man and the Mongol group of recent mankind. Whether or not the broad and flat nose of *Sinanthropus* points to the same direction I do as yet not venture to state. However, in addition, there is another conspicuous feature which, I believe, serves as further evidence for the assumption of such a special relationship. All three adult skulls show a large 'inca-bone' (*os epactale*) which, it is true, is not confined to the ancient Peruvian natives as the name suggests but also occurs in other races of to-day. However, it is much more frequent in the American Indian and Mongol group (up to 7.8 per cent) than in the latter (up to 2 per cent).

One of the most striking features revealed by the recently recovered skulls is met with in the endocranial casts. I had previously remarked (1936) that, in the *Sinanthropus* Skull of Locus D (Black's Skull II), the pole of the frontal lobe of the brain projects far outward and continues with a sharp keel downward (orbital rostrum). This peculiarity is especially pronounced in Skull III, and in somewhat different manner also in Skulls I and II of Locus L; in the latter two the keel is not so sharp, but nevertheless it projects downward in a very straight line. In this respect the endocast of Skull III resembles that of a chimpanzee, while Skulls I and II resemble more that of a gorilla. At any rate, all endocasts differ distinctly in this respect from those of Neanderthal man or *Pithecanthropus*. Skulls II and III are furthermore remarkable for the existence of an astonishingly low and narrow temporal lobe, a condition which I had pointed out when describing the temporal bone of Skull III of Locus H (1936 a).

As to the relation to *Pithecanthropus*, *Sinanthropus* Skull II of Locus L, together with the fragmentary *Sinanthropus* of Locus I mentioned above, prove incontestably that there is no appreciable difference between *Pithecanthropus* and *Sinanthropus* so far as the general shape and the lowness of the skull caps are concerned. Since it has been assumed that these two *Sinanthropus* skulls belong to female individuals, it is very probable that *Pithecanthropus* also belongs to the

same sex, a probability which had already been pointed out by E. Dubois and Hrdlička. The *Sinanthropus* skulls differ from *Pithecanthropus* by only two characters, namely, in that the frontal bone proper is more vaulted in *Sinanthropus*, although its inclination to the glabella-inion line is distinctly more pronounced than in *Pithecanthropus* (compare measurements 10 and 11 of

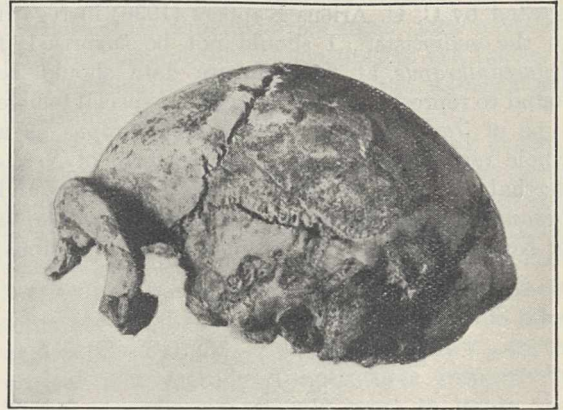


Fig. 3.

Sinanthropus pekinensis, SKULL III, LOCUS L, ADULT MALE (YOUNG). NORMA LATERALIS, LEFT SIDE. $\times \frac{1}{3}$.

table). Furthermore, the supraorbital ridges of *Sinanthropus* are separated from the forehead by a really broad furrow, while in *Pithecanthropus* they continue gradually to the brow. The latter phenomenon, however, seems to have some connexion with the formation of the frontal air-sinuses. In *Pithecanthropus* these sinuses are conspicuously large and extend far lateralward over the roof of the orbit, whereas in all cases in *Sinanthropus* they are very small and closely confined to the inter-orbital region. I consider this appearance in the case of *Sinanthropus* as an indication of its being more primitive than *Pithecanthropus*, and the latter, in spite of the absence of prominent frontal tubera, as a more advanced type of hominid.

Another important fact is disclosed by *Sinanthropus* Skull I of Locus L. This skull is not only the largest of all *Sinanthropus* skulls recovered hitherto (c. 1,200 c.c.) but at the same time also the highest. Although its general structure and essential details show the same characters as the lowest Skull II of Locus L, yet its greater cranial

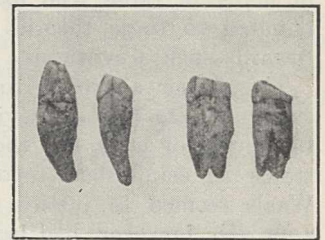


Fig. 4.

UPPER CANINES AND UPPER FIRST PREMOLARS OF MALE SKULL I AND FEMALE SKULL II. $\times \frac{1}{3}$. FROM LEFT TO RIGHT: CANINE, SKULL I, CANINE, SKULL II; PREMOLAR, SKULL I, PREMOLAR, SKULL II.

capacity approaches closely the more primitive representatives of the Neanderthal group as revealed by the table. I had earlier (1936 *b*) assumed that there must be some relation between *Pithecanthropus* and *Javanthropus soloensis*, the latter resembling the former in several primitive characters. On the other hand, there is no doubt that *Javanthropus* has many peculiarities in common with *Sinanthropus*, as recently demonstrated by C. U. Ariëns Kappers (1936) in regard to the endocasts. I should not be surprised if *Pithecanthropus* at some future date should be found to represent nothing else but a special female type of *Javanthropus*. Since *Javanthropus* as a whole represents a very primitive form of Neanderthal man, the line linking *Pithecanthropus* and *Sinanthropus*, respectively through *Javanthropus* or Neanderthal man, to recent man is continuous.

The fact that there may be certain racial deviations does not matter greatly, since the determining factor does not depend on relatively minute differences but on the main course of human development itself.

LITERATURE.

Black, Davidson (1931). "On an Adolescent Skull of *Sinanthropus pekinensis* in Comparison with an Adult of the Same Species and with Other Hominid Skulls Recent and Fossil". *Palaeontologia Sinica*, Ser. D, 7, Fasc. 2.

Kappers, C. U. Ariëns (1936). "The Endocranial Casts of the Ehringsdorf and *Homo soloensis* Skulls". *J. Anat.*, 71, 61-76.

Weidenreich, Franz (1935). "The *Sinanthropus* Population of Choukoutien (Locality 1) with a Preliminary Report on New Discoveries". *Bull. Geol. Soc. China*, 14, No. 4, 427-468.

Weidenreich, Franz (1936a). "Observations on the Form and Proportions of the Endocranial Casts of *Sinanthropus pekinensis*, Other Hominids and the Great Apes: a Comparative Study of Brain Size". *Palaeontologia Sinica*, Ser. D, 7, Fasc. 4.

Weidenreich, Franz (1936b). "*Sinanthropus pekinensis* and its Position in the Line of Human Evolution". *Bull. Peking Nat. Hist.*, 10, Pt. 4, 281-290.

Weidenreich, Franz (1937). "The New Discoveries of *Sinanthropus pekinensis* and their Bearing on the *Sinanthropus* and *Pithecanthropus* Problems". *Bull. Geol. Soc. China*, Ting Memorial Volume.

The Structure of Liquids

THE Edinburgh discussion of the Faraday Society on September 24-26 on the subject of "The Structure of Liquids and Solutions" was a particularly successful and satisfactory conference. The choice of subject had been very happily timed. The theory of the structure of liquids, which has been in recent years approached from a number of different angles, appears now to have reached a stage in which a larger synthesis is possible, and the bringing together in Edinburgh of many of those who have most notably contributed to these theories has markedly helped towards such a synthesis.

The earlier approach to the theory of liquid structure was almost inevitably an extension of the theory of gases, and the continuity of the two states as established theoretically by Van der Waals seemed to justify this treatment. This approach, however, had led to but little advance in explaining most of the characteristic properties of liquids. A recent tendency, on the other hand, which has taken its origin in the X-ray studies of liquid structure, has been to treat the liquid as more closely analogous to the crystalline solid. This has proved a much more fruitful line of advance for ordinary liquids, that is for liquids at temperatures far removed from their critical temperatures.

The chief difference between liquids and crystals is that in liquids we have irregularity of position and orientation of molecules in the place of the regularity of the crystal arrangement. This irregularity is limited by the general condition that in liquids the molecules are approximately

close-packed. A great advance in the study of liquids is the development of the precise method of defining the molecular or atomic *configuration* of a liquid under any conditions. This has been achieved by means of the distribution function $g(r)$ of Debye and Prins, which gives the probability

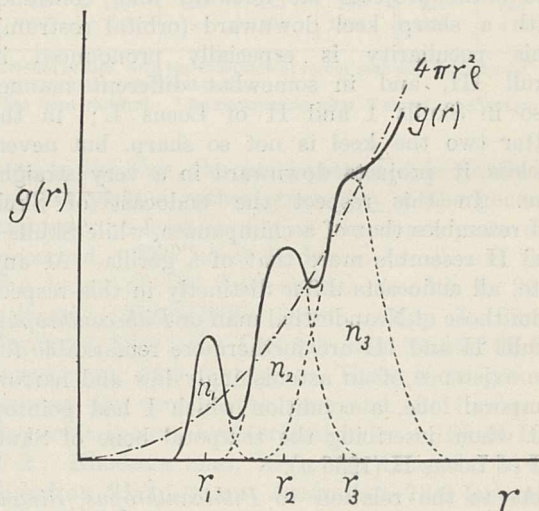


Fig. 1.

of finding a molecule at every distance from an arbitrarily chosen one (see Fig. 1). The peaks of the distribution function correspond to the perfect co-ordination spheres surrounding atoms in a regular crystal structure, and Prins has suggested that one can be derived from the other by considering each co-ordination sphere of mean radius r_k and

containing n_k molecules to be smeared out by a form of error function, so that the distribution function may be written

$$g(r) = \sum_k g_k(r) = \sum_k \frac{n_k}{4\pi r k^2} \sqrt{\frac{c}{r k}} e^{-\frac{1}{\lambda^2} \left(\frac{r-r_k}{kT}\right)^2}$$

Bernal has attempted to apply this idea to the conditions of equilibrium of liquid structures. Any possible configuration of the liquid can be defined by a distribution function depending on only three variables, the average number N of close neighbours of any molecule, the mean distance R of these neighbours, and the variability of this distance, which is equivalent to the measure of the irregularity of the structure. Of all configurations defined in this way, that one will be stable for which each free energy is a minimum for any variations of N , R and λ . With rise in temperature the values giving such a minimum will change, the co-ordination number in general falling and the irregularity increasing. We may think of the change of configuration of a liquid on heating as equivalent not only to change in the number of excited vibrations, as occurs in a crystal, but more to the transformation of one crystalline phase into another. In a liquid there is an infinite sequence of different configurations, while the condition that the free energy remains constant for any change of phase becomes the general condition of minimum free energy for all configurations. The increasing potential energy on passing from a low-temperature to a high-temperature configuration consequently gives to liquids a term in the specific heat which does not exist in the crystalline solid, and makes the specific heat of liquids at low temperatures larger than can be explained by any theory based on the excitation of degrees of freedom alone.

Prof. F. London, who presented an admirable introductory paper on "The Nature of the Forces acting between Atoms and Molecules in Liquids", discussed particularly the structure of what should be the ideal, but what is actually the most anomalous of liquids, liquid helium. Here the importance of zero point energy is so great that the minimum of potential energy has little effect in fixing the configuration of the liquid, so that each atom has only four neighbours instead of the twelve that occur in normal liquids. E. Bartholomé and A. Eucken and L. Brillouin dealt with the theory of specific heats of liquids. So far, however, no quantitative theory has been successfully evolved to cover either the behaviour of liquids at very low temperatures or near the critical point, where the general theory indicated above would require considerable modification.

The crucial question of whether the liquid and crystalline states form a continuum in the same

sense as liquid and gaseous states was much discussed. J. Frenkel claimed that such a continuum exists, from theoretical considerations, and believes that the transition between crystals and liquids can only be achieved at low temperatures under large negative pressures. F. Simon, on the basis of experimental evidence, considers that, if it occurs at all, it is only at high temperatures and positive pressures. According to Bernal, on the other hand, for purely geometrical reasons no intermediate state should be possible. This question, however, is probably premature, as the theory is not sufficiently advanced and the experimental conditions very difficult to achieve.

Several very notable semi-empirical generalizations on the properties of liquids were given to the conference. According to Bauer and Magat, it appears that a number of properties of liquids, notably their specific volume, surface tension and specific heat, can all be plotted on the same curves, if the temperature ordinate be taken as $\theta = (T - T_F)/(T_C - T_F)$, where T_C and T_F are the critical and melting temperatures respectively. These generalizations would seem to imply that the structures of different liquids resemble one another far more than do the structures of corresponding crystals; they would almost merit the sweeping statement *that there is only one liquid state*. This requires to be qualified, however, by the possibility that for all the liquids investigated, except water, which is as usual anomalous, the molecules or molecular groups are in a state of free rotation, and that consequently the generalization applies only to assemblages of effectively spherical units. Liquids with highly asymmetrical molecules would tend towards the greater regularity of the liquid crystalline state. Hudleston has shown that similar regularities occur in the compressibilities of liquids, and that they can be referred to a very simple semi-empirical law, while A. G. Ward, by considering the constant B in the viscosity temperature relation,

$$\eta = A e^{B/RT},$$

has shown that it is closely related to the latent heat of melting and the general physical type of the liquid.

A new method of investigating the properties of liquids, the measurement of absorption of ultrasonic waves studied by M. P. Biquard and J. Errera, has led until now to highly anomalous results. This absorption is found to be larger, and sometimes as much as a thousand times larger, than that which would be expected under existing theories, and this suggests very forcibly that there are some phenomena in liquids, possibly related to changes of configuration, that have an appreciable characteristic time of the order of a millionth of a second.

The second part of the conference, devoted to solutions, is more difficult to summarize because here general principles were not so much in evidence. Prof. J. H. Hildebrand, in his introductory paper, laid stress on the need of greater precision in defining the nature of the intermolecular forces in solutions and the meaning of association. In particular he emphasized the much greater importance of the extremely active hydrogen and hydroxyl bonds in liquids compared with the less localized dipole forces.

There was considerable discussion as to the validity of Raoult's law for liquid mixtures and in the changes of entropy on solution, but the general impression, well expressed in Prof. J. Kendall's paper, was that in this field anomalies are more apparent than regularities. The structure of liquids themselves being so complex, that of solutions, except dilute solutions of very simple substances, must be far more so. There are so many factors, in the size and shape of the molecules, in the existence of active association centres and in the possibility of formation of limited or indefinite clusters, that it is only in groups of fairly closely related substances in the same solvent that regularities may be expected. Thus, for example, J. A. V. Butler has shown that a series of aliphatic alcohols dissolved in water have heats of solution which can be calculated additively from the number of carbon atoms they contain, and that the entropy of solution is a linear function of the heat of solution.

The value of new methods, such as those of density and magnetic susceptibility, in studying solutions, was brought out in many papers. Perhaps the most important was the study of the infra-red absorption of solutions carried out by J. Errera. He was able to show, for example, by a change of frequency in absorption in a solution of alcohol in carbon tetrachloride, that the alcohol molecules are appreciably associated in pairs at concentrations so low as 0.1 mol.

With the analogous use of Raman spectra, it should be possible to determine in liquids and liquid mixtures the degree and kind of molecular association, because whenever this association is a close one it will affect both infra-red and Raman spectra. It may even be possible in some cases to calculate the intermolecular potentials from some form of model structure, as proposed by Magat. But so far, except in the case of water, where quantitative agreement can be got, the results are only qualitative. It is clear, however, that the time has come to begin attack on the problems of liquids and solutions on the basis of molecular theory, and that all this means we shall be able to explain many, at any rate, of the difficulties that have remained unresolved by the application of classical methods in this field.

The Edinburgh discussion of the Faraday Society showed the beginning of this process, and it is to be hoped that if the lead there given is followed up, the structure of liquids will no longer remain the most unsatisfactory part of molecular physics.

Obituary Notices

Mr. P. A. Ellis Richards

By the death on December 22 last of Percy Andrew Ellis Richards at the age of sixty-eight years, Great Britain lost one of its foremost public analysts, chemistry one of its most devoted servants, and the teaching profession one who graced it throughout a long and successful career. Born in 1868, and educated at St. Paul's School and King's College, London, he studied analytical chemistry under the late Prof. C. W. Heaton, whom he succeeded as lecturer in chemistry at Charing Cross Hospital. After the passing of his chief, he set up in practice as a consulting and analytical chemist, and was soon appointed public analyst for the parish of St. Martin-in-the-Fields, continuing his work in this capacity when his parish was joined with others to form the City of Westminster. Not long after, he was appointed to a similar post at Hammersmith, and held both until a few years ago, when failing health compelled his retirement.

During his analytical career, Richards carried out work upon the 'facing' of rice, on vinegar, and on preservatives in imported meat for the Local Government Board—now the Ministry of Health. He also served on the Departmental Committee on Preservatives and Colouring Matters in Food appointed by the Minister of Health in 1923, and on the Departmental Committee on 'Improvers' in Flour in 1925. He contributed numerous papers to scientific journals upon topics not only in his own sphere, but also upon other subjects such as the saline waters of Boston Spa and of Salsomaggiore, ancient Russian and Irish bog oak, the determination of platinum in alloys, and the determination of iron in animal organs in connexion with researches on pernicious anaemia.

Richards' merits as a teacher were no less than those as an analyst. Very many past students of Charing Cross and the Royal Dental Hospitals and of Queen's College, London, will recall with gratitude his gentle and painstaking manner no less than his

powers of lucid exposition of difficult points in chemistry and metallurgy. He was the author of what is perhaps the best-known work on practical chemistry for medical students.

Richards was unstinting in the service he gave to chemistry. He was a fellow of the Chemical Society, a fellow of the Institute of Chemistry and a member of the Society of Public Analysts. He served the Institute for two periods of four years as a member of Council and for another four-year period as examiner in food and drugs. He was for seventeen years honorary secretary to the Society of Public Analysts and for two years its president.

A marked ability in matters financial was put to very good use as bursar of Queen's College, treasurer of the Royal Dental Hospital and sometime auditor to the Institute of Chemistry. For many years honorary analyst to Charing Cross Hospital, his marked interest and ability in medical chemistry and toxicology led to his being consulted in some famous cases.

During Richards' life scientific history has been made. From the beginnings of the Periodic Law which his early days witnessed, we have progressed as far as the expansion of the Periodic Table to include elements that Nature has apparently never made, but which her creature man has. To readers of NATURE the enormous growth of chemistry within the past forty years or so will need no stressing, nor will the recent coming into its own of Richards' side of it—analytical chemistry. This part of the science, once almost contemned, has been called upon successfully to elucidate problems ranging from the detection of elements in far-off worlds to the fixing of the approximate age of our own world.

Science had in Richards a loyal and energetic servant who contributed his due, and more, to its advancement; it mourns one who at the height of his powers was laid aside, and to his infinite regret had to look on while work to which he had devoted his life was being brought to a successful conclusion. His interest in science never flagged during his years of failing health, and it afforded him keen pleasure to witness the ultimate glorious success of the branch of it which he had made his own.

F. W. EDWARDS.

Mr. L. de Whalley

MR. LAWRENCE DE WHALLEY, formerly chief chemist of Messrs. Tate and Lyle, died at his home at Orpington on January 9 aged eighty-three years. He was born and educated in Lancashire, and was successful in obtaining a scholarship at the Royal School of Mines, London, where he worked under Huxley, Valentin and Edward Frankland, whose honorary assistant he became. He attended Prof. Seeley's geological excursions and was keenly interested in Nature and natural history, an interest he never forsook. At the University of London he obtained his B.Sc. with honours in physics, and was one of the original members both of the Physical Society and of the Society of Chemical Industry, being honoured at the latter's jubilee in 1931, when

he was presented with its memorial plaque. He was also a fellow of the Institute of Chemistry and of the Chemical Society, a member of the Society of Public Analysts and one of the founders of the Chemical Club. His earliest appointment was at the works of Messrs. Forbes, Abbot and Leonard, now part of the South Metropolitan Gas Co. In 1890 he joined his two brothers-in-law, the late John Joseph Eastick and Charles E. Eastick, later managing director of Martineaus, Ltd., at the refinery of Messrs. Abram Lyle and Sons at Plaistow Wharf, Victoria Docks, London, and became chief chemist when J. J. Eastick left to take up an appointment in Australia. This position he held until his retirement in 1930.

De Whalley was a great authority on matters of sugar refining, particularly in regard to bone charcoal, and was one of the first to see the advantages of using kieselguhr for sugar filtration. He introduced the affination process at Plaistow Wharf, and greatly improved the manufacture of golden syrup. He originated the iron test for sugar liquors and the sulphide stain method for sulphites, and was one of the first to adopt Molisch's alpha-naphthol test. He attended many international conferences on sugar analysis both in Great Britain and on the Continent and visited many foreign countries and refineries in regard to process developments. He was chairman of the Congress of Sugar Chemists (The Raffinose Conference) at the Sugar Institute in Berlin in 1910, when he contributed some work on raffinose in raw beet sugar. During the Great War, he was a representative at the Royal Commission on Sugar Supply; in August last he attended the meeting of the International Commission for Uniform Methods of Sugar Analysis.

De Whalley was a good mathematician and linguist and a lover of the classics, having in early life learnt Latin and Greek. He spoke French, German, Russian and Polish and was frequently engaged in the translation of technical works even up to within a week of his death. For many years he was an abstractor in the sugar section for the *Journal of the Society of Chemical Industry*.

In addition to his scientific work, de Whalley found time to interest himself in many other different spheres, and was for many years secretary and later president of the Cheerybles Musical Society. He was also a Freemason of long standing and high rank, Grand Lodge of England.

De Whalley married in 1883 Annie, only daughter of Z. Eastick, an early gas works chemist, and leaves a widow and twelve sons and daughters, nine of whom are married, and nineteen grandchildren.

We regret to announce the following deaths:

Prof. Michael Lenhossek, emeritus professor of anatomy in the University of Budapest, and president of the Hungarian Academy of Sciences, an authority on the histology of the nervous system, on January 26, aged seventy-three years.

Dr. F. Sowerby Macaulay, F.R.S., known for his mathematical work, on February 9, aged seventy-four years.

News and Views

Science and Social Ethics

THE attitude of scientific workers towards warfare, and what it now signifies to the future of the human race, has been the subject of many articles and other communications published in *NATURE* in recent years. Following a leading article in the issue of May 9, 1936, a letter from twenty-two graduate workers at the University of Cambridge was published in *NATURE* of May 16, and similar views on the international character of science and the barbarity of war were afterwards expressed by representatives of science in Cape Town and Bangalore. Whatever part physical conflict between individuals or communities has taken in the progressive development of man in the past, it cannot be questioned that the outlook for the future is very dark if all the resources of modern science are to be available for destructive purposes in the struggle for superiority among nations. Dr. Goebbels, who practically controls the Press of Germany, has said: "War is the most simple affirmation of life. Suppress war, and it would be like trying to suppress the processes of Nature". Such a primitive conception of the functions of war leaves out of consideration man's ethical and spiritual nature, and regards him purely as a fighting animal. Those of us who believe in a higher destiny for the human race cannot think it will be achieved through the use of high explosives, poison gas and incendiary bombs to settle disputes between civilized communities. It is because of such uses of their discoveries that scientific workers have not only the right but also the responsibility of making a collective pronouncement upon these disturbing aspects of our so-called civilization. Science has a message to deliver and a social mission to perform with far higher aims than those usually associated with it in the public mind. It believes in the evolution of social ethics, and therefore associates itself with all spiritual teaching which will promote peace upon earth and goodwill among men. On this account we are glad to put on record the following resolution adopted at the spring session of the Church Assembly at Westminster last week; and we suggest that a similar resolution might just as appropriately be passed at a representative assembly of workers for the advancement of natural knowledge.

The Christian Church and War

THAT this Assembly—

- (1) endorses the Resolution of the Lambeth Conference, 1930, that war as a method of settling international disputes is incompatible with the teaching and example of our Lord Jesus Christ;
- (2) deplors the general rearmament throughout the world;
- (3) calls upon all Christian people to redouble their efforts to promote international good will;

(4) assures the Government of its moral support in all efforts to remove the political and economic causes of war, and in securing a general reduction of armaments by international agreement;

(5) welcomes the declared policy of the Government to adhere to the Covenant of the League of Nations, and to use armed force only for the defence of the country and in the interests of international security and peace;

(6) recognizes the right of the Government to maintain such forces as the Imperial Parliament deems necessary for the pursuance of this policy, and believes that, so long as this policy is maintained, Christian citizens may bear arms in the service of their country;

(7) affirms the responsibility of Christian people to support, criticize, or oppose all defence programmes in the light of Christian principles and in relation to their advancement of the Kingdom of God.

The University of Oxford Appeal

ON February 9, in speeches by Lord Halifax and others at the Goldsmiths' Hall in London, the appeal that the University of Oxford is making for money was launched. The capital sum aimed at is a million pounds, and some of the needs for which this sum is required are urgent. About a quarter of it is needed to ease the fund which the University has been accumulating for paying its share of the large cost of the extension to Bodley's library now being built. A similar amount is needed for the erection and equipment of new laboratories and other buildings. The remainder is required as a trust fund, the interest of which may be used to endow for a period of years new developments in any subject which looks promising, rather than be tied down to this particular subject or that. These needs are altogether separate from those of the medical school, which have been generously met by Lord Nuffield recently, and cannot be paid for out of his two million pounds gift. That gift, unlike some gifts, will not in any way be a liability on the University, but obviously the new school of clinical research which it is calling into existence, by quickening research throughout all departments of the University, must indirectly make new endowments of scientific departments a necessity. The needs for which the appeal is being made are, indeed, independent of, and of longer standing than, those of the medical school, and Lord Nuffield has recognized this by subscribing an additional £100,000 towards the million pounds required.

AGREEMENT has been reached as to the order in which the immediate scientific needs should be met. Most urgent is a new physics building for Prof. F. A. Lindemann. The Clarendon Laboratory of 1872, in which his department is housed, was never a suitable

place for research, and despite the ingenious make-shifts its deficiencies have called forth, has now become almost intolerable. It is proposed to adapt this laboratory for the Department of Geology, at present cramped in the Museum itself, and to erect and equip a new building near the old and consequently near the other Physics Department, the Electrical Laboratory. The Clarendon should be a suitable place for the Department of Geology, which under the new professor to be elected soon should readily take on a new lease of life within it. Next, it is intended to build a physical-chemistry institute—the first *University* building for this subject—not, as might be thought most convenient, next to the Inorganic Laboratory (there is quite insufficient space available there for an adequate new building, especially when possible extensions of both departments are envisaged), but immediately on the other side of the Organic Chemistry Laboratory from it. Researchers in physical chemistry who now do their work in the laboratories and cellars of Balliol, Trinity and Jesus Colleges, overflowing at times into the engineering and organic chemistry laboratories, should find in the intended University institute an ampler and much more convenient home. After that building has gone up, it is hoped to rebuild, near by, the Physiology Laboratory, which dates from 1884.

Reflection of Radio Waves from the Middle Atmosphere

THE method of studying the ionized regions of the upper atmosphere by emitting small pulses of electric waves and recording the echoes reflected from the ionosphere is now well-known and is in everyday use in many parts of the world. The commonly recognized reflecting regions are at heights of 80 km. and above. Communications to the correspondence columns of NATURE of May 9 and 23, 1936, described observations indicating the existence of reflecting regions at much lower heights. These new regions were first discovered in May 1935, and an account of their investigation over a period of about a year from that date was given in a paper presented on February 4 to the Royal Society by R. A. Watson Watt, A. F. Wilkins and E. G. Bowen. A summary of the paper will be found on page 299. It appears from this work that there may be three electrified regions in the middle atmosphere at average heights of 10, 40 and 60 km., which are capable of reflecting radio waves of frequencies of the order of 6 megacycles per second and above (wave-lengths 50 metres and below). The lowest region has been found to be stratified to such an extent as to indicate the existence of five distinct layers at heights between 8.5 and 13.5 km., with reflection coefficients as high as 0.7. The observations so far made do not indicate any marked diurnal or seasonal changes. An interesting feature of the investigation so far conducted is that echoes from these layers have been recorded at sensibly vertical incidence at wave-lengths at and below those now in use for the television service. The existence of such echoes would cause the picture seen in a television receiver to have a doubled or blurred appearance. There is, however,

insufficient evidence available to state how serious this possibility may be in the development of television services on the wave-lengths at present in use.

Auroral Display on February 3

REPORTS from various observers in Yorkshire and south Lancashire, who witnessed a display of the aurora borealis in the evening of February 3 last, have appeared in the *Yorkshire Post*. The aurora, which was evidently a striking phenomenon to those favoured with a clear sky, began about 18^h 30^m and lasted for an hour. One observer at Bradford noted a broad band of red passing overhead from east to west. On inquiry at the Royal Observatory, Greenwich, it was stated that a magnetic disturbance, which could be associated with this aurora, had been recorded at the Abinger magnetic station. The disturbance began suddenly on February 2 at 23^h 5^m U.T., and within a few hours a range of 220 γ in horizontal force had been registered. The disturbance then died down, but was renewed between 17^h and 22^h on February 3; a typical movement (associated with auroras) in declination occurred about 19^h with a range of $\frac{3}{4}^\circ$, the range in horizontal force being 190 γ . At the commencement of the magnetic disturbance on Feb. 2^d 23^h, the centre of the large sunspot, reported on p. 228 of NATURE of February 6, was about 40° west of the sun's central meridian and the following extremity of the spot about 32° west. A statistical analysis made at Greenwich of big sunspots and associated magnetic storms shows that spots of the size of the recent one are associated, in about two out of three cases, with either a large or a small magnetic storm, occurring on the average about 1½ days after the central meridian passage of the spot. It may be added that 27 days (or a solar synodic rotation) before the aurora on February 3, the Abinger magnetic traces at about 19½^h on January 7 show a movement distinctive of auroral activity. An observer at the Saltburn Coastguard Station who saw the aurora on February 3 is reported by the *Yorkshire Post* as having stated that he "saw the lights a month ago".

The United States Floods

WHILST it is fully expected that the liability of the countryside to flooding through the possible bursting of the riverside levees in the Mississippi Valley will continue to be a menace for another week or ten days, yet there has been a perceptible diminution in the anxiety felt as regards the general situation, which is much more satisfactory than at the time of our previous issue. The crest of the flood wave is gradually diminishing in height. It did not quite reach the anticipated level at Cairo, and as it passes down the valley, unless reinforced by fresh rains, it should subside in intensity. There is believed to be a margin of at least four feet available above water surface level from New Madrid to New Orleans, and this should be adequate for the occasion. None the less, caution is being exercised, and some 120,000 workmen are being kept on the alert along the course

of the river to deal at once with any incipient signs of weakness in the banks. In the Ohio Valley, the inhabitants are being permitted to return in detachments to their houses. The total death roll, as at present ascertained, amounts to 407, and the number of homeless is still in the neighbourhood of a million. At Louisville, several persons have been killed and a score or so injured in a series of explosions due to the ignition of an accumulation of gas in buildings following the inundation of the town.

As regards the damage done in the Ohio Valley, more accurate computation raises the figure to 527 million dollars (105½ million pounds) for the five States of Indiana, Kentucky, Illinois, West Virginia and Ohio. The fund contributed to the American Red Cross for the relief of sufferers has reached a total of three million pounds and the American Senate has passed a Bill authorizing a relief appropriation of 790 million dollars (158 million pounds). President Roosevelt has sent to Congress a report of the National Resources Committee with a message advocating the sanction of a "long-range plan and policy for construction" to ensure protection for the nation from a repetition of such calamitous experiences. The scheme is estimated to cost 2,750 million dollars (550 million pounds) and would occupy a period of about six years to complete. It covers flood protection and drainage work in almost every State of the Union.

Floods in France and Southern England

THE north of France has been experiencing an abnormal amount of rainfall during the past few days which has resulted in the flooding of extensive areas of country between Dunkirk and Cassel and between Hazebrouck and Armentières on the Flanders frontier. The River Lys has overflowed its bank both at Armentières and Bethune, while at Houtlines a number of dwellings have had to be evacuated. The bursting of a dam at St. Denis, north of Paris, has resulted in local flooding to a depth of five feet, and some fifty families have had to leave their homes. In southern England, after some further heavy rainfall and a resumption of the rise in the level of the Thames, the flood waters are again subsiding, and there does not seem to be further cause for alarm.

A Volcano under an Ice-Sheet

AT an evening meeting of the Royal Geographical Society on February 8, Dr. Niels Nielsen gave an account of volcanic eruptions in 1934 and 1936 underneath the ice-cap of Vatnajökull in Iceland. Subglacial volcanic outbursts of this character have been known for many years from the catastrophic floods—known in Icelandic as *Jökullhláup*—which result from the melting of the ice adjacent to the hot lavas and ashes, but until the investigations of Dr. Nielsen and his collaborators, no scientific accounts of these phenomena were available. It appears likely that there are at least two types of these volcanic outbursts—one, as at Grímsvötn, probably

of central type, with a relatively small output of ash material but enormously energetic, forming craters in the ice; and another at Hágöngur, perhaps a fissure eruption, which produced a considerable amount of lava but so little energy that it was unable to penetrate through an ice-sheet only 100–200 metres thick. The volume of glacial melt-water liberated by the first of these volcanic outbursts was in the neighbourhood of ten thousand million cubic metres. The geological interest of these remarkable phenomena is great. Following upon the University of Glasgow geological expedition to Iceland in 1924, Dr. Martin Peacock postulated that the early-glacial 'palagonite formation', a great series of globular basalts and tuffs which covers very extensive areas in Iceland and builds up some of the highest mountains in that island, was formed by the extrusion of lavas under the thick Pleistocene ice-sheet. Dr. Nielsen (*Geografisk Tidsskrift*, Dec. 1936) has shown that rocks wholly similar to the palagonite formation have been formed in these recent eruptions, with the result that Peacock's hypothesis is now brought within the realms of established fact.

Transition State in Chemical Reaction

THE thirty-sixth Bedson Lecture was delivered by Prof. M. Polanyi, of the University of Manchester, on February 1, in Armstrong College, Newcastle-on-Tyne. Prof. Polanyi took as his subject, "The Transition State in Chemical Reactions", and illustrated his remarks with particular reference to the ozone-oxygen reaction. Molecules are closely-packed groups linked by chemical bonds and separated by wider gaps from other molecules. The course of a chemical reaction between the molecules involves the breaking of these original chemical bonds, with the formation of new ones. During this change, the gaps between the initial molecules disappear and new ones appear between the final molecules, and between these two states there must be an infinite number of atomic configurations. At some point between the initial and final gaps separating the molecules, there is an intermediate state when no distinction can be drawn between the initial and final states. This is defined as the 'transition state of the reaction'. Turning from the purely geometric to the energy conception of the transition state, Prof. Polanyi demonstrated how the potential energy in the reaction between the molecules rises to a maximum. The position of the maximum indicates the transition state, and further, the energy of the reaction must be sufficient to surmount this energy barrier. Hence the plotting of the energy changes occurring in the reaction of two particles will indicate the transition state and the energy of activation of the reaction. Prof. Polanyi traced the evaluation of the energy changes and showed how it was possible to determine the heat of activation by application of wave mechanics and molecular constants. He also indicated how various properties of the transition state determine the changes in reaction rate caused by varying conditions such as hydrostatic pressure, change of solvent, etc.

Scientific Associations of Coventry

A JOINT meeting of the Coventry Engineering Society and the Midland Branch of the Institute of Physics was held in the Coventry Technical College on February 5, when Sir James Jeans delivered a lecture on "Some Large Scale Problems of Astronomy". Sir Alfred Herbert, president of the Society, presided over an audience of more than 900. Prior to the meeting, a civic reception was given to Sir James Jeans, and in welcoming him and Lady Jeans to Coventry, the Mayor (Alderman A. H. Barnacle) mentioned some well-known men of science who had been associated with Coventry. Among them were Thomas Huxley, who spent his boyhood in the City, and Sir Norman Lockyer, who was born at Rugby and spent his youth at Ashow, and was connected by marriage with some of the oldest families in Coventry. In speaking of Sir Norman's work, the Mayor pointed out that he founded *NATURE*, which he referred to as the leading scientific periodical of its kind in the world. In his reply, Sir James recalled an early visit to Coventry when he was about five years of age; he was shown a tree which he was told marked the centre of England, but, he continued, "I wondered how a tree could be the centre of an area which I imagined was nothing like circular". Following the reception, a private dinner in honour of Sir James and Lady Jeans was given in the ancient St. Mary's Hall by Sir Alfred Herbert. Among those present were representatives of the Institute of Physics and well-known local industrialists and civic officials.

Centenary of Practical Marine Screw Propulsion

To mark the centenary of practical marine screw propulsion, a special exhibit was opened at the Science Museum, South Kensington, on February 11. In accordance with the usual practice of the Museum, this shows both the history of the pioneer experimental work, as well as the subsequent developments and current practice in marine screw propellers. In February 1837, Francis Pettit Smith successfully tried his first screw-propelled steam launch (a model of which is shown) on the Paddington Canal. The screw had two complete turns; on one of the trips it struck an obstacle, and about one-half of it was broken off. To the inventor's astonishment, this accident materially increased the speed of the boat. The S.S. *Archimedes* (1838) was fitted with a double-threaded screw of half a turn, in accordance with Smith's amended patent. Other historical exhibits include models of Ericsson's experimental screw of 1837, and those of the S.S. *James Lowe* (1838), the S.S. *Novelty* (1839-40), and the first French screw steamer *Napoléon* (1843). Screws were at first used as an auxiliary means of propulsion, and in order that they should not impede the vessel when under sail only, lifting screws (an example by Maudslay, 1846, is shown) were introduced, which could be disconnected from the shaft and raised clear of the water. Other developments represented are the 'common screw', which was the most successful form of propeller up to about 1860, Hirsch's propeller

(1860-66), and the adjustable pitch propeller patented by Griffiths in 1868. Various examples of modern practice are also included, notably a model of the four-bladed bronze propellers of the Cunard White Star liner R.M.S. *Queen Mary*, which are 20 ft. in diameter, each weighing 35 tons. These are the largest screw propellers which have ever been cast in one piece.

Gift to the Massachusetts Institution of Technology

IN connexion with the announcement last month of a bequest of one million dollars to the Massachusetts Institute of Technology under the will of Mr. Charles Hayden, Dr. Karl T. Compton, president of the Institute, has issued a statement in the course of which he says that: "Mr. Hayden's generous bequest to the Massachusetts Institute of Technology only serves to emphasize the constructive value of his lifelong interest in the institution and the great personal loss suffered in his passing. At the time of his death, he was not only a member of the corporation of the Institute but was also a member of its finance committee, chairman of its student loan fund committee and chairman of the research associates of M.I.T. To the latter two of these activities Mr. Hayden had been a generous contributor as well as active in their administration. Mr. Hayden's interest . . . in his professional training in mining engineering was given material expression in his contribution of a principal portion of the funds used in the construction of the Institute's building devoted to mining and metallurgy. In addition to these major contributions Mr. Hayden was continually and quietly contributing to student needs. . . . His specific bequest of one million dollars to the Institute gives us great encouragement and will enable us quickly to make substantial progress in the twelve and a half million dollar program of objectives which were approved by the corporation last October as representing the urgent needs of the institution at this time."

Lawrence Memorial Medal

THE Lawrence Memorial Medal of the Royal Central Asian Society has been awarded to Sir Charles Bell, the great authority on things Tibetan, whose friendship with the late Dalai Lama was an outstanding event in British relations with Tibet, and who has an intimate and authoritative knowledge of events in Tibet and Mongolia, on which he has written valuable books. This is the second award of this medal, the first having been made to Major J. B. Glubb, in recognition of his work in administering the nomad territory of Northern Arabia, which lies within the frontiers of Trans-Jordania, and the success he has had in promoting friendly relations between the tribes of that region. The Lawrence Memorial Medal was founded by the Society in memory of T. E. Lawrence, under the then president, the late Lord Allenby. It exists to recognize work of outstanding distinction in travel, research or letters, when such work contributes to the study and the solution of the problems of Asia, made by officials, travellers, students or others who are working in the area covered by the activities of the Royal Central Asian Society.

London Television Service

THE first public demonstrations of the reception of television programmes from the British Broadcasting Corporation's experimental station at Alexandra Palace were given on the occasion of the Radio Exhibition at Olympia in August 1936. These were followed in November by the inauguration of the present television broadcasting service from the same station. In accordance with the recommendations of H.M. Postmaster-General's Television Advisory Committee, the programmes were shared between two separate transmitters installed respectively by the Baird Television Co., Ltd., and by the Marconi-E.M.I. Television Co., Ltd. The object of this arrangement was to enable an adequate, practical test to be made to ascertain the relative merits of the two systems of transmission, which differ considerably in technical details and in scanning speed and picture frequency. According to an announcement in *The Times*, the Television Advisory Committee has now recommended that the experimental period should be terminated, and that a single set of technical standards should be adopted for public transmissions from the London station. This recommendation has been approved by the Postmaster-General, and provides for a standard of interlaced scanning at a speed of 405 lines per picture, with a picture frequency of 50 per second. The result of this decision is that in future the B.B.C. television programmes from the Alexandra Palace will be emitted by the Marconi-E.M.I. system, although it may be possible to convert the Baird system to the required standards at a later date. The adoption of the new standards, which will not be altered before the end of 1938, will render possible a certain degree of simplification in the design of television receivers. In common with those of other firms, the existing receiving sets made by the Baird Company are capable of receiving the Marconi-E.M.I. transmissions.

Sir Joseph Banks's London House

It is too late to protest against the destruction of Sir Joseph Banks's town house at 32 Soho Square, and our commercial age will demand its removal together with many other examples of eighteenth century domestic architecture. Only the tablet placed on the house in 1911 and the description and plan in *Country Life* of September 27, 1913, will remain to us. Sir Joseph moved there from New Burlington Street in the autumn of 1777, and remained there until his death in 1820. The Linnean Society leased part of the house from 1827 until 1857, when it moved to Old Burlington House. The subsequent tenants, including the Hospital for Diseases of the Heart and a firm of decorators, made many alterations, but the fine ceilings and an exquisite overmantel and fireplace were reminders of its original beauty. Banks's magnificent collections were housed there under the able care of the botanist-librarians Solander, Dryander and Robert Brown. Banks bequeathed his collections to Brown, who transferred them to the British Museum, remaining in charge of them until his death in 1858.

A National Industrial Health Service

THE Medical Research Council, with the Industrial Health Research Board as well as the various colleges and schools of the universities, are occupied with research work which has, either directly or potentially, an industrial application; the time-lag, however, in applying or testing the results of such research work is usually too long. Some large organizations provide a full-time medical service, but there are many which have not yet realized that there is any need for such a service, and the smaller organizations cannot afford this. Even when a medical officer is appointed, his previous education has not trained him to recognize, or to deal adequately with a number of problems he meets, nor does he know where to get the required knowledge which, unknown to him, may exist. With the rapid development of new processes utilizing new products, it is necessary that their physiological and toxicological properties should be studied: also the medical officer will find himself confronted by a number of psychological problems concerning which he knows little or nothing. Discussions of the problem of making practically effective in industry the results of research work of medical importance have appeared in *Industrial Welfare* of December 15 and the *British Medical Journal* of December 5. Since it seems impracticable to add anything to the curriculum of the medical student, a post-graduate course is suggested. The works' doctor must be able to ascertain that (a) the workers taken on for certain jobs are reasonably fit to carry them out from the health point of view, and (b), in co-operation with works' engineers and others, that the conditions under which the employees are required to work are not prejudicial to their health.

SINCE small organizations cannot afford to give the medical services possible to the larger ones, some way of providing them must be considered. One way would be for a number of small organizations to be served by one medical officer; there are, of course, difficulties in the way, but they need not be insuperable. Who shall pay for these services must also be considered. Shall the organizations or the State? It is suggested that a National Industrial Health Service should be formed, which should include not only a medically qualified personnel, but also a number of engineers who have been trained in the study of works' practice from the physiological point of view, physiologists and medical-industrial psychologists. Not only would the curative aspect of industrial medical practice be dealt with but also the preventive, and this would involve the study of the conditions of work and the total environment of the employees. It would also be the business of this service to keep in touch with existent research work and bring it to the notice of those concerned. There should also be some arrangement whereby the application of a particular piece of research or investigation could be considered: for this a special committee or board is needed, comprising representatives of the State, the industry concerned, the trade union or unions representing the particular industry, and the research worker or organization responsible.

Supply of Vitamins in Soviet Russia

PROF. P. V. GOLOVIN, president of the Vitamins Council of the Soviet Commissariat of the Food Industry, has recently stated that whereas the anti-scurvy vitamin C used previously to be manufactured from conifers, it is now being made from the sweet briar rose. Vitamin C is mainly used by people living in the north and in the Arctic. In 1935 three million doses of this vitamin were manufactured in Soviet Russia, and in 1936 thirteen million doses would be turned out. Confectionery factories are now producing caramels, sugar plums and jellied sweets containing vitamin C. Two vitamin factories have been constructed in Leningrad and Schnellkovo. In the latter place a vitamin combine is being built which would produce vitamin A in addition to vitamin C. In Moscow a factory has been built for the manufacture of anti-rickets vitamin D obtained from yeast.

Announcements

SIR ALBERT SEWARD, formerly professor of botany in the University of Cambridge, was elected an honorary member of the New York Academy of Sciences at its annual meeting held on December 21.

LORD SWINTON, Secretary of State for Air, has appointed Dr. D. R. Pye to be director of scientific research in the Department of the Air Member for Research and Development, Air Ministry, on the retirement of Mr. H. E. Wimperis, and Mr. W. S. Farren to be deputy director of scientific research in succession to Dr. Pye.

DR. E. NEAVEYSON has been awarded the Medal of the Liverpool Geological Society. Dr. Neaveyson, who is senior lecturer (palaeontology) in the Department of Geology of the University of Liverpool, is well known for his work on the Carboniferous rocks of North Wales and the Quaternary beds of the Rhyl district. Farther afield, he has carried out research on the bottom-deposits collected on the voyages of the R.R.S. *Discovery*. He is a past president of the Liverpool Geological Society.

THE following appointments have recently been made to the Colonial Service: A. C. E. Callan, produce inspector, Agricultural Department, Zanzibar; W. K. Hubble, principal, Kadoorie Arab Agricultural School, Tulkarm, Palestine; G. F. Clay, (deputy director of agriculture, Uganda), assistant director of agriculture, Nigeria; W. F. Jepson, (Phytalus investigator), entomologist, Agricultural Department, Mauritius; H. Macluskie (agricultural superintendent, British Guiana), agricultural officer, Sierra Leone.

It is announced in *Science* that, following the Harvard tercentenary, the French Government has conferred membership in the Legion of Honour with the rank of commander on President J. B. Conant. Prof. George D. Birkhoff, Prof. Julian L. Coolidge, Prof. James B. Munn and Jerome D. Green, director of the tercentenary, have been promoted from the

rank of chevalier to that of officer of the legion. The rank of chevalier has been conferred on Profs. Bliss Perry, Edward B. Hill, Edward W. Forbes, Roger Bigelow Merriman, Ralph Barton Perry, Edward A. Whitney, Kenneth J. Conant and George H. Edgell.

THE one hundredth and fifth annual meeting of the British Medical Association will be held in Belfast, commencing on July 16. The president-elect is Prof. R. J. Johnstone, professor of gynaecology in Queen's University, Belfast.

THE Faraday Society will hold a general discussion on "The Properties and Functions of Membranes, Natural and Artificial", on April 22-24, at University College, Gower Street, London, W.C.1. Another discussion on "Reaction Kinetics" will be held in the University of Manchester on September 13-15. As is usual at these general discussions, contributions will be made by a number of foreign men of science. Further information can be obtained from the Secretary, Faraday Society, 13 South Square, Gray's Inn, W.C.1.

A SERIES of eight lectures on "The Economic Problem and World Peace" to be given in the Essex Hall, Strand, London, W.C.1, during February and March has been arranged by the National Peace Council. The first lecture, on February 8, was given by Graham Hutton on "The Continental Western Democracies". Subsequent lectures cover "The Small Countries of Central and South-Eastern Europe" (T. Balogh); Germany (B. Thomas); Italy (H. Fines); the Soviet Union (L. Segal); Japan and China (F. Utley); the United States (H. Quigley) and the British Empire (H. V. Hodson). The lectures are to be given on Mondays at 6.15 and tickets (4s. for the course) and other particulars can be obtained from Mr. G. Bailey, National Peace Council, 39 Victoria Street, S.W.1.

THE Rockefeller Foundation has recently given 9,000 Swiss francs to the University Psychiatric Clinic at Bern for the erection of a laboratory for investigation of the anatomy of the brain.

NORWAY has introduced a regulation by which no professional motor-driver may consume any alcoholic beverage while driving or during the previous eight hours. In suspected cases a blood test is carried out, when, if the blood has an alcohol content of more than 0.5 per mille, the law will be considered to have been broken.

In the letter entitled "Equivalent Particle Observers" by Prof. Leigh Page in *NATURE* of January 16, p. 111, the first sentence of the second paragraph should read: "My approach to the relativistic kinematics differs from Milne's in that I employ the concept of equivalence to establish reference systems consisting of dense aggregates of synchronous particle-observers relatively at rest".

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. 290.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Nature of the Causative Agent of the Rous Fowl Sarcoma

THE opinions of workers in the field of Rous sarcoma are divided into two schools, one of which uses as a working hypothesis the suggestion of Fraenkel¹ that the agent is a pure chemical substance or a 'virus-enzyme', while the other considers it to be a particle resembling a virus. These opinions are represented by two quotations from recent publications. Murphy² states that "Without proof that normal tissues harbour the cancer virus, a fantastic conception and one difficult of experimental test, the virus theory for the etiology of cancer appears untenable. The only proved relationship is that a virus may act as a carcinogenic agent in initiating changes leading to malignancy, but has no part in the formal genesis of neoplasms." Against this may be set the contention of Amies³ that "The total evidence seems, therefore, sufficiently strong to justify the conclusion that the tumour agents exist in the form of elementary bodies similar to but somewhat smaller than those which represent the causal agents of such typical virus diseases as Vaccinia and Fowl-Pox".

We have confirmed the fact that it is possible to deposit the agent from extracts of Rous sarcoma by centrifugation at 15,000 r.p.m., but we have been unable to obtain satisfactory correlation between the number of elementary bodies in different active preparations and the infectivity of the extracts. The supernatant after centrifugation is usually much less active and contains many fewer ultra-microscopic particles than the original extracts, but the infectivity of material concentrated many times on the centrifuge is seldom so active as would be suggested by the enormous numbers of elementary bodies present. An example will make this point clear:

Material injected	Minimum volume required to give tumour	Ultra-microscopic appearance
Original Extract	0.005 c.c.	Very large number of particles
Supernatant after centrifuging for 1 hour at 15,000 r.p.m.	0.50 c.c.	Very few particles
Deposit made up in 1/45 of original volume	0.20 c.c.	Very large number of particles

This observation was confirmed by the use of eluates prepared from the deposit obtained by adsorption of tumour extracts on to Willstätter's alumina⁵. In such eluates we have often observed very few elementary bodies, and yet they had an

activity comparable with that of the original extract. Our impression is that the tumour-producing activity of Rous extracts is associated with material which can be deposited at 15,000 r.p.m., but we believe that only a small proportion of the elementary bodies visible in the extract can be associated with that activity, and we would emphasize that the possibility that the active agent is adsorbed on the surface of such particles cannot be excluded. Particles with similar optical properties can be obtained from normal tissues or glycogen solution by fractional centrifugation. Such a process in itself ensures uniformity of optical properties in the product, so that if all the particles in a preparation are similar in appearance, this gives little information as to uniformity in their chemical or biological properties.

The hypothesis of a purely chemical agent of the Rous sarcoma seemed to be confirmed when Jobling and Sproul⁶ claimed that repeated injections of an acetone extract of fresh Rous sarcoma tissue would produce similar tumours. They stated further that if the residue from extraction was extracted again with acetone, the extract would only produce tumours if incubated with an extract of 'normal' tissue obtained by the injection of kieselguhr into the breast muscle of normal fowls. Tumours could also be obtained with carbon tetrachloride extracts of dried sarcoma powder if treated in the same way with 'normal' tissue extract.

We have attempted to repeat this work using acetone extracts of fresh tumour and dried sarcoma powder. We have kept our material as free from oxygen as possible throughout the experiment, and acetone extracts have always been thoroughly centrifuged at 3,500 r.p.m. and filtered through paper before removal of the solvent. Material was prepared for injection by dissolving in a little acetone and pouring into Ringer solution. Fine suspensions obtained in this way were injected alone or after incubation with 'normal' tissue extract, as described by Jobling and Sproul. We have also incubated the inoculum with embryo extract and with residues left after extraction, but we have never obtained a tumour by any of these means. We have, however, obtained tumours by injection of the residue left after acetone extraction of dried sarcoma powder, in agreement with the observation of Claude⁷, but no activity has been observed in the residue left from acetone extraction of fresh sarcoma tissue.

Unless our technique has differed in some way we have not appreciated from that of Jobling and Sproul, we must conclude that their results were due to fine suspensions of active material in their solvents, and this possibility is enhanced by the fact that in our experiments with dried powders the activity remained in the residue after extraction. This conclusion is

disappointing from the point of view of the 'chemical' hypothesis, but it does not exclude the conception suggested by the phrase 'virus-enzyme', as such a substance might be expected to be insoluble in acetone.

E. M. FRAENKEL.
C. A. MAWSON.

John Burford Carlill Laboratories,
Westminster Hospital Medical School,
London, S.W.1.
Jan. 19.

- ¹ Fraenkel, E. M., *Z. Krebsforsch.*, **35**, 47 (1931).
- ² Murphy, J. B., *Proc. Staff Meetings, Mayo Clinic*, **11**, 789 (1936).
- ³ Amies, C. R., *Ann. Rep. Brit. Emp. Cancer Campaign*, 281 (1936).
- ⁴ Fraenkel, E. M., and Mawson, C. A., *Rep. Intern. Cong. against Cancer* (Brussels, 1936).
- ⁵ Fraenkel, E. M., and Mawson, C. A., *Brit. J. Exp. Path.*, **16**, 416 (1935).
- ⁶ Jobling, J. W., and Sproul, E. E., *Science*, **84**, 229 (1936).
- ⁷ Claude, A., *J. Exp. Med.*, **61**, 41 (1935).

Measurements of Oxide Films on Copper and Iron

RECENT letters from Dobinski¹ and Nelson² report the rapid appearance of oxide upon unheated copper and iron on exposure to air. This oxide, which doubtless causes the rapid change in the behaviour of these metals to silver and copper nitrates respectively³, can be estimated by measuring the number of millicoulombs needed for its cathodic reduction. The principle was formerly used to measure silver iodide films⁴, and gave numbers agreeing with

THICKNESS (MEAN GENERAL INTERCEPTS*) OF OXIDE-FILMS.

Iron tinted to:	Electrical (New)	Optical (Constable)	Gravimetric† (New)
Straw	440A.	460A.	390A.
Reddish yellow	530	520	470
Red brown	560	580	500
Purple	625	630	560
Violet	695	680	625
Blue	725	720	650

Copper tinted to:	Electrical (New)	Optical (Constable)
1st Order		
Dark brown	370	380
Red brown	410	420
Purple	460	450
Violet	485	480
Blue	520	500
Silvery green	800	880
2nd order		
Yellow	940	980
Orange	1,170	1,200
Red	1,240	1,260

* We believe that both electrical and optical methods give the mean of the intercepts made by normals to the general plane of the surface. Some authorities prefer to use the word 'thickness' as denoting the mean intercept made by the local normals; if so, it is necessary to divide by the specific surface.

† The invisible oxide present on the surface during the first weighing must be determined electrically; the effect of embedded oxide will be considered in the Carnegie Scholarship Memoirs, vol. 25.

both gravimetric and iodometric methods. For oxide films it has yielded results in reasonable accord with optical⁵ and gravimetric methods (see accompanying table), and consistent with early chemical determinations made on the films after stripping⁶. Former disagreement between gravimetric and optical methods has been largely due to neglect of invisible films, or to different meanings attached to the term 'thickness' as applied to a non-uniform film on an uneven surface.

Having thus been tested on films of the interference colour range, the method has been applied to measure the invisible oxide produced on copper in a desiccator at 18° or in a furnace at 62° C. The points on Fig. 1

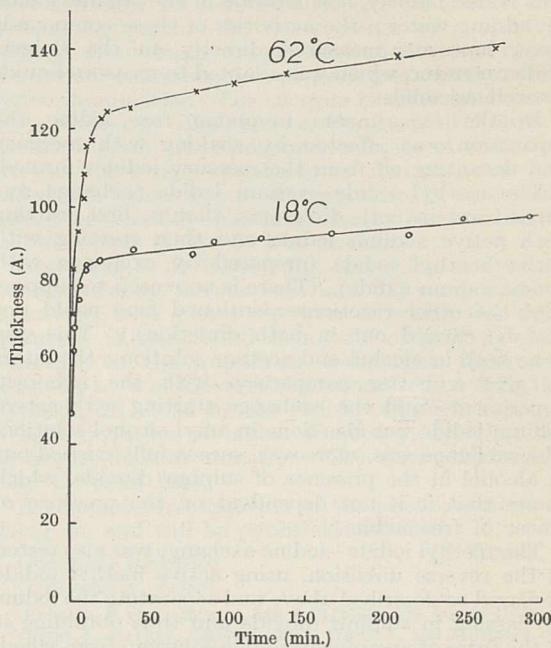


Fig. 1.

(each the mean of at least four determinations) may all be affected by a constant 'zero-error', due to eutectic oxide or other causes; this will not influence the shapes of the curves.

Additional results on iron will appear later in the Carnegie Scholarship Memoirs, vol. 25.

U. R. EVANS.
H. A. MILEY.

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University, Cambridge.
Jan. 18.

- ¹ Dobinski, S., *NATURE*, **138**, 31 (1936).
- ² Nelson, H. R., *NATURE*, **139**, 30 (1937). Nelson considers the low-temperature oxide to be Fe₃O₄; the authors incline to γ-Fe₂O₃.
- ³ Evans, U. R., *J. Chem. Soc.*, 2491 (1925); 1030 (1927); 101 (1929). Possibly the further development of the oxidation explains the slowly increasing resistance to a polluted atmosphere established by Vernon, W. H. J., *J. Chem. Soc.*, 2279 (1926); *Trans. Faraday Soc.*, **23**, 127, 164 (1927).
- ⁴ Evans, U. R., and Bannister, L. C., *Proc. Roy. Soc., A*, **125**, 378 (1929).
- ⁵ Constable, F. H., *Proc. Roy. Soc., A*, **117**, 376, 385 (1927-28).
- ⁶ Evans, U. R., and Stockdale, J., *J. Chem. Soc.*, 2656 (1929).

Exchange Reactions of Iodine Compounds

JULIUSBURGER, Topley and Weiss¹ found by the artificial radioactive indicator method that an exchange takes place between sodium iodide (c. 0.5M) and methyl iodide (c. 2M) in alcoholic solution at room temperature; the exchange is complete in a minute or two. Under similar conditions, allyl iodide exchanges with sodium iodide, but ethyl, propyl, isopropyl and methylene iodides do not; nor does iodoform exchange in acetone solution. Further, Glückauf and Fay's² successful concentration of active iodine from methyl iodide after neutron bombardment shows that no appreciable exchange occurs between iodine and methyl iodide in the absence of a solvent.

I have confirmed and extended these results (with the exception of the allyl iodide exchange). The technique for alcohol and acetone solutions was essentially the same as that of Juliusburger, Topley and Weiss, namely, a separation of the organic iodide by adding water; the activities of these compounds were, however, measured directly on the Geiger-Müller counter, which was adapted to measure liquids as well as solids.

In the experiments involving free iodine the separation was effected by shaking with mercury and decanting off from the mercury iodides formed.

The methyl iodide-sodium iodide exchange was carried out in both directions, that is, first starting with active sodium iodide and then starting with active methyl iodide (prepared by exchange with active sodium iodide). (There is no reason to suppose that the other reactions mentioned here could not also be carried out in both directions.) This was done both in alcohol and acetone solution—the latter to give a better comparison with the iodoform experiment—and the exchange starting with active sodium iodide was also done in amyl alcohol solution. The exchange was, moreover, successfully carried out in alcohol in the presence of sulphur dioxide, which shows that it is not dependent on the presence of traces of free iodine.

The methyl iodide-iodine exchange was also tested in the reverse direction, using active methyl iodide prepared as described above and separating the iodine by passing in sulphur dioxide and thus obtaining it in the form of an aqueous iodide solution, from which silver iodide was precipitated; no exchange was found. No exchange was found in carbon tetrachloride, carbon disulphide, or ether solution.

Although methyl iodide is the only alkyl iodide which exchanges with sodium iodide in dissociating solvents at room temperature, an exchange was established for ethyl, propyl, isopropyl, butyl and isoamyl iodides at 100° C.; the experiments were done in sealed tubes. The reaction was approximately complete after 15 minutes in all cases. In the case of ethyl iodide it was shown that the exchange is nearly complete after 15 minutes at 50°-55° C. Methylene iodide and iodoform also exchange with sodium iodide at 100° C. in alcoholic solution. The addition of a few drops of concentrated hydrochloric acid failed to make ethyl iodide or iodoform exchange at room temperature.

Some aromatic compounds, namely, phenyl iodide, *p*-nitroiodobenzene, and *p*-iodoaniline, were tested under similar conditions at 100° C. but failed to exchange.

Iodoacetic acid exchanges with sodium iodide in aqueous solution at room temperature, but β -iodopropionic acid does not. The acids were separated by adding sodium sulphate and extracting with ether. *m*- and *p*-Iodobenzoic acids also failed to exchange with sodium iodide in acetone solution (separation by adding water).

Further experiments, including kinetic measurements, are in hand.

I wish to express my thanks to Prof. G. Hevesy for his very valuable advice and suggestions.

Note added in proof.—The methyl iodide-iodine exchange takes place in 15 minutes at 100° C., but not in 2-3 minutes at room temperature in alcoholic solution; at 100° C. the reaction was tested in both directions. No reaction was observed at 100° C. in the absence of a solvent, starting with active methyl iodide. (Separation, starting with active sodium

iodide, by adding water and passing in sulphur dioxide; starting with active methyl iodide, by shaking well with sodium iodide solution—with which the iodine exchanged—washing the iodide solution with chloroform, and precipitating silver iodide.) It may be concluded that iodine ions are necessary for the exchange.

β -Iodopropionic acid and sodium iodide exchange nearly completely in aqueous solution on warming to the boiling point for a minute or two.

H. A. C. MCKAY.

Institute of Theoretical Physics,
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Jan. 23.

¹ *J. Chem. Phys.*, **3**, 437 (1935).

² *J. Chem. Soc.*, 390 (1936).

A Relation between the Lyotropic Series and Free Energies

MANY physical-chemical properties and reactions of solutions, such as hydration of ions, flocculation of sols, swelling and liquefaction of gels and surface tensions, are influenced by the presence of ions the order of effectiveness of which is often expressed as the lyotropic or Hofmeister series. The order is not invariable and, whilst factors such as hydrogen ion concentration, valency and activity are of much importance¹, the series appears still to embody some fundamental property. It is of much interest, therefore, that the order of the anions arranged in the lyotropic series runs closely parallel with the order of the (Gibbsian) standard free energies of formation from their elements (see accompanying table).

STANDARD FREE ENERGIES OF ANIONS RELATIVE TO $\Delta F^{\circ} H^{\dagger} = 0$.

Anions		ΔF°_{298-1}
Conventional Lyotropic Series	Others	kgm. cal./gm.-ion
Tartrate		?
Citrate		?
SO ₄ '		- 176.5
	Oxalate	- 158
	Fumarate	- 144.6
	HSO ₃ '	- 123.9
	SO ₃ '	- 116.7
Acetate		- 89.7
F'		- 65.7
	IO ₃ '	- 31.6
Cl'		- 31.3
NO ₃ '		- 26.5
Br'		- 24.6
	CNO'	- 23.8
I'		- 12.3
	ClO ₄ '	- 10.9
	NO ₂ '	- 8.5
	ClO ₃ '	- 0.3
SCN'		?
	BrO ₃ '	+ 2.3
	HS'	+ 2.9
	CN'	+ 39.4

The halides are spaced as one would expect, and the bromide-nitrate pair, which have similar lyotropic properties, have also similar free energies. The second column includes ions less often investigated, and shows the position forecast for them if the general thesis is true. Except for the chlorate ion, this order agrees with such scattered records as have been found. Furthermore, when the free energy of formation of the thiocyanate ion becomes known, one would expect it to be around zero or positive.

Although a fundamental relationship between the lyotropic series and some change or other in free energy might well be anticipated, it is not obvious (except perhaps for the halides) why the free energy of formation of ions from their constituent elements should show such a close apparent relationship, since complete disintegration of oxy-acids is not in question. The free energies of formation of the halide ions are proportional to their standard electrode potentials, so that for these an explanation of the lyotropic series may perhaps be sought in their relative readiness to engage in electron transfer.

It is suggested, therefore, that a more quantitative study of the series from the thermodynamic and electrode potential points of view at equal concentrations of hydrogen ions may well lead to results of great interest.

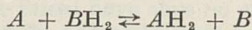
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¹ Cf. Loeb, J., "Proteins and the Theory of Colloidal Behavior" (New York, 1922), chapter v.

A Photochemical Antagonism of Radiations

THE chemical action of light of different wave-lengths on a thermal oxidation-reduction equilibrium of the following type :



may, under certain conditions, in the absence of oxygen, lead to displacements in opposite directions. Suppose that the hydrogen acceptors *A* and *B* have each an absorption band in different parts of the visible spectral region, *A* absorbing mainly the longer waves ($\lambda \sim 700\text{--}500\text{ m}\mu$) and *B* the shorter ones ($\lambda \sim 500\text{--}400\text{ m}\mu$). Then light of longer waves may drive the equilibrium to the right and that of the shorter waves to the left. A good example of such an equilibrium in a liquid system is constituted of the two oxidation reduction systems: methylene blue (*A*)—leucomethylene blue (AH_2) and phenylhydrazine-sulphonate (BH_2)—benzenediazosulphonate (*B*) in diluted acid solutions¹.

The following qualitative experiment shows the light-effects very well. A dark-equilibrium mixture of the reaction components in 0.01 molar hydrochloric acid, the concentrations of *B* and BH_2 being about 0.01 molar and that of methylene blue about 0.0001 molar, is divided between two test tubes. The first tube stands in a tartrazine solution absorbing the radiation of shorter wave-lengths (blue, violet and near ultra-violet); the second in a saturated copper sulphate solution, chiefly absorbing in the red and yellow spectral region. Exposure to sunlight will give a more or less rapid bleaching of the dyestuff in the first tube, but an increased concentration of dyestuff in the second. A stationary state is reached, regulated by the light intensity and the thermal reactions, the velocity of which is increased with the temperature to about double for an increase of about ten degrees. The thermal reaction: $A + BH_2 \rightarrow AH_2 + B$ also shows a very prominent dependence on the hydrogen ion concentration, increasing rapidly with the latter. On the reverse reaction, $B + AH_2 \rightarrow BH_2 + A$, the acidity has no such marked influence. After the cessation of illumination, the original equilibrium is restored by the thermal reactions.

On the other hand, the photo-active absorption of the two hydrogen donors, AH_2 and BH_2 , are

situated in the near ultra-violet (AH_2) and in the middle ultra-violet (BH_2). The spectra are characterized by a marked predissociation: both components are dissociated adiabatically by the absorbed radiation into an activated acceptor-molecule and gaseous hydrogen. In the presence of a suitable catalyst absorbing hydrogen, such as platinum black, the reverse recombination process goes on after completed illumination. The energies of dissociation may be preliminarily discussed on the basis of Franck's postulate from the equivalent energies of radiation on the absorption thresholds or maxima, and the calculated values are in an approximate agreement with the results obtained from electrometrical measurements (about 30 kcal./mol.).

According to J. Weiss², the quenching of dyestuff fluorescence by ferrous ions and SH-compounds is connected with photo-reactions in which the light quantum is transferred from the excited dyestuff molecule to the quenching component (hydrogen donor) by a collision of the second kind. Thus the dyestuff, activated by the visible radiation, replaces a light quantum of higher frequency, splitting the hydrogen donor directly. The same mechanism may be valid here.

A complete investigation of the photo-reactions is going on, and will be published elsewhere.

G. HOLST.

Chemical Institute,
University, Lund.

¹ Holst, G., *Z. phys. Chem.*, A, **169**, 1-19 (1934); **175**, 99-126 (1935).

² Weiss, J., *NATURE*, **136**, 794 (1935). Weiss, J., and Fischgold, H., *NATURE*, **137**, 71 (1936); *Z. phys. Chem.*, B, **32**, 135 (1936).

Gradients in Wool Growth

THE purpose of this letter is to suggest a possible fundamental and common interpretation of results derived by various investigators, including myself, from fleece analyses and from experiments concerned with the effects of diet and abnormal conditions on fleece and fibre characteristics. A recent paper by Swart¹ is one account of this kind of experimentation. Work of a different kind and concerning fibre-type arrays is described in a stimulating paper by Dr. Galpin²: it appears to be possible to link together results from such apparently different types of work.

Dr. Galpin states that in the New Zealand Romney lamb there is a main gradient in fibre-type arrays from britch to poll. Recent investigations of my own^{3,4} point to a main gradient of a similar kind in mean fibre fineness: one fleece, for example, exhibited mean diameter at the shoulder region of 31.4μ and this gradually increased to 33.3μ at the britch.

Generally the finer parts of the fleece occur anterodorsally. Admitting general embryological evidence and results of studies on the fetal development of the sheep⁵, one must, I think, accept the idea of a physiological skin activity greater in the forward parts of the body than it is in the britch region. Assuming this, there is thus the apparent contradiction that where the activity is *greater*, the fibres are generally *finer*. This may be explained in the following way. The greater activity anteriorly is not expressed by the production of coarser fibres, but often by a *greater number of fibres*, that is, a fleece density which is greater anteriorly than posteriorly. General evidence for this view is supplied by analysis from three different breeds. In Suffolk, Cheviot, and Welsh Mountain fleeces examined, there appears to

be a main antero-posterior gradient in number of fibres per unit area. In a Welsh Mountain fleece, density decreased from 7,960 fibres per 4 sq. cm., at the shoulder, to 6,770 in the britch region. Additional evidence is furnished by a study of coat development in the foetus. In all stages the follicles are very much greater in number over the neck and shoulder than elsewhere, diminishing in number more posteriorly and ventrally. There is here a definite gradient in number of follicles. Incidentally, although high density may later cause the production of fine fibres, it is difficult to appreciate Dr. Galpin's point of view that even some differences between arrays are the results of 'overcrowding' at such an early stage as the trio-stage.

It has been stated that there are no gradients in fibre fineness, because relatively large variations occur over small areas of the fleece, and what has been named 'spotted' or short-period variation is evident. I think this is a narrow view. Main trends do occur over the fleece, certainly more evident in the less uniform fleeces, and about these trends occurs the short-period variation. Often the practical necessity of taking relatively few samples for measurement has served only to demonstrate the short-period variation, which has masked any possible indications of gradients which exist. In very uniform fleeces gradients are more difficult to demonstrate, but they are manifest in other types and in the coats of lambs.

Another possible expression of greater activity forward is in the greater length of fibre. Swart states that a ration increased from sub-normal caused increased fibre-length, and the effect was more marked on the back than on the britch and belly. Results of a few analyses I have made, especially on the Welsh Mountain fleece, tend to indicate that there is a main antero-posterior gradient in straight-length of fibre, one fleece, for example, having mean values between 13.6 cm. at shoulder and 12.4 cm. in the britch region.

Many investigations are required to demonstrate subsidiary gradients and to substantiate or disprove these possible explanations. Such suggestions as those I have made are only tentative and arise from a desire to apply a coherent and unifying significance to the mass of results being published.

Wool Industries Research Association, Leeds.

Jan. 8.

¹ Swart, J. C., *Z. Züchtung.*, **36**, Hft. 2, 197 (1936).

² Galpin, Nancy, *Emp. J. Exp. Agric.*, (4), **14**, 116 (1936); *NATURE*, **137**, 585 (Oct. 3, 1936).

³ Wildman, A. B., *J. Text. Inst.*, **27**, P181-P196 (1936).

⁴ Wildman, A. B., unpublished data.

⁵ Wildman, A. B., *Proc. Zool. Soc.*, Pt. 2, 257 (1932).

Effect of Vitamin E Deficiency on the Thyroid

SINGER¹ found that vitamin E deficiency produced hypoplasia of the thyroid in rats. I have noticed what appears to be cretinism in the young of vitamin E-deficient rats. Female rats kept on an E-free diet usually have an initial fertility and produce a litter of living young before becoming absolutely sterile; the litters of such rats or of rats which have been proved sterile and have then been given a small dose of vitamin E concentrate, just sufficient to produce a litter of two or three, show definite signs of thyroid deficiency.

In one case a rat which had been maintained on a vitamin E-free diet for ten months had a litter of

three, all of which appeared normal at birth, but which failed to grow, in spite of the fact that the mother was lactating freely. The appearance of the litter became increasingly cretinous; the head was large, the fur sparse and the nose upturned. The forepaws of one animal were abnormal, one foot being much larger than the other. The animals moved slowly and seemed to be of subnormal intelligence; they lived 17, 22 and 30 days respectively.

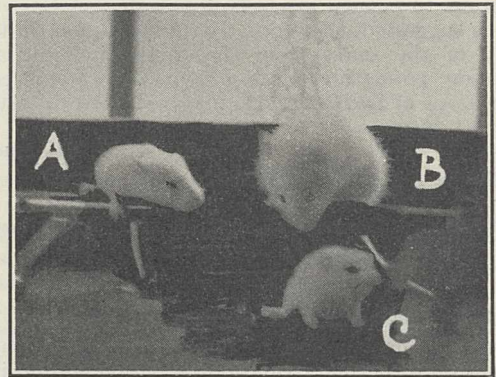


Fig. 1.

The second example was that of a litter of a rat which had been proved sterile and then dosed with a very small quantity of vitamin E concentrate. Again, three young were born, one died within the first few days and the other two gradually became cretinous, one dying at three and the other at four weeks of age. In one of the animals the feet were deformed, there being definite clubbing of the toes. One animal was very much smaller than the others, and post-mortem examination revealed two pink bodies in the position of the thyroid, but these showed no typical thyroid structure. The head was very large, and the fontanelles still widely open.

Fig. 1 shows a cretinous rat C, aged 21 days, and weighing 18.5 gm. with a normal rat B of 21 days, weighing 40 gm., and a normal rat A also weighing 18.5 gm. but aged only 10 days.

This complication of vitamin E deficiency is being investigated in greater detail, and will be fully reported in due course.

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Jan. 8.

¹ *J. Physiol.*, **87**, 287 (1936).

Protein Digestion of Wood-boring Insects

THE nitrogen supply of wood-boring insects has never been investigated. Ripper¹ assumes that it is derived directly from the wood. Mansour and Mansour-Bek² arrive at the same conclusion, and since their summary has been published, Parkin³ has found a proteolytic enzyme in *Lyctus*, which supports this view.

During an investigation into the nutrition of the ash bark-beetle, *Hylesinus fraxini* Panz., which I am carrying out, I examined its protein digestion, and found it necessary to compare it with that of wood-boring beetles of different habitat. For this purpose a number of infested samples of wood was examined,

and a comparative analysis of frass and wood carried out. The result is expressed in the accompanying table (numbers being percentages of dry weight of material):

Insect	Sample	Total N	Non-protein N	Protein N	Protein
<i>Hylesinus fraxini</i> Panz.	ash bark	0.54	0.08	0.46	2.88
	frass of larva	0.41	0.182	0.288	1.43
	frass of adult	0.68	0.326	0.354	2.21
<i>Lyctus</i> sp.	English oak sapwood	0.207	neglig.	0.207	1.30
	frass of larva	0.176	0.149	0.027	0.169
<i>Anobium punctatum</i> Geer.	Oak(?) heartwood	0.51	0.237	0.273	1.70
	frass of larva	0.345	0.170	0.175	1.09

The assimilation of nitrogen is really greater than appears here, as a considerable loss of weight occurs during the passage of material through the insect gut.

The frass of the *Hylesinus* larva consists of particles about the size of sand grains, and it is very probable that the gastric juices have thus no access to a large part of the protein, and so leave it unchanged. This applies to an even greater extent to the frass of the adult, which is much coarser, and only part of which passes through the gut at all. The rest, falling from the mouthparts, is, of course, altogether unattacked by gastric juices.

It is particularly interesting that the frass of the adult contains more nitrogen than the unattacked bark. The adult is therefore continuously decreasing its nitrogenous substance. This follows from the fact that the loss of weight by the conversion of wood into frass is very low and the increase of non-protein nitrogen is very large. This result is surprising in view of the fact that I found in the *Hylesinus* imago quite a strong trypsin and erepsin.

The *Lyctus* frass is exceedingly fine, and it is therefore not surprising that the protein is almost entirely broken down while passing through the gut.

In the case of the wood sample infested by *Anobium*, the high percentage of non-protein nitrogen is surprising. The reason for this is not known, but it can scarcely be connected with natural growth. Why such a high percentage of the protein remains here unattacked I cannot say, but I suspect that not all the chewed up material actually passes through the gut. Nothing is known about the presence and strength of proteolytic enzymes in this case.

Each of the values above is an average from a series of estimations. The numbers must still be regarded with reserve, as there is a considerable fluctuation in the different stages of the life-history, a question demanding further investigation.

I have also examined a sample taken from a deal chest, probably wood of *Abies* sp., infested by the Cerambycid *Hylotrupes bajulus* L. I had too little material to give definite results, but it seems that the original protein content of the wood is in the neighbourhood of 1.28 per cent, and that about 25 per cent of the nitrogen has disappeared in the frass.

The nature of the nitrogen compounds excreted seems to offer a wide scope for further investigations. Only in *Anobium* does uric acid play the main part.

Though this compound is also present in the others, it does not account for all the protein broken down. In *Hylesinus*, a considerable amount of ammonia was found in the excretions, which has possibly been derived from uric acid by bacterial action. On the whole, the problem of excretion in the wood-feeding insects remains still entirely unsolved.

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H. S. HOFF.

Jan. 13.

¹ Ripper, *Z. vergl. Physiol.*, 13 (1930).

² Mansour and Mansour-Bek, *Biol. Rev.*, 9 (1934).

³ Parkin, *Ann. App. Biol.*, 23 (1936).

Jan Swammerdam

SINCE writing the sketch of Swammerdam which appeared in NATURE of February 6, p. 218, I have received some notes on the Dutch naturalist from that learned enthusiast Dr. H. Engel, of Amsterdam, which I hope he will publish in full in his forthcoming paper on the same subject. When I wrote my own contribution, I had not succeeded in obtaining a copy of the oration delivered by Prof. B. J. Stokvis at the celebration of the bicentenary of the death of Swammerdam held at Amsterdam in 1880. From this publication, and from Dr. Engel, I now learn that Swammerdam's grandfather was Jacob Dirksz. (= Jacob the son of Dirk, *ang.* Theodore or Richard), who was a wood merchant living in the village of Swammerdam, and it was he who migrated to Amsterdam and there adopted the name by which the great naturalist is known. Swammerdam's father, the apothecary, was therefore Jan or Johan Jacobsz. (= Jan the son of Jacob), and Swammerdam himself was baptized at the Oude Walenkerk of Amsterdam on Sunday, February 15, 1637, as Jan the son of Jan Jacobsz. Swammerdam and Baerta Jans Corvers. According to Harting, as quoted by Stokvis, Swammerdam's scientific career extended over twelve years only, from 1663 until 1675. It is improbable that he ever practised medicine. When he died, he was nearly forgotten, and it was the "magician" Boerhaave who brought to light his lost MSS. which gave immortality to the "sleeping beauty".

The statement so often made that Swammerdam's emotional obsessions were due to the influence of Anthoinette Bourignon seems to be an exaggeration. His friendship with her was the result, and not the occasion, of his deep interest in religion. The Dutch edition of the "Ephemeris Vita" testifies to his own innate and meticulous piety. Never was a sermon more deeply underlined or more laboriously justified. A scriptural basis for almost every word proclaims at once a profound knowledge of the Bible and an ingenuous belief in the literal interpretation of isolated texts.

Dr. Engel has found in Amsterdam an edition of the "Ephemeris Vita" published in Utrecht in 1699, a copy of which apparently does not exist in England. I also learn from him that the house where Swammerdam worked is still standing, and may be identified by a tablet erected during the celebrations of 1880. It remained in the possession of the family until 1716.

The decennial 'Swammerdam Medaille', also instituted in 1880, has been awarded to Siebold (1880), Haeckel (1890), Gegenbaur (1900), de Vries (1910), Max Weber (1920) and Spemann (1930).

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F. J. COLE.

Potential Constants of Tetrachlorethylene

G. B. B. M. SUTHERLAND and D. M. DENNISON¹ have deduced the relations between the parallel frequencies and the potential constants of the ethylene molecule from a given potential function; the following deals with the extension of these relations to a similar type of molecule, namely, that of tetrachlorethylene.

If from the data on Raman and infra-red spectra² we assume for the frequencies (Sutherland's notations):

$$\nu_1 = 913 \text{ cm.}^{-1}; \quad \nu_2 = 445 \text{ cm.}^{-1}; \quad \nu_3 = 345 \text{ cm.}^{-1}; \\ \nu_4 = 1569 \text{ cm.}^{-1}; \quad \nu_8 = 236 \text{ cm.}^{-1}$$

and substitute these values in equation (a)

$$\nu_1^2 + \nu_3^2 + \frac{M+2m}{M} \frac{\nu_2^2 \nu_4^2 \nu_8^2}{\nu_1^2 \nu_3^2} = \nu_2^2 + \nu_4^2 + \nu_8^2$$

which has been deduced from the potential function, we obtain satisfactory agreement.

However, before computing the potential constants, it is necessary to modify the experimental values of the frequencies in order to satisfy equation (a) exactly.

A least square solution gave:

$$\nu_1^* = 913 \text{ cm.}^{-1}; \quad \nu_2^* = 442 \text{ cm.}^{-1}; \quad \nu_3^* = 345 \text{ cm.}^{-1}; \\ \nu_4^* = 1569 \text{ cm.}^{-1}; \quad \nu_8^* = 230 \text{ cm.}^{-1}.$$

The smallness of the change of the experimental frequencies sufficient to verify equation (a) exactly should be noted.

Finally we find:

$$a = 4.59 \times 10^5 \text{ dynes/cm.}; \quad b = 1.89 \times 10^5 \text{ dynes/cm.} \\ c = 6.15 \times 10^5 \text{ dynes/cm.}; \quad d = \pm 1.52 \text{ dynes/cm.}$$

a, b, c, d being the potential constants.

The difference between my value of c (C-C bond) and Sutherland and Dennison's value for ethylene (9.79×10^5 dynes/cm.) is very remarkable. For this reason, I also used the Delfosse potential function³, which is absolutely independent of Sutherland and Dennison's. Furthermore, I used only the three Raman frequencies ν_2, ν_4, ν_8 , which are much more certain than the ν_1 and ν_3 necessary in Sutherland and Dennison's theory. This ought to give more weight to the following results.

We find:

$$F = 6.25 \times 10^5 \text{ dynes/cm.}; \quad \gamma = 2.24 \times 10^5 \text{ dynes/cm.}; \\ f = 1.28 \times 10^5 \text{ dynes/cm.}$$

f and F are respectively proportional to the C-Cl and C-C distances; γ is a force proportional to the angle variation Cl-C-Cl.

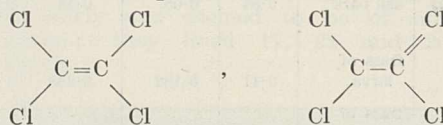
The agreement between the two values of the C-C strength bond is very striking. It should be noted that the value γ is greater than f . This is contrary to ordinary chemical conceptions. The difference between the C-C value for ethylene and tetrachlorethylene agrees qualitatively with Badger's formula⁴

$$r_e^* = (C_{ij}/k_e)^{1/3} + d_{ij},$$

which shows a very definite relation between the force constant k_e for a particular bond and the inter-nuclear distance r_e associated with that bond. Consequently, if the force constant is smaller in C_2Cl_4 than in C_2H_4 , the C-C distance should be larger in C_2Cl_4 than in C_2H_4 . Electronic diffraction and spectroscopic measurements do not invalidate this deduction. L. O. Brockway⁵ gives 1.38 Å. for tetrachlorethylene, W. Scheib and P. Lueg⁶ 1.34 Å. for ethylene. The C-C distance deduced from

Badger's formula is too small. However, Penney and Sutherland⁷ have shown that considerable divergences exist from the formula in other compounds.

If the force constant is real, its variation might be due to the fact that tetrachlorethylene is a combination of molecules showing quite different structures, as for example:



In that case, the C-C value would be a sort of resonance between the double and single bonds.

These considerations do not, however, exclude the possibility that this molecule cannot be treated in the same way as C_2H_4 .

In the preparation of this note, I am especially indebted to Prof. V. Henri for his personal attention, and to Dr. G. B. B. M. Sutherland for correspondence.

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¹ Sutherland, G. B. B. M., and Dennison, D. M., *Proc. Roy. Soc.*, A, **148**, 250 (1935).

² Landolt-Börnstein Tables, 992 and 995; Ta-You-Wu, *Phys. Rev.*, **46**, 465 (1934).

³ Delfosse, J. M., *Ann. Soc. Sci. Brux.*, **55**, 114 (1935).

⁴ Badger, *J. Chem. Phys.*, **3**, 710 (1935).

⁵ Brockway, L. O., *Rev. Mod. Phys.*, **8**, 261 (1936).

⁶ Scheib, W., and Lueg, P., *Z. Phys.*, **81**, 764 (1933).

⁷ Penney, W. G., and Sutherland, G. B. B. M., *Proc. Roy. Soc.*, A, **156**, 676 (1936).

Raman Spectra of Oxonium Compounds

THE study of the Raman spectra of oxonium compounds is of interest for the elucidation of the nature of the oxonium bond. Such a study was made by Briegleb and Lauppe¹, who investigated the spectra of mixtures of ethyl ether with hydrogen bromide and stannic chloride. However, their work does not give a clear and unequivocal answer to the question of the nature of such compounds. We have undertaken the study of the oxonium molecule $(CH_3)_2O.HCl$, which is known to exist even in the gaseous state. The equilibrium between methyl ether and hydrogen chloride has been studied in the vapour state with sufficient exactness². It cannot be doubted, therefore, that $(CH_3)_2O.HCl$ exists as an individual molecule. We have obtained for $(CH_3)_2O$ in the liquid state, at 280° K., the following frequencies: 408 (2) (e, k); 921 (6d) (e, k, i); 1095 (1) (k); 1448 (2d) (e, k); 2813 (10) (e, k, q, p); 2868 (3) (e, k, i); 2908 (3) (e, k, q); 2947 (2) (e, k, q); 2988 (6) (e, k, q, p).

These data agree well with the results of Kohlrausch³. We have investigated the spectra of equimolecular mixtures of methyl ether, $(CH_3)_2O$, and hydrogen chloride at 280° K. in the liquid state. We obtained the following frequencies: 418 (3) (k); 891 (4d) (e, k); 1081 (1) (k); 1449 (1d) (e, k); 2829 (7) (e, k, q); 2875 (2) (e, k); 2923 (2) (e, k, q, p); 2953 (2d) (e, k, i); 3003 (5d) (e, k, q).

The same mixture was investigated at low temperatures down to 220° K. No shift at all could be observed in comparison with the spectra at 280° K. The comparison of the spectra of $(CH_3)_2O.HCl$ with the spectra of $(CH_3)_2O$ shows the absence of new lines. It may, however, be stated that displacements were noticed in a series of frequencies that were greater than the error of the experiments ($\sim 5 \text{ cm.}^{-1}$). Of the greatest interest is the decrease of the frequency

$\nu(\pi)$ of $(\text{CH}_3)_2\text{O}$ from 921 cm^{-1} to 891 cm^{-1} . Evidently it is caused by the bond between the ether oxygen with HCl. Our results contradict the supposition that the valency of the oxygen is increased; since in this case the molecular model would be changed, which would change the number and magnitude of the fundamental frequencies. It may be supposed that the bond between the ether oxygen with HCl belongs to the hydrogen bond type⁴, that is, we do not have the usual O-H bond with a distance of 1 A. and corresponding frequency 3600 cm^{-1} but rather a bond of an intermediate type between the chemical and the Van der Waals forces with a distance of the order of 1.3 A. between O and H.

The dispersion of our spectrograph is too small to distinguish between the proper frequency of HCl and the very close frequencies of the CH_3 group⁵. However, a detailed study of the photometric curve obtained with a Zeiss microphotometer did not show any change which could be attributed to the line of HCl. Its absence apparently indicates the strengthening of the heteropolarity of HCl, which can make this line forbidden, in the Raman spectra.

The measurements of specific electric conductivity of a mixture of 0.41 molar hydrogen chloride and 0.59 molar ether at 253° K. gives 0.0034 Ω^{-1} . This indicates insignificant dissociation.

Besides the compound described above, we have investigated the complex $(\text{C}_2\text{H}_5)_2\text{O}\cdot\text{HCl}$, in the spectra of which we were unable to find any change in comparison with the spectra of $(\text{C}_2\text{H}_5)_2\text{O}$. We also studied $(\text{CH}_3)_2\text{O}\cdot\text{HBr}$, but it was impossible to obtain the spectra of the oxonium compound because of a very fast reaction with the formation of CH_3Br .

The detailed account of this work will be published in the *Acta Physicochimica U.R.S.S.*

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Jan. 8.

¹ Briegleb and Lauppe, *Z. Phys. Chem.*, B, **28**, 154 (1935).

² Maas and Morrison, *J. Amer. Chem. Soc.*, **45**, 1675 (1923). Jitaro Shidei, *Mem. Coll. Sci. Kyoto Imp. Univ.*, A, **9**, 99 (1925).

³ Kohlrausch, *Monats. Chem.*, **63**, 349 (1936).

⁴ Latimer and Rodebush, *J. Amer. Chem. Soc.*, **42**, 1419 (1920). Bernal and Megaw, *Proc. Roy. Soc., A*, **151**, 384 (1935).

⁵ Salant and Callihan, *J. Chem. Phys.*, **2**, 317 (1934).

Factors influencing the Height of the Combustion Levels attained in Flame Gases

DURING the past seven years, many hundreds of measurements of the combustion levels¹ in flames and explosions have been made. They range from 70 to 99 per cent of the heat of combustion, and without exception they fit into the following analysis of the factors which tend to heighten or lower them.

For convenience of presentation, the inflammable mixtures selected for purposes of illustration are those which after combustion yield a theoretical temperature of 1,900° C. when calculated upon the basis of the quantum specific heats.

(1) *Influence of the nature of the combustible gas.* Temperature measurements in flame gases after combination at constant atmospheric pressure yield the following combustion levels²:

CO-air	CH ₄ -air	C ₂ H ₂ -air
80 per cent	83.5 per cent	85 per cent

So far as our experiments have gone, the highest combustion level is attained in C₂H₂-air mixtures.

(2) *Influence of the nature of the diluent gases.* The flame temperatures were measured after combination at constant atmospheric pressure. Attention is directed to the low combustion level attained with argon as the diluent gas.

CO-O ₂ -A	CO-O ₂ -CO ₂	CO-air
72 per cent	77 per cent	80 per cent

(3) *Influence of small quantities of diluent gases in certain cases.* The mixtures carbon monoxide-oxygen-nitrogen and carbon monoxide-oxygen-argon, in which carbon monoxide and oxygen are present in combining proportions, yield lower combustion levels than similar mixtures in which a small quantity of the nitrogen or argon is replaced by oxygen.

As a result of a discovery by Wohl and von Elbe, it has been found that there is an appreciable raising of the combustion level in hydrogen-air explosions by the addition of a small quantity of water vapour³. Additions of water vapour to carbon monoxide-air mixtures, while they speeded up the explosions, had no very large influence upon the combustion levels attained.

(4) *Influence of pressure at which constant pressure combustion takes place.* The following combustion levels were measured in carbon monoxide-air mixtures burning at pressures of 1 atmosphere and 5 atmospheres:

1 atmosphere	5 atmospheres
80 per cent	86.5 per cent

The increase with pressure of the combustion level in methane-air mixtures was not nearly so marked as in the case of carbon monoxide-air and acetylene-air mixtures⁴.

(5) *Influence of the instantaneous pressure in the flame front.* It was shown in a recent letter to NATURE⁵ that from an examination of the intensity of the after-glow resulting from the passage of flame through a long open tube, it appeared that the combustion level increased with distance of flame travel and therefore with the instantaneous pressure in the flame front. The flame gases in which the measurements referred to in (1), (2) and (4) were made corresponded to those left behind the initial slow flame movement. The combustion levels measured are therefore probably the lowest attainable in the mixtures.

(6) *Combustion levels in large vessel explosions.* The explosions were made in a large spherical vessel fitted with electrodes for central ignition. During the initial slow movement of the flame after the passage of the spark, the flame gases have combustion levels as given in (1), (2) and (4). Later, the instantaneous pressure in the spherical flame front begins to increase and the combustion level in the gases left behind becomes greater and greater. The flame gases in the central portion constitute only a small proportion of the total gases and it is therefore clear that the combustion level averaged over the whole of the exploded gases must be high. In an over-rich carbon monoxide-oxygen mixture initially at 3 atmospheres pressure, the combustion level averaged over the whole of the exploded gases was found to be as high as 99 per cent. In low density explosions it is considerably less⁶.

It will be clear that the combustion level in any given mixture may be raised by increasing the pressure of the gases before combustion or by arranging for high instantaneous pressure in the flame front, or both—as in high-density explosions

and in internal combustion engines. Interesting possibilities also are suggested by the fact that a little water vapour increases the combustion level in hydrogen explosions.

W. T. DAVID.

Engineering Department,
University,
Leeds, Jan. 18.

¹ NATURE, 139, 67 (1937).

² Phil. Mag., 21, 280 (1936).

³ Phil. Mag., 18, 311 (1934).

⁴ Phil. Mag., 21, 280 (1936).

⁵ NATURE, 139, 67 (1937); also 138, 930 (1936).

⁶ Phil. Mag., 22, 513 (1936).

Physical Constants and some Curious Coincidences

MANY comments have been made on the nearness of a certain constant in modern physics to the number 137, but I have seen no comments on the following coincidence.

The velocity of light *in vacuo* is 2.99774×10^{10} cm. a second, and the gravitation constant is 6.670×10^{-8} in c.g.s. units; the first of these is therefore just a little less than 3×10^{10} and the second just a little greater than $\frac{2}{3} \times 10^{-7}$, both interesting coincidences with simple numbers in themselves, but the product of these numbers is 1,999.5, a remarkably close approach to 2,000. The product is, however, not a 'mere number' and the coincidence must therefore depend upon the relative magnitudes of the c.g.s. units.

Curiously enough, if both the above physical 'constants' are expressed in English units, the product is 1.05, a very near approach to unity—another coincidence.

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Points from Foregoing Letters

PROF. E. M. FRAENKEL and Dr. C. A. Mawson report that although they are able to deposit the agent of the Rous fowl sarcoma by centrifugation at 15,000 r.p.m., they are unable to correlate the cancer-producing activity of the extracts and concentrates with the number of ultra-microscopic particles present, and suggest that only a fraction of the visible particles are associated with carcinogenic activity. They have been unable to obtain tumours by injection of acetone extracts of fresh or dried tumour tissue, but the residue left after the extraction of dried powder retains its carcinogenic properties.

New electrical measurements of the oxide films responsible for interference colours on copper and iron, announced by Drs. U. R. Evans and H. A. Miley, show satisfactory agreement with three other methods. Thus tested, the method has been used to study the rapid growth of invisible oxide on copper at 18° and 62° C. The results accord well with recent electron diffraction work by Dobinski.

The exchange of iodine atoms between organic compounds containing such atoms and sodium iodide or iodine itself, at a temperature of 100° C. in various solvents, has been investigated by H. A. C. McKay, by utilizing radioactive iodine as indicator. The author describes the behaviour of the higher alkyl iodides, (ethyl, propyl, isopropyl, butyl and isoamyl iodides), iodoacetic acid, β -iodopropionic acids and of some aromatic compounds (phenyl iodide, *p*-nitroiodobenzene, *p*-iodoaniline and *p*-iodobenzoic acids).

A table is submitted by Dr. L. H. N. Cooper, showing that the order in which acidic ions are arranged in the Hofmeister (lyotropic) series, which indicates their effectiveness in the swelling of gels, flocculation of sols, etc., runs parallel to the order of their (Gibbsian) standard free energies of formation from their elements. The free energies of formation of the halide ions are proportional to their electrode potentials, so that the effect may possibly be explained by the relative readiness of the ions to part with their electrons.

An example of the power of light of different wave-lengths (near and middle ultra-violet) to shift in opposite directions the equilibrium of a thermal oxidation-reduction reaction is described and discussed by G. Holst. The system considered consists of methylene blue (A)—leucomethylene blue (AH₂) and

phenylhydrazinesulphonate (BH₂)—benzenediazosulphonate in dilute acid solutions, the photo-active absorption of AH₂ being situated in the near ultra-violet, and that of BH₂ in the middle ultra-violet.

Dr. A. B. Wildman states that many fleece analyses indicate the existence of gradients over the fleece in mean fineness and fleece density. Such results are consistent with the idea of increased physiological activity in the skin anteriorly, and form evidence in addition to that of Dr. Galpin's for the existence of a main antero-posterior gradient in wool growth.

Symptoms of cretinism, a disease associated with the absence of the thyroid gland, are described by Miss M. M. O. Barrie in young rats deficient in vitamin E.

H. S. Hopf compares the nitrogen contents of the frass of wood-boring insects with that in the wood on which the insects feed. The results indicate that the larvæ retain much of the nitrogen from the wood, but the adult of the ash bark-beetle appears to be continuously decreasing its nitrogenous substance.

Jules Duchesne compares the values of the parallel frequencies calculated from the Raman and infra-red spectra of tetrachlorethylene, with those necessary to satisfy the relation deduced from the 'potential function' by applying the formula of Sutherland and Dennison. The author calculates the forces linking different atom groupings in the C₂Cl₄ molecule and finds the result at variance with the ordinary chemical conception of its structure.

From a study of the Raman spectra of ethyl ether and hydrochloric acids in equimolecular proportions, M. Wolkenstein and Prof. J. K. Syrkin conclude that the valency of oxygen in the oxonium molecule is not increased. The bond between the ether oxygen and HCl is of a type intermediate between the chemical and the Van der Waals forces, with a distance of the order of 1.3 Å. between the oxygen and hydrogen atoms.

Various factors influencing the 'combustion level' (ratio of maximum observed temperature to the theoretical temperature) in flames and explosions are discussed by Prof. W. T. David. These include the influence of the nature of the combustion gases, of the diluent gases, size of vessel, etc. The combustion level may be raised by increasing the pressure of the gases before combustion or by arranging for high instantaneous pressure in the flame front.

Research Items

Homo modjokertensis

DR. E. DUBOIS, in a recent communication to the Koninklijke Akademie van Wetenschappen te Amsterdam (*Proceedings*, 39, 10), sets out his reasons for regarding this skull, found in February 1936 in the early Pleistocene deposits of Modjokerto, Java, as an infantile form of the same race as that found at Ngandong, to which the specific name *soloensis* has been given. The striking fact about the skulls of Solo man is the low brain capacity, which in the largest male has been calculated at 1,295 c.c., barely equalling the male Australian, while the largest female (probable) is put at 1,095 c.c. The adult of Modjokerto cannot have been more than *Sinanthropus* I, which is 915 c.c. The Modjokerto skull itself probably has a capacity of 650 c.c., agreeing with a Papuan child of two years, which would give a capacity in the adult of 900 c.c., approximating to *Sinanthropus*. This and other facts bring together *pekinensis* and *soloensis*. As to the racial identity of Solo man and Modjokerto man, there can be no doubt. In both there are peculiarities due to the necessity of poisoning the head on the vertebral column. The similarity in the brain of Peking man and of Solo man is striking. The contour lines in normal laterals nearly coincide. The conclusive proof, however, is in the unique morphology of the tympanic portion of the temporal bone. The meatus acusticus externus is not directed forward, as in all the modern races, and Neanderthal and Rhodesian man, but transversely and somewhat backward. The tympanic plate is exceedingly thick and strong, the forward part being more or less convex, and not concave as in the modern. The border of the porus acusticus externus shows a peculiar re-entering, which in *Sinanthropus* is continued in a roundly terminating fissure, strikingly resembling such a fissure in a young, probably less than one year old, Papuan child. Finally, if Modjokerto and *pekinensis* are both early Pleistocene, may not Solo man also be early Pleistocene? The evidence for late Pleistocene is unsubstantial.

Fauna of Singapore

THE *Bulletin* of the Raffles Museum, Singapore, Straits Settlements, No. 12, May 1936 (issued December 1936) contains much that is interesting relating to the fauna of Singapore and adjacent waters. A list of the fishes in the collection of the Raffles Museum is given by the curator, Mr. M. W. F. Tweedie, and eleven new species from the Malay Peninsula are described and illustrated by Mr. W. P. T. Hesse. The fishes of this district are of great interest; not only are there many new species to be found, but also it may be considered as a half-way point between the Red Sea and the east coast of Africa, and the isles of Polynesia. The fishes of China and India commingle and, as the author's recent collections show, many fishes hitherto known only in the Philippines also occur on the reefs and in the creeks of Singapore and Johore. The migratory fishes of the Indo-Pacific pass Singapore, and its reefs swarm with a rich and varied fish fauna. There are several papers dealing with the Crustacea, especially freshwater decapods, and with marine crabs of the

family Grapsidae mainly collected in the mangrove swamps. Among the freshwater decapods is *Palaemon* (*Parap.*) *trompi* de Man subsp. *armatus* n. subsp. from Johore, which hitherto was only known from Borneo, and which lives in the same waters as *Palaemon pilimannus* de Man. The eggs are large and few in number, but apparently nothing is known of its life-history. Among the other contributions are two papers on "Nidification of some Javan Birds" by A. Hoogenwerf, and "The Nidification of some Malayan Birds" by G. C. Madoc. Both contain much original observation, and the first is illustrated with very beautiful photographs.

Chemical Carcinogenic Agents

AN extremely valuable summary of the last three years work on chemical compounds as carcinogenic agents by J. W. Cook, G. A. D. Haslewood C. L. Hewett, I. Hieger, E. L. Kennaway and W. V. Mayneord ("Reports of the Second International Congress of Scientific and Social Campaign against Cancer"; Brussels, 1936) shows that there is a large number of pure chemical compounds which produce cancer in animals. The most active compounds, such as methylcholanthrene, cholanthrene and 3:4-benzpyrene, produce epitheliomata of the skin when painted on mice and sarcomata when injected subcutaneously in either rats or mice. Reference is made to the discovery by Sasaki and Yoshida of the action of amino-azo-toluene, which produces cancer of the liver and bladder when fed to animals. Amino-azo-toluene is a commercial orange dye used for varnishes, fats, margarine and leather. It has also been recommended for medicinal use to promote the growth of skin on wounds. Carcinogenic hydrocarbons are fat-soluble; but water-soluble carcinogenic compounds have been described. The sodium salt of 1:2:5:6-dibenzanthracene-9:10-endo- $\alpha\beta$ -succinic acid, produced by combination of 1:2:5:6-dibenzanthracene with maleic anhydride, produces sarcomata on injection in mice, and some of these sarcomata are accompanied by leucocytosis in the blood. A water-soluble quinoline styryl compound which was originally tested for trypanocidal action was found by Prof. C. H. Browning to cause the development of cancer in mice whether the mice are infected with trypanosomes or not. The natural female sex hormone oestrin induces cancer of the mamma and adenoma of the pituitary, although not of the skin when it is painted on mice. The mechanism of carcinogenesis is still not clear, but such work as has been done to increase understanding of the process emphasizes the importance of the species, strain and sex of the animals employed.

The Asparagus Fly

THE asparagus fly (*Platyparea pascioptera* Schr.) is a native of central and southern Europe, but it appears to be moving slowly westward, and since the beginning of this century has become a serious pest in the valley of the Seine. It was first reported in Holland in 1931, and four years later it appeared in England. In view of the possibility of its further spread, the illustrated account of the life-history of the fly with recommendations for its control given

by A. S. Buckhurst (*J. Min. Agric.*, 43, No. 10) will be useful to both the private and commercial grower of asparagus. The damage is done by the larvæ which tunnel in the stems, so that either the young edible shoots are spoilt or the later growth weakened according to the time of emergence of the flies. The latter is considerably earlier on the Continent than in England, but the period during which the flies are on the wing extends to about six weeks in both cases. There is only one generation in the year, the pupæ over-wintering in the stems at or below ground-level. So far, no entirely successful method of control has been found, as traps are only partially effective and spraying is not an economic proposition. To remove and burn all distorted stems as early as possible in the autumn, taking care to cut as near the crown as possible, is the best method at present known for reducing the trouble, but even then many of the pupæ escape destruction. Experiments are in progress with the view of finding a soil insecticide which will eradicate the pest more thoroughly, but although small-scale trials are giving promising results, no definite recommendations can as yet be made.

The Cape Crawfish

LITTLE was known of the development of this crustacean, although much has been written on its anatomy. Dr. C. von Bonde in his recent work "The Reproduction, Embryology and Metamorphosis of the Cape Crawfish (*Jasus lalandi*) (Milne Edwards) Ortman" (Department of Commerce and Industries, Fisheries and Marine Biological Survey Division, Investigational Report. No. 6. Union of South Africa, Government Printer, Pretoria, 1936) now gives us a good account of the reproductive and developmental stages, which are described in detail, and at the same time certain facts relating to the post-ovum stages in the description set forth previously by Gilchrist are substantiated or corrected. Part 1, on reproduction, deals with sexual differences and reproductive organs, sperm cells and ova, period of sexual maturity, frequency of spawning, mating, preparation for egg laying, fertilization of the eggs and attachment of eggs to the abdomen. Part 2, on embryology, deals with the maturation and segmentation of the ovum and later embryological stages. Part 3 deals with metamorphosis and subsequent growth and Part 4 with technique. The author has in preparation a further paper on the phyllosoma stages obtained by artificial hatching and rearing, but in the present work it is shown that the larva hatches at a stage still younger than that described by Gilchrist (1913) as the nauplisoma. Stage III is a true phyllosoma, and numerous stages occur between those of 3.8 mm. and 24 mm. to be described later. At 35 mm. the last phyllosoma changes to the puerulus stage of 22 mm. "which appears in all essentials to be like a small adult and the appendages including the pereopods (but excluding the pleopods) are adult-like in form". The stage immediately following the puerulus resembles the adult still more, and this may be regarded as the youngest stage of the fully-formed crawfish. The paper is illustrated by photographs and by two coloured plates of the developing embryo.

Nerve Fibres in Cephalopods and Crustaceans

THE structure of the nerve fibres in cephalopods and a crustacean, *Maia*, has been investigated by J. Z. Young (*Proc. Roy. Soc.*, B, Dec. 1936). In the

former, each axial fibre is furnished with a nucleated sheath of a collagenous nature. Faint longitudinal striation is visible in both living and fixed fibres, but no neurofibrils are present. Indeed, if a giant nerve fibre is cut, the axoplasm flows out from the sheath, showing it to be a viscous fluid. The volume of the sheath is in general only about two thirds that of axoplasm. In *Maia*, each axon is surrounded by a connective tissue sheath which contains a certain amount of fat, but it is not similar histologically to the medullated sheath of the vertebrate nerve, although this has previously been stated to be the case. The sheath is slightly thicker relative to the axon than in the cephalopods.

Endemic Flowering Plants of the British Isles

A CONSIDERABLE number of floral units—mostly sub-specific—are now recognized as endemic to the British Isles. In a discussion of the problems which they present, Wilmott (*South-Eastern Naturalist and Antiquary*, 41; 1936) suggests that hybridization is a probable cause of the origin of endemism in some groups. Thus, the numerous endemic mossy saxifrages of western Ireland may have arisen through original crosses between the Arctic *S. caespitosa* and the Atlantic *S. hypnoides*, which were brought together as a result of migrations imposed by the glacial period. Evidence is adduced to show that other Irish endemics are pre-glacial survivors, but in the case of the Hiberno-American *Spiranthes*, it is difficult to believe that whilst the southern Irish plant is a survivor its very close ally in the north is a recent immigrant, as is suggested. As regards British endemics, a correlation is attempted between their distribution in relation to areas of glaciation. It is shown that whilst some occur in areas which were not glaciated, others, for example, *Sorbus* spp. and *Helianthemum Breweri*, grow on cliffs which might be presumed to be free from ice in the summer, and the view is expressed that they also represent relatively ancient elements of the flora.

Production of Polyploid Plants

THE subject of polyploidy in plants has grown so rapidly and has become of such importance in connexion with plant genetics that the recently issued bulletin of the Imperial Bureau of Plant Genetics on "The Experimental Production of Haploids and Polyploids" will be very useful for plant breeders (Imperial Bureau of Plant Genetics for Crops other than Herbage. The Experimental Production of Haploids and Polyploids. Pp. 28. Cambridge: School of Agriculture, 1936. 5s.). The production of allo- and autopolyploids is one of the most important methods of producing new basic types of economic plants. The bulletin briefly summarizes the cases of polyploidy in somatic cells and the production of polyploid cells by changes in temperature, the use of X-rays, chemicals, centrifuging, tumours and shoots from callus. Polyploid gametes have been produced by similar methods including fumigants, attack of pests, puncturing the buds and virus mosaic. Polyploidy resulting from hybridization is recorded in a large variety of plants, with a long list of cases especially in wheat and tobacco. It is probable that the experimental production of haploids and polyploids will become a matter simply of selecting the best technique for each case. The bibliography, while merely representative, comprises nearly 300 entries including certain references to non-economic plants.

Resistance of Cotton to the Wilt Fungus

A SHORT paper by Dr. B. B. Mundkur (*Proc. Ind. Acad. Sci.*, 3, No. 6, Sec. B., 1936) gives the results of some experiments on the resistance of Indo-American and Indian varieties of the cotton plant, *Gossypium hirsutum*, to the fungus causing wilt disease (*Fusarium vasinfectum*). Two forms of the fungus evidently occur, an Indian and an American strain. Indo-American cottons are immune to the American strain in India, but susceptible in America, whilst the Indian form of the fungus parasitizes Indian cottons strongly in India, but only slightly in America. It seems as though the fungus had developed one geographical strain capable of parasitizing the host when grown on the sandy and acid American soils, and another strain to fit the particular physiology of the cotton plant when cultivated upon the heavy alkaline soils of India.

Low Temperature Thermometry

WHILE the practical methods of making measurements of temperature which approximate closely to the standard thermodynamic scale are now quite accurate enough for industrial purposes, it is still necessary for scientific purposes to secure greater accuracy in the region in which helium is liquid. At the Congrès International du Froid held at Amsterdam in June last, Prof. Keesom gave an account of the present position of the problem, which has now appeared as Supplement No. 80 of *Communications from the Kamerlingh Onnes Laboratory* of the University of Leyden. In *NATURE* of December 5, p. 977, the Leyden value of the pressure coefficient of helium, 0.0036611, and the absolute zero to which it leads, -273.14°C ., were given. Between 0° and -190°C ., the platinum resistance thermometer is correct to 0.05°C ., but for greater accuracy it will have to be replaced by some other metal, possibly gold. For the range -190°C . to -259°C ., a formula of correction secures an accuracy of 0.07°C . Temperatures below this down to about 2°K . are measured by the vapour pressure of liquid helium, and lower still by the resistance of a phosphor bronze wire containing 2 per cent tin and 0.05 per cent lead. This, however, becomes unsuitable in magnetic fields, and further research is necessary to find an alloy less influenced by such fields.

Entropy of Sulphur

THE determination of the heat capacities of rhombic and monoclinic sulphur at low temperatures, leading by graphical integration to the entropies of the two forms, is of interest as a check on the third law of thermodynamics. E. D. Eastman and W. C. McGavock (*J. Amer. Chem. Soc.*, 59, 145; 1937) have redetermined the heat capacities over the range 15° – 375°K . and have calculated the entropies. The values of C_p for rhombic sulphur may be represented approximately up to $C_p = 3.0$ by the function $f(T/\theta)^n$, proposed by Lewis and Gibson, if $\log \theta = 1.992$ and $n = 0.5025$. From previous determinations of the heat of transition the authors select the value 0.258 ± 0.027 e.u. at the transition point. From the entropies now determined, the value 0.215 ± 0.05 at the same temperature is calculated. The conclusion is drawn that the third law is accurately applicable, without complications of the types that sometimes occur, to the sulphur transition. The uncertainty of 0.05 – 0.10 e.u. in this test of the law is stated to be smaller than that in many others, and it is claimed

that the experimental basis of the third law, as supported by the sulphur transition, is strengthened by the new results.

Deuterium Content of Normal Water

THE ratio of deuterium and protium, D/H, in normal water has been given between the rather wide limits of 1 : 5600 and 1 : 8900. J. L. Gabbard and M. Dole (*J. Amer. Chem. Soc.*, 59, 181; 1937) have prepared deuterium-free hydrogen by electrolysis of water to which sodium peroxide had been added, and combined it with atmospheric oxygen by passing over heated copper with the hydrogen always slightly in excess to prevent fractionation of the oxygen isotopes. The resulting water was 9 p.p.m. lighter than Lake Michigan water. When 6.4 p.p.m. are added to 9 p.p.m. to correct for the difference in atomic weight of atmospheric oxygen and aqueous oxygen, the density of D-free water containing normal oxygen is 15.4 p.p.m. lighter than normal water. From this the ratio D : H (atoms) in Lake Michigan water is calculated as 1 : 6900. The authors conclude that the commonly accepted ratio is too high, and the revision downward should be somewhat more than that recommended by N. F. Hall and T. O. Jones (1936).

Velocities of Meteor Streams

IN a paper published early last year (*Mon. Not. Roy. Astro. Soc.*, 96, 7; May 1936) Mr. R. A. McIntosh described a method of determining the velocities of meteors by measurement of the displacement of the radiant as observed in northern and southern latitudes. He provided two tables to facilitate the computations, and the method presents certain attractive features. In the November issue of the same journal (97, 1; 1936), Dr. M. Davidson shows that there is a serious error in the method of compilation of the first of Mr. McIntosh's tables, and that this renders the whole process useless.

Internal Constitution of Eclipsing Binaries

IN *Mon. Not. Roy. Astro. Soc.*, 96, 9, Supplementary Number, October 1936, there is a paper with the above title by Zdenek Kopal, the object of the research being the determination of the density concentration in the interior of stars, starting with eclipsing binaries as material. The ellipticities of the components were used by Walters, but an unfortunate error vitiated some of his quantitative results, as pointed out by Kopal. He deals with the problem very fully, and concludes that the density concentration depends on the age of the system, the components of a new-born binary being nearly homogeneous. The density concentration becomes appreciable in the course of the evolution of the system, until finally both components come close to the model requiring a high density concentration. With advancing spectral type there is an increase in the density concentration, and here we may find something of fundamental physical significance. If it be assumed that stellar energy originates in the formation of heavy elements out of simple ones, we must expect an increase in the number of heavy atoms as the star ages, and these will sink to the centre. If future investigation should confirm this view, there will be some evidence in favour of the theory of the transmutation of elements in stellar interiors. It is suggested that the results may be generalized for spectroscopic binaries.

Early Man in Java

A COMMUNICATION by Dr. P. V. van Stein Callenfels to the Royal Anthropological Institute, which appears in summary form in *Man* of December, urges the desirability of reconsidering the age and standing of *Pithecanthropus*. Dr. Callenfels has classified the fossil fauna of the Java Pleistocene into three groups—early, middle and late Pleistocene. Among those of the early Pleistocene are *Stegodon cf. praeursor* (between Tertiary *praeursor* and Middle Pleistocene *trigonocephalus*), *Hippopotamus antiquus*, *Leptobos*, three antelopes and marine molluscs, of which at least 30 per cent are extinct; Middle Pleistocene *Stegodon trigonocephalus*, *Hippopotamus namadicus*, *Bos (Bubalus) bubalis palaeokarabau*, *Axis axis lydekkeri* (abundant), *Duboisia* (antelope); Late Pleistocene *Stegodon trigonocephalus*, *Hippopotamus namadicus*, *Bos (Bubalus) Axis axis lydekkeri* (very rare), *Axis axis javanicus* (abundant).

By the associated fauna *Pithecanthropus* belongs to the Middle Pleistocene and Solo man to the late Pleistocene. In February last, however, a fossil skull of a child between one and three years was found at Modjokerto, which belongs somewhere in the line of human development. It may have been an infant *Pithecanthropus*. It belongs to the oldest Pleistocene. The discovery of a skull of this age necessitates raising the whole *Pithecanthropus* problem. No fossil fauna of the oldest Pleistocene survives into the Middle Pleistocene and it is, therefore, unlikely that the hominoid only should have survived. The Middle and Late Pleistocene have most of the animals in common, so that Solo man, known from one site only, may have existed in Middle Pleistocene times.

The records of the discovery of the femur of *Pithecanthropus*, which was made by Dubois himself, are known; but of the discovery of the skull-cap, which was made by a sergeant, the record has not been preserved. It is possible that the skull-cap is older than the femur. It may belong to the same stratum as the infant skull, while the femur is that of Solo man. The stone and bone artefacts discovered with Solo man clearly must belong to late Pleistocene; but implements recently discovered at Patjitan by Dr. G. R. H. von Koenigswald, identical with Chellean and Clactonian, are so different as to suggest that they cannot have been made by the same type of man.

In this connexion attention may also be directed to a discussion by Prof. E. Dubois of *Pithecanthropus* and other early forms of man from Java which appears in *Man* of January. Prof. Dubois proceeds by setting out two propositions which he supports by argument.

Proposition I. *Homo soloensis* is human and proto-Australian, forming with Rhodesian man, who closely resembles Solo man, a proto-Australian group representing the most primitive type of *Homo sapiens* and distinct from *Homo neanderthalensis*, the other human species.

Wadjak man is also proto-Australian, and was described as such so long ago as 1920, though its character was recognized when it was first discovered in 1890. The distinguishing characters which determine this classification of Rhodesian man, notwithstanding its gorilloid qualities, are the pulp cavities of the teeth, the slender limb bones, the peculiar nuchal plane of the occipital bone, and the low

cranial capacity, the size of the brain approaching but not quite equalling that of the Australian. The form of the *torus supraorbitalis* in Rhodesian man is of the type of the supraorbital ridge of the Australian rather than of the torus of Neanderthal man. The resemblance of Solo man to Rhodesian man is most striking.

H. soloensis and *H. rhodesiensis* then, with *Sinanthropus*, are the most important of all known fossil men, as representing the most primitive type of *H. sapiens*. The Australian aborigine has conserved much of the primitive somatic character, especially the fundamental and, therefore, most distinctive quality of the mammalian organism, the characteristic brain volume. In the Australian (male) this may be taken as averaging 1,295 c.c. The cubic capacity of the brain of Rhodesian man has been calculated as 1,280 c.c., and for Solo man in the skull Ngandong I as approximately 1,200 c.c. The proto-Australian of Ngandong and the proto-Australian of Rhodesia both had brains which were a little smaller than the brain of the Australian of to-day.

In regard to age, a very recent age is to be attributed to the deposit in which Rhodesian man was found, while fossil Solo man is of post Trinil geological age.

Proposition II. *Pithecanthropus* was not a man, but a gigantic genus allied to the gibbons, superior to its relatives on account of its exceedingly large brain volume, and distinguished at the same time by its erect attitude.

Decisive evidence in support is afforded by the four new femora which were recognized in the Trinil collection in 1932. Corrosion in these, by removing the superficial or periosteal bone layer, has laid bare the internal structure of the shaft wall. This deeper shaft structure is entirely different from the human, and betrays a muscular function and a locomotion, which though facultatively erect and human-like on the ground, was also arboreal, and perhaps on uneven ground a perfection of the semi-erect gait of the gibbon. Thus this new evidence of the morphological and functional distinctness of *Pithecanthropus* furnishes proof at the same time of its close affinity with the gibbon group of anthropoid apes.

The gibbon-like appearance of *Pithecanthropus* is evident from the general form and many morphological details of the skull. It is evident, for example, that the gravitational centre of the head was a considerable distance in front of the condyles, and hence there was no parietal vertex of the brain, a distinctive character of man. Here *Pithecanthropus* agrees with chimpanzee and gibbon. The head was not poised on the vertebral column. The mandible most resembles that of the gibbon, so far as its features are anthropoid, while the strongest evidence is that given by the volume of the cerebrum, which on the law worked out by Prof. Dubois, regulating cerebral quantity in mammals, entirely confirms this second proposition.

Prof. Dubois adds a postscript dealing with the fossil child's skull discovered in February 1936, and described under the name of *Homo modjokertensis*. In another context it has been called "the oldest datable human fossil". In the opinion of Prof. Dubois, however, it is a child of *Homo soloensis*, the proof of identity being the similarity of the peculiar tympanum (see also p. 291).

The Lochaber Water Power Scheme

AN article on "The Lochaber Hydro-Electric Power Undertaking", in *NATURE* of November 29, 1930 (126, 848-849), described the first and main portion of an engineering scheme of considerable magnitude by which water from a catchment area of 303 square miles in Inverness-shire is being collected and led to a power station at Fort William, near the foot of Ben Nevis, which will have an ultimate capacity of 120,000 horse-power—by far the largest installation of its kind in Great Britain. The first instalment of the undertaking, costing about three million sterling, utilized the natural reservoir in Loch Treig by means of a tunnel pipe line to Fort William, and was completed in 1930. The second in the sequence of three stages of development was commenced shortly thereafter and completed in 1934, at a cost of another million. It forms the subject of a paper read on December 15 before the Institution of Civil Engineers by Mr. A. H. Naylor, who was chief assistant engineer to Mr. B. N. Peach, the resident engineer for the undertaking under Messrs. C. S. Meik and Halcrow of Westminster, the consulting engineers responsible for the design and supervision of the works from their inception. The following information of interest is extracted from Mr. Naylor's paper. Reference should be made to the map of the district which appeared in the issue of *NATURE* mentioned above.

The second stage comprises essentially the collection of the discharges from the Loch Laggan and Loch Ossian catchment areas into a reservoir formed by the construction of a dam at the western end of the former and the diversion of the impounded water through a tunnel to Loch Treig, with the provision of further storage through the construction of a dam at the northern end of Loch Treig. Loch Treig is the

main storage reservoir of the system, and the construction of the dam raises the overflow level from the original height of +784 ft. o.d. to +819 ft. o.d., a capacity of 7,838 million cub. ft. being obtained above the lowest level (+695 ft. o.d.) to which it can be drawn down. By arranging that the Loch Laggan reservoir should be capable of being drawn down to +804 ft. o.d. and should spill at +820 ft. o.d., a further storage capacity of 1,480 million cub. ft. is rendered available. The tunnel connecting the two lochs, constructed almost entirely through rock of good quality, has a fall of 15 ft. in its length of $2\frac{3}{4}$ miles. The cross sectional outline is made up of circular segments, giving a width inside the concrete lining of $14\frac{1}{2}$ ft. and a height of $13\frac{1}{2}$ ft. Three streams passing over the tunnel are diverted into shafts leading into the tunnel.

The Laggan dam is noteworthy as representing the first instance in Great Britain of the embodiment of a large siphon spillway in the design. Six siphon units are installed having shaft diameters of 4 ft. 6 in., fitted with jet dispersers at their outer extremities, the intakes being 3 ft. high by 6 ft. 10 in. wide. By inclining the outlets at 30° above the horizontal, it is calculated that the issuing jet will strike the river bed at about a maximum distance from the toe of the dam and reduce to a minimum the danger to the dam from vibration or undermining.

For the third and final stage of development it is contemplated to divert the waters of the upper Spey westward into the River Pattack which flows into Loch Laggan, so that, whereas originally the River Spean flowed into the River Spey to discharge into the North Sea, under the projected scheme, the Spey will flow into the Spean and discharge into the Atlantic Ocean.

BRYSSON CUNNINGHAM.

Forestry Research in the Malay Peninsula

THE annual report for 1935 of the Forest Research Institute of the Malay Forest Department has been recently issued, as also the Programme of Research for 1936 (Kuala Lumpur: Forest Department, 1936). Owing to financial difficulties, these reports are reproduced from typescript.

The Institute has been under Mr. J. G. Watson and Mr. E. J. Strugnell during the year. The cost of maintenance is a charge on the budget of the Forest Department, and this in recent years of financial depression has necessitated considerable economies. It is said that the funds available for apparatus and travelling have been limited, and it has been impossible to provide technical subordinates, to whom a great deal of the routine which has fallen on the shoulders of the senior staff could have been entrusted.

The curtailment of research work has been taking place in many parts of the British Empire; but it is a short-sighted policy where existing unworked and only partially known tropical and subtropical forests

are concerned, which represent a part of the capital assets of the country containing them. It is this want of recognition that the large forest tracts in so many of the Dependencies and Colonies of the British Empire represent an undeveloped capital of considerable potential value upon which funds must be put out if it is to be developed (as in the case of the primary development of a gold or other mines) which is delaying progress; whilst in many cases the forest capital is deteriorating in value under the current and injurious practices of the users.

The report deals with the work of the various branches of the Institute—silviculture, botany, wood technology, timber mechanics, seasoning and wood working, timber preservation and durability, and the investigations carried out in the chemical and entomological branches. A brief description of the education work carried out at the Forest School is appended to the report.

The work described for the year indicates the wide field which is now being covered by the research

officers, and a careful study of the report proves that research work of the very highest value, not only to the Department concerned but also to the country as a whole, is being carried out.

The programme of research for 1936 indicates the lines of work to be undertaken under the different branches; but in some cases it is noted that suggested work must be postponed until there is an officer available to undertake it.

In the *Malayan Forest Records*, No. 12 (Malay States Govt. Caxton Press, Ltd., Kuala Lumpur, 1936), Mr. H. E. Desch, wood technologist, discusses "Commercial Timbers of the Malay Peninsula. No. 1, The Genus *Shorea*", botanical notes being contributed by the forest botanist, Mr. C. F. Symington. Mr. Desch had started a series of articles on Malayan timbers in the *Malayan Forester* but gave them up in order to concentrate on the production of this record, as a new method of treatment had become necessary.

"Further investigation disclosed," says the author, "that the then-accepted groups, in the case of timbers of the genus *Shorea* particularly, were arbitrary and unworkable. For example, having described the timber of *nemesu* (*S. pauciflora*), it was found that the description fitted timbers of the *meranti tembaga* (*S. leprosula*) type in most essential respects, while the timbers of species allotted, at that time, to the

meranti bakau group were not really dissimilar. It was apparent that the attempt to set up divisions in a group of timbers so similar to one another was impracticable, while the assumption that differences did exist was responsible for some of the prevailing misconceptions and might well lead to further inaccuracies." Mr. Desch therefore decided to classify the timbers of a genus on their anatomical structure, general appearance and physical properties, irrespective of existing conceptions of classification. The first genus to be so treated was *Shorea*, the most important source of timber in the Peninsula, and it has been found that the classification of species conformed closely with Mr. C. F. Symington's parallel botanical studies.

Concentrating on the more salient features of groups of species, 47 species have been dealt with in six more or less natural divisions, but repetition has not been entirely eliminated. This overlapping was felt to be unavoidable until features of specific significance are better understood.

The treatment of his subject is both useful and instructive and although, as Mr. Desch says, the publication is a compromise in an endeavour to cater for those interested in the scientific study of wood, and those engaged in the practical utilization of timber, it is none the less interesting for that reason.

Education in England and Wales*

THE report of the Board of Education for the year 1935, published under the title "Education in 1935", is, in the main, like those of previous years. The volume is, as usual, a compendium of facts and figures duly arranged in successive chapters, dealing all too briefly with subjects which range from the elementary school to adult education, as well as the museums at South Kensington and Bethnal Green which are financed out of the Board's vote, and the whole miscellany is supplemented by tables of statistics, of which it may safely be said that they are more detailed and elaborate than those which are supplied by the Ministry of Education of any other European country. It is, in fact, not so much an account of 'Education in 1935' as a bare record, with little by way of comment or suggestion to relieve it, of the Board's administration during the year in question.

In one respect, the report makes a welcome new departure. The year of King George V jubilee has provided an occasion in an opening chapter for an interesting survey of education since the King's accession in 1910, a period which has witnessed "a more conscious recognition of the claims of the individual and a greater emphasis on the development of each child according to his bent and capacity". Though there is no room for complacency, it will scarcely be denied that there has been marked progress over the whole field. The abolition of half-time attendance at elementary schools, and of exemptions before fourteen years of age, has resulted in an increase of 87 per cent in the number of children over thirteen in these schools; out of 20,854 schools,

4,760 are new or have been extensively enlarged; the education given in the schools is less bookish and more practical, the percentage of schools for children over 11 which make provision for handicraft having risen from 23 in 1910 to 65 to-day: lastly, the re-organization of the elementary system with its provision for "advanced instruction", as adumbrated in the Hadow Report, though long overdue and still incomplete, has at least gone so far that 55 per cent of the older children are in reorganized schools.

The developments in technical education include the establishment of grouped courses and of the scheme of examinations for National Certificates. The provision in the Act of 1918 for a system of part-time day continuation classes for adolescents of 14-18 years is discreetly referred to as "a plan which would . . . have had a profound influence on the system of Technical Education and the relations of the schools with industry and commerce". This is an understatement. It would, we think, be true to say that this provision of the 1918 Act, had it been implemented, would have had social and educational results not less important than those which have followed from the Act of 1902; and the failure of successive Governments to tackle the problem of adolescent education is one of the most lamentable omissions of post-War statesmanship.

As for secondary education, the years from 1910 to 1935 cover nearly the whole period during which secondary schools have existed as an integral part of the State system of education. The growth in the number, size and efficiency of these schools, in which the elementary school teacher of to-day will usually have been educated and from which the technical schools and colleges now derive a large proportion of their students, may justly be regarded

* Education in 1935, being the Report of the Board of Education and the Statistics of Public Education for England and Wales. (London: His Majesty's Stationery Office, 1936.) 3s. 6d. net.

as the most notable educational advance of King George V's reign. The extent of that advance can only be measured by comparison with conditions in pre-War days, when teachers were ill-paid and too often ill-qualified for their important tasks, when the pupils came late and left early—the average length of school-life being less than three years—when nothing had been done to co-ordinate examinations or to reduce their number, when sixth form work was ill-developed and the flow of secondary school pupils to the universities was in some areas a mere trickle and in a large number of schools non-existent. For information as to the conditions which exist to-day the report must be consulted.

In regard to the output to the universities, Table 48 shows that 36 per cent of all the entrants in 1934–35 entered direct from State-aided secondary schools, and this figure does not take account of those who entered after an interval. The figures given on page 49 of the report show that 53 per cent of the open scholarships and exhibitions awarded at Oxford and Cambridge were won by pupils from the State-aided schools, and that in 1935 candidates from these schools gained 56 per cent of the first classes in the final honours schools and triposes (Part II) awarded to candidates from all schools in England and Wales. The flow of pupils to the universities has been encouraged by the institution of State scholarships, which will in future be open to candidates from 'public schools' as well. As to the after careers of the State scholars, it would appear that, in the period 1929–34,

50 per cent of these scholars (men 34 per cent, women 70 per cent) took up teaching, 20 per cent entered other professions and 13 per cent engaged in research. These figures, compared with corresponding figures for the previous five years, show a decrease of 8 per cent in those who entered teaching, an increase of 6 per cent in those entering other professions and 5 per cent in those who took up research work.

It may well be asked whether the report has anything to tell us as to what is actually going on in the class-rooms, practical rooms and science laboratories of the schools with which it deals. The answer must be in the negative. The scientific reader who wants, for example, to know what steps are being taken to devise a general syllabus of elementary science and whether biology is now receiving the attention it deserves, will find no answer to his question in the volume under review. Containing as it does much information which those engaged in educational administration will be glad to have at hand and, in its initial chapter, a valuable survey which the general reader may study with profit, it tells us scarcely anything of the actual work of the schools. Statutory requirements no doubt determine the form of the Board's report, and may to some extent limit its contents; but it is permissible to suggest that if the omission to which we have directed attention could in a measure be made good, the Board's annual reports would be of more general interest and incidentally secure a wider publicity.

F. B. STEAD.

Immunity of Plants to Disease

THE third International Congress on Comparative Pathology met at Athens on April 15–18, 1936, and there were three main sections, namely, human medicine, veterinary medicine, and plant pathology. Reports of the various deliberations are now being published, and the first volume, from the Section of Plant Pathology, deals with plant immunity against disease-producing agents*.

Dr. E. J. Butler reviewed the problem, and after insisting upon the relatively local reactions of plant tissue, through absence of any circulatory system, he recognized five types of immunity, namely, (1) that following a previous infection and affecting the whole plant, (2) resistance to further local infection in the immediate region of a previous attack, (3) immunity by 'vaccination' with a less virulent strain of the pathogen or of substances formed in diseased tissues, (4) intracellular acquired immunity, and (5) symbiosis, which might vary towards immunity with changing conditions.

Dr. J. Dufrenoy considered the role of amino acids and phenolic compounds in susceptibility or resistance of plants. He showed that resistance is due, not so much to the pre-existence of phenolic compounds in healthy plants before attack, as to the ability of the host to produce such substances when under the stimulus of the entering fungus. Several plant diseases exhibit zones of cells rich in anthocyanin or phenolic compounds, around the point of fungal attack. In *Vitis* hybrids, many concentric zones

follow attack by mildew, each made during a dry period. The intervening green zones indicate moist intervals.

Several interesting comparisons between animal and plant pathology were drawn by Prof. Ernst Gäumann. Animal immunity is more active than plant immunity, since animal parasites are introduced passively into an active host, whilst plant parasites must themselves gain entrance to a relatively passive victim. Prof. Domenico Carbone agreed with many speakers at the Congress, that there is no evidence for the formation of definite antibodies in plants; but described the diffusion of defensive substances from pieces of plant tissue kept in solutions, or gels, *in vitro*. Dr. J. Magrou maintained that phenomena which might be termed phagocytosis appear in the plant kingdom. Mycelial masses of the symbiotic mycorrhiza of orchids are, for example, often digested by the host.

Prof. Jean Politis directed attention to the part played by certain substances in the struggle of the plant against a parasite. He stressed the fact that the vacuoles containing such substances are derived from the cell nucleus, and are therefore under the same hereditary influences as the nucleus. The degree of hydration of the vacuole determines the susceptibility or resistance of the host, according to Prof. H. S. Reed, who also proceeded to review the influence of nutritive relations upon host-parasite reactions. Prof. A. J. Riker had a short but interesting paper on "Biochemical and Physical-Chemical Studies on the Bacteria which stimulate Atypical and Pathological Multiplication of Plant Cells".

*III^eme. Congrès Internat. de Path. Comparée, Athènes. Tome premier, Rapports, 2^eme Partie, Section de Path. Végétale, "L'Immunité Chez les Végétaux". (Athènes: Editions "Flamma", 1936.)

Much light can be thrown on the problem of immunity by a study of the resistance of plants to non-living poisons and alkalis. Dr. Winifred E. Brenchley considered the effect of excess mineral nutrients, of inorganic and organic poisons, of gases and sprays, and in the section on resistance to alkalis reviewed much recent work on the plants of chalky soil, and on chlorosis. Prof. F. T. Brooks discussed the resistance of trees to ligneous fungi, and Dr. Tewfik Fahmy described the production of cotton plants immune to the fungus *Fusarium vasinfectum* var. *Egypticum*, by breeding and selection.

Prof. L. W. Rischkow reviewed the conditions where resistance of the host was shown towards virus diseases, and Dr. R. N. Salaman dealt with the same subject, but from a different point of view. He showed that a plant could be rendered immune from attack by a virulent form of virus 'X', if it were previously vaccinated with a non-virulent strain of the same virus. Dr. Kenneth Smith and Mr. J. P. Doncaster had a paper on "The Particle Size of Plant Viruses".

Immunity against bacterial plant pathogens was treated in an encyclopædic manner by Prof. Tr. Săvulescu, who claimed that the use of vaccines or bacteriophage, in plant therapy, is understood in theory, but is not yet of practical utility. A very extensive bibliography appears at the end of Prof. Săvulescu's paper. Two very informative papers on "The Nature of Resistance of Cereals to Rust", by Dr. E. C. Stakman and Miss Helen Hart, and "The Development of Disease-Resistant Plants", by Dr. H. B. Humphrey, end the volume.

The teacher of mycology, and those plant pathologists who were not fortunate enough to attend the Congress, cannot but be grateful for this volume of reports. It is a welcome gathering of knowledge from many, and often conflicting, points of view, which do not appear so conflicting when tempered by the international atmosphere of the conference, and when bound within the confines of one volume. With the exception of one paper in Italian, all the communications are in English, French or German, and with the provision of a French summary to each article, the contents will be available to most students.

Science News a Century Ago

Prof. Edward Turner (1798-1837)

ON February 13, 1837, Prof. Edward Turner died at Hampstead at the age of thirty-nine years through inflammation of the lungs. He had been appointed professor of chemistry at University College, London, in 1828, and his death was regarded as a severe loss not only to the College, but also to many scientific societies in the Empire. Born in Jamaica in 1798, he was taken to Edinburgh at an early age and was educated there, graduating M.D. in 1819. After a period of study under Stromeyer at Göttingen, he began to lecture in Edinburgh and published his "Introduction to the Study and Laws of Chemical Combination", which he afterwards worked into his "Elements of Chemistry", 1827, one of the standard text-books of the time.

At University College, Turner had a large class and his lectures were remarkable for their lucidity. Speaking of his work to the Chemical Society in 1900, Sir Edward Thorpe said he was "an excellent

manipulator and his analytical and determination work was of a high order. He is specially to be remembered for his determination of the atomic weights of lead, chlorine, silver, barium, mercury, nitrogen and sulphur; they were the first atomic weights to be measured by a British chemist and are worthy to be ranked with those of Berzelius". In the course of his work, Turner pointed out that the atomic weights hitherto commonly used by British chemists had been adopted without due inquiry and that several of the most important ones were erroneous, and that the hypothesis that all equivalents are multiples of a whole number of the equivalent of hydrogen was inconsistent with the state of chemical knowledge at the time, being at variance with experiment. His work led to the rejection of Prout's theory, and the position he arrived at was precisely that to which Stas arrived half a century later."

Turner was buried in Kensal Green Cemetery. A marble bust of him was placed in University College by his pupils. He was succeeded by Thomas Graham.

Claude-Pierre Molard (1758-1837)

By the death on February 13, 1837, of Claude-Pierre Molard, the French nation lost a distinguished mechanic who had been one of the most active founders of the National Conservatoire des Arts et Métiers in Paris and its director from 1801 until 1816. When he died, he was president of the Section of Mechanics of the Paris Academy of Sciences. Molard was the elder brother of another well-known mechanic, Emmanuel-François Molard (died 1829), and was born near St. Claude, Jura, on June 6, 1758. Though the son of poor parents he was able to attend schools at St. Claude and Lyons and became a draughtsman, his ability as such attracting the attention of Jacques de Vaucanson (1709-82), who had formed a collection of machines which he left to the nation, and which eventually formed the nucleus of the collections at the Conservatoire.

In 1785, Molard went to Paris to work under Vandermonde, who was in charge of Vaucanson's collections, and he was made a member of the commission appointed by a decree of February 11, 1794, to report on the preservation of monuments and works of art. To this commission belonged Lamarek, Berthollet, Vauquelin, Monge, Prony and other men of science, and it was through them the decree of 19 vendémiaire an III. (October 10, 1794) was passed which led to the foundation of the Conservatoire.

Skey on Muscular Fibre

At a meeting of the Royal Society on February 16, 1837, a paper was read by Frederic Skey entitled "On the Elementary Structure of Muscular Fibre of Animal and Organic Life". The author, said the report, concludes from his microscopic examination of the structures of muscular fibres that those subservient to the functions of animal life have, in man, an average diameter of one 400th of an inch, and are surrounded by transverse circular striæ varying in thickness and in the number contained in a given space. Each of these muscular fibres is divisible into bands or fibrillæ, each of which again is subdivisible into about one hundred tubular filaments, arranged parallel to one another, in a longitudinal direction around the axis of the tubular fibre which they compose, and which contains in its centre a soluble

gluten. The diameter of each filament is one 16,000th of an inch.

Frederic Carpenter Skey (1798-1872) was a pupil of Abernethy and became successively assistant-surgeon, lecturer on anatomy and surgeon at St. Bartholomew's Hospital. He was elected F.R.S. in 1837 and in 1863 served as president of the Royal College of Surgeons.

Royal College of Surgeons

THE *London Medical Gazette* of February 18 contains the following eulogy of the Royal College of Surgeons:

"Of the existing institutions connected with the medical profession the College of Surgeons is in various respects by far the most important. The building is worthy of the great national establishment; the library is a magnificent addition, which has grown up of late years; the museum is a monument worthy of the name it bears, and creditable to the nation. Nor do the names of many among its present members reflect less honour upon English surgery than the greatest of their predecessors, while of the existing Council it is but justice to add that they have shown their determination to keep pace with the march of intellect and the improvement of the times. In these respects—we mean setting aside ancient prejudices—in gathering wisdom from passing events—and in rendering their institution available to great national objects—we must say they have far outstript their elder brethren in Pall Mall, and accordingly are their character and influence as a public body proportionately greater. It is in Lincoln's Inn Fields that the battle between the new and the old race of practitioners must be fought. . . ."

University Events

CAMBRIDGE.—Prof. J. Proudman will give a course of six lectures on dynamical oceanography in the Zoological Lecture Theatre at 5 p.m. on Mondays, Wednesdays and Fridays, commencing on Monday, February 15.

The following have been approved for the degree of Sc.D.: D. A. Bannerman, of Pembroke College, and E. A. Guggenheim, of Gonville and Caius College. Miss Frances Mary Hamer, of Girton College, has been approved for the title of the degree of Sc.D.

EDINBURGH.—The Cameron Prize for 1937 has been awarded by the Senatus to Prof. J. Bertram Collip, professor of biochemistry in McGill University, Montreal, in recognition of his many contributions to endocrine therapy and in particular his work on the parathyroid gland.

At a meeting of the University Court on January 25, an offer was received from the University Grants Committee of a non-recurrent capital grant up to a maximum of £15,000 towards the cost of a building for a Students' Union for men and women on the King's Building site at West Mains Road, the building to include a refectory and a gymnasium. The total cost, exclusive of furnishings, is estimated at £20,000, and the Committee has offered the grant on condition that the remainder of the cost be obtained from other sources, and that the scheme should be proceeded with as soon as possible, and in any case within two years from the date of the offer.

Societies and Academies

London

Royal Society, February 4.

R. A. WATSON WATT, A. F. WILKINS and E. G. BOWEN: The return of radio waves from the middle atmosphere. Observations spread over a year from May 1935 have established the existence of sustained stratified electrification, persisting for several days, of such ionization density and gradient as to return radio waves of frequency 6-12 Mc./sec. at vertical incidence, at such heights as 8.5, 9.3, 10.3, 10.75 and 13.5 km. with reflection coefficients of the order of 0.7, giving measurable echoes up to the tenth order, beyond which they are not readily distinguished from ionospheric echoes. Apparently independent stratification at 45-50 km., with a reflection coefficient of 0.3 for 6 Mc./sec. waves, and the *D* region at and above 60 km. are also recorded. Reflections from all these regions are obtained at and above the frequencies proposed for television services. The ionization does not fall to very low values at night, and has no seasonal variation of large amplitude. Evidence is given of replenishment around the 20-30 km. levels by local thunderstorms.

H. J. BHABHA and W. HEITLER: The passage of fast electrons and the theory of cosmic showers. Relativistic quantum mechanics have been used to calculate the number of secondary positive and negative electrons produced by a fast primary electron with energy E_0 passing through a layer of matter of thickness l . The primary electron in the field of a nucleus has a large probability of emitting a hard light quantum which creates a pair. The pair electrons emit again light quanta which create pairs, and so on. The number of secondaries increases rapidly with E_0 . If an electron of 10^{11} e-volts passes through a lead plate of 5 cm. thickness the number of particles emerging from the plate amounts to 1,000 or more. Thus showers can be explained by the ordinary quantum theory. Comparison with experiments shows that Rossi's transition curve and Regener's absorption curve in the atmosphere can be understood on this theory. The penetrating power of fast electrons appears to be very much greater than a straightforward consideration of the energy loss would indicate. The absorption coefficient of the radiation found at a depth of 100 metres of water cannot, however, be understood on the basis of this theory if this radiation is due to primary electrons.

Paris

Academy of Sciences, January 11 (*C.R.*, 204, 77-160).

MARCEL GODCHOT and M^{lle}. GERMAINE CAUQUIL: The action of hydrocyanic acid on 4-methylcyclohexanone and the preparation of the two stereoisomeric 4-methylhexanol carboxylic acids.

PAUL LÉVY: The arithmetic of the laws of probability.

MARC COURTAND: *Gauche* curves of the third order.

PAUL VINCENSINI: Bodies of constant width in space of three dimensions.

ANDRÉ MARCHAUD: The contingent and paratangent at a point of a simple Jordan surface.

MICHEL GHERMANESCU: Homofocal quadrics.

LOUIS THIBAUDIER: The Poncelet polygons inscribed and circumscribed in two conics.

MAX EGER: The canonical systems of an algebraic variety.

DÉMÉTER MANGERON: Certain boundary problems for a class of partial differential equations of higher order.

NATAN ARONSZAJN and ALEXANDRE WEINSTEIN: The convergence of a variational method of approximation in the theory of encased plates.

ALEX GARDEDIEU: Heterogeneous fluid masses in rotation.

NICOLAS Slioskine: The oscillations of rotation of an unlimited cylinder filled with a viscous liquid.

JACQUES VALENSI: Measurement of the circulation along various sections of a wing.

RENÉ SWYNGEDAuw: The position of the neutral line in homogeneous belts.

JEAN LAGRULA: Measurements of the intensity of gravity carried out in northern Africa during the year 1936.

MME. MARIE ANTOINETTE TONNELAT-BAUDOT: The linearization of the density of energy and of the action function with the assistance of complex vectors.

LOUIS LEPRINCE-RINGUET and JEAN CRUSSARD: Study of the particles of high energy in the cosmic radiation in the magnetic field of the Bellevue electromagnet. In this work a Wilson chamber was placed between the poles of the large electromagnet at Bellevue, giving a field of 13,000 gauss. About five hundred trajectories have been measured and an analysis of the results obtained is given.

MME. NELICIA MAYER: The oxido-reduction potential of reductinic acid.

ARAKEL TCHAKIRIAN: The electrolysis of germano-chloroform or germanohydrochloric acid. The experimental results furnish a further proof of the existence of the complex ion Ge^+HCl^3 , in agreement with the theory of G. Urbain.

LOUIS BRÜNINGHAUS: A new fluorometer. A modification of the Gaviola instrument, the Kerr cells being replaced by piezoelectric quartz.

GEORGES ALBERT BOUTRY: A new type of photo-emissive cell. Discussion of the causes of the errors of the usual type of photo-cell and suggestions for eliminating them.

Mlle. YVETTE CAUCHOIS: The L absorption spectrum, and the characteristic levels of mercury.

ALBERT PORTEVIN and LOUIS GUITTON: Contribution to the study of the role of inclusions in the corrosion of steels.

CHARLES DUFRAISSE and ROBERT PRIOU: Dissociable organic oxides. The photo-oxide of mesodimethoxyanthracene, $\text{C}_{16}\text{H}_{14}\text{O}_4$. Photo-oxymethoxyanthracene was prepared and, contrary to the authors' expectation, was not dissociable.

RAYMOND QUELET and JEAN ALLARD: The synthetic preparation of ethoxy-methylbenzyl alcohols.

JULES JARROUSSE: Diphenylpyruvic acid. Preparation of the phenylbenzylsuccinic acids.

RENÉ JACQUEMAIN and ALFRED MOSKOVITS: Some compounds obtained with the aid of iodoargentonitrobenzoic complex compounds.

L. CAPDECOMME and G. JOURAVSKY: The indicators of reflective powers of slightly absorbent crystals.

GÉRARD WATERLOT: The structure of the Cambrian massif of Rocroi.

L. PETITJEAN: The comparative variation of the anomalies of barometric pressure and the solar activity. Over the interval 1884-92, the polar air

was more active than the tropical air when the number of sunspots presented a more rapid diminution or a slower increase.

ALEXANDRE DAUVILLIER and ANATOLE ROGOZINSKI: The reality of Hoffmann shocks. From the experiments described, the authors conclude that the Hoffmann shocks do not represent a special accidental form of discharge in gases, but they measure effectively the energy of the particles associated with cosmic radiation.

RENÉ SOUÈGES: The embryogeny of the Primulaceae. The development of the embryo in *Samolus Valerandi* (brook-weed).

JEAN LE CALVEZ: The schizogonic process in the foraminifer *Planorbulina mediterraneensis*.

MAURICE ROSE and Mlle. M. HAMON: The dehiscence of some spermatophores of decapod crustaceans.

RAYMOND TURPIN and ALEXANDRE CARATZALI: The influence of twin births and of maternal age on the proportion of the sexes.

JACQUES RABATÉ: Gaultherioside (ethylprimeveroside). Its biological synthesis. In a previous communication, a new heteroside, gaultherioside, was described as obtained from the leaves of *Gaultheria procumbens* (winter-green). It is now found to be formed from primeverose and the alcohol used for the extraction, and probably does not exist in the leaves.

JEAN ROCHE and RENÉ COMBETTE: The osmotic pressure and molecular weight of various erythrocytins (invertebrate haemoglobins).

DENIS BACH: The destruction of the dehydrogenases of the yellow *Staphylococcus* by heat. The protective action of the substrate.

Moscow

Academy of Sciences (*C.R.*, 4, No. 3; 1936).

V. S. IGNATOVSKIJ: The Laplacian transformation (3).

S. LECHNICKIJ: The strains in an endless anisotropic plate weakened by an elliptical hole.

P. A. WALTHER: Pressure on wings, and its momentum at high velocities.

J. WEICHERZ and B. GOUQUELL: A new equation expressing the state of matter.

M. B. NEUMANN and P. M. TUTAKIN: The transition of a cold flame into a hot one at low-temperature auto-ignition of butane.

V. ŠARONOV: Determination of the light-extinction factor and of the field of vision by the data obtained with an apparatus for measuring the haziness of air.

M. A. ROSENBERG, K. E. AVALIANI and F. B. JURKOVSKAJA: Dissolution of the 'vacuum films' of metals in acids. (1) Dissolution of chromium in sulphuric acid.

V. V. TRŠČENKO and M. D. RYDALEVSKAYA: An attempt at the chemical investigation of the humic acids of different soil types.

B. N. FORSCH: Geochemical composition of oceanic and of continental water (the water of Lake Baikal).

A. TARANETZ: Description of three new species of the genus *Icelus* Kröyer (Pisces, Cottidae) from the Sea of Japan and from the Okhotsk Sea.

E. P. SLASTENENKO: Species of the genus *Tripterygion* found in the Black Sea (Pisces, Clinidae).

G. STREICH and E. SVETOSAROV: Significance of temperature and of the sexual hormone in the moulting process of birds.

E. SVETOSAROV and G. STREICH: Factors determining the sexual and the seasonal dimorphism in ducks.

ERRATUM.—The title of the paper by S. Sobolev (NATURE, Jan. 2, 1937, p. 40) should read: The fundamental boundary problem for polyharmonic equations in a domain with degenerated contour.

Prague

Czech Academy of Sciences and Arts, January 17, 1936.

JAR. PETRBOK: Molluscs from the travertine of the Slovak karst formation, from Janovce and its neighbourhood, Spiš and Rušbach.

B. NĚMEC, J. BABIČKA, A. OBORSKÝ: Occurrence of gold in horse-tails. *Equisetum palustre* (having more than sixty per cent SiO_2 in the ash) accumulates gold from soil with 0.2 gm. gold per ton so that its ashes contain 610 gm. per ton. The soil consists of decomposed andesite and rhyolite.

J. MILBAUER: The associated phenomena of catalysis. Pairs of catalysts like Pd, SeO_2 , HgSO_4 , Ag_2SO_4 , CuSO_4 are much more efficient in the oxidation of carbon monoxide by hot concentrated sulphuric acid than single catalysts.

F. VALENTIN: On 3,6-anhydromannite.

March 20.

Z. BAŽANT: The precise solution of the walls of cylinders.

E. VOTOČEK and S. MALACHTA: New transitions from the series of the sugars to those of the pyranes and pyrrols. Methyl-*iso*-pyromucic acid.

J. KOMÁREK: Can the larvæ of food pests produce intestinal diseases?

J. H. KŘEPELKA and V. ŠVARC: Contribution to the extraction and identification of veronal and luminal.

J. BAŠTA: Theory of the fatigue of materials, especially in engineering structures.

L. BOROVANSKÝ: Sexual dimorphism of the human skull.

F. NĚMEC: Palæobotanical research on the travertine deposits of the Slovak karst.

V. H. MATULA: The preparation of an accurate emanation standard from pitchblende. This is dissolved in hydrochloric acid, silica is separated and decomposed by hydrochloric acid; any residue is dissolved in nitric acid and added to the solution.

May 29.

J. MILBAUER: (1) Study of carbonyl sulphide. This substance decomposes in concentrated sulphuric acid already at 150°C . In the presence of palladium as catalyst, it reacts at 90°C .; other catalysts show decreasing effects in the series SeO_2 , Pt, Ag_2SO_4 , CuSO_4 , V_2O_5 , HgSO_4 , TeO_2 , SnO_2 , Sb_2O_3 . (2) Remarks on the author's work on catalysts.

K. KAVINA: Allogony of *Salix caprea* L.

V. JANDA: Colour change of transplanted skin, and artificially united body fragments of *Dixippus morosus*.

R. BRDIČKA: Dependence of the polarographic reaction of proteins on hydrogen ion concentration. The catalytic polarographic protein reaction giving a characteristic 'wave' on current-voltage curves is shown not only in the presence of ammonium chloride and ammonia, but also in any buffered solution. The 'wave' depends on the concentration of protein, on the hydrogen ion concentration of the solution, and on the quality and capacity of the buffer.

F. NĚMEC: Contribution to the recognition of Permo-Carboniferous flora in the coal deposits of the foot of the north-east slope of Velebit (Yugoslavia).

A. VANČURA and V. SUTNAR: The chronological development and pathogenesis of the syndromes inside and exterior to the kidneys in acute nephritis following angina.

B. BOUČEK: Graptolites of the Bohemian lower Ludlow.

A. ŘÍHA: The new bellerophonitids of the Czech Palæozoic.

October 23.

B. NĚMEC, J. BABIČKA and A. OBORSKÝ: New analysis of plant ashes from auriferous ground. The content of gold found in the ashes of plants is in *Equisetum arvense* 576, *Mentha arvensis* 300, *Clematis vitalba* 110 gm. per ton. In *Fagus sylvatica*, *Carpinus Betulus*, *Salix caprea*, *Polyporus fomentarius* only traces. In seeds more gold than in wood; the gold content increases with the silica content.

E. VOTOČEK and Z. ALLAN: The rotation of certain sugar hydrazones with respect to the α -configuration of carbon.

E. VOTOČEK and J. WICHTERLE: The connexion between the rotation of sugar hydrazones and the α -configuration of carbon.

E. VOTOČEK, F. VALENTIN and J. BULFŘ: The constituents of mullein-seed oil.

J. MILBAUER: The minimum quantities of catalysts having maximum effect in concentrated sulphuric acid. In the oxidation of gases by concentrated sulphuric acid at 250°C ., homogeneous catalysts (like copper, mercury and silver sulphates) give a maximum effect when their solubility is reached. Heterogeneous catalysts (like the platinum metals) act most through their dissolved portion. Ruthenium, rhodium and palladium are more efficient than osmium, iridium and platinum.

V. HLAVATÝ: The system of Weyl connexions.

J. BAŠTA: Preliminary contribution to the mechanical theory of the equation of state.

P. PACHNER: Sexual dimorphism of the human pelvis, and mutual relations of pelvic measurements.

V. HOVORKA: Separation of lead from sulphuric acid, and determination of lead by means of *o*-hydroxyquinoline.

O. PANKRAZ: Two integral equations.

VRAT. VELICH: Agar and saponin from malt as a preferential culture base for mycodermis.

V. KRYŠTOFEK: The problem of simultaneity and the theory of relativity.

November 27.

B. BOUČEK: Silurian stratigraphy in the Daleje valley.

F. NĚMEC: (1) The seed cones of *Discinities* K.F. (2) A revision of the Carboniferous and Permian flora of the Central Bohemian coal basin.

O. PANKRAZ: A special condition for the stationary circulation of economic goods.

Forthcoming Events

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

Monday, February 15

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 4.—Prof. G. E. Gask: "John Hunter in the Campaign in Portugal, 1762-1763".

ROYAL GEOGRAPHICAL SOCIETY, at 5.—H. P. Smolka: "The Economic Development of the Soviet Arctic".

IMPERIAL COLLEGE—ROYAL COLLEGE OF SCIENCE, London, at 5.30.—Prof. W. L. Bragg, F.R.S.: "The Structure of Alloys".*

Tuesday, February 16

INSTITUTION OF CIVIL ENGINEERS, at 6.—Sir Noel Ashbridge: "Modern Developments in Broadcasting Radio Transmission and Television".

Wednesday, February 17

ROYAL METEOROLOGICAL SOCIETY, at 5.—Dr. C. E. P. Brooks: "Meteorological Circumstances of the Floods in the United States of America".

UNIVERSITY OF LONDON INSTITUTE OF EDUCATION, at 5.30.—Dr. W. G. Adams: "Adult Education in England" (John Adams Lecture).*

INSTITUTE OF CHEMISTRY (LONDON AND SOUTH EASTERN COUNTIES SECTION), at 7.30.—Prof. J. F. Thorpe, F.R.S.: "The Past and Future of the Institute".

ROYAL SOCIETY OF ARTS, at 8.15.—Dr. R. C. Fisher: "Recent Work on Wood-destroying Insects".

Thursday, February 18

LONDON MATHEMATICAL SOCIETY, at 5—(in the rooms of the Royal Astronomical Society, Burlington House, W.1). Prof. G. H. Hardy, F.R.S.: "Ramanujan and the Theory of Primes".

Friday, February 19

GEOLOGICAL SOCIETY OF LONDON, at 3. Annual General Meeting.

INTERNATIONAL SOCIETY OF LEATHER TRADES' CHEMISTS, February 19-20. A symposium on "Scientific and Technical Aspects of Wetting and Detergency" to be held in the Mathematics Lecture Theatre, Imperial College of Science, South Kensington, S.W.7.*

Appointments Vacant

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

ASSISTANT LECTURER IN CIVIL ENGINEERING in the City and Guilds College—The Secretary, Imperial College of Science and Technology, Prince Consort Road, South Kensington, S.W.7 (February 16).

PRINCIPAL of Willenden Technical College—The Secretary, H. M. Walton (T), 10 Great George Street, Westminster, S.W.1 (February 16).

HEAD OF THE ENGINEERING DEPARTMENT of the North Staffordshire Technical College—The Clerk to the Governors, Town Hall, Hanley, Stoke-on-Trent (February 17).

LECTURER OR ASSISTANT LECTURER IN MATHEMATICS in Westfield College, London, N.W.3—The Principal's Secretary (February 19).

ASSISTANT LECTURER IN MECHANICAL ENGINEERING in the County Technical College and School of Art, Newark-on-Trent—The Principal (February 20).

ASSISTANT SECRETARY at the Institution of Petroleum Technologists, Aldine House, Bedford Street, London, W.C.2—The Secretary (February 20).

LECTURER IN AGRICULTURE (BIOLOGY AND CHEMISTRY) in the School of Agriculture, Plumpton—The Director of Agriculture, County Hall, Lewes, Sussex (February 21).

WAR DEPARTMENT CHEMISTS—The Under-Secretary of State (C.5), The War Office, S.W.1 (Quote Appts./19) (February 23).

PHYSICIST on the staff of the Northern Coke Research Committee, Armstrong College, Newcastle-upon-Tyne—The Secretary (February 27).

PROFESSOR OF APPLIED MATHEMATICS in the University of Birmingham—The Secretary (March 1).

MUSGRAVE PROFESSOR OF PATHOLOGY in the Queen's University of Belfast—The Secretary (March 19).

CHEMIST in the R.N. Cordite Factory, Holton Heath—The Secretary of the Admiralty (C.E. Branch), London, S.W.1. (Quote C.E. 77/1937.)

Official Publications Received

Great Britain and Ireland

The New Commonwealth. Series F, No. 3: The Functions of an International Equity Tribunal. Pp. 19. (London: The New Commonwealth.) 6d. [151]

Seventh Annual Reports of the National Radium Trust and Radium Commission, 1935-1936, including a Statistical Report. (Cmd. 5342.) Pp. 91. (London: H.M. Stationery Office.) 1s. 6d. net. [161]

"Defence" that is no Defence. By C. E. M. Joad. Pp. 8. (London: National Peace Council.) 1d. [201]

The Manchester Museum: The University of Manchester. Museum Publication 112: Report of the Museum Committee for the Year 1935-36. Pp. 18. (Manchester: Manchester Museum.) 6d. net. [211]

The National Council for the Unmarried Mother and her Child. Eighteenth Annual Report, 30th September 1936. Pp. 41. (London: National Council for the Unmarried Mother and her Child.) 4d. [251]

Department of Scientific and Industrial Research. Report of the Building Research Board, with the Report of the Director of Building Research, for the Year 1935. Pp. vi+176+16 plates. (London: H.M. Stationery Office.) 3s. 6d. net. [251]

St. Thomas's Hospital Reports, Second Series, Vol. 1. Editors: Prof. O. L. V. S. De Wesselow, C. Max Page, assisted by N. R. Barrett, Dr. J. St. C. Elkington, Dr. A. J. Wrigley. Pp. 199+13 plates. (London: St. Thomas's Hospital.) 10s. [251]

Other Countries

State of Illinois: Department of Registration and Education: Division of the Natural History Survey. Bulletin, Vol. 21, Article I: The Effect of Petroleum-oil Sprays on Insects and Plants. By M. D. Farrar. Pp. vi+32. (Urbana, Ill.: Natural History Survey.) [201]

Proceedings of the United States National Museum. Vol. 84, No. 3001: Revision of the North American Beetles of the Staphylinid Subfamily Tachyporinae, Part 1: Genus *Tachyporus* Gravenhorst. By Richard E. Blackwelder. Pp. 39-54. (Washington, D.C.: Government Printing Office.) [201]

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. Deuxième Série, Fasc. 4: Le thorax et ses appendices chez les vrais et chez les faux Gryllotalpides. Par F. Carpentier. Pp. 86+1 plate. Deuxième Série, Fasc. 5: The Katanga Skull. By Dr. Matthew Young. Pp. 25. Deuxième Série, Fasc. 6: Les Hydrana de la péninsule Ibérique. Par A. d'Orchymont. Pp. 48+2 plates. Deuxième Série, Fasc. 7: Revision des "Colostoma" (S. Str.) non Américains. Par A. d'Orchymont. Pp. 38. Mémoire No. 74: Copepoda parasitica from the Belgian Coast, II (including some Habitats in the North-Sea). By J. H. Schuurmans Stekhoven, Jr. Pp. 20+5 plates. Mémoire No. 75: Revision des tabulés dévonienés décrits par Goldfuss. Par Dr. M. Lecompte. Pp. 112+14 plates. Mémoire No. 76: Végétaux coëcènes des environs de Bruxelles. Par Dr. F. Stockmans. Pp. 57+3 plates. Mémoire No. 77: La Faune des schistes de Matagne (frasnien supérieur). Par Eug. Mailheux. Pp. 75+1 plate. Mémoire No. 78: Faune malacologique des sables de Wemmel. 1. Pélécytopodes. Par Maxime Gilbert. Pp. 242+7 plates. (Bruxelles: Musée Royal d'Histoire Naturelle.) [201]

Proceedings of the United States National Museum. Vol. 84, No. 3002: Revision of the Fishes of the Family Microdesmidae, with Description of a New Species. By Earl D. Reid. Pp. 55-72. (Washington, D.C.: Government Printing Office.) [211]

The Cawthron Institute, Nelson, New Zealand. Tracing the Dawn of Life further Backwards. By Dr. R. J. Tillyard. (Cawthron Lecture, 1935.) Pp. 37+7 plates. (Nelson: Cawthron Institute.) [211]

University of California: Publications in American Archaeology and Ethnology. Vol. 37, No. 2: Culture Element Distributions, 2: Yana. By E. W. Gifford and Stanislaw Klimek. Pp. iii+71-100. 35 cents; 1s. 6d. net. Vol. 37, No. 3: Culture Element Distributions, 3: Ara and Climax. By A. L. Krøber. Pp. ii+101-115. 25 cents; 1s. 3d. net. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) [221]

Astrophysica Norvegica. Vol. 2, No. 4: On the Trajectories of Electric Particles in the Field of a Magnetic Dipole with Applications to the Theory of Cosmic Radiation, 6. By Carl Størmer. Pp. 193-243. (Oslo: Jacob Dybwad.) [221]

Catalogues

View Point: Colour Photography and Printing. Pp. 12. (London and Bradford: Percy Lund, Humphries and Co., Ltd.)

Archaeologie, Numismatik der Griechen und Römer. (Antiquariats-Katalog Nr. 710.) Pp. 154. (Leipzig: Gustav Fock G.m.b.H.)

A Pictorial Record of a British Achievement. Pp. 32. (Potton, Beds.: COPO (Cox's Orange Pippin Orchards), Ltd.)

Sale List of Physical Apparatus. (GT 1181.) Pp. 8. (London: Griffin and Tatlock, Ltd.)