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## Philosophy of Early Education

IT was a foregone conclusion that so original and stimulating a contributor to contemporary thought as Mr. H. G. Wells—on this occasion we are almost invited to dub him Dr. H. G. Wells—would have things to say to Section L (Education) of the British Association calculated to provoke lively interest and discussion. Few listeners to his presidential address, many of whom were working teachers, could have adopted the language of Tennyson's "Northern Farmer": "An' I thowt a said whot a owt to 'a said, an' I coom'd awaÿ". The address was probably the better for being plain-spoken and provocative, for only so could Mr. Wells have been at his characteristic best.

Notwithstanding certain of his earlier experiences, Mr. Wells disclaimed the right to appear before his audience as a teacher, but preferred to introduce himself as a citizen at large. We take this to mean, what is indeed sufficiently obvious, that he is no expert in the art of teaching a class and managing a school, but that he claims the right of every intelligent citizen to criticize the results of the teaching and the output of the schools. Mr. Wells, however, is something more than a distinguished outsider. In his later phase at least, his writings have been those of a public teacher, who definitely sets out to show what young people ought to learn, if they are to become efficient citizens in the world of to-day. In other words, though he makes only a limited claim to talk about methods of teaching, he makes, rightly as we believe, an emphatic claim to talk about the content of teaching, the mental fare which the schools provide for potential citizens. His now famous "Outline of History", followed by the companion outline of "The Science of Life"—both of them necessarily written with much collaboration

—indicated his general view as to the kind of thing which an educated person ought to know. An acquaintance with the fifteenth chapter of his later book, "The Work, Wealth and Happiness of Mankind", further prepared one for the opinions to which he has now given full and forcible expression.

Mr. Wells began and ended his discourse with an almost solemn warning as to his self-imposed limitations. Questions of "drill, skills, art, music, the teaching of languages, mathematics and other symbols, physical training and development, and the rest", he deliberately placed outside the scope of his message. He felt he could be most helpful by concentrating on the sort of world picture we are presenting to young people, the essential framework of knowledge that should be established betimes in the normal citizen of our modern community. Whether he was fundamentally right in making all these exclusions from the essential framework is bound to be a sharply controversial topic, upon which we cannot fully enter. Suffice it to say that, according to Mr. Wells's judgment of educational values, the indispensable and irreplaceable structure of fact, the main beams and girders of which structure must be laid down, soundly or unsoundly, before the close of adolescence, should rest upon a threefold foundation of history, biology and geography, widely interpreted. These three, says Mr. Wells in effect, are the things that abide, and it is probably safe to add that in his view the greatest of these is history. But merely to quote these familiar labels would be to convey a totally inadequate idea of the length and breadth of his message.

What Mr. Wells means by history was already familiar to many, we hope to most, of his listeners. But he took the opportunity of denouncing once

more the sort of history which, at any rate until recently, has been taught in our schools, and in great measure accounts for that "crazy combative patriotism" which now threatens to destroy our civilization. Equally mischievous, he added, is the "furtive anti-patriotism of the leftish teacher". We suggest, however, that if Mr. Wells thinks that the sort of history denounced long ago by Herbert Spencer as "an obituary of kings and queens" and denounced later by John Richard Green as "drum-and-trumpet history", is still encouraged in our schools, he ought to make further inquiries. But the rest of his indictment is not so easily disposed of. He demands that school history should not only shed its insularity, its narrow nationalism and its contempt for the lesser breeds without the law, but that it should also be nothing less than the story of man's great adventure upon this planet. He claims that the archæologists, and the historians of the rise and fall of empires, have provided far finer material for the mental equipment of modern youth than the 'hole-and-corner' history of a single nation. Here he will have many sympathizers and some severe critics. It was to be expected that this part of his address would receive special comment in the daily Press.

As regards the rest of the informative content of the curriculum as conceived by Mr. Wells, there will be general agreement with his ideas about the teaching of geography and simple economics; and indeed the modern teacher in schools of every kind has already gone a long way towards satisfying his requirements. The chanting of lists of capes and rivers is mostly a thing of the past. Where geography passes over into biology his strictures are just. Too many young people leave school ignorant of the wonderful story of life upon the earth, and equally ignorant of the working of their own bodies. But, asks Mr. Wells in effect, who is sufficient for these things? Certainly not, he declares, the present generation of teachers, two-thirds of whom ought to be re-conditioned or superannuated. Here again, having regard to the work done in summer schools and refresher courses, and the activities and publications of such large and important professional bodies as the Science Masters' Association and the Geographical Association, Mr. Wells should have made further inquiries. Also even a cursory examination of the text-books or reading-books now available for pupils of all ages, and exhibited by publishers at such meetings as those of the Annual Conference of Educational Associations, would have shown him

that the school books of to-day are vastly superior in every respect to those of the past.

The present position is that teachers as a body are more mentally alert and educationally active than ever they were. True, they may not be sufficiently intent upon the informative components of the curriculum as advocated by Mr. Wells, but their general attitude suggests plenty of room for hope. A generation ago, teachers were too much occupied in fighting for reasonable conditions of service. To a great extent they are now occupied in fighting for a better chance for the pupils.

But we wish to close these comments upon a note of appreciation. In one of his charming and vigorous philosophical essays, William James took up strongly the position that the great philosophic thinkers, however much they might try to sink the fact of temperament, could never succeed in doing so. The philosopher's temperament, declared James, "really gives him a stronger bias than any of his more strictly objective premises. It loads the evidence for him one way or the other, making for a more sentimental or a more hard-headed view of the universe". James proceeded to a broad classification of the great philosophic thinkers as the tender-minded and the tough-minded. The tender-minded he described as rationalistic (devoted to abstract and eternal principles), idealistic, optimistic, religious, free-willist and dogmatic. The tough-minded he described as empiricist (devoted to facts in all their crude variety), materialistic, pessimistic, irreligious, fatalistic and sceptical.

Not for one moment would we wish to apply to Mr. Wells every item in the second of these lists of adjectives. But he is one of the outstanding public teachers of our time, accustomed to take the broad philosophic outlook upon every problem that he touches; and if we were asked in which of the two categories we would place him, we should inevitably place him among the tough-minded. Few of our prominent thinkers could, for example, have got to the end of *any* sort of discourse on education without ever mentioning Shakespeare; but Mr. Wells forgot even to mention literature among the skills, etc., which he designedly excluded from his survey. Perhaps the British Association will next year seek to restore the balance by inviting one of the tender-minded brotherhood to address the Education Section. Meantime, the tough-minded Mr. Wells has given to all interested in education, something to think about and something to follow up.

## Social Theory and Discipline

### (1) The Development of Sociology

By Prof. F. N. House. (McGraw-Hill Publications in Sociology.) Pp. viii + 456. (New York and London: McGraw-Hill Book Co. Inc., 1936.) 24s.

### (2) Control in Human Societies

By Prof. J. Dowd. (The Century Social Science Series.) Pp. xvii + 475. (New York and London: D. Appleton-Century Co. Inc., 1936.) 16s. net.

### (3) Ideology and Utopia:

an Introduction to the Sociology of Knowledge. By Karl Mannheim. (International Library of Psychology, Philosophy and Scientific Knowledge.) Pp. xxxi + 318. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1936.) 15s. net.

CURRENT interest in the co-ordination of views on the social responsibilities of scientific workers gives topical interest to these three volumes. From different angles they are all concerned with the contribution which science could offer to the solution of social problems, and more especially with the conditions and principles of scientific thought in this field. In turn they give us a broad historical survey of the subject, a practical study suggestive of lines of research and a stimulating contribution to original thought on the underlying principles of social theory and discipline.

(1) About half of Prof. House's comprehensive but not exhaustive account of the development of sociology is concerned with the growth of sociology in the United States, and particular aspects and characteristics of that growth. As an introduction to the extensive literature of this field and as a reasonably balanced survey of the development of thought on social questions, it can be commended to the growing number of scientific workers who, in considering the social consequences of their work or the place of scientific thought and method in social and political questions, are anxious to gain some background of theory and experience.

Some such background is essential whether we are concerned with the theoretical aspects of social science or with its actual technique in the handling of social and political problems on scientific lines, if only because nowhere in the field of science is the question of values more important than in social problems. The historic background gives the clue to the meaning of many social phenomena and has a practical bearing in the interpretation of present-day conditions and problems. It is a fundamental objective in the preservation and transmission of the social heritage.

Prof. House is sometimes a little too comprehensive to be as lucid as is desirable in the furtherance of the objectives so clearly set forth in his introduction, and more judicious selection would have made the work less tedious and increased its value to the general reader and student. None the less, he has traced clearly the development of social thought from its origin until it commenced in the eighteenth century to take on a form which may reasonably be styled scientific, and in the first two parts of the book ample justice is done to writers and thinkers in this field both in Great Britain and in Europe. His survey of American conditions notes a number of weaknesses of social research in that country which have already received trenchant criticism from Flexner, but suggests that the belief that sociology has important practical bearings on problems of citizenship, personal conduct and occupational problems may lead to it being regarded less as a subject to be taught to college students. On the other hand, he is a little sceptical as to the prospects of the integration of sociology, economics, political science and anthropology into a social science.

(2) Prof. Dowd, limiting himself to the evolutionary or dynamic aspects of society, gives us a comprehensive study of the controlling influences which determine the evolution of human societies and enters a strong plea for research on the lines advocated by Prof. W. McDougall in "World Chaos". The major part of the book, following a brief discussion of the origin and functions of control in society and a summary of the development of control in such varied fields as industry, religion, art, government and family life, which he summarizes as a transition from paternal to social control accompanied by an increasing individual opportunity, incentive and development, is devoted to a highly stimulating examination of the varied factors which are involved in problems of control which confront us at the present time.

This is a book which anyone who is interested in social problems to-day, whether of leadership or of the re-integration of society under the impact of science, can read with profit and with interest. Prof. Dowd gives a well-balanced treatment of the many factors which complicate these studies. His chapter on control in industry is highly suggestive and is an admirable corrective to the narrow angle from which industrial administration is sometimes approached. We have in it one more plea that industrial efficiency cannot be dissociated from social efficiency. No individual can be inspired to do efficient work unless he has opportunity,

like the professional worker, to exercise his initiative, to share responsibility for the product and to receive recognition for his part in it, and the author lays a good deal of stress on the value of developing group loyalties and incentives of the professional type. He clearly believes that in the society of the future the motive of private profit will be insignificant and unnecessary.

Particularly to those who are concerned with the preservation of democracy and freedom of thought in the face of clashing systems of totalitarian States and social organization should this study make its appeal. The author never fails to recognize the need for discipline, and whether he is concerned with order in the State, in industry, or in the religious institution, he regards its development as of the first importance. Recognizing the fundamental principle of discipline that loyalty to group ideals and standards progresses from the smaller to the larger fellowship groups, he points out that the very existence of dictatorship is a confession of failure to engender the primary loyalties. Discipline, however, is not mere conformity to a fixed standard, but the acceptance of some ideal or principle as the determining influence in conduct and action.

This study of social control is in fact primarily a study of the meaning of liberty and its preservation. The ultimate object of social control is to facilitate the flowering of whatever genius or talent the individual may possess, and the main purpose of the book is to discuss the principles which may be applied in the development of a social order in which the individual can best express his personality and in which human relations may be most felicitous. This can only be achieved as a measure of discipline is accepted, at least sufficient to prevent a relapse to the social chaos which demands paternalism for its correction. Scientific workers at least should respond to the plea for the acceptance of group disciplines and larger loyalties, which will enable the individual to resist transient appeals likely to throw him out of his social orbit, no less than to the plea to enter on the wide fields of research now open to us.

Prof. Dowd makes many wise observations suggestive of lines of thought or study in respect of such matters as recreation as a social function, the relation between physical, moral and social efficiency, and professional or other occupational ability, or the growing significance of the service motive in industrial and business enterprise. He believes that if private business cannot be organized primarily to serve the public, it must give way to some form of State control, and he directs attention to the difficulty of effective discipline for citizenship if conditions are perpetuated which overstimulate man's desires for material possessions.

(3) Mannheim's work is scarcely one for the general reader, but is unquestionably the most significant of the three works as a contribution to the theory of sociology. Even in his discussion of the relation between social theory and political practice entitled "The Prospects of Scientific Politics", the author eschews the practical side and is concerned essentially with the fundamental principles by which effective action is determined. If, however, the book is primarily one for the specialist, apart possibly from the fifth section, which is little more than a scientific outline of the sociology of knowledge, written essentially as an article for an encyclopædia, it would be unjust to suggest that even the general reader will not find stimulating and suggestive passages in this work.

Prof. Mannheim lays a welcome stress on the necessity for precision of thought and on the interdependence and sensitivity to change and varying emphasis in the meaning of words. Thought, he points out, is a particularly sensitive index of social and cultural change, and few things have hampered progress in the development of the social sciences more than the loose and inaccurate terminology so often employed. Moreover, it is a rapidly changing intellectual world which makes possible the effective criticism of ideas and values formerly regarded as fixed. We need continually to recognize that every point of view is particular to a certain definite situation, and must be ready to determine by analysis the nature of this particularity. Knowledge is distorted when it fails to take account of the new realities applying to a situation, and when it attempts to conceal them by thinking of them in inappropriate categories. One of the weaknesses of the cultural sciences to-day is that they view their knowledge and formulate their problems abstract and torn from their concrete settings. To recognize more clearly this confusion is an enrichment rather than a loss, for the way out is to be won by the gradual extension and deepening of our insight and by careful advance in the direction of control.

The plea for fundamental thinking does not, however, lead Prof. Mannheim to understate the necessity for practical politics, though he does not attempt to elaborate even programmes for research in such fields. He clearly does not believe that the sphere of human activity on the mastery of which our fate depends will not yield its secrets even to scientific research. Nor is he to be numbered with those social scientists who believe that science must restrict itself to the causation of actual phenomena, that science is not concerned with what should be done, not with what ought to be but rather with what can be done, and with the manner of doing it. He has sought to trace the connexion between the actual interest groups

in society and the ideas and modes of thought they espoused. He has shown that these complexes of ideas which direct activity towards the maintenance of the existing order do not merely direct thought from the object of observation, but also fix attention upon aspects of the situation which might otherwise be observed or unnoticed.

Prof. Mannheim has thus given us an effective instrument for fruitful empirical research. He also insists on the acuteness of the problem of objectivity in the social sciences, and the interest of the observer in the observed and the overwhelming influence of beliefs about the ends of action. He shows clearly also that the factors at work in the human mind impelling and disturbing

reason are the same dynamic factors that are the springs of all human activity. The new discipline he outlines, which promises to give a fresh and profound understanding of social life, is supplemented by a clarification of some of the major moral issues of to-day. If the treatment is not always as lucid as might be desired, the book is none the less a significant contribution to thought in a field with which not merely the specialist but also all scientific workers and others interested in the deeper problems of to-day are increasingly concerned, and not the least of our thanks are due to the translators for the critical preface contributed by Louis Wirth.

R. BRIGHTMAN.

## Fluorine Poisoning

### Fluorine Intoxication:

a Clinical-Hygienic Study; with a Review of the Literature and some Experimental Investigations. By Kaj Roholm. Pp. xi + 364 + 47 plates. (Copenhagen: Arnold Busck; London: H. K. Lewis and Co., Ltd., 1937.) 20s. net.

**F**LUORINE intoxication from domestic or industrial causes is rare in Great Britain. For this reason the knowledge of its occurrence, causes and results is inadequate and restricted. In this recently published excellent survey in English of the clinical and experimental work on the subject, much useful information has been presented and the main points will be reviewed.

All fluorine compounds are toxic to man and animals. Taken orally, hydrofluoric acid solutions, sodium fluoride, hydrofluosilicic acid and sodium fluosilicate are highly toxic, calcium compounds being less toxic. Cases of acute poisoning from accidental and premeditated use are increasing. The compounds in the fatal preparations were either sodium fluoride or fluosilicate. Death occurred in all in less than twelve hours.

The cases of chronic poisoning can be divided into three groups. A small number of sporadic distribution are due to the use of insecticides for plants or animals, or rat poisons. A larger number occur in certain industries. Cryolite workers provide the largest number of cases, and it is the study of these that has been the important original contribution of Roholm's work. The other group of chronic cases represents the mildest but yet obvious form of fluorine effect, namely the 'mottling' of teeth. This occurs in localized regions, many instances of which have been recorded in

the United States. Mottled teeth occur in Italy, Spain, Holland and England (Maldon, Essex). In all these regions the effects on the teeth are similar in type but different in degree. The teeth can only be affected during development; they are chalky white and later they become stained with unsightly dark brown patches or 'mottled'. The cause is the presence of sodium fluoride in the drinking water. Even two parts per million fluorine in the water can cause this, and so calls for a change of supply.

In Morocco and the Argentine there is a form of chronic poisoning called 'darmous' which results from the extensive fluorine-containing phosphorite rock deposits. The cattle are badly affected with a form of osteomalacia. Feeding rock phosphate can lead to this condition. The use of bone meal has so increased that the supply is inadequate and rock phosphate is used instead. It is essential that the latter should be fluorine-free. Vegetation in the neighbourhood of chemical works emitting fluorine is affected and can be a source of danger to grazing animals. Similar results have followed volcanic eruptions in Iceland.

The distribution of fluorine has been considered. This part of the subject is not in a satisfactory state because of the difficulty of determination of fluorine, especially in animal material. Fluorine is not a necessary element in nutrition, nor is it present in more than a trace in average teeth; even mottled teeth only contain 0.05 per cent of fluorine.

Roholm's special work has been the study of fluorosis among workers in a cryolite factory. Cryolite ( $\text{Na}_2\text{AlF}_6$ ) deposits occur in Greenland, are quarried and shipped to the United States and Copenhagen. In the latter the working of the

crude mineral to a fine pure state takes place. Those therein employed have been studied. The danger, one similar to that in silicosis, lies in the fine dust produced during the working. In all, sixty-eight workers, male and female, were examined (*questionnaire*, urine analysis and X-ray of limbs and pelvis). Gastric disturbances, palpitations, dyspnoea and rheumatism were the commonest complaints made by the workers themselves.

The X-ray examination revealed that intoxication was generalized, all bones being affected with a diffuse osteosclerosis accompanied by a calcification of ligaments. This was considered the most serious effect because it led to a decreased mobility of joints, in particular of the spinal column. The children of female workers in a few cases, where suckling had been prolonged, showed mottling of their permanent teeth. Experiments in which cryolite was fed to rats, pigs, calves and dogs verified the clinical findings, so that a clearer understanding of the workers' symptoms has been gained.

Convinced, then, of the toxic properties of fluorine, it is important to emphasize the sources of danger and possibilities of prevention. Danger lies in the manufacture and use of compounds of fluorine for insecticides, plant sprays, rat poisons and rock phosphate, for manure or cattle supplement. Prevention should aim at restricting the handling and hence the use of fluorine compounds. Where handling of minerals takes place, similar precautions are required as for silicosis prevention. Industrial waste containing fluorine should be converted to the least toxic compound, calcium fluoride.

My own inquiries in Great Britain have indicated that fluorosis has not yet been recognized as an industrial danger. Apparently fluorine minerals are not dealt with here. The danger, however, exists in the use of insecticides. A case of poisoning from accidental use of a chicken disinfectant was reported a little more than a year ago.

It is fortunate that a volume of such industrial, clinical and scientific value is available, in English, should the danger of fluorine intoxication become more common.

M. M. MURRAY.

## The Living World

### Science of Life Series

By H. G. Wells, Julian Huxley and G. P. Wells. Vol. 1: The Living Body. Pp. xi + 223. Vol. 2: Patterns of Life. Pp. x + 239. Vol. 3: Evolution—Fact and Theory. Pp. x + 271. Vol. 4: Reproduction, Heredity and the Development of Sex. Pp. x + 222. Vol. 5: The History and Adventure of Life. Pp. x + 259. Vol. 6: The Drama of Life. Pp. x + 316. Vol. 7: How Animals Behave. Pp. x + 263. Vol. 8: Man's Mind and Behaviour. Pp. x + 271. Vol. 9: Biology of the Human Race. Pp. ix + 205. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1934-1937.) 4s. net each.

WE confess that we commenced to read with a certain prejudice, for we thought of the many distinguished authors who combined to write the "International Science Series" and cheaper "Primers" of still earlier date. Each wrote on his own speciality, and we assumed a certain virtue in this. We were sceptical in respect to this combination of literary capacity, of imagination and of learning, perhaps expecting that the latter on account of its 'youthfulness' would not be allowed its full play. However, we found ourselves reading Volume 1 on a train journey, and a volume has been our inseparable companion on all such for the last three months. We admit 'second

childhood' with its consequent loss of memory—and thus our reading gave us pleasure, point following point as to life and the methods thereof, in such definite order that they produced in us a happy restfulness, not the boredom that induces sleep. We found a well-authenticated story and could read without the worry of hybrid names, too often coined to glorify an author rather than of necessity. "We ought to have a name for it." "Why?" "Well, someone else will give one, anyhow!" Far from valid reasoning.

Our authors are so merged that they might have been one. They start with "The Living Body"—and it is the human body—a machine reacting to its varied surroundings, its driver a nervous system, and efficient so long as it is properly fuelled and cleaned, until in course of time it wears out. This leads naturally to the various 'patterns' affected by animals and plants, and then our attention is directed to the way in which they may have been evolved. We are not allowed to assume without ample evidence the overwhelming positions of evolution and natural selection, which sometimes are rejected owing to man's pride or fear. 'Heredity' is all-important here, reproduction, sex and the body changes as the individual grows—a happily written and clear series of essays.

"The History and Adventure of Life", weaving it into the conditions of each geological stratum, naturally appeals, but a map showing the proportional length of time of each period is not accessible where we want it, the table given devoting two-thirds of its length to man, its post-War column especially in our opinion being out of place; this we disliked, but we found the rest of the volume corrective and admirable. The "Drama of Life" is scarcely a self-explanatory title for life in the sea and on land and in its waters, and the swaying balance between the animals and plants in communities (ecology). To us this quite learned volume shows a curious lack of those personal and humorous touches which we had become accustomed to expect, and which recur in full measure in the consideration of 'behaviour'—a separate volume is devoted to man—and of the "Biology of the Human Race".

Our suggestion to parents who have children going to a university for any science course, and to teachers, is to use these volumes so that their children or pupils may be educated, not merely crammed. There are nine of them, one for the summer vacation before the first term, and then one in each vacation until the student sits for final honours. The examinational result—whether the student is biologist, physicist or chemist—a certain understanding, will be great, and the candidate will have something which will add permanently to his interest in life, and will help him in his relationship with his fellows and his community.

The series is a reproduction in convenient form of the volume entitled "Science of Life", originally published in 1929 and reviewed in NATURE of March 28, 1931; the separate and handy little volumes now before us have been appearing at intervals since 1934.

## Theism Restated

### The Philosophical Bases of Theism

By Dr. G. Dawes Hicks. (Hibbert Lectures.) Pp. 272. (London: George Allen and Unwin, Ltd., 1937.) 8s. 6d. net.

THE substance of Prof. Dawes Hicks' book was delivered as the Hibbert Lectures in 1931. The volume is designed primarily for the general reader, especially for those "who have abandoned the resort of basing their religious trust on a miraculously attested revelation", and for whom, therefore, the philosophic approach to religion is indispensable. The author admits that "philosophy can as little provide us with a new religion as the science of ethics can provide us with a new morality"; yet "a religious mind which has reflected upon the principles upon which its religion rests, is clearly an advance upon the religious mind which has not so reflected".

Dealing with what is known as the cosmological argument for the existence of God, we may note that Prof. Dawes Hicks rejects the idea of a creation out of nothing. "This idea of Nothing, in the sense in which we take it when we oppose it to that of existence, is a pseudo-idea, and the problems which are raised round it are pseudo-problems." Furthermore, "the idea of creation as an event which occurred at a definite date in the past calls to be unhesitatingly rejected. . . . If the notion of 'creation' is to be sustained at all it can only be in the sense of continuous creation—of a constant dependance of the world on the supreme Being". The gist of the argument for the existence of God from the existence of Nature,

is that "we are logically driven to acknowledge that there is a real existence beyond nature, unless we are prepared to rest in ultimate inexplicability, and to relinquish the attempt to frame any intelligible conception of nature at all".

In framing the teleological argument, Prof. Dawes Hicks stresses the point that Nature is strikingly adapted to human thought and reason, and in its very essence would seem to be intimately related to mind or intelligence. He alludes also to the work of the American biologist, Prof. L. J. Henderson, on the fitness of our material environment to support life. Countless other distributions of those three indispensable elements, carbon, hydrogen and oxygen, would have been no less antecedently possible, and yet we find "just *that* distribution, just *that* conjunction of properties, which is *fittest* for the maintenance of life".

Nor is the ontological argument overlooked by Prof. Dawes Hicks, and he does not admit that it was disposed of by Kant when he stressed the difference between 300 thalers in his mind and 300 thalers in his purse. For, after all, God is something very different from thalers, and as Anslem (who invented the argument) expressly affirmed, it was *only* in reference to the idea of the infinite that his argument had any significance. "This is an idea the content of which is wholly inexplicable by reference to finite, and therefore limited facts; and, accordingly, its mere presence in our consciousness is sufficient to establish the existence of a reality corresponding to it."

J. C. H.

### Index to the Palace of Minos

By Dr. Joan Evans. With Special Sections classified in detail and chronologically arranged, by Sir Arthur Evans. Pp. vi+221. (London: Macmillan and Co., Ltd., 1936.) 31s. 6d. net.

PUBLICATION of an index in a volume separate from the main work would not in the ordinary course call for special comment, beyond note of the fact of issue. The index of "The Palace of Knossos" stands in a different category. The fact that the history of the Palace, as reconstructed in Sir Arthur's excavations, covers the whole of the Minoan age, and the scale in range and detail on which the index has been compiled, not only make it an indispensable aid to the use of the book, of which it is an appendage, but also constitute it a guide to the history of the period and its civilization at large.

Even that, however, does not exhaust its claim to be an essential tool of the historian and the archæologist. The appearance of Sir Arthur's name as joint author is no mere formality; and for certain entire headings, distinguished by his initials, he has been entirely responsible. As these headings are all of first-rate importance in the archæological and cultural sense, no one will quarrel with the author for having departed from the strict canons of the indexer. He has made each of them a chronological summary and survey of the subject with which it deals. The amount of detail which has thus been included may be judged from the fact that the entry for "pottery" runs to twenty-three pages, and many other heads of importance are treated on a like scale. The author's modest suggestion that the index may serve as a guide for those students who cannot afford the whole work does less than justice to its value and utility.

### With a Spade on Stane Street

By S. E. Winbolt. Pp. xi+240+12 plates. (London: Methuen and Co., Ltd., 1936.) 10s. 6d. net.

STANE STREET, the Roman road running from Chichester to London, presents numerous problems, some of which have given rise to much controversy. The literature relating to it, in consequence, is considerable. Mr. Winbolt's contribution, however, cannot be regarded as in any way superfluous. Not only does he trace the road, field by field, in all its stages, but also he has submitted new and doubtful solutions for determining the line to the test of archæological excavation, where the application of this method has been possible. His verdict, therefore, may be taken as final. It is unfortunate that excavation has been possible at two only of the *mansiones*, or road-side stations. At Ewell, between which town and London the road is usually regarded as non-existent, the author has boldly attempted a reconstruction of the Roman town upon lines which, while purely conjectural, are supported by cogent argument. Mr. Winbolt is a strong supporter of an early date for the road, and maintains that its importance was due not to military exigencies, but to its use for public and commercial purposes.

### Organische Synthesen (Organic Syntheses)

Übersetzt und für deutsche Verhältnisse bearbeitet von Dr. Richard Asmus. Pp. xii+586. (Braunschweig: Friedr. Vieweg und Sohn, 1937.) 45 gold marks.

IN the collected volume (1932) of the first nine annual volumes of "Organic Syntheses" (1921-31), several improvements were incorporated. New processes for several compounds were included, the descriptions of experimental procedure were enriched with small but important improvements, and indexes to reactions, substances and processes were provided. Such small but highly useful improvements as the statement of amounts of corrosive liquids and solvents in cubic centimetres as well as grams made a considerable difference in the practical utility of the volume. The descriptions are very full and references are given to the literature.

In the German translation the American materials and apparatus have been replaced by those obtainable from German firms and any necessary modifications of procedure introduced. By co-operation with the American editor-in-chief, Prof. Gilman, improved methods and corrections not to be found in the American edition have been introduced. The German edition will therefore be of interest to those who already possess the American volume, and it should prove most valuable to chemists who are more familiar with German than English. The paper and printing are good, and the translation appears to be careful and accurate.

### The Future of Woman

By Anthony M. Ludovici. (To-day, To-morrow and After Series.) Pp. viii+152. (London: Kegan Paul and Co., Ltd., 1936.) 3s. 6d. net.

THIS little book forms a supplement to the author's "Lysistrata", which he now regards as too mild an indictment of feminism. As in his previous works, he maintains that one of the first and principal steps in the regeneration of the Western world is a masculine renaissance of man both as animal and as spirit. Feminism he regards as "nothing more than a government of odd people, by odd people, for odd people". In conclusion, he declares that there can be no solution of life's problems for normal women which leads them away from their normal function of nursing and training children.

### Essentials of Modern Medical Treatment

By Dr. Vincent Norman. Pp. xvi+200. (London: Hutchinson's Scientific and Technical Publications, 1936.) 10s. 6d.

CONSIDERABLY smaller and less comprehensive than the well-known "Index of Treatment", to which numerous specialists have contributed, this volume, which is the work of a single author, is to be recommended to the practitioner and student for its lucidity, conciseness and up-to-date character, as well as for its considerably lower price. In addition to the eminently practical advice on treatment, a short account is given of the causation and symptoms of the various diseases.



## Assam Origins in Relation to Oceania\*

By Prof. J. H. Hutton, C.I.E.

IN choosing this subject I am not attempting to offer any definite solution to the problems of Indonesian migrations, but propose rather to examine one aspect of them in the hopes that I may elicit further information which may contribute towards the ultimate solution of what is really a complex of very difficult problems, as I feel that although a clearing up of the main question may be very distant, some analysis of the Assam side of the problem is perhaps possible.

Many parallels are to be found of one sort or another between Assam and Oceania, some of which were pointed out by Sir Henry Yule and by S. E. Peal in articles in the *Journal of the Anthropological Institute* in February 1880 and 1893 respectively, and others of which I myself indicated in an article on "Assam and the Pacific", in *Man in India* in 1924. In 1925 Henry Balfour pointed out cultural connexions between Assam and Indonesia in the matter of certain types of thorn-lined fish traps and, more recently, of fretted horn and shell ear ornaments.

It is fairly clear that identity of culture, in so far as it exists, is not that of a single culture, but rather of a complex of cultures in each case. It is certain that Assam may be able to throw some light on the Indonesian problem, as the stratifications can, at any rate to some extent, still be traced. The last immigrants are undoubtedly people of Kuki and Kachin affinities. There is a strong tradition among the Chins of the Arakan hill tracts pointing to their migration down the Chindwin Valley, no doubt throwing off parties which must have penetrated the Assam hills from the east on the way, after which one portion of the Kukis at any rate seem to have worked up northwards again from the Bay of Bengal, a movement which has barely ceased, if it has ceased, in the present generation. It would seem that the Kayans of Borneo probably formed part of the same movement. A tradition quoted by Hose and McDougall assigned the arrival of the Kayans in Borneo to the earliest years of the fourteenth century A.D., a date which fits well enough with Kuki and Tippera tradition.

Apart from such preceding migrations, of which there may have been many originating in movements in the Chindwin Valley caused by this southward Kuki-Kachin migration, and of which we probably have a memory in the traditions of

the Angami Lhota and Ao movements from Manipur westwards, the two previous cultures in the Assam hills seem to have been definitely matrilineal and to have belonged to two types. One of these—and presumably the later—seems to have been analogous to the present Khasi and Synteng cultures, the other to that of the Garo and of the Kachari of the Assam plains. The Khasi migration clearly came from the east, and the parallel culture in Tonkin to their earliest remains in Assam is dated by Coëdes to about the beginning of our era. The Garo-Kachari peoples seem to have migrated from the north bank of the Brahmaputra, and while the Kachari is now predominantly patrilineal, as the Garo is matrilineal, both may still be said to be in the process of change as the result of contact between two systems.

It is interesting to notice that in Madagascar the Vazimba, who preceded the Hova as immigrants, had a number of features in common with the megalith-using Khasi, not all of which were afterwards adopted by the Hova. The latter, for example, built in wood, whereas the Vazimba used stone. One may also observe that Hocart, writing on the early Fijians, is inclined to think that the more civilized community was swamped by barbarians before the more recent migration of Polynesians from the east. Undoubtedly the Naga tribes at present represented by the Konyak Nagas in the north and to a lesser degree by Kachha Nagas to the south of the Naga hills, are associated with a more civilized culture in some respects than that of the intervening tribes who have come up from Manipur, always excepting the Angamis, who are in many respects *sui generis* and who probably have incorporated a very great deal of the civilization which preceded them on their present sites.

One important feature of the Konyak tribes, shared, it is true, by their neighbours the Aos, and in a ruder fashion by the Sangtam, Chang and Yimtsung of the east, is the possession of enormous slit wood gongs to which I give the name 'canoe gong' on account of their shape. S. E. Peal was the first to report on these gongs, which he called 'canoe drums'; Prof. Henry Balfour calls them xylophones, and the only reason that I do not adopt his term is that I prefer to keep that name for the more usual type of xylophone consisting of a number of slats of wood giving different notes when beaten which is found among the Kuki, though not among the Naga tribes. These canoe gongs are the basis of an important cult intimately

\* From the presidential address to Section H (Anthropology) of the British Association, delivered at Nottingham on September 3.

associated with head-hunting, and strongly suggestive of much that is associated with canoes in Oceania.

The true canoe gong with carved figure-heads and long hull like that of a dug-out is almost entirely limited to the Konyak, Ao, Chang and Sangtam tribes, and of these four undoubtedly the Chang and the Ao contain a large admixture of Konyak blood. The Sangtam only use a typical canoe gong in those villages which march with the Ao and Chang country. Farther south the shape is much less elaborate, and the Yimtsungr to the east of them used a mere hollow tree-trunk. South of the Sangtam tribe the canoe gong completely disappears except for the following instance: the Tangkul tribe use a remarkable form of gong, hitherto, I believe, unpublished, which might be described as resembling an inverted boat, the two ends of which are skeleton, while the centre part consists of the usual slit gong of more or less cylindrical type. The Angami use an unornamented wooden vessel of similar shape (without the skeleton ends) for the reception of liquor in bulk on ceremonial occasions, and one recalls Ellis's account of the man of Rurutu who came off to meet him "at a distance of two miles" from the island in a wooden food-vessel 6 feet long and 18 inches to 2 feet wide. A smaller slit gong of somewhat similar pattern, but much simpler, is used for scaring the birds from their fields by the Kachha Naga. Farther south again, the Zanniat Chins, who, unlike the other Chins, have a democratic organization, have a small slit gong not more than 6 feet long very like the Angami vat, while the Ngawn Chins use one of the same size not unlike the South American *teponatzli*, and put food in it on the occasion of a ceremonial dance.

It is interesting to observe that in South America the canoe gong appears to have developed independently from a hollow tree. It is, of course, possible that the canoe gong of the Naga hills has similarly developed from a tree trunk, but since we find no example of signalling by hammering on trees, we are perhaps entitled to argue that the process in Assam has been the other way, and that the smaller slit gongs, or the hollow tree trunks, used by some villages, are degenerate forms of the original gong which started as a canoe, and it is possibly significant that in the Kachin story of the great flood the two survivors escape drowning in "a large oval-shaped drum". On the other hand, it must be admitted that a simple form of slit gong occurs in Yunnan, as it does in Malaya and in Borneo, suggesting either marginal degenerations from a developed type in Assam, or possibly simple types from which the Assam one might have been elaborated. The real argument, therefore, for the canoe gong's being a survival from a real canoe

rests on its associations with head-hunting and a typical canoe culture.

Now the Naga canoe gong is closely associated with the men's house, and generally, if not kept in it, it is kept in an annexe. It is in some respects treated almost as an idol, and tremendous effort is expended on carving it and dragging it up to the village. All human heads brought in are first placed on the canoe gong, at any rate by the Ao, suggesting the Marquesan practice of decorating the prows of their war canoes with the skulls of their enemies. When the gong is dragged up to the village over wooden rollers, such as those used in launching a vessel, the blood of the sacrificed animals is poured on to it, and in the old days any stranger, whether friend or foe, who came to the village on the day when a new drum was dragged in, was killed in order that his head might adorn the drum and his soul inhabit it. Indeed, until a head had come in, or had been brought in for the drum, a fence was put round it which could not be removed, nor could the drum be beaten until the young men had been out and fetched a head to remedy the defect. This head was first laid on the new drum.

The parallel with Melanesian canoe practice is here very close. Codrington writes as follows: "In the eastern Solomon Islands, if no victim was met with in the first voyage of a new canoe, the chief to whom the canoe belonged would privately arrange with some neighbouring chief to let him have one of his men, some friendless man probably, or a stranger, who would then be killed, perhaps as he went out to look at the new canoe. . . . Further west also captives were kept with a view to the taking of their heads when new canoes were launched." He goes on to give an example in a footnote: "The chief of Ravu bought his *peko* [war canoe] . . . for a large sum of money. It was brought over secretly and put into a . . . canoe house, where it stood till a head should have been procured. . . . In the morning a single man came by . . . in his canoe . . . they caught and killed him, set up his head at the prow of the [newly bought] canoe and paddled back to Ravu with shouting and blowing conch shells."

Nowadays in the Ao country a mock raid takes the place of a real one, but even this chastened sacrifice leads to a great success in hunting and in agriculture. The Ao gong nowadays wears a necklace of basket balls representing heads. Real heads were never used in this way, although they were laid on the gong when first brought in. These basket-work ornaments perhaps afford a parallel with the carved head which formed part of the figure-head of the Melanesian canoe. The figure-head of an Ao canoe is generally in the form of a buffalo or gayal head, that of the Konyak tribes

an elephant, buffalo or hornbill head, but Peal, writing in 1893, remarks that the Konyak figure-head is (as depicted in his drawing) a crocodile, although "there are no crocodiles in these hills", and he points out that it is a familiar decoration in Indonesia and the Pacific. Although I have covered most of the ground visited by Peal in the last century, I have never seen any figure-head resembling the head of a crocodile, so that this tradition has apparently disappeared in the forty years since he visited the Naga hills.

It has occurred to me that the instruments used for beating the Naga canoe gong may conceivably be degenerate paddles. The ordinary type is more like the dumb-bell than anything, but often one end of the dumb-bell takes an ornamented form such as the hornbill's head, and in any event this 'dumb-bell' is not unlike a paddle in which the blade has degenerated to proportions similar to those of the handle.

F. E. Williams, writing of the Pairama ceremony in the Purari Delta in Papua, tells us that "when a successful hunt returned at evening the corpse of the victim was borne from the canoe to the *ravi* amid great enthusiasm. The men uttered that prolonged shout or roar which has a singularly exciting effect upon the listener, and rattle their paddles upon the sides of the canoes with the rhythm called *raruki raruki*. . . . On the following day the . . . hunter who first brings down the victim . . . is paraded in triumph through the village standing astride the canoe and balancing himself with a spear". It was formerly the custom of Meithei to signal across the Logtak Lake in the Manipur State in Assam by beating with their poles or paddles on the sides of their dug-outs as the Nagas do on a canoe gong, and I am further told by Mr. William Shaw, who served many years in the Manipur State, that some Kabui villages which have no canoe gongs still have the tradition of having used them once, while in Kabui Khulen village a sort of boat, with a high prow, is dragged in every year at the harvest festival "for all who have died in the past year". The best dressed of the young men rides on the boat, while there is a tug-of-war between the two clans of the village, one pulling at each end of the boat by ropes attached to pierced lugs left on when fashioning this dug-out, which is known as the *thingkhutong*—the plank to which a dead body is ordinarily fastened for burial in that village being called *thingkhu*. It must, I think, represent a boat or a boat-shaped coffin and be associated again with the fertility of the crops, so largely bound up both with the spirits of the ancestral dead, and of dead enemies, while the riding of the boat by the young warrior is reminiscent of the Pairama ceremony described by F. E. Williams.

Boat-shaped coffins are found occasionally in several of the Naga tribes, particularly in the Konyak country, where in one village at any rate they are associated with a tabooed chief, and it is worth noticing that a stone is put up by the Fijian 'spirit house' for each corpse brought in, precisely as the Konyak Nagas put up an erect stone outside the men's house for each head; and it is also remarkable that in one case, at any rate, there seems to have been a close association between the Fijian war canoe and the gong known as *lali*, since the chief Rokona named his war canoe *Vatutulali*, after his large gong.

The Samoans have a similar gong known as *longo*, the sound of which—according to Brown—will carry for twenty miles under favourable conditions. Brown also mentions that the Samoans struck the sides of their canoes with the handles of their paddles to mark time.

One more parallel is worth indicating in connexion with this subject. Writing in the *Journal of the Royal Society of Arts* of February 1937, La Valette illustrates the uptilted roofs of a branch of the Toradja tribe in Celebes, which he says are deliberately got from the prow and stern of a canoe, and are "bound up with the tribal traditions of their ancestors, who originally arrived from a country overseas to which the spirits of the dead must return". The roofs he illustrated are almost identical with forms common in one branch of the Konyak Nagas, east of the frontier of Assam.

I have elsewhere suggested a possible migration from Indonesia, and migrations from Indonesia to Ceylon and South India are placed by Hornell at about the beginning of the Christian era. I cannot help thinking that if, as I am tempted to believe, there was an Indonesian migration which swept upwards northwards into Assam before the Kukis came south, it must have been at an earlier date than that; at any rate there does seem to have been some expansion in many directions from Indonesia at a date which perhaps precedes the dates suggested by Coëdes and Colani for the megalithic civilization of south-east Asia. It would be interesting to know how far the stratifications of cultures in Oceania will correspond to the apparent succession in Assam of an Oceanic canoe culture, a matrilineal megalithic culture and that of a more recent patrilineal one associated with the Kayan and Kuki. The principal point which I wish to make, however, is that the hill cultures of Assam correspond to other distant cultures or combinations of cultures, all of which appear to be marginal in distribution from an Indonesian centre, and that there is some ground for supposing that migrations of culture, if not of people, have taken place from some centre in or near the Indian archipelago in various directions, one of which terminated in Assam.

## Noise and the Nation\*

By Dr. G. W. C. Kaye, O.B.E.

### NOISE ON THE ROAD

THREE reports on road transport noise have been issued by a Departmental Committee set up by the Minister of Transport, and the position is that for the first time in Great Britain a comprehensive attack has been made on the problem of road traffic noise. To this end, loudness measurements, many thousands in number, have been conducted under widely different working conditions, on the over-all noise of some 800 motor vehicles, both new and old, representing all the main types on the roads to-day. The results (at a distance of 18 feet sideways or 25 feet to the rear) mostly ranged between about 70 and 105 phons (the latter value corresponding to a noisy road drill). The Committee was led to propose simple running and racing engine tests which are associated under specified conditions with an 'over-all' noise limit of 95 phons (roughly equivalent to the noise in a tube train) for all vehicles in use on the road, and of 90 phons for new vehicles leaving the manufacturer's works.

The adoption of these noise limits, while making very moderate demands on most types of vehicles would, by ruling out the arch offenders, constitute a substantial contribution to the amenities of the road. In the meantime, the industry, which has already discovered that 'silence is saleable', has the matter well in hand, and indeed it is not unlikely that future developments will not only enable manufacturers to meet the proposed requirements with comparative ease, but may indeed enable the limits to be lowered as time goes on.

To assist the motor industry in this laudable object, the Ministry recently set up four noise-testing stations in different parts of the country. At each of these stations an N.P.L. noise meter is installed, and manufacturers are enabled to submit types of their products and so ascertain for themselves how the noise levels compare with the limits proposed.

The whole question will be further facilitated when the simplified objective noise meter, which has recently been developed by the National Physical Laboratory for the Ministry, is put on the market. Such meters, which will be checked against the Laboratory standard meter, should, when available in quantity, be of great assistance at such time as it may be decided to bring into force regulations for dealing with noise on the road.

(Continued from p. 449.)

### THE ABATEMENT OF NOISE

There are two guiding principles when the question of noise abatement is being considered. One is that the degree of abatement of a noise in a particular locality need be no more than will conform to the background of noise which obtains in that locality. The other is that in a medley of noises, the loudest must be tackled first to achieve any appreciable benefit, after that the next loudest, and so on. This is illustrated by the fact that if there are two similar components and one is 10 decibels less intense than the other, the weaker one will contribute only half a phon to the over-all loudness.

The first line of attack on noise abatement, and in general much the most effective and economical, is to tackle an objectionable noise at the source, and find the best means of reducing the output as much as possible. The next step, possibly as a confession of failure, is to find a feasible method of confining or 'smothering' the noise in the place where it is generated. In either case we turn to the engineer for help, and we may anticipate that he is likely to be the more interested if he can see a potential demand from the public.

The path of a noise in its journey from source to hearer may be either *via* the intervening air or *via* a sequence of solid materials or structures. Experience has shown that the two effects require very different remedies for abatement. The study of the general problem of noise transmission is more complex than might be imagined, and some of the major difficulties are not as yet completely resolved. For the practical elucidation of the various factors involved, specially designed 'sound-proof' laboratories, such as those at the National Physical Laboratory, have proved to be necessary. Parenthetically, it may be mentioned that the N.P.L. acoustics laboratory, since its erection four years ago, has been so fully engaged in transmission and absorption work, mainly for the architectural profession and the building industry, that extensions are now in hand and should be available for use by the end of the year. Much research work on building acoustics is also being carried out for the Ministry of Health in connexion with slum clearance, and for the Architectural Acoustics Committee of the National Physical Laboratory and the Building Research Station.

To revert to the case of a non-suppressible noise, if most of the noise is transmitted by air, the best

remedy, should circumstances render it practicable, is some sort of sound-proof enclosure, the design of which may need careful attention both as regards weight and discontinuity of structure. There is, of course, no such thing as a sound-proof material, and success in sound insulation is largely a matter of design.

Certain large-scale operations may require 'sound-proof' buildings to mask them, the doors and windows of which should be heavy and close-fitting and preferably situated on the side remote from that where the noise is liable to be regarded as a nuisance. Doors and windows, particularly high windows and skylights, may require to be doubled and, in extreme cases, it may be necessary to employ double walls mounted on independent foundations. Buildings in which noisy operations are carried on should, if possible, be put under the lee of larger buildings, which may afford advantageous shielding to the locality. In the interior of noisy buildings, it is usually beneficial to the workers to divide groups of noisy machinery, so far as may be possible, into smaller units, each in its own enclosure. Appreciable benefit may also result from lining walls and ceilings with acoustical absorbent, so preventing the noise level from building up unduly.

In the case of structure-borne noises, the remedy is discontinuity somewhere in the structure either in the form of an air gap or as resilient material, for example, under the foundations of noisy or vibrating machinery.

Modern building design and materials do not provide protection from noises, whether from inside or outside, like the more solid houses of a generation ago. The noise problem is accentuated

in the case of the large blocks of flats which are being erected in all quarters, and which apparently are mainly adapted for quiet tenants who are prepared to conform in this respect to a landlord's reasonable requirements. The situation lies largely with local authorities, who should lay down building by-laws, setting forth minimum standards of acoustic insulation. The architect and builder have of necessity been driven from traditional methods of construction to meet the economic requirements and closer scientific designing of to-day. Discontinuity of structure and the use of massive and poorly conducting materials formerly provided defence against sound, but instead we now have monolithic structures which are not only thinner and lighter than the old, but also are composed of good conducting materials. The steel-framed and ferro-concrete building, cement mortar, hard bricks and plaster, to say nothing of a general ramification of central-heating, running water and other piping, have replaced the softer brickwork, lime mortar and plaster, wooden beams, joists and studding, and the localized piping of the older houses. No one pretends, of course, that we can go back to the old methods, but if we are to mitigate the noise nuisance in modern buildings, we must adopt measures which are best incorporated during the designing stage.

There is, too, another aspect which should be clearly appreciated, and that is, if sound insulation in buildings is desired, it has to be paid for. The public, at present enticed with a plethora of labour-saving devices by landlords of flats, has yet to learn that reasonable acoustic privacy is obtainable provided it is prepared to face a small proportionate increase in the rent.

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## Structure of Protein

THERE can be few problems of predominantly chemical interest which are being attacked by such a variety of methods of investigation as that of protein structure. This was well illustrated by the symposium on protein chemistry held on September 3 in Section B (Chemistry) of the British Association, in which the contributions ranged in subject from biochemistry to mathematics, each justifying its inclusion either by the addition of some significant fact to the total sum of knowledge or by the formulation of a stimulating hypothesis to account for facts which still await complete explanation.

The foundation of protein chemistry as we know it to-day has been laid by organic chemistry, which, chiefly in the hands of Emil Fischer and

his pupils, has provided not only detailed information concerning the composition of proteins, but above all the unquestionable demonstration of the peptide linkage as the predominant feature of their intramolecular structure. Moreover, through the development of improvements in peptide synthesis, particularly the carbobenzoxy method, organic chemistry has provided a wealth of material which has illuminated the mode of action of proteolytic enzymes and which now promises to throw light on the physico-chemical behaviour of proteins and even perhaps on their immunological specificity. These points were brought out by Prof. C. R. Harington (London) in opening the symposium, but he was at the same time at pains to emphasize that the peptide theory in its simplest form is

unable to account for all the properties of proteins, which can only be explained by the assumption of subsidiary linkages within the molecule.

The importance of the peptide linkage was further emphasized by Dr. K. Linderström-Lang (Copenhagen), who pointed out that this linkage is the only one known with certainty to be attacked by proteolytic enzymes. These enzymes, as is well known, may be roughly classified into the proteinases which attack complete protein molecules or their higher degradation products, and the various peptidases which attack peptides at points adjacent to free amino or carboxyl groups or both. Dr. Linderström-Lang directed attention to the interesting evidence which has recently accumulated that the true proteinases owe their peculiar specificity to the fact that they can only attack peptide linkages remote from free dissociating groups.

One of the greatest advances in the understanding of the physico-chemical behaviour of amino-acids and proteins is due to the zwitterion theory introduced by Bjerrum in 1923. The development of this theory and the evidence for its applicability to amino-acids was discussed by Dr. A. Neuberger (London), who laid particular emphasis on the good agreement to be observed between the experimentally determined dissociation constants of amino-acids and those calculated on the basis of the theory; evidence derived from dissociation constants of amino-acids other than  $\alpha$ -amino-acids shows that such molecules exist in solution in a relatively unbent condition with the charged groups far apart, thus accounting for the high electrical moment required by the zwitterion theory. Dr. Neuberger proceeded further to demonstrate the fact that it is now possible to interpret the electrometric titration curve of a protein with reasonable accuracy in terms of the polyvalent amino-acids which it contains, the additional dissociating groups of these amino-acids being the factors which determine the electrochemical behaviour of the protein molecule as a whole.

The determination of the very large molecular weights of proteins is a matter of considerable difficulty, and no method has afforded more valuable information on this point than the ultracentrifugal method evolved by Svedberg. This procedure was described by Mr. J. St. L. Philpot (Oxford), and was illustrated by a very beautiful application in which the molecular weight of the enzyme xanthine oxidase was observed by its rate of sedimentation from a solution containing the enzyme system, methylene blue and iodate; the solution, at first colourless throughout, becomes coloured from the top downwards in the ultracentrifuge owing to re-oxidation of the leuco-methylene blue by the iodate as the enzyme is removed.

The remaining two contributions to the symposium were chiefly concerned with the nature of the subsidiary linkage in the protein molecule, which was referred to by the opener. The evidence to be derived from X-ray measurements was discussed by Dr. W. T. Astbury (Leeds), who recalled his well-known earlier work on the structure of the keratins, showing these proteins to be made up of bundles of peptide chains joined by subsidiary linkages which might be either the disulphide linkage of cystine or so-called hydrogen bonds or covalent linkages of unknown nature. It was pointed out by Dr. Astbury that X-ray measurements indicate a transition in structure from the stretched keratin or myosin molecule, through the partly folded molecule of unstretched keratin as it occurs in hair, to the completely folded molecule of the 'globular' proteins such as insulin. The evidence provided by X-ray measurements regarding the mechanism of denaturation of proteins was also discussed; it appears that this process certainly involves rearrangement and unfolding of peptide chains, but it seems to the present writer at least that the real nature of the phenomenon remains as obscure to physicists as it is to chemists.

Of the various theories of protein structure which have been proposed from time to time, few are of greater interest than the 'cyclol' hypothesis advanced on geometrical reasoning by Dr. D. M. Wrinch (Oxford). This theory, which has already been presented in a series of communications to NATURE, was briefly outlined by Dr. Wrinch, who claimed with justice that it is in fact a logical development of the peptide hypothesis built up within the framework of existing knowledge. The criticism of Dr. Linderström-Lang that the cyclol molecule contains linkages of a type not known to be attacked by enzymes was met by Dr. Wrinch with the admission of the possibility of spontaneous breakdown of the structure following initial enzymic rupture of the normal peptide linkages, which it does in fact contain.

The symposium was closed by two brief but interesting contributions, from Dr. Irving Langmuir on the possibilities offered by the study of protein films, and from Dr. D. Jordan Lloyd concerning the important physico-chemical work of Cohn and his collaborators at Harvard.

The general impression left by the symposium was that the problem of protein structure can only be solved by a combination of all applicable methods of attack. The listener was left in no doubt as to the magnitude of the problem, but nevertheless with the feeling that improvements and new developments of technique are now forthcoming at a rate which affords justifiable hope of its solution in the not very distant future.

## Health and the Community

ON September 2, the physiologists of the British Association for the nonce forsook their frogs, cavies, rabbits and almost, but not quite, their rats. They left the cloistered calm of controlled experiments *in camera* and the discussion of intricate problems of nerve conduction or surface films, interesting, no doubt, to those who have at least mastered the terminology but deadly dull to those who have not, and descended to the world of men, and to a consideration of the criteria of the healthy life both of man as an individual and as an integer in a community. They could not, however, quite part with the rat. The important part this rodent has played and is still playing in the progress of civilization would need a whole article to describe, but we only heard of its value in assaying food for certain vitamins, and were warned of the dangers of accepting results obtained from experiments on rats as applicable without reserve to man. For example, the anti-vitamin D influence of cereals—so clearly demonstrable on rats and puppies, due to the absence from their alimentary tracts of an enzyme capable of freeing phosphate from *phytin*—leads to low-phosphorus rickets, a condition unknown in man. The breakfast cereal, whether provided dry or as Scots porridge, thus leaves the physiological court of appeal without a stain on its character, or, to be more cautious, with the Scots verdict "not proven".

Experiments on animals have given valuable information, and they are still necessary, especially for purposes of assay, but before far-reaching conclusions of value to the community can be drawn, they must be shown to be valid for man by long-term experiments on man. Before these can be attempted, some measure of agreement must be reached as to standards of performance. What is a healthy man? How can his health be measured? It is all very well to talk of the bloom of health, the clear eyes, silky sheen of hair, easy upright carriage and the pleasant facial expression of those physiologically fit, but these qualities are immeasurable. They have no yard-stick. As standards are necessary, such items capable of measurement as height-weight ratio, chest expansion and absence of demonstrable fatigue after moderate work have to be used for want of better. A person may be called normal if he does not depart more than  $\pm 5$  per cent from the average.

This led to a discussion on sub-nutrition—a vague lack of efficiency demonstrably due to inadequate intake of the so-called protective foods.

The threshold for these foods varies from individual to individual, some requiring more and some less to enable vital processes to be carried on at full efficiency; so, to play for safety in planning diets for large groups, maximum amounts should be given (not necessarily taken). Laboratory animals have been shown to suffer from excess of these foods. In fact, many diseases common to man may have symptoms similar to those produced by overfeeding rats with certain dietary constituents, but the overfeeding has to be gross. So far, no ill effects have followed *luxus* consumption by a healthy man of any article of diet taken in the ordinary course.

Health and industrial efficiency are not quite synonymous terms, but there is no doubt that ill health causes large industrial losses. The Section had, as guest speaker, Dr. E. Atzler of Dortmund, who told, in fluent English, of his attempts, which met with a large measure of success, to raise the industrial efficiency of the workers in Westphalia. He stressed the value of slow adaptation to working conditions. The operative starting work under new conditions has to become acclimatized, and unless this is done carefully his efficiency and his general health may be impaired. He directed special attention to mineral metabolism—the need for phosphates being noticeable in those about to undergo heavy muscular work, and for chlorides when the work was to be done under semitropical conditions. These mineral needs are less after the worker has become 'hardened' to his job.

The Section turned its attention to more general problems. It was told of a steadily decreasing birth-rate, especially in those classes more financially comfortable. It has been computed that for every hundred women aged twenty-five years in England and Wales to-day, there would be only 83 in 1942, 70 in 1952 and 60 in 1962. Whatever we do now, these figures cannot be increased. Further, there is a tendency to postpone marriage in the better-off classes. Thirty-six per cent of the women of the professional classes who marry do not arrive at the altar until they have passed thirty years of age. The corresponding figure for miners is 10 per cent (Reg. Gen. Report for England and Wales, 1921). Even those who marry younger tend to postpone childbirth. To determine the safest age for reproduction, that is, the age with the lowest death-rate for mother and child, necessitates the close study of a large area with a fairly stable population. Figures were given of 30,000 mothers, 98 per cent of whom came from

the classes covered by State insurance. It was made clear that the safest rate of reproduction for both mother and offspring was the *modal* rate, that is, when the first pregnancy occurred when the mother was round about twenty-five years of age, the second, third and fourth between the ages of twenty-five and thirty and not more than three pregnancies in the next five years. *On the whole*, this rate was observed only by the lower paid members of the community. As income (or security of tenure) improves, there is a tendency to postpone the first pregnancy, with obviously a shortening of the reproductive period and, statistics

showed, with a consequent increase both in maternal mortality and in the number of still-births. The increase in still-births is almost offset by the decrease in child mortality. The result of this is that those who are least able to obtain the necessary food for full health are the very people who are contributing most to the maintenance of the population. To improve the condition of the child-bearers and incidentally of the children born, education in food values and other physiological truths is not of much use unless the necessary food and service are available at a price to suit their incomes and conditions of life. D. B.

## Obituary Notices

### Mr. A. Sharples

MR. ARNOLD SHARPLES, formerly mycologist in the Department of Agriculture, Federated Malay States and head of the Pathological Division of the Rubber Research Institute of Malaya, died at St. Anne's-on-Sea on August 6, after a long illness.

Mr. Sharples was born at Great Harwood, Lancashire, on November 25, 1887. He received his elementary education at Stoneyholm School, Burnley. He left school early, but later, overcoming great difficulties, he became a student at the Burnley Technical College, where in 1908 he won a scholarship to the Royal College of Science, London, and at the same time was awarded King's prizes in both geology and mineralogy. At the Royal College of Science he was especially interested in botany and came under the notice of Sir John Farmer as a particularly promising student. He became an associate of the Royal College of Science and was awarded the diploma of the Imperial College of Science in 1912. His interest in mycology had already been stimulated by his association with north-country naturalists, especially the late Mr. James Needham of Hebden Bridge. On leaving the Royal College of Science he was appointed assistant mycologist in the Department of Agriculture, Federated Malay States, but before going to the East he spent some time at Kew to extend his knowledge of mycology under the direction of the late Mr. G. Masee and Miss Wakefield. All his professional life was spent in Malaya. In 1916 he was appointed chief mycologist in the Department of Agriculture, and in 1930 he was seconded from Government service to be head of the Pathological Division of the Rubber Research Institute of Malaya, situated at Kuala Lumpur. He retired in 1934 and settled at St. Anne's-on-Sea.

During the Great War he served in Mesopotamia (1917-19) as a lieutenant in the Royal Engineers. In this capacity he was concerned with the purification of water supplies for the troops.

From the time of his arrival in Malaya until his retirement, Sharples was a most energetic and able investigator of the diseases of tropical crops, especially rubber. From 1914 onwards there was a constant stream of papers from his pen, published by the Department of Agriculture or the Rubber Research Institute, or appearing at home in the *Annals of Botany* and the *Annals of Applied Biology*. At one time or another he covered the whole range of rubber tree pathology. He treated exhaustively, sometimes in association with colleagues, such diverse topics as the spotting of plantation rubber by mould fungi, pink disease, the root and branch disease of rubber trees caused by *Ustilina zonata*, mouldy rot and brown bast of the tapped bark, lightning damage to coco-nut and rubber trees, and callus formation in tropical plants. These and other investigations were marked by thoroughness and insight. Sharples was not content merely to investigate a disease sufficiently to give advice to planters, but being interested in the fundamental aspects of plant pathology, he examined in great detail the relations of plant and parasite or other disease-producing agency in connexion with environmental conditions. His account (with H. Gunnery) of callus formation in *Hibiscus* and the rubber tree (*Annals of Botany*, 1933) is probably the best description available of the development of this tissue. His wide botanical interests prevented him from becoming a narrow specialist. Sharples was an example of the best type of officer in the tropical departments of agriculture, who realizes both the practical and the fundamental issues involved in problems of crop cultivation.

Sharples had a profound knowledge of all matters concerning rubber cultivation in Malaya, and his advice was constantly sought by the planters, with whom he was always on the best of terms. They had complete confidence in him. He will long be remembered with gratitude by the planting community of Malaya. During his service with the Rubber Research Institute he acted as director for a period.



After retirement, Sharples devoted his leisure to writing an up-to-date book on the "Diseases and Pests of the Rubber Tree" (Macmillan and Co., Ltd., London, 1936). This was a most notable addition to books on the diseases of tropical crop plants; it is, in fact, a treatise on the principles of plant pathology with particular reference to rubber cultivation, and is eloquent testimony to the enlightened outlook which Sharples had on the problems of disease in plants. Unfortunately his health began to fail shortly before the publication of this book, and he died at the early age of forty-nine years. It is sad to think that after such a strenuous life in the East he did not live to enjoy the leisure he had so richly earned.

Personally, Sharples was something of a 'rough diamond', albeit his outspokenness became mellowed with age. He was entirely sincere and courageous in his opinions, and no one was ever a more loyal and kindly friend than he. His high achievement in spite of early handicaps is striking testimony to his sterling character. In an enervating climate he maintained his energy in an astonishing manner: tropical ennui never affected him. In any joint investigation he always pulled his weight, and generously shared credit with his colleagues. As a young man, he was keen on association football and in later life he was fond of tennis and golf. He married Edith Thornton in 1917, who survives him. There were two sons of the marriage, one of whom died a few years ago.

#### Prof. J. G. Thomson

PROF. JOHN GORDON THOMSON, director of the Department of Medical Protozoology at the London School of Hygiene and Tropical Medicine, whose death took place in London on August 13, was one of the few outstanding medical protozoologists in Great Britain. In addition he was, and continued to be until shortly before his death, a well-known investigator of tropical disease in the field.

Prof. Thomson commenced his career at the University of Edinburgh, where he graduated M.A. in 1903 and where he qualified in medicine with honours in 1908. Two years after qualifying he was appointed Durning-Lawrence research fellow in tropical medicine at Liverpool and later, 1912-13, pathological research fellow at the Liverpool School of Tropical Medicine. During his time at Liverpool, where he worked under Sir Ronald Ross, he carried out many researches on trypanosomiasis and on cultivation of the malaria parasites. His work in this last connexion, which was done largely in collaboration with his brother, Dr. D. Thomson, was perhaps that for which his name was best known.

In 1914 Prof. Thomson was appointed lecturer in protozoology at the London School of Tropical Medicine, but on the outbreak of the Great War he joined the Forces and proceeded in 1915 to Egypt, first as member of a commission to study bilharzia in that country and later as protozoologist to the Central Military Laboratory at Alexandria. On his

return to England he was appointed officer in charge of the Malaria Research Laboratory at the War Office, where again he was associated with Sir Ronald Ross. Whilst in Egypt and later, he published many papers on amoebic dysentery and other intestinal protozoal conditions, as well as studies directed to the finding of satisfactory serological tests for malaria.

In 1918 Prof. Thomson took up the duties of the appointment at the London School of Hygiene and Tropical Medicine which he held at the time of his death; there he worked in post-graduate teaching and in the carrying out of many researches. In 1921 and again in 1922 he went on an expedition to study blackwater fever in Rhodesia. The results of these investigations were presented in a memoir, published by the School, which is now one of the best-known standard accounts of this disease. In 1924 he visited the West Indies, Honduras, Guatemala, Costa Rica and Panama. In 1934 he visited and carried out investigations in Nyasaland, studying more especially the indigenous malaria, and at various times he visited other tropical countries. In the intervals of travelling and demands made on his time by teaching, he published many papers on protozoological subjects and was joint author in Thomson and Robertson's "Text Book of Protozoology", a very useful and condensed source of information on the subjects dealt with.

Though Prof. Thomson worked at many different problems, the malaria parasites were always his favourite study, and even up to shortly before his death the nature of malarial immunity and drug treatment in malaria were much engaging his attention. Prof. Thomson's name is one familiar to research workers in tropical medicine both of British and of other nationalities, and his death will be a loss not only to his colleagues and many friends but also to a very wide circle where his work was known and appreciated.

#### Prof. Luigi Pernier

WE regret to record the death of Prof. Luigi Pernier, professor of archæology and the history of ancient art in the University of Florence, which took place in Rhodes at the age of sixty-two years in August last, while he was attending the Dante Alighieri course of "Alta Culture". His death is a great loss to archæological studies in Italy, more especially in connexion with the investigation of the sites of the early civilizations of the Mediterranean area.

Luigi Pernier was born in Rome on November 23, 1874. On completing his education, he was appointed to the Administration of Antiquities, and took part in the Italian archæological mission to Crete in 1900, acting as director of the excavations at Festos. In 1909 he was appointed director of the Royal Italian School of Archæology at Athens and of the "Missioni Italiani in Oriente". While he was head of the School, archæological explorations were carried out in Crete, Delos, the Sporades and Euboea under his direction. In 1916 he was appointed director of the

Archæological Museum of Florence and of the Musei i Scavi dell'Etruria, when he was responsible for the excavation of Vetulonia, Arezzo, Cortona and Orvieto, investigations of the first importance for our knowledge of the Etruscan civilization. After his appointment as professor of archæology in the University of Florence in 1922, he also became head of the archæological mission to Cyrene, where important excavations were carried out under his charge.

WE regret to announce the following deaths:

Prof. A. J. Ewart, F.R.S., professor of botany and plant physiology in the University of Melbourne, aged sixty-five years.

Miss A. Lorrain Smith, O.B.E., formerly of the British Museum (Natural History), known for her mycological studies, on September 7, aged eighty-three years.

## News and Views

### Heavy Nitrogen

AT a recent meeting of the American Chemical Society Prof. H. C. Urey reported that he had prepared heavy nitrogen in considerable quantities (see also p. 512). Ordinary nitrogen has long been known to consist of two isotopes of mass numbers 14 and 15, the heavier one being present, however, to only four parts in a thousand. Isotopes of several elements have been already separated in a fairly pure state; of these hydrogen and deuterium are the best known, but other examples are lithium 6 and 7, and neon 20 and 22. The difficulty of the problem solved by Prof. Urey can be appreciated by comparing it with that presented by the neons, where the percentage difference in mass is greater and also the heavier isotope is naturally present to the extent of nearly 10 per cent, instead of the half per cent in the case of nitrogen. It is stated that the heavy isotope is being separated at the rate of a quarter of a litre a day. The separation of pure heavy nitrogen will undoubtedly lead to a great deal of important work in nuclear physics. Nitrogen 15 differs from nitrogen 14 simply in the structure of its nucleus, there being one more neutron present in the heavier type. Ordinary nitrogen has already proved most interesting, since it can be disintegrated in a variety of ways by bombardment with  $\alpha$ -particles, neutrons, protons and deuterons. The investigation of the behaviour of heavy nitrogen under the same conditions should lead to valuable conclusions about the effect of the extra neutron in the nucleus. It has also been suggested that heavy nitrogen will be of great service for research in physiological chemistry, since various substances which are important in the body can be made containing some heavy nitrogen instead of ordinary nitrogen, and while their behaviour will be unaltered, these particular molecules can always be identified later by means of the heavy nitrogen atoms.

### Mentality of Fish

DR. J. GRAY'S evening discourse to the British Association delivered on September 6 at Nottingham shows how closely the reactions of fishes resemble those of man. In the behaviour of man the involuntary machine-like reflex plays a very important part, and in a fish that is swimming freely the movement involves a high degree of co-ordination between a

large number of muscles; the whole of this highly co-ordinated mechanism being completely independent of that part of the fish's brain which corresponds to our cerebral hemisphere and therefore to that part of the brain which is associated with consciousness in ourselves. It is well known, however, that a fish may be trained to make mental associations, and in the last few years the problem has been subjected to rigid scientific investigation. By experiment it is found that a fish is sensitive to a great variety of gentle stimuli such as a very slight change in temperature and the shape and colour of objects in its vicinity. Fish are also capable of carrying out highly complicated migratory excursions. In these types of behaviour Dr. Gray asks us if we do not see most if not all the activities of the human race. Almost certainly the association powers of a fish are on a much lower level than those of man, but the power is there, and it is difficult if not impossible to put our finger on any one of our mental powers and say, "Herein are we a race apart, elevated above the rest of the world". Dealing with the migratory experiments with the Pacific salmon, in which that fish is proved always to return to its own native waters, he says, "I venture to think that if we were to have carried out comparable experiments on a race of human beings, and got similar results, we would have said 'They do it, as you or I would do it, consciously noting the landmarks, memorising them, and so retracing their steps'—in fact they are performing a conscious act, a premediated, thoughtful, and purposive act. Are we to apply the same conclusions to the fish—if not, why not?"

### Rivers and their Formation

IN connexion with the recent British Association meeting at Nottingham, a public lecture on "Rivers", which was abundantly illustrated, was delivered by Mr. R. Kay Gresswell in Lincoln on September 3. Mr. Gresswell pointed out that when a river has once been formed, by virtue of its motion the water is able to carry a load consisting of rock actually dissolved in the water and also of finely powdered rock and pebbles of all sizes, which serve as eroding agents. When it has acquired a load, the river can use it as a kind of file or battering-ram with which to erode its banks and bed and so add to the quantity

it is transporting until it becomes fully laden. The main features of a river are the direct result of the water constantly trying to adjust its bed to suit its load. If the river enters a reach fully laden and the slope is such that the water continues to flow at its original speed, then just as much material will leave that reach as enters it and so no erosion takes place. Should, however, a fully laden river enter a reach the slope of which is less steep than it has been upstream, the rate of flow of the water will be decreased and a proportion of the load is then deposited. This mostly occurs at the beginning of the reach and thus the river gradually steepens the slope until it becomes sufficient for the entering load to be carried through.

IN the lower part of its course, a river normally enters upon a plain. Here the rate of flow is greatly diminished and the fully laden river proceeds slowly towards the sea. In turning a corner, the speed on the outside of the curve is always much greater than that on the inside. This results in the water on the outside being able to take on an additional load and thus erode the bank. Conversely, the water on the inside is unable to carry the whole of the load it already possesses and deposits sediment on the inside of the curve. The bend thus becomes steeper and steeper, and it is owing to this action that rivers always meander in the plain tract. Quite commonly the river still does a little actual erosion and in consequence by the continual change of position of the various loops of the meanders, the general level of a strip of land, about one or two miles wide in the case of rivers the size of those found in England, is gradually lowered, the edges of this band, which mark the extreme limit of past meanders, often forming steep cliff-like slopes. If, as the result of earth-movements, the general slope of a river-valley be increased, the river flows more quickly and is thus able to increase its erosion. It sometimes happens that a meandering river is thus re-juvenated, and in that case the river deepens its bed in the shape the meanders then happen to possess. The land between the individual loops are then in time left standing high above the new low river-level. This has happened in the case of the River Wye in Monmouthshire, and has resulted in very beautiful scenery.

#### Fauna and Climate in Early Palestine

IN view of the interest of the various geographical and distributional problems in the prehistory of Palestine, to which a notable contribution has been made by the preliminary examination of the finds in the bone-bearing beds of Bethlehem (see *NATURE*, Sept. 4, p. 431) attention may be directed to a communication from Prof. L. Picard, of the Hebrew University, Jerusalem, which appears in the recent issue of the *Proceedings of the Prehistoric Society* (Jan.-June). Prof. Picard there examines in detail the data of palæontology, geology, archæology and stratigraphy in their bearing, first on the climate of Palestine in prehistoric times, and secondly on the origin and geographical relations of the fauna of that period.

Writing before the publication of the evidence from Bethlehem, he concurs with Miss Bate's previously published conclusion as to the complete absence from Palestine of a boreal (cold period) fauna, though its existence has been asserted; but he is unable to accept her interpretation of the palæontological evidence as pointing to a change from a forested landscape with humid conditions to a drier climate and more open country. He finds that while there were a number of forms, now extinct, contemporary with the old Acheulean—the earliest evidence of man's handiwork then available to him—some of these, such as probably the hippopotamus, survived even so late as Biblical times.

As a whole, the various classes of evidence (in palæontology, trees and plants, as well as land and aquatic fauna) are interpreted by Prof. Picard as concurrently pointing to the fact that no important change in climate takes place down to recent times. In fact, the present climatic conditions, the aridity of the eastern section and the Mediterranean or 'etesian' climate of the western, existed in the Pliocene, and date back to the Upper Miocene. Further, the geographical conditions in the south were such as to preclude migration to, or from, Africa in the Pleistocene. The fauna which has been designated as African-Asiatic has been domiciled in Palestine since the end of the Miocene and can be regarded as endemic during the Plio-Pleistocene. The problem, it will be seen, is of considerable general interest, but to palæontologist and archæologist more especially in relation to recent discovery in East Africa. Further evidence from Bethlehem will be awaited eagerly.

#### Human Skeletal Remains in London

EXCAVATION work in Farringdon Street, London, E.C.4, for the foundations of an extension of the offices of the *Evening Standard* has brought to light a large number of human skeletal remains. About three hundred skulls and two thousand other bones have been found. It is suggested that the excavation may have opened one of the pits in which victims of the great plague of 1665 were buried indiscriminately. There were a number of these pits situated in various parts of London. One of the largest was in Tothill Fields, Westminster, near where Caxton Hall now stands; another near Newgate was adjacent to the site of Christ's Hospital, the Bluecoat School, demolished for the extension of the Post Office, and still another was in Whitechapel. Dr. A. J. E. Cave, of the Royal College of Surgeons, who has inspected the recent finds, is of opinion, according to a statement published in the *Evening Standard* of September 10, that, judging from their condition, they are probably the skeletons of men, women and children who died in the seventeenth century and may well have been victims of the plague. They are all of the same type, and differ but very slightly from typical skulls of to-day. Though they have not yet been submitted to an exact examination, Dr. Cave is stated to have said that the skulls appear to have a

vault a little more pointed than the modern skull. It will be remembered that Prof. F. G. Parsons some years ago examined a large number of seventeenth and eighteenth century skulls of Londoners, when a graveyard, presumably of the adjacent St. Clement Danes, was discovered on the demolition of King's College Hospital in Portugal Street. He then concluded that little change had taken place in the physical characters of the Londoner during the last two or three hundred years, except that the skull showed a slight tendency to broaden.

#### Recent Excavation at Meare, Somerset

A FORTNIGHT'S work of excavation at Meare Lake Village by Mr. H. St. George Gray and Dr. A. H. Bulleid has brought to light an interesting variant in the method of constructing their dwellings employed by the inhabitants. The season's work, as already indicated (see NATURE, Aug. 28, p. 352), is directed to the investigation of the central portion of the eastern half of the village. Excavation of the area surrounding Dwelling Mounds Nos. 16, 17 and 19, which, it is reported in *The Times* of September 13, has now reached the southern half of the floors of the circular dwellings, has shown that there are at least two floors, or layers of clay, separated by a quantity of ash, black earth and refuse deposited during the occupation. The peat in this part of the village is so firm that the usual timber foundations for the support of the clay floors appear to have been unnecessary. In the area surrounding the dwellings the refuse from the huts is found to contain a considerable amount of ornamented pottery (Iron Age "B") and evidence of weaving in the form of loom weights, spindle whorls and bobbins. Portions of bone needles also have been found. In the occupational refuse between the clay floors, the proportion of bones and pottery sherds found to the area at present examined is unusually high. The bones are mostly of lamb and young oxen, but there are also the remains of a small horse, pig and dog, a few bones of red and roe deer and also of birds. Here there is further evidence of weaving—spindle whorls of baked clay, stone and tin, bobbins, etc., as well as a highly polished bone needle and two bone pins with mouldings and long slots of a type unusual in western Britain. Objects of iron are not plentiful, but include a butcher's knife with convex edge. In bronze are a couple of fibulae, an openwork harness ornament, and a hinge-plate with rivet holes. The ornaments include shale bracelets, and among the beads is one of blue, strung on a bronze wire.

#### Recent Earthquake in Sussex

SHORTLY after 1 a.m. on September 8, an earthquake of intensity 5 or more (according to the Rossi-Forel scale) was felt in the west of Sussex, especially at Horsham and the neighbouring village of Warnham. The earthquake is of some interest owing to its connexion with the series of shocks that have occurred for nearly three centuries in the district around Chichester, the first known to us being that of the year 1553. A little more than a

century ago, between September 1833 and August 1835, there was a series of eight earthquakes in the district, which were studied by a small committee, the first ever instituted for the study of British earthquakes. One of the most important of these earthquakes was that of January 23, 1834. It was of about the same intensity as the recent shock. Its centre lay 4 miles west-north-west of Chichester, and the longer axis of its disturbed area of 780 sq. miles, if produced, passes through Horsham. Readers who are willing to aid in the investigation of the new earthquake should send their accounts to Dr. A. T. Dollar, Emmanuel College, Cambridge.

#### Mechanization in the Modern World

AMONG the matters handled at the meeting of the International Committee on Intellectual Co-operation at Paris on July 12-17 was the inquiry into mechanization in the modern world. The plan of this inquiry has been approved by the Committee and preparations are now in hand by the Institute. National lists of organizations concerned with social sciences are also being collected by the Institute, and lists have already been received from the United States, France, Japan, Italy, Czechoslovakia, Belgium and Norway. The inquiries on unemployment among intellectual workers are being pursued and the establishment of an advisory committee including representatives of the national bureaux and international organizations concerned has been authorized. The Institute has also collected most of the bilateral intellectual agreements in a volume which will shortly be published. The International Committee on Intellectual Rights has been concerned with preparations for the revision of the Berne Convention and for the Universal Conference on authors' rights, and a meeting of experts is being held to formulate final proposals for two conferences at Brussels on these subjects. The Advisory Committee of Intellectual Workers of the International Labour Office, however, pronounced in favour of keeping the question of the moral rights of salaried artists in the applied arts on its agenda.

#### The S.S. *Orcades*; the Latest Orient Liner

LAST month the Orient liner *Orcades* started on her maiden voyage. According to an article in the *Electrical Review* of August 27, it is claimed that she is the first British ship on the Suez route to have a public sitting-room supplied with conditioned air. Conditioned air is supplied to the public rooms and to several of the cabins. It is not sufficient for comfort to have only ventilation and correct temperature; the humidity must also be controlled within fairly narrow limits. In the tropics, the atmosphere is frequently uncomfortably damp. To reduce the temperature without extracting moisture from the air raises the relative humidity and may make the conditions more uncomfortable. When the climate is colder, air after warming sometimes becomes unpleasantly dry. Hence although air conditioning as it is managed at present is expensive, it may add greatly to the comfort and well-being of the passengers. The new vessel—an eight decker—has been built by

Vickers Armstrong for cruises and for service on routes between England and Australia. Its gross tonnage is 23,445 and it will accommodate 463 first-class and 605 tourist passengers and a crew of 466. Steam is provided by six oil-fired Babcock and Wilcox boilers. Pipes conduct it to two sets of 1,715 revs. per min. Parsons turbines. These drive the propellers at 112 r.p.m. by means of mechanical gearing. Two systems of intercommunication telephones are installed. The Marconi International Communication Co. has installed an all-wave radio installation, including a direction finder, and an 'echometer' depth sounder, together with a broadcast system of loud speakers throughout the vessel. Time is given by means of 82 synchronous clocks. A portable sound picture equipment by the Western Electric Co. is one of the many forms of entertainment provided.

#### The Problem of Dates of Publication

THE study of natural history has branched into many side-lines; but it is strange to think how far off the direct line of acquisition of nature knowledge the need for accuracy has led. For the convenience of naturalists the world over, animals and plants bear specific names, and the proper name where several have been given is determined conventionally by priority of christening. But so difficult is it in some cases to determine priority that an extensive literature has developed around these knotty problems, and so insistent is the demand for accuracy that a Society for the Bibliography of Natural History has been formed. The first part of its *Journal* is a catalogue of papers concerning the dates of publication of natural history books, arranged in alphabetical order of the authors of the books, and this ought to be of great service to systematists. Sometimes it is difficult to see exactly how the alphabetical order has been determined; "Ent. Soc. Lond." appears under "London", "Ent. Soc. N. S. Wales" under "Ent."; "Royal Phys. Soc. Edinburgh" appears under "Proc.", while the Wernerian Society of the same city appears under "Edinburgh". Doubtless there are sound reasons for this grouping, but they are not obvious, and they are not set out in the very brief introductory notes. The Society maintains a card index of papers concerned with the dates of publication of natural history books, and copies of such papers will be welcomed by the Secretary at 41 Queen's Gate, London, S.W.7.

#### Empire Grants Committee for Museums

THE final report to the Carnegie Corporation of New York on the activities of the Empire Grants Committee appears in the *Museums Journal* of May. It is a stimulating document. On April 1, 1934, the Committee was set up to administer a fund of 54,000 dollars granted by the Carnegie Corporation of New York for Colonial Museums, with an addition of 9,000 dollars for expenses, £12,550 in all. All museums in the British Colonies, and in Newfoundland and Southern Rhodesia were invited to submit applica-

tions for grants; forty applications were received and twenty-five grants were made. They ranged from £60 to Kandy Museum and Bermuda Historical Museum to £1,000 for Nairobi, Cyprus, Barbados, Singapore, Zanzibar, Jamaica. Various strict regulations had to be made as to the conditions upon which grants could be made; but the Committee is satisfied that the effect of grants has been in nearly every instance most stimulating to the local museum movement. At Bulawayo and Salisbury, the museums have been elevated to the dignity of national museums; in Cyprus, Barbados and Antigua more attractive premises and added Government recognition have been gained; but in most cases grants have been given for cases and equipment, so that museum interiors have been brightened and organized on modern lines. The success of the experiment leads the Committee to suggest that there are good reasons for continuing so promising a first effort.

#### Time Measurement

THE history and development of time measurement have already been described in a Science Museum Handbook ("Time Measurement", Part 1). The second part of the handbook which has recently been issued (London: H.M. Stationery Office. 2s. net) contains a detailed description of the objects in "The Time Measurement Collection at the Science Museum, South Kensington". The exhibits, ranging from the ancient Egyptian shadow clocks and water clocks to modern electric time-keepers, include sundials, mechanical clocks, watches and chronometers, escapement models and chronographs, as well as various auxiliary devices such as striking mechanisms, time recorders and time switches. Introductory remarks to each chapter explain the system of classification adopted, and outline the general principles involved in the respective groups of instruments. Many of the exhibits at the Science Museum are shown in continuous operation, while others can be operated by visitors—a facility that appears to receive perpetual appreciation. In addition, several of the more delicate watch mechanisms are illustrated by large-scale models. It may be noted that Harrison's four marine timekeepers (the fourth, completed in 1759, being the chronometer which won for Harrison the British Government prize of £20,000) are now represented in the Museum only by photographs, the originals themselves, long associated with the Royal Observatory, Greenwich, having been transferred to the National Maritime Museum at Greenwich. This handbook with its numerous illustrations provides an admirable introduction to a study of the Time Measurement Collection, and it will also serve as a useful handbook of reference for other occasions.

#### Meteorology in India

THE Meteorological Department of the Government of India has for several years had to contend with serious financial obstacles in the shape of reduced grants, when the increasing requirements of aviation have demanded increased departmental activity. The

report on the Administration of the Meteorological Department of the Government of India in 1935-36 (Delhi: Manager of Publications, 1936) describes how various economies have been devised in order that the demands of aviation and other interests may be met so far as is possible. By taking full advantage of aeronautical wireless stations for the exchange of weather telegrams between aerodromes, and aided by cheaper telegrams, a saving of more than half a lakh of rupees annually has resulted. Economy was not made any easier by the disastrous earthquake of May 31, 1935, at Quetta, which demolished the Meteorological Office there, as well as the observers' quarters. This led to the pilot balloon station at Quetta being moved to Dera Ismail Khan for a time, and to the setting up of a temporary surface observatory at Quetta when the situation there was well enough in hand again. Research work did not slacken. Dr. T. Royds, director of the Kodaikanal Observatory, joined the expedition organized by the Royal Society and the Royal Astronomical Society to observe the solar eclipse of June 19, 1936. He took with him what is described as "perhaps the most powerful spectrograph ever used at an eclipse". The discovery of oxygen in the sun's chromosphere was announced from Kodaikanal in 1936 (see NATURE of April 11, 1936). Several pieces of research were carried out in the office at Poona with the voluntary aid of students guided by the official meteorologists. These included the development of a spectrograph for the study of ozone in the earth's atmosphere.

#### Activities of the Rockefeller Foundation

A REVIEW by its president, Mr. Raymond Fosdick, surveys the work of the Rockefeller Foundation during 1936. The expenditure totalled 11,300,000 dollars in connexion with its programme "to promote the well-being of mankind throughout the world". The agencies assisted included institutions, research work in medicine, biology and other sciences, and the humanities. Investigations on the jungle form of yellow fever and other health problems have been promoted, displaced German scholars have been helped, and appropriations have been made for trial work in the development of radio-programmes of cultural and educational value. A grant was given to the Orthological Institute in China for the preparation of a series of books for Chinese readers in 'basic' English.

#### Encke's Comet

A TELEGRAM from Copenhagen announces that Dr. Jeffers, Lick Observatory, has observed Encke's Comet. The position on Sept. 3-38542<sup>d</sup> U.T. was R.A. 2<sup>h</sup> 19<sup>m</sup> 4.9<sup>s</sup>, N. Decl. 27° 10' 20". The magnitude is given as 18. In the "Handbook of the British Astronomical Association" for 1937, Dr. A. C. D. Crommelin gives an ephemeris based on an orbit in which perturbations of Jupiter and Saturn are taken into account. The observed position corresponds closely with that predicted by Dr. Crommelin.

#### Discovery of a Super-Nova in *Canes Venatici*

PROF. H. SHAPLEY has announced the discovery of a super-nova by Zwicky, and Humason found that it had a typical super-nova spectrum. Stobbe, at Kiel, gives its position as R.A. 13<sup>h</sup> 2<sup>m</sup> 57.56<sup>s</sup>, N. Decl. 37° 57' 19.2", equinox 1937.0, and magnitude 8.7.

#### Announcements

A DEPARTMENT for psychology under the direction of Prof. E. R. Jaensch, director of the Institute of Psychological Anthropology at Marburg, has recently been added to the Imperial Leopoldine Caroline German Academy of Natural Science.

THE following awards have been announced by the North East Coast Institution of Engineers and Shipbuilders: The Institution Engineering Gold Medal to Harry Hunter, vice-president of the Institution, for a paper on "Singing Propellers"; M. C. James Medal to Mr. H. E. Lance Martin, head of the Civil Engineering Department at King's College (formerly Armstrong College), Newcastle-upon-Tyne, for a paper on "The Determination of the Residual Strains and Stresses in Arc-Welded Plates"; The Institution Scholarship, value £100, to R. A. Lyall, an apprentice of the Central Marine Engine Works, West Hartlepool.

THE board of Rolls-Royce, Ltd., has decided to found, in memory of Sir Henry Royce, a travelling research fellowship to be known as the Henry Royce fellowship. The Fellowship will not exceed £450 a year and will be tenable for one year, by a graduate of a British university or holder of the higher national certificate or other equivalent qualification. Research is to be concerned with the construction, design, materials, or methods of production of automobile transport, including applications to aircraft and modern engineering.

AN International Conference on Physics, Chemistry and Biology will be held in connexion with the Paris International Exhibition in the Palace of Discovery on September 30-October 9. The president will be Prof. Jean Perrin. Further information can be obtained from the General Secretary, L. W. Tomarkin, 11 Rue Pierre Curie, Paris, 5<sup>e</sup>.

THE ninth Annual Conference of the National Smoke Abatement Society will be held at the Philosophical Hall, Leeds, on September 30-October 2. The programme includes discussions on town planning and smoke abatement, and education and smoke abatement. Further information can be obtained from the Secretary, Chandos House, 64 Buckingham Gate, London, S.W.1.

DURING the forthcoming winter, Mr. H. V. Garner, the guide demonstrator of Rothamsted Experimental Station, Harpenden, Herts, and other members of the staff are available for giving lectures to interested institutions on the Rothamsted experiments. All communications regarding lectures should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

## 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. 509.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

### Observations of the Solar Eclipse of June 8, 1937

A SCIENTIFIC expedition was organized early in the present year to observe the total solar eclipse of June 8 from somewhere on the coast of Peru, and the party of three sailed from Yokohama in the beginning of April. I was in charge, and arrived at Lima on May 10; after consultations with the Eclipse Committee of the University Mayor of San Marcos, I decided to have the observing station at Huanchaco, some 14 kilometres north-west of Trujillo. Two other members of the party, together with the instruments, landed at the port of Salaverry on May 20, and immediately proceeded to the station.

A large house of Sr. Victor Larco Herrera was kindly put at our disposal, where a large party of Peruvian scientific workers under Dr. G. Garcia was staying for the same purpose. Early in June, Dr. Clyde Fisher's American party also came to the same spot.

The main object of our party was to take large photographs of the inner corona with a ten-metre camera in conjunction with the 30-cm. cœlostat. Further, I had an independent set of cinematographic arrangements to get a rapid succession of photographs of three visible contacts, spectra of the flash and the corona, the extensions and the brightness of the corona. As the sun was about  $9\frac{1}{2}^\circ$  in altitude at the time of the eclipse, all instruments were set conveniently inside the rooms of the house and the sun could be observed through the available windows. A separate room was used for meridian observations of longitude and latitude made by me with a 38 mm. astronomical theodolite, the roof being taken away temporarily.

The weather was generally good during the interval of our stay at the camp, except for a few days in the very beginning of June when the skies were continuously overcast. The rehearsals and other preparatory work were well carried out.

On the day of the eclipse, the sky was overcast in the morning, but later it became clear and by 3 o'clock we had a perfect sky. The three visible contacts were observed as follows:

	1st Contact	2nd Contact	3rd Contact
Observed standard time	16 <sup>h</sup> 15 <sup>m</sup> 29 <sup>s</sup>	17 <sup>h</sup> 18 <sup>m</sup> 20 <sup>s</sup>	17 <sup>h</sup> 20 <sup>m</sup> 57 <sup>s</sup>
Corrections to computed time	+6	+3	+5
Observer	M. Horii	I. Yamamoto	I. Yamamoto

With the ten-metre camera, four plates were exposed for the partial phase and eight for the totality, with the exposures ranging from one tenth to 30 seconds. Upon developing, these plates have revealed splendid structures of the inner corona. My own cinematographic arrangements were partially successful, revealing good images only of the inner corona and the flash spectra.

According to these photographs, the coronal streamers are well developed around the sun. Especially in the north-east portion of the sun's limb there is a group of strong streamers and arches over

a wide area, where daily observations of the sun's surface during previous weeks suggest an activity area of large sunspots. Characteristic rays from both the north and the south poles of the sun are completely hidden by strong coronal streamers. Hence the present corona is of the 'sunspot maximum' type.

There are about a dozen prominences visible around the sun. Two of them are magnificent, one in position angle  $35^\circ$  and the other in  $290^\circ$ .

I observed the longitude and latitude of our station on three nights. The preliminary result for the latitude is  $-8^\circ 4' 46.6''$ , but that of the longitude has not yet been reduced.

ISSEI YAMAMOTO.

(Director, Kwasan Observatory,  
Kyoto Imperial University.)

Lima.

June 20.

### Photo-conductivity and Phosphorescence of Zinc-blende

FROM early experiments on the photo-conductivity of zinc-blende, Gudden and Pohl<sup>1</sup> deduced that the current must be transported by two kinds of carrier, and according to present-day theory these must be electrons and 'positive holes'—vacant places left in a normally full electron energy band when an electron is ejected. While electrons are liberated by blue light, positive holes do not become mobile until a subsequent illumination by light of longer wavelength, for example red or infra-red, but the reason for this need not be discussed here.

The photo-induced conductivity is proportional to the intensity of illumination, which shows that electrons travel a finite distance (*Schubweg*) and are then 'trapped', the trapping *not* being in general due to recombination; for if it were, the current would be proportional to the square root of the illumination. The mechanism of this trapping need not concern us here; but either under infra-red illumination or thermal agitation the trapped electrons can be set free again. Trapping and re-liberation occur a number of times in succession, but the electrons finally come to rest by combining with a positive hole. The crystal is then said to be quenched.

That this is the case is shown by the way in which the conductivity dies away during quenching. If  $n$  is the number of electrons (a constant proportion of which will be in the conducting state), and also the number of holes, then if they are recombining their number will decrease according to

$$\frac{dn}{dt} = -c_1 n^2,$$

whence, integrating, we obtain

$$\frac{1}{n} = c_1 t + c_2,$$

$c_1$  and  $c_2$  being constants. Thus we shall expect the

resistance of the crystal to be a linear function of the time. This is confirmed by experiment. For example, Fig. 1 shows the resistance-time relation found during the quenching of a specimen by infrared light at  $-196^{\circ}\text{C}$ . It is seen that within the limits of experimental uncertainty the relation is linear.

It is interesting to note that phosphorescence decay data for zinc-blende obtained recently by Antonow-

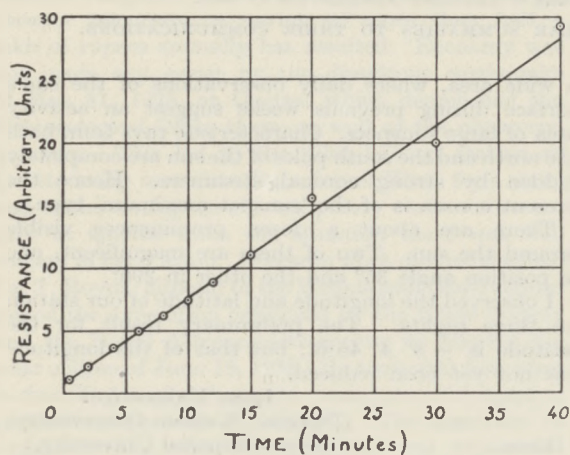


Fig. 1.

Romanowsky<sup>2</sup> are in full accord with these results, in that they show that the phosphorescence is due to a bimolecular reaction. It is easily seen that on the assumption that the intensity of phosphorescence,  $p$ , is proportional to the rate of recombination of electrons with holes,  $p^{-1/2}$  should vary linearly with time. Plots of  $p^{-1/2}$  against  $t$ , obtained from Antonow-Romanowsky's data, show that this is,

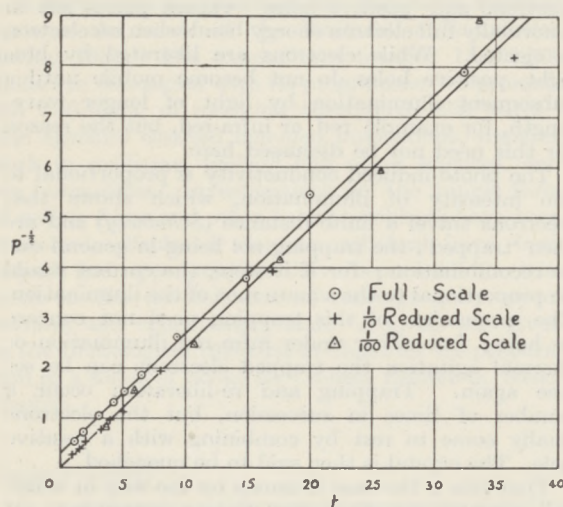


Fig. 2.

indeed, the case. An example of such a plot is given in Fig. 2, in which the lower line is to be regarded as a continuation of the upper one, representing the points on the two reduced scales.

A. L. REIMANN.

Royal Society Mond Laboratory,  
Cambridge.  
August 18.

<sup>1</sup> Gudden, B., "Lichtelektrische Erscheinungen" (Springer, 1928).  
<sup>2</sup> Antonow-Romanowsky, W. W., *Sov. Phys.*, 7, 366 (1935).

### Phosphine and Arsine Derivatives of the Group I(b) Metals: Volatile Derivatives of Gold

WE have shown that the trialkyl phosphine and arsine derivatives of cuprous iodide, previously considered to be  $R_3P(As)\rightarrow CuI$ , have a fourfold macro-molecule<sup>1</sup>,  $[R_3P(As)\rightarrow CuI]_4$ , and are therefore tetra-kis-[iodo-trialkylphosphine (or arsine)-copper]. A complete X-ray examination of the triethyl-arsine member,  $[Et_3As\rightarrow CuI]_4$ , showed that the four copper atoms occupy the apices of a regular tetrahedron; the iodine atoms are situated each above the central point of one face of this tetrahedron, so that they also form a tetrahedron external to that of the copper atoms. Beyond each copper atom is an arsenic atom lying on the elongation of the axis joining the centre of the inner tetrahedron to the copper atom. The iodine atoms are thus 3-covalent, each being joined to the three neighbouring copper atoms apparently by one covalent and two co-ordinate links: if this is so, the stereochemistry of the 3-covalent iodine atom must be similar to that of 3-covalent sulphur, and the iodine atom can be regarded as occupying one apex of a tetrahedron with its valencies directed towards the other three apices.

The corresponding silver compounds have now been examined, and prove also to have the fourfold molecule,  $[R_3P(As)\rightarrow AgI]_4$ . These silver compounds have, moreover, the same constitution as the cuprous compounds, since  $[nPr_3As\rightarrow AgI]_4$  is strictly isomorphous with  $[Et_3As\rightarrow CuI]_4$ . This is a remarkable example of isomorphism, the effect of the replacement of the copper by silver atoms being compensated by the replacement of the ethyl by the *n*-propyl groups. It follows that both the 4-covalent cuprous and argentous atoms have a tetrahedral configuration, in confirmation of the results obtained by Cox, Wardlaw and Webster<sup>2</sup>.

The aurous compounds,  $[R_3P(As)\rightarrow AuX]$ , where X is a chloride, iodide or thiocyanate radical, prove, however, to be monomolecular, and the gold thus shows a true co-ordination number of 2. The phosphine compounds,  $[R_3P\rightarrow AuX]$ , where X is Cl or I, possess remarkable stability, and can be freely distilled under reduced pressure. The compound  $[nBu_3P\rightarrow AuCl]$  can be volatilized even at atmospheric pressure, and the vapour, if passed through a heated tube, deposits a fine film of gold. There are thus two distinct chemical methods of producing gold films, the first having been recently described by Prof. C. S. Gibson in NATURE of August 14 (p. 279).

It is noteworthy that, whilst the copper and silver atoms both acquire 7 electrons in the above compounds and thus attain the electronic structure of the next inert gas, the gold atoms acquire only 3 electrons and thus remain 4 short of the radon structure. The gold in these compounds, however, falls in line with mercury, which acquires 2 electrons in compounds such as  $HgR_2$  and  $Hg(SR)_2$ <sup>3</sup>, and with thallium, which acquires 1 electron in compounds such as  $[TlR_2]X$ , a group of 4 shared electrons in the sixth quantum group allowing considerable stability in all three cases.

F. G. MANN.

A. F. WELLS.

University Chemical and  
Crystallographic Laboratories,  
Cambridge.  
August 19.

<sup>1</sup> Mann, Purdie and Wells, *J. Chem. Soc.*, 1503 (1936).

<sup>2</sup> Cox, Wardlaw and Webster, *J. Chem. Soc.*, 775 (1936).

<sup>3</sup> Mann and Purdie, *J. Chem. Soc.*, 1549 (1935); Wells *Z. Krist.* 96, 435 (1937).



### Behaviour of Cylinders of Inflammable Gas in a Fire : Extinguishing Flames by Coal Gas

On the night of October 5, 1936, a fire occurred in Pearse Street, Dublin, in a shop which housed two full cylinders of compressed gas, one containing 150 cu. ft. of oxygen, the other 100 cu. ft. of coal gas. In each case the internal pressure was 120 atm. During the fire explosions took place, and a large portion of the building collapsed. It was found afterwards that three firemen had lost their lives. A Tribunal of Inquiry, appointed by the Minister for Local Government and Public Health of Saorstát Éireann, has recently issued its report (Stationery Office, Dublin). "The Tribunal is satisfied that the explosions must be attributed to the two full cylinders of coal gas and oxygen," and includes among the results of the explosions "the trapping of three firemen who were then within the building thereby causing their deaths".

The fire, and the inquiry which followed, raise a point of general interest. If a fire occurs in premises in which cylinders of compressed gas are stored, will that fire be likely to be much more disastrous than if cylinders are absent?

In the present instance, there is no doubt that the cylinders burst in the course of the fire, for they were found ruptured in the ruins. There was general agreement, however, that the result of the physical bursting of a cylinder of compressed coal gas, followed by the *burning* of its contents, was likely to be much less disastrous than if the contents of the cylinder became mixed with air and suffered chemical *explosion*.

The men of science who attended the inquiry as expert witnesses found themselves faced with the following problem. Suppose the back of the shop (where the coal gas cylinder was placed) in flames, and suppose the front of the shop not yet on fire. The coal gas cylinder bursts, presumably in the midst of the flames. Could the gas (if the burst took place on the suitable side of the cylinder) make its way through the flames into the air in the front part of the shop, form an explosive mixture, and explode if a flame reached the mixture before it had become too dilute?

There is no doubt that the emerging coal gas could extinguish the flames in immediate contact with the cylinder. Intense cooling (in this instance 500°–600° C.) would result from an almost adiabatic expansion. Further, the concentration of combustible material would far exceed the upper critical explosion limit, which is about 28 per cent of combustible in the case of Dublin coal gas. I expressed the opinion that the jet of coal gas, shot with high velocity from the ruptured cylinder, might thus extinguish the flames in its path, and blast its way through the surrounding fire to the air in the front of the shop, where chemical explosion would probably follow. The alternative picture submitted was that of the coal gas swelling out of the ruptured cylinder as a 'balloon' which would *necessarily* be kindled at its periphery. It would then make its way to the nearest outlet as a gigantic flame, prevented by a mantle of burnt gases from mingling with air so as to form an explosive mixture.

The essential problem is therefore: Can a jet of coal gas extinguish flame *without itself being ignited*? If the answer is in the affirmative, there exists a possibility of *chemical* explosion in a case such as the present. Whether explosion actually occurs will depend on a variety of factors, such as the volume

and pressure of the escaping combustible gas, and the extent of the fire by which the container is surrounded.

I have carried out experiments, which I believe to be new, showing that coal gas *can* extinguish flame without itself being ignited.

A coal gas flame, five or six inches high, was established in the open air. A small cylinder of compressed coal gas (20 cu. ft.), fitted with the usual nozzle to control the rate of discharge, was used. The nozzle was opened full and the stream directed, from a distance of 3–4 ft., on to the flame. After a little practice, one was able to extinguish the flame without igniting the stream of gas from the cylinder.

A less striking experiment was carried out as follows. A five-litre flask was filled with coal gas, and the mouth covered with thin paper to form a temporary barrier to the gas. The flask was adjusted, mouth downward. A small gas flame was prepared. The tube from which this gas issued was surrounded at the mouth by a short piece of wider glass tubing with irregular edges, to puncture the paper before the flame reached it. The edge of the wider tubing was only just above the level of the top of the flame. When the flame was pushed up into the flask of gas, it was of course extinguished. The gas which issued from the flask sometimes took fire, but on numerous occasions the flame was extinguished without igniting the gas.

KENNETH C. BAILEY.

Trinity College,  
Dublin.  
August 12.

### Formation and Breakdown of Amino-acids by Inter- molecular Transfer of the Amino Group

WE have previously reported<sup>1</sup> the discovery in muscle of a highly active metabolic mechanism, by the action of which the amino group and two hydrogen atoms of glutamic acid are transferred to pyruvic acid (added or of metabolic origin) with the formation of alanine (and ketoglutaric acid). This is the key to the puzzling fact that glutamic acid is transformed into succinic acid by muscle tissue without the formation of either ammonia or amide nitrogen (D. Moyle-Needham).

Further work, to be published in detail elsewhere, showed this reaction to be a reversible one. From alanine and  $\alpha$ -ketoglutaric acid muscle tissue rapidly forms glutamic and pyruvic acids, equilibrium mixtures of similar composition resulting in both the direct and the reversed reaction.

The presence of the enzyme system responsible for this process of *Umaminierung* can be readily demonstrated not only in muscle, but likewise in other organs (heart, brain, liver, kidney), irrespective of their capacity or inability to metabolize amino-acids by oxidative deamination or reductive amination respectively. In organs containing Krebs's aminodehydrogenase the intermolecular transfer of the amino group competes with oxidative deamination and, owing to its greater velocity, completely inhibits the latter process in the presence of an excess of pyruvic acid. Only with nucleated erythrocytes and malignant tissues no evidence of *Umaminierung* has been obtained up to the present.

$\alpha$ -Ketoacids other than pyruvic, for example,  $\alpha$ -ketobutyric,  $\alpha$ -ketocaproic, oxaloacetic or phenylpyruvic acid, may equally serve as acceptors for the amino group of glutamic acid. On the other hand, all

$\alpha$ -amino acids readily give up their amino groups to  $\alpha$ -ketoglutaric acid in the presence of muscle tissue; the formation of glutamic acid has been demonstrated with sixteen different natural and racemic amino-acids including such as glycine or histidine, known to be difficultly accessible to oxidative deamination by surviving tissues. The rate of *Umaminierung* is astonishingly high; thus, no less than 6.5 mgm. glutamic acid is formed in two minutes from glycine and ketoglutaric acid by one gram of muscle tissue. This would correspond to a value of  $Q_{Umam} = 152$ . In our opinion, the mechanism of this biocatalytic reaction is the same as that discussed by Herbst<sup>2</sup> in recent studies on a somewhat similar model reaction, occurring when amino-acids are heated with ketoacids in aqueous solution.

Aspartic acid behaves in the same way as glutamic acid (Kariagina, this laboratory), and oxaloacetic acid—as ketoglutaric acid, in the function of amino nitrogen donors or acceptors respectively. The 'trapping' of oxaloacetic acid by the acceptance of amino groups, interfering with the action of Szent-Györgyi's "fumarate system", offers an adequate explanation for the inhibitory effect of amino-acids on the respiration of muscle and other non-deaminizing tissues, repeatedly observed by different authors. An attractive hypothesis on the origin of diabetic ketosis was recently put forward by Koranyi and Szent-Györgyi<sup>3</sup>, who consider this condition as a result of damage to the fumarate system, possibly brought about by *Umaminierung* or a similar mechanism.

It deserves special attention that no transfer of the amino group occurs unless either the amino-acid or the ketoacid is a dicarboxylic one. No instance of a direct amino nitrogen transfer between two monocarboxylic acids has yet been observed, but some evidence has been obtained showing that the reaction can be brought about by the catalytic action of dicarboxylic amino- or ketoacids, added in small amounts and functioning as intermediary amino nitrogen carriers. The above data indicate that the dicarboxylic amino- and ketoacids probably play an important and specific part in the intermediary nitrogenous metabolism, bearing some analogy to the catalytic function of the  $C_4$ -dicarboxylic acids in tissue respiration.

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M. G. KRITZMANN.

Laboratory of Oxidation-Reduction Processes,  
Department of Metabolic Research,  
All-Union Institute of Experimental Medicine,  
Moscow. July 25.

<sup>1</sup> *Bull. Biol. et Med. Exper., Moscow*, 3, 230 (1937). *Biochimia*, 2, 242 (1937).

<sup>2</sup> Herbst and Engel, *J. Biol. Chem.*, 107, 505 (1934). Herbst, *J. Amer. Chem. Soc.*, 58, 2239 (1936).

<sup>3</sup> Koranyi und Szent-Györgyi, *Deutsch. Med. Wochenschr.*, No. 27 (1937).

### Meteorites: the Number of Pultusk Stones, and the Spelling of "Widmanstätten Figures"

(1) IN NATURE of July 17, Dr. Stenz<sup>1</sup> expresses the opinion that not more than 3000 stones fell near Pultusk in the famous meteorite shower of January 30, 1868, and that only a curious misreading of a chemical analysis led to the usually quoted number of 100,000 stones.

The Pultusk fall is of special interest, being one of the very few—six or seven—cases in which the orbit of a meteorite could be calculated; according

to the astronomer Galle<sup>2</sup>, for the Pultusk stones a hyperbolic velocity, hence an extrasolar origin, is proved. Furthermore, from the acoustic and optical phenomena of the fall he concluded that the stones were not fragments produced by an "explosion" in the atmosphere, but had already entered the solar system as a shower. The question as to their approximate number is, therefore, of some importance, and it may be permissible to quote a few statements from the literature which seem clearly to contradict Dr. Stenz's drastic reduction of the figure.

The well-known Bonn mineral dealer, Dr. A. Krantz, procured 34 kgm. of the stones<sup>3</sup>. He ascertained that 1 kgm. contained some 210 stones with a perfect crust<sup>4</sup>, this being proof that all the stones he counted had fallen as separate units, although some did not weigh more than a gram. It follows that this one dealer possessed more than 7000 stones, that is, more than twice the number Dr. Stenz ascribes to the whole fall. Altogether 200 kgm. were secured<sup>5</sup>, representing—on the basis of Dr. Krantz's statistics—some 42,000 stones. In the shower the smaller stones were obviously more numerous than one would infer from some collections, for which the bigger ones were preferred; but, for example, Dr. Melion's description of the 125 Pultusk stones in his possession<sup>6</sup>, of a total weight of 1150 gm., shows still the marked preponderance of the small type (86 stones of less than 7 gm.).

Now, considering that in the shower of stones the majority only weighed a few grams—the so-called "Pultusk peas"—and that the fall covered an area<sup>7</sup> of 17 km.  $\times$  6 km. of rough and partially flooded land<sup>8</sup>, the assumption that the total number was two or three times the number of stones recovered is very conservative. Vom Rath<sup>4</sup> even thinks it possible that several hundred thousand stones fell. There is certainly no reason to change the usually quoted round figure of a hundred thousand for the 3000 of Dr. Stenz.

One gram was apparently the smallest mass anyone in the Pultusk area called a "stone" and thought worth picking up, but Galle<sup>2</sup> may be right in assuming in the original shower the presence of "innumerable" smaller particles.

(2) For more than a century the well-known etching-patterns on iron meteorites have been called "Widmanstätten figures", after their discoverer, Alois von Widmanstätten (1754-1849). He, however, personally published nothing on the subject, but left this duty to his friends. Four years ago, Dr. Spencer<sup>9</sup>, in a very thorough survey of meteorite literature, showed that the spelling of the name Widmanstätten was not consistent, the "tt" sometimes being replaced by "dt", the "ä" by "e", and so on, and stated that all the various forms hitherto used are wrong, the correct spelling of the family name being Widmanstetter. Following Dr. Spencer, writers on meteorites in Great Britain and abroad<sup>9</sup> begin to speak of "Widmanstetter figures".

It is certainly no use trying to decide whether "tt" or "dt", "ä" or "e" is the more correct spelling of an Austrian name of a hundred years ago; as these differences are not audible in pronunciation, both ways of writing were then considered as equivalent. The "t" instead of "n" at the end of the name is a somewhat more serious difference. A study of the history of this particular family shows that for decades both forms occurred; but Cohen, who was already aware of this discrepancy, on the authority

of Wurzbach's dictionary<sup>10</sup>, declares in his "Meteoritenkunde"<sup>11</sup> that the discoverer of the etching-figures himself usually wrote "Widmanstätten" and therefore this form ought to be chosen. In view of Dr. Spencer's publication, I asked friends in Vienna and Graz to inquire anew about the form of the name personally used by the scientist. They went rather fully into the question and completely confirmed Wurzbach's and Cohen's statement. Official documents are still preserved which mention Alois von Widmanstätten as the owner of a house in Graz, as the inventor of a balance, etc.

Keepers of meteorite collections may be glad to learn that there is, therefore, no reason to alter the hundreds of labels bearing the name Widmanstätten.

F. A. PANETH.

Imperial College of Science and Technology,  
London, S.W.7.

August 5.

<sup>1</sup> Stenz, E., *NATURE*, **140**, 113 (1937).

<sup>2</sup> Galle, J. G., *Abhandl. d. Schlesischen Gesell. vaterländ. Cultur*, p. 79 (Breslau, 1868).

<sup>3</sup> Wülfing, E. A., "Die Meteoriten in Sammlungen", p. 287 (Tübingen, 1897).

<sup>4</sup> vom Rath, G., "Ueber die Meteoriten von Pultusk im Königreich Polen", *Festschrift Gesell. für Naturkunde*, p. 135 (Bonn, 1868).

<sup>5</sup> "Die Meteoriten des Dr. Jos. Melion", p. 7 (Brünn, 1889).

<sup>6</sup> Brezina, A., "Die Meteoriten vor und nach ihrer Ankunft auf die Erde", p. 22 (Wien, 1893).

<sup>7</sup> "Notice sur la météorite tombée le 30 Janvier 1868 aux environs de la ville de Pultusk, publiée par la Haute Ecole de Varsovie (1868)"; Meunier, St., "Météorites", p. 491 (Paris, 1884).

<sup>8</sup> Spencer, L. J., *Mineral. Mag.*, **23**, 329 (1933).

<sup>9</sup> For example, Heide, F., "Kleine Meteoritenkunde", *passim* (Berlin, 1934).

<sup>10</sup> von Wurzbach, C., "Biograph. Lexikon d. Kaiserthums Österreich", p. 258 (Wien, 1887).

<sup>11</sup> Cohen, E., "Meteoritenkunde", I, p. 40 (Stuttgart, 1894).

### Response of the Pigeon Crop Gland to Prolactin: Inhibition by Œstradiol Monobenzoate

Riddle and Braucher<sup>1</sup> showed that injections of the hypophyseal lactogenic hormone, prolactin, discovered by Stricker and Grueter<sup>2</sup>, will cause growth of the crop glands of the pigeon. In view of the fact that established lactation is inhibited by administration of Œstrogenic hormones<sup>3,4,5</sup>, it is of considerable interest to determine whether or not simultaneous administration of Œstrogens will affect the response of the pigeon crop to prolactin injections.

Two groups of 24 young pigeons of 'homer' type were used. Each bird was given six daily subcutaneous injections of 1 ml. of a solution containing 5 mgm. of prolactin. For the gift of this material, which was prepared by the method of Bates and Riddle<sup>6</sup>, omitting the final purification, we are indebted to Dr. F. G. Young. In addition, on the fifth day before the commencement of the prolactin injections one group was given injections of 1 ml. progynon B oleosum forte (kindly supplied by Dr. H. Neumann of Messrs. Schering, Ltd.) containing the equivalent of 5 mgm. Œstradiol monobenzoate in sesame oil, followed by similar injections on the day of commencement of prolactin treatment. The other (control) group received equivalent injections of sesame oil alone. Twenty-four hours after the last injection the birds were killed and weighed. The sex of each was determined and the crop glands dissected out, fixed in Bouin's fluid and weighed from 70 per cent alcohol after pressing in muslin. The mean weights of the crops in mgm. per 100 gm. of body weight at killing are given in the accompanying table, the results for the two sexes being given separately. The crop gland region in the normal

pigeon usually weighs about 300 mgm. per 100 gm. body weight.

	Male		Female	
	No. of birds	Mean crop weight in mgm. per 100 gm. body weight	No. of birds	Mean crop weight in mgm. per 100 gm. body weight
Œstradiol monobenzoate	9	680 (±67)	15	830 (±50)
Sesame oil	7	1490 (±103)	17	1080 (±47)

The figures given in parentheses are probable errors of the means against which they are entered.

In both sexes administration of Œstradiol monobenzoate caused a marked inhibition of the crop gland response, the mean inhibition amounting to about 54 per cent in the males ( $P = 1 : 2,500$ )\* and about 23 per cent in the females ( $P =$  about 1 : 40).

This difference between the sexes in the degree of inhibition (sex-difference statistically significant at  $P = 1 : 140$ ) is for the most part accounted for by the fact that in this experiment the reaction of the control birds to prolactin + sesame oil was significantly greater in males than in females ( $P = 1 : 180$ ), while in the group receiving Œstradiol monobenzoate the difference between the responses of the two sexes was negligible.

It is noteworthy that the group receiving Œstradiol monobenzoate lost on the average 7.7 per cent of body weight in the course of the experiment ( $P = 1 : 90$ ), although the control group gained on the average 6.7 per cent ( $P = 1 : 210$ ). In both groups the mean change in body weight was somewhat greater in the females than in the males.

Since the prolactin response of hypophysectomized pigeons appears to be either nil<sup>7</sup> or considerably less than that of intact birds<sup>8</sup> it is possible that Œstradiol monobenzoate inhibits the response by way of the pituitary.

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Aug. 3.

\*  $P =$  Probability that an effect at least as great as the observed effect should have arisen purely as an accident of random sampling. See Fisher, R. A., "Statistical Methods for Research Workers" (1934), Edinburgh and London, chap. v. *passim*.

<sup>1</sup> Riddle, O., and Braucher, P. F., *Amer. J. Physiol.*, **97**, 617 (1931).

<sup>2</sup> Stricker, P., and Grueter, F., *C.R. Soc. Biol. Paris*, **99**, 1978 (1928).

<sup>3</sup> Jongh, S. E. de, *Acta brev. neerl. Physiol.*, **3**, 52 (1933).

<sup>4</sup> Robson, J. M., *Quart. J. Exp. Physiol.*, **24**, 337 (1935).

<sup>5</sup> Folley, S. J., *Biochem. J.*, **30**, 2262 (1936).

<sup>6</sup> Bates, R. W., and Riddle, O., *J. Pharm. and Exp. Therap.*, **55**, 365 (1935).

<sup>7</sup> Gomez, E. T., and Turner, C. W., *Proc. Soc. Exp. Biol. N.Y.*, **35**, 59 (1936).

<sup>8</sup> Schooley, J. P., Riddle, O., and Bates, R. W., *Proc. Soc. Exp. Biol. N.Y.*, **36**, 408 (1937).

### Some Interrelations between Bivalve Spatfalls, Hydrography and Fisheries

In a study of the intensity and distribution of spatfalls of *Cardium edule* on the Cork sands in Morecambe Bay, it was found that the heaviest falls occur (a) where tidal streams meet—such localities being described locally as 'meetings'—and (b) where banks shelter a stretch of ground from prevailing winds. The heaviest falls occur at about the half-tide level.

The fall of spat is contemporaneous with considerable depositions of fine sand intermingled with some

detritus, and larvæ and post-larvæ of various other organisms such as *Polydora*, *Macoma*, other bivalves and worms. Such settlements form a densely populated mud or slutch. The same phenomenon occurs in the Dee estuary. In winter the slutch disappears.

It is clear that the *Cardium* and other organisms become concentrated and precipitate out of the plankton in localities where slack and eddy waters occur. As many as 100,000 young *Cardium* per square metre may occur in the centre of such areas<sup>1</sup>, with diminishing concentrations towards the periphery of the meetings and low values outside them.

Recognition of these conditions at once suggested comparison with those found by Davies<sup>2</sup> on and near the Dogger Bank. Here concentrations of the fish-food, *Spisula truncata*, up to 8,250 per square metre occurred in the centre of elongated or ovoid areas, with diminishing numbers to the periphery in each case. This distribution resembles that of *Cardium* and other organisms in Morecambe Bay, and it was suspected might be brought about in a similar way, namely, by the concentration of the planktonic forms in eddying waters over and around the Dogger Bank. Recently Tait<sup>3</sup>, in investigating the surface drift of water in the North Sea, finds stream currents giving rise to eddies or swirls in several localities, including one on the north-east of the Dogger Bank. This eddy practically overlies the part of the Dogger Bank where Davies found the great spatfalls of *Spisula*.

There can be little doubt that immense quantities of larval fish foods in the form of bivalves and worms become concentrated in these swirls or eddies. Where sub-surface conditions are suitable as over the Dogger Bank, in the Moray Firth, in the mid-east Scottish coast and other areas, the larvæ settle out of the plankton to form rich feeding grounds for fish. We have therefore now a rational explanation of how such grounds are formed, and a clear indication of where to find them. On natural oyster beds oyster larvæ also tend to settle most frequently (*a*) where eddies form, as at the junction of a side stream with the main one, as well as in eddies formed along the shores of the main channel, and (*b*) in other regions of relatively still water<sup>4</sup>.

In the recent planktonic studies in the south-western North Sea by Savage and Hardy<sup>5</sup> and Savage and Wimpenny<sup>6</sup>, only the area of the drift west and south-west of the Dogger Bank was investigated, and it is a reasonably safe prediction that an immensely rich planktonic area remains to be discovered in the eddy over the north-eastern region of the Dogger Bank. This eddy is not stationary, so that spatfalls may settle out in different but adjacent places, as is apparent from Davies's justifiably painstaking research. These spatfalls indicate, moreover, that the eddy over the Dogger Bank may extend sometimes from the surface into deeper water—probably during certain sets of tides when bivalve larvæ are ready to settle—or may enclose a body of relatively still water at all depths.

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August 14.

<sup>1</sup> Orton, J. H., "James Johnstone Memorial Volume" (1934).

<sup>2</sup> Davies, F. M., *Fish Invest., Min. Agric. and Fish.*, II, 6, 2 (London, 1923).

<sup>3</sup> Tait, J. B., *Fish. Scotland, Sci. Invest.*, No. 1 (1937).

<sup>4</sup> Orton, J. H., "Oyster Biology and Oyster Culture", p. 135 (1937).

<sup>5</sup> Savage, R. E., and Hardy, A. C., *Fish Invest., Min. Agric. and Fish.*, II, 14, 2 (1934).

<sup>6</sup> Savage R. E., and Wimpenny, R. S., *Fish Invest., Min. Agric. and Fish.*, II, 15, 1 (1936).

### Consumption of Oxygen in Sea Water under Controlled Laboratory Conditions\*

DURING a recent hydrographical cruise of the *Atlantis*, the oxygen consumption in samples of water taken from eighteen levels between surface and 4,600 metres depth at Station 2886 (32° 19' N., 65° 59' W.; June 19, 1937) was determined under controlled laboratory conditions. Two glass bottles (with ground-glass stoppers) were filled from each of the Nansen water bottles as soon as they were brought on deck; one set of eighteen samples was stored at a temperature of 11° in an electric refrigerator and the other set at a temperature of 24° in the laboratory. After ten days of storage in darkness, oxygen contents of the two sets of samples were determined and subtractions of these values from initial oxygen contents of the samples gave results we have termed oxygen consumption.

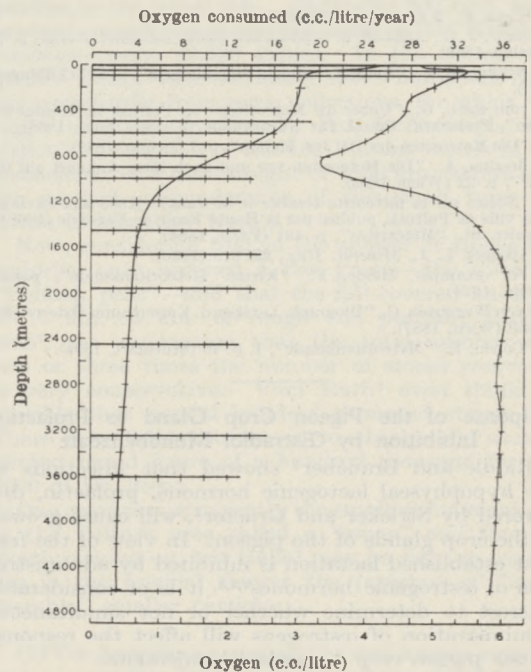


Fig. 1.

OXYGEN CONSUMPTION IN C.C. PER LITRE PER YEAR (OBTAINED BY MULTIPLYING MEAN DAILY VALUES BY 365) FOR VARIOUS DEPTHS SHOWN BY HORIZONTAL LINES REFERRED TO TOP SCALE; VERTICAL DISTRIBUTION OF OXYGEN, RIGHT CURVE REFERRED TO BOTTOM SCALE; VERTICAL DISTRIBUTION OF TEMPERATURE, LEFT CURVE, REFERRED TO TOP SCALE. DATA FROM *Atlantis* STATION 2886

The oxygen consumption at 24° ranged from 0.058 to 0.165 c.c. per litre per day, and at 11° it ranged 0.020 to 0.069 c.c. per litre per day; higher values characterized water from levels below 1000 metres depth. The average oxygen consumption of all eighteen samples incubated at 24° was 0.1224 c.c. per litre per day, and for those at 11° it was 0.0487 c.c. per litre per day.

In an attempt to estimate what the oxygen consumption would have been if the samples of water had been incubated at their respective observed temperatures *in situ* (Fig. 1), it was assumed that the

\* Contribution No. 151 from the Woods Hole Oceanographic Institution.

variation in oxygen consumption with temperature (between 25° and 2°) was of the form :

$$(1) \quad \ln k = c - \frac{A}{T};$$

which equation after being differentiated and then integrated between the limits  $k_1$ ,  $T_1$ , and  $k_2$ ,  $T_2$  results in a form of the Arrhenius equation :

$$(2) \quad \ln \frac{k_1}{k_2} = \frac{Q}{R} \left( \frac{1}{T_2} - \frac{1}{T_1} \right),$$

which frequently represents in a satisfactory manner the effect of temperature on biological reactions over limited temperature ranges.

Upon determination of the constant  $Q$  ( $R$  is the gas constant) from the average consumption values at 24° and 11°, each of the 18 pairs of values obtained at these temperatures were reduced by means of the Arrhenius equation to values corresponding to observed temperatures (range 25°-2°) at the depths from which the samples were taken, and the means of each pair of values (after multiplying by 365) are plotted against depth in Fig. 1. It is realized that this method of extrapolation may not hold for this particular phenomenon over the entire temperature range of 25° to 2°, but it does furnish an approximation.

The results (Fig. 1) after reduction are too high, particularly in the deeper levels, to be used in estimating oxygen consumption *in situ* in the water column itself. For example, at Station 2886, water from the minimum oxygen layer (less than 60 per cent saturated, occurring approximately between depths of 700 and 1000 metres) had an average daily adjusted oxygen consumption of 0.0363 c.c. per litre, which is about 32 times greater than the value of 0.42 c.c. per litre per year previously estimated for this layer; and water from between 1000 and 2000 metres had an adjusted daily consumption in the laboratory of 0.0385 c.c. per litre, which is more than 100 times greater than the more reasonable previously estimated value of 0.103 c.c. per litre per year for this part of the water column.

Thus, it appears that conditions in the sea, other than temperature, restrict the rate of oxygen consumption, and the above results are of interest since they indicate the potential rates of oxygen consumption throughout a water column of the sea when its equilibrium is disturbed by laboratory conditions.

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#### Role of Heteroauxones in Legume Nodule Formation, Beneficial Host Effects of Nodules, and Soil Fertility

FOLLOWING identification of  $\beta$ -indolacetic acid<sup>1</sup> as a constituent of ether extracts of cultures of *Rhizobium phaseoli* in dextrose-bacto-tryptophane and in dextrose-bacto-tryptophane-peptone broths, these crude extracts were tested for auxones by applications to coleoptiles of *Avena*, and to hypocotyls and internodes of *Phaseolus vulgaris*, var. Red Kidney. The tests were strongly positive. Thus far we have been unable to determine whether  $\beta$ -indolacetic acid is the only heteroauxone in the preparations because of the scarcity of material.

Further, extraction of nodules of spontaneously infected Red Kidney bean plants first with acidulated 95 per cent alcohol (in which the nodules were ground

with pumice) and then with peroxide-free ether has yielded preparations which feebly affect growth of coleoptiles of *Avena* and of hypocotyls and internodes of the Red Kidney bean. Thimann's<sup>2</sup> method of extraction with acidulated chloroform probably will reveal a higher auxone content. Possibly the lot of nodules extracted was too old on the average to give a maximum auxone yield and possibly the sample used (50 gm.) was too small. Work is under way with larger and younger samples and with other methods of extraction. Tests with ferric chloride, hydrochloric acid and amyl alcohol indicate  $\beta$ -indolacetic acid as a nodular constituent. Unfortunately, the test is made with difficulty and uncertainty because of the dark colour of the crude extracts. Until more material and better tests are available, it will be impossible to identify  $\beta$ -indolacetic acid more positively or to determine whether the extracts contain growth substances other than  $\beta$ -indolacetic acid.

In conjunction with our findings<sup>1</sup> that pure  $\beta$ -indolacetic acid, applied in different concentrations and amounts in lanolin paste to primary roots of Red Kidney bean induces: (1) positive bending; (2) coiling; (3) retardation or suppression of root elongation; (4) premature and excessive lateral root initiation; (5) local diameter increase and nodulation, and with Thimann's<sup>3</sup> findings that pea nodules are hyperauxonic in relation to normal healthy pea roots and that  $\beta$ -indolacetic incites nodulation in roots of *Pisum sativum*, our new findings indicate that  $\beta$ -indolacetic acid is one of the chemical agents, if not the agent, responsible for incitation of nodulation in susceptible hosts by *Rhizobium phaseoli* and other nodule-forming organisms.

The relative yields of total crude extracts from equal weights of nodules and of healthy roots as well as the greater growth-affecting capacity of the former, indicate hyperauxony for the nodules. These observations, together with Thimann's<sup>3</sup> report that nodules of pea have a greater auxone content than non-infected root tips of the pea, seem to support the hypothesis<sup>1</sup> that tumours (including callus and galls) are brought about by local hyperauxony. This may be due to autoauxones, to heteroauxones, or to both added to the normal autoauxone content.

Coupled with our earlier findings<sup>1</sup> that  $\beta$ -indolacetic acid applied experimentally to the bean may augment or be in part a substitute for its autoauxones, the results reported here suggested the hypothesis that the beneficial effects of suitable concentrations of  $\beta$ -indolacetic acid and other auxones acting as heteroauxones may account in part for the characteristically beneficial effects of: (1) nodules for some host plants; (2) green manuring with nodule-bearing plants; (3) fertilizing with manures rich in dung and urine, or with compost; (4) humus soils; and (5) mycorrhizal fungi for some host plants.

This research was supported in part by a grant from the Rockefeller Foundation to the University of Chicago. Miss Virginia Eggers executed the growth tests. Prof. F. C. Koch kindly permitted use of space and equipment of his biochemical laboratory for execution of the extractions.

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July 29.

<sup>1</sup> Link, G. K. K., Wilcox, H. W., and Link, A. DeS., *Bot. Gaz.*, 98, 816-867 (1937).

<sup>2</sup> Thimann, K. V., *J. Gen. Physiol.*, 18, 23-34 (1934).

<sup>3</sup> Thimann, K. V., *Proc. Nat. Acad. Sci.*, 22, 511-514 (1936).

## Structure of a New System of CO Bands

In a previous note<sup>1</sup> the discovery of a new system of red-degraded CO bands, placed just before the heads of the violet-degraded Third Positive system, was reported. Inspection and measurement of high-dispersion spectrograms now show that the new bands have a structure appropriate to a  $^3\Sigma \rightarrow ^3\Pi$  band-system, the lower state being the  $a^3\Pi$  state, which is the usual final state of the CO triplet systems. The upper  $^3\Sigma$  levels of the new bands lie about  $83705 \text{ cm.}^{-1}$  and  $85885 \text{ cm.}^{-1}$  above the CO ground state; they have observable spin-splittings and rotational constants  $B' = 0.7$  to  $0.8 \text{ cm.}^{-1}$ . The system may tentatively be designated as  $f^3\Sigma \rightarrow a^3\Pi$ . It may be considered, however, as probably due to transitions from the higher vibrational levels of  $a^3\Sigma$  to the lower vibrational levels of  $a^3\Pi$ . For, within the heights of the initial levels  $f^3\Sigma$  of the new bands occur also the initial levels  $b^3\Sigma$  of the Third Positive bands, and the latter are strongly perturbed, as has already been established<sup>2</sup>, by vibrational levels of the  $a^3\Sigma$  state, for which we have predicted term values and rotational constants of the magnitude now observed for the new bands.

Rotational analysis and details will be published shortly elsewhere.

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<sup>1</sup> Schmid, R., and Gerö, L., *Naturwiss.*, **25**, 90 (1937).

<sup>2</sup> Schmid, R., and Gerö, L., *Z. Phys.*, **105**, 36 (1937) **106**, 205 (1937).

## L-Emission Bands of Zinc, Copper, Nickel and Cobalt

I HAVE studied the intensity of the L-emission bands of metals from Co (27) to Zn (30). The apparatus used was a vacuum spectrograph using a bent crystal of mica, and the source of the radiation was an X-ray tube.

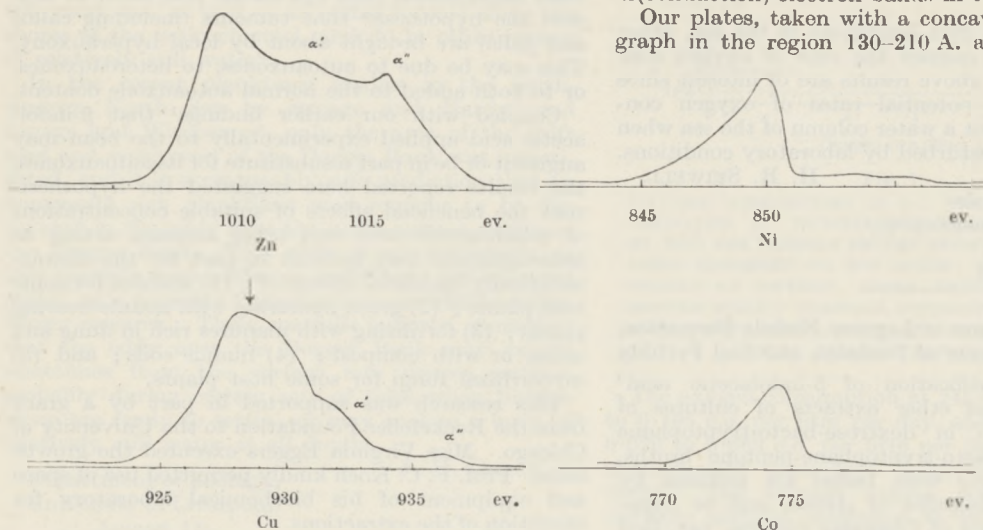


Fig. 1

To obtain the actual intensity distribution of the emitted radiation, the plate was calibrated by a method already described<sup>1</sup>. The curves giving the intensity of the  $L_a$  bands against energy (in electronvolts) are shown in Fig. 1.

It is well known that the L-emission bands are emitted when  $M_{IV, V}$ -electrons make transitions into the  $L_{II, III}$ -levels ( $L_{\alpha_{1,2}}$  and  $L_{\beta_1}$ ). There are also transitions of  $N_I$ -electrons into the  $L_{II, III}$ -levels. For these metals the  $N_I$ - or  $4s$ -electrons are the conduction electrons, and occupy levels which overlap in energy those of the  $M_{IV, V}$ - or  $3d$ -electrons.<sup>2</sup> Thus the observed bands represent transitions of both  $3d$ - and  $4s$ -electrons. But for copper and zinc, unfortunately, the short wave-length ends of the bands, which are probably due to the  $4s$ -electrons, are completely masked by satellites, which are strongly enhanced by the reorganization of the atom on account of the Auger effect<sup>3</sup>,  $L_I-L_{III}$ .

The position of the short wave-length edge of the  $L_a$ -bands may be estimated from the L-absorption spectra, and is given by the wave-length of the slope of the absorption curve near the minimum absorption. For copper, we can deduce from the absorption curve of Sandström<sup>4</sup> that the edge of the  $L_a$ -emission band is given by the arrow marked on Fig. 1. From the comparison of the L-emission and absorption bands it is obvious that the width of the  $L_a$ -band is about 5 ev.

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<sup>1</sup> *Comptes rendus*, **204**, 1242.

<sup>2</sup> See Mott and Jones, "The Theory of the Properties of Metals and Alloys" (Oxford, 1936), p. 191.

<sup>3</sup> See Coster and Kronig, *Physica*, **2**, 13 (1935).

<sup>4</sup> Sandström, A., Thesis, Uppsala (1935).

## M-Emission Bands of Zinc, Copper and Nickel

WE have had the opportunity of seeing Dr. Farineau's letter before it was sent to press. We have recently observed the M-emission bands of nickel, copper and zinc metals, and it seems worth while to add a note, since the two sets of results, especially taken together, allow one to draw certain conclusions about the structure of the  $3d$ - and  $4s$ (conduction)-electron bands in these metals.

Our plates, taken with a concave grating spectrograph in the region 130–210 Å. and with an X-ray tube run at 3,000 v. as source, give results which, on a scale of energy, are almost identical with Farineau's L-emission bands. This is good evidence that, apart from transition probability factors, the curves represent features of the density-functions of the combined  $3d$ -conduction-levels of the

metals. We also obtain for zinc and copper the peaks marked  $\alpha'$  and  $\alpha''$  by him. But, contrary to his conclusion, when we compare the wave-lengths of points on the M-emission bands with the wave-lengths of the M-absorption edges which we have determined<sup>1</sup>, we

arrive at the definite result that for both copper and zinc the peaks marked  $\alpha'$  are part of the main emission band, only the  $\alpha''$  peaks being satellites. Also it would, in the present case, be difficult to understand how the Auger mechanism could account for more than one satellite. A wave-length error, either in the  $L$ -absorption or the  $L$ -emission band of copper, seems the most likely explanation of the discrepancy.

If the  $\alpha'$  peaks are to be included in the main bands, the shapes of the  $L$ - (or  $M$ -) emission bands, free from satellites, can be fairly accurately gauged from Farineau's Fig. 1, except in the case of zinc. Two points of interest stand out. (1) The curves show the shifting of the main peak (certainly due to  $3d$ -electrons, which form a shell, incomplete for cobalt and nickel but complete for copper and zinc) towards the low energy end of the band as we pass from nickel to zinc. It is true that the resolving power of the method is not very good, being limited by the Auger broadening of the excited state. The unsharpness of the high-energy edge of the main bands gives a measure of this broadening. (2) The total breadths of the bands obviously represent the energy-spread

of the conduction ( $4s$ ) electrons. For copper, it may be taken as  $8\frac{1}{2}$  volts, including the  $\alpha'$  peak, but correcting for the unsharpness of the edge. It is found that this is only a little greater than the breadth of 7 volts calculated, assuming one conduction electron per atom, on the elementary Sommerfeld theory (this correspondence is fairly general<sup>2</sup>.)

Now nickel and copper have the same crystal structure and almost the same lattice constant. So, from the present point of view, they differ only in the number  $N$  of conduction electrons per atom. Since the band-width is proportional to  $N^{2/3}$ , the energy-spread (6 volts) for the nickel band allows us to determine  $N$  for nickel as 0.59. This agrees excellently with the value postulated to explain the magnetic properties<sup>3</sup>.

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University, Bristol.

Aug. 18.

<sup>1</sup> Skinner and Johnston, *Proc. Roy. Soc., A*, **16**, 420 (1937).

<sup>2</sup> See O'Bryan and Skinner, *Phys. Rev.*, **45**, 370 (1934).

<sup>3</sup> See Mott and Jones, "The Theory of the Properties of Metals and Alloys", chap. vi.

### Points from Foregoing Letters

An account of the Kyoto University expedition to Peru to observe the total solar eclipse of June 8, 1937, is given by Prof. Issei Yamamoto, who states that excellent photographs showing the structure of the inner corona were obtained by means of a ten-metre camera.

A graph showing that the resistance of zinc-blende, after excitation by blue light and 'quenching' by heat or infra-red light, decreases linearly with time is submitted by Dr. A. L. Reimann. The author infers that the electrons experience increasing difficulty in finding 'positive holes' to combine with as quenching proceeds. The linear rate of decay of the phosphorescence of zinc-blende, the author states, also agrees with this view. An outline of a mechanism of conduction is sketched, which seems necessarily to follow from the decay data, together with the results of early work on other photo-conductivity phenomena by Gudden and Pohl.

Drs. F. G. Mann and A. F. Wells show that aliphatic trialkyl phosphines and arsines unite with cuprous and argentous iodides to give fourfold molecules,  $[R_3P(As) \rightarrow CuI]_4$  and  $[R_3P(As) \rightarrow AgI]_4$ , the structure of which has been determined in detail. Aurous halides give, however, the simple compounds of type  $[R_3P(As) \rightarrow AuX]$ , the phosphine members of which can be distilled without decomposition.

Prof. K. C. Bailey states that a gas flame 5-6 inches high can be extinguished by a jet of coal gas from a cylinder, without the jet being ignited. He infers that coal gas from a cylinder, bursting during a fire, may extinguish the fire locally, and thus make an opportunity of mingling with the air, and forming an explosive mixture, possibly with disastrous results.

Further work by Prof. A. E. Braunstein and M. G. Kritzmann on the transference of an amino group and two hydrogens from glutamic to pyruvic acid (with the formation of alanine and ketoglutaric acid), shows that the reaction is a reversible one. The enzyme responsible for the process occurs in various organs (muscle, brain, liver, etc.). The exchange of

amino group and hydrogen atoms takes place between other similar molecular couples, provided either the amino- or the ketoacid has two carboxylic groups.

Prof. F. A. Paneth brings evidence to prove that the number of stones, of one gram weight and heavier, in the Pultusk meteorite shower was of the order of 100,000. He also discusses the correct spelling of "Widmanstätten figures" (etching-patterns on iron meteorites).

It has been found that prolactin, a hormone stimulating milk production, will cause growth of the crop glands of the pigeon. Drs. S. J. Folley and P. White now find that if the pigeons are previously given injections of one of the female sex hormones, oestradiol monobenzoate, a marked inhibition of the crop gland response to prolactin is observed.

Prof. J. H. Orton states that the spatfall of the cockle is observed in localities where slack and eddy waters occur, that is, where tidal streams meet or where banks shelter a stretch of ground from prevailing winds. As many as 100,000 young cockles per square metre may occur in the centre of such areas.

The consumption of oxygen in sea water (that is, the amount of oxygen disappearing after ten days from samples of sea water obtained from various depths and kept under controlled laboratory conditions) has been determined by H. R. Seiwel. It appears that conditions in the sea, other than temperature, restrict the rate of oxygen consumption as found in the laboratory, since some of the results obtained, particularly for the deeper levels, are much too high as compared with previous estimates.

Prof. George K. K. Link reports that *Rhizobium phaseoli*, the bacterial incitant of nodulation of bean roots, produces the heteroauxone  $\beta$ -indolacetic acid when grown in pure culture in tryptophane-containing broths. He finds also that nodule extracts contain  $\beta$ -indolacetic acid, which may account for nodule production and for the beneficial effects of green manuring with nodule-bearing plants, and of humus soils, manures and mycorrhizal fungi.

## Research Items

### Canoes of Oceania

DR. A. C. HADDON and MR. JAMES HORNELL have made a detailed study of the canoes of Oceania, of which the first volume by Mr. James Hornell, dealing with the canoes of Polynesia, Fiji and Micronesia (Bernice P. Bishop Museum, Honolulu, *Special Publications* 27) is based in part on personal investigations in certain of the islands in 1924-25, in part on an exhaustive and critical examination of references in early travel literature with its illustrations, as well as of the models which are preserved in museums. References in early literature are usually inadequate, while the illustrations and the models are often inaccurate. Problems of distribution and dispersal will be considered by Dr. Haddon in a third volume. From the present collection of facts certain general conclusions as to population movements in Polynesia emerge. Two classes of vessel have to be taken into account, the outrigger and the double canoe. In outrigger canoes, in addition to rig and form of hull, the number of outrigger booms and the method of attachment to the float must be considered; in the double canoe the form and relative proportion of the hulls. The fundamental canoe types are reducible to three: (1) Proto-Polynesian, in which the hull has pointed ends, inclined upwards, but little emphasized, is strengthened by inserted ribs, and the canoe is rigged with a primitive sprit-sail; (2) Melanesoid-Polynesian, with head low and stern curved up high, profusely ornamented with carving, the sail a primitive sprit-sail, triangular or sub-triangular; (3) Tangaroan, plank-built hull with ribs tied to ridges, the planks sewn together through holes, rigged with a primitive lateen sail. This third type was probably introduced by an Indonesian people who worshipped Tangaroa. From the evidence of the canoes it may be argued that the Proto-Polynesians reached Polynesia direct from Indonesia by way of Micronesia; and not after coasting along the shores of the Melanesian Islands as is held in the generally accepted view.

### Fishes of Paraguay

A REMARKABLE similarity exists between the fish fauna of the La Plata and that of the Amazon basin, and two explanations have been offered: that the two faunas represent the same initial stock, which by migration over the marshy uplands between the Tapajos and the Paraguay or across the low divide between the latter and the Guaporé peopled the two river basins; or that the two faunas illustrate the parallel evolution of two distinct stocks. A contribution to a solution of the problem is made by Prof. Nathan E. Pearson, who has listed the fishes of the Paraguayan basins, and considers that it is unnecessary to assume parallel evolution to explain their Amazonian resemblances (*Pub. Calif. Acad. Sci.*, 23, 99; 1937). Migration is a sufficient explanation. The fishes entered South America some time during the Tertiary Period and crossed the low Amazon valley and a highland divide to enter Paraguay. The Rio Guaporé and other tributaries of the Amazon seem to have

afforded the migratory paths. At the present time, the possibility of such migration has been cut off, since the fall in the volume of the streams flowing from the highlands of Matto has given rise to an effective barrier, but the nature of the fishes on the two slopes of that barrier indicate that it is of recent origin.

### Life-History of *Apophallus venustus*

FOLLOWING a previous account of its morphology and taxonomy, T. W. M. Cameron has published an account of the life-history and bionomics of the trematode, *Apophallus venustus* (*Canadian J. Res.*, 15, No. 2; 1937). This trematode is endemic in the Lower Ottawa Valley, and has been found in cats, dogs and racoons. It has also been found in the great blue heron, though not in several other species of fish-eating birds examined. The first host is an operculate snail, and the only species discovered naturally infected was *Goniobasis livescens*, in which the percentage of infection may reach 31.6. The metacercaria stage lives in the second host, a fish, and eleven out of twelve species of freshwater fish when eaten by cats under controlled conditions were found to be capable of carrying infection. The metacercariae are present in the subcutaneous tissue or the muscles. The adult in the cat lives principally in the ileum, and in the laboratory all infected cats lost their infection during the winter, so that the reservoir would appear to be the fish.

### Lac in Malaya

ATTEMPTS to cultivate the lac insect (*Laccifer lacca*) outside India have been made from time to time. The most recent effort has been tried out in Malaya and an account of the experiment is given by Mr. N. C. E. Miller in Scientific Series No. 19 (1937) of the Department of Agriculture, Straits Settlements and Federated Malay States. Consignments of brood lac for the work were obtained from the Lac Research Institute, Nankum, India, in which country the insect has been propagated for several hundred years. It may be added that about 25,000 tons of shellac products are exported annually from India to all parts of the world. The consignments received in Malaya were used to inoculate rain trees (*Enterolobium saman*), *Cajanus indicus*, *Zizyphus jujuba* and plantation rubber trees. The outcome of the experiments was disappointing. It was decided that the climatic conditions in Malaya, especially the high degree of humidity, and other circumstances are wholly unsuitable. The very young insects, or swarming larvæ, showed a prominent tendency to colonize the host trees towards or on the main stems and to neglect the young growing shoots. Owing to this erratic behaviour and the rapid suberization of the branches, they failed to survive. Another contributing cause of the failure was the prevalence of a chalcid parasite of destructive propensities. These causes, and the inroads made by synthetic substitutes for resins, are stated to have led to the abandonment of any further trials.



### Endosperm and Embryo in Reciprocal Cereal Crosses

In reciprocal crosses of plants with different chromosome multiples, the more successful cross is usually the one in which the high chromosome number comes from the female parent. Messrs. J. W. Boyes and W. P. Thompson (*J. Genet.*, 34, No. 2) discuss this subject in relation to cereals, recording a series of observations on embryo and endosperm development in reciprocal hybrids between *Triticum vulgare* and *T. durum*, *T. vulgare* and *T. dicoccum*, *T. spelta* and *T. monococcum*, as well as back-crosses and crosses between wheat and rye. Chinese wheat, unlike other varieties, can be readily crossed with rye pollen. In the crosses low-chromosome female  $\times$  high-chromosome male, although there is a higher rate of endosperm growth, abnormalities in the endosperm are frequent. These include nuclei of unusual sizes, abnormal structure and irregular shapes, weakly staining cytoplasm and persistent non-cellular regions. The reciprocal crosses do not show these abnormalities, except in the widest crosses. The embryo, on the contrary, is healthy in development in all except the widest crosses, and the reciprocals show very little difference. In rye (7 chromosomes)  $\times$  wheat (21), fertilization rarely occurs although the pollen germinates well on the rye stigma. In the back-crosses  $F_1$  female  $\times$  *vulgare* male, the endosperm varies widely from normal to conspicuously abnormal. This is attributed to a variable amount of chromosome unbalance, which is believed to be one of the causes of the differences in the endosperm of reciprocal crosses.

### Diseases of Ornamental Plants

THE *Gardeners' Chronicle* of July 10 announces the appearance of two fungus diseases upon ornamental plants. Mr. D. E. Green directs attention to a downy mildew of snapdragons caused by *Peronospora Antirrhini*. The disease has been known in southern Ireland, and has now appeared in England. It checks the growth of young shoots, has a tendency to curl the leaves downwards, and often causes the plant to send out many small shoots from the base. Messrs. A. Beaumont and P. H. Gregory describe a leaf-spot disease of *Gerbera Jamesoni*, a plant which can be grown outside for market in Devon and Cornwall. The fungus *Ascochyta Geberae* attacks the leaves, and produces brown spots with margins of purple. Pycnidia of the fungus are embedded within the tissue of the spots. The disease appeared in Italy in 1913, and has not since been described until its occurrence in Cornwall in 1936.

### Protective Spray Deposits

THE efficiency of protective insecticides and fungicides depends largely on the amount of spray material which remains on the foliage immediately after spraying, and the degree to which this resists the various agencies which tend to remove it. Fajans and Martin (*J. Pom. and Hort. Sci.*, 15, 1, 1-24; 1937) denote these two properties by the terms 'initial retention' and 'tenacity' respectively. They describe laboratory experiments from which are evaluated the effects of a number of spray supplements, particularly wetting agents, on initial retention and tenacity, the supplements being added to spray materials used in the form of suspensions. In the majority of the systems examined, the initial retention of a suspension was found to be the same as that of the aqueous phase,

but in some cases the latter was reduced by the presence of the solid particles. This reduction seems to be related to an effect on the wetting and spreading properties of the spray, but is not independent of the nature of the surface sprayed. The tenacity of the spray deposit is dependent upon the characters of the spray supplement, the solid particles and the surface sprayed. It is comparatively higher on surfaces wetted with difficulty and is enhanced by oils, both hydrocarbon and glyceride. Highly surface-active supplements, especially at high concentrations, reduce tenacity, whilst those like gelatine and lime casein, which yield residues insoluble in cold water, have a favourable effect. These conclusions were tested in the field by treating a crop of potatoes against blight (*Phytophthora infestans*) with cuprous oxide sprays to which ten different spray supplements were added. A high degree of correlation was obtained between the amounts of spray residue and the control of blight.

### Meteorology of American Floods

THE unprecedented floods on the Ohio and lower Mississippi Rivers last winter, coming so soon after the exceptional floods of March-April 1936 in the middle and north Atlantic States, have led C. F. Brooks and A. H. Tiessen to a study of the meteorology of such floods. An account of their work has appeared under the heading "The Meteorology of Great Floods in the Eastern United States" (*Geographical Rev.*, 27, No. 2, April 1937) and has recently been reprinted as a separate paper. The flood of 1937, with its monetary loss of at least six hundred million dollars, is, according to these writers, the greatest American flood on record. They find that two meteorological features are common to all great floods such as those of 1882, 1889, 1903, 1913, 1922 and 1927, and those of the last two years, namely, "a rapid and continuing flow of moist tropical air into the country and a frequent and persistent elevation of this tropical current by a colder air mass over the same region". This arises from a persistent anticyclone over the western part of the North Atlantic and another over the central or northern interior of the United States, or a little farther to the west. The one drives tropical air northwards, the other polar air southwards, and ascent of the warm air is continuous and sometimes violent along the front between the two. The importance of the weather before the heavy rains that are the immediate cause of the flood is pointed out; a rapid run-off is favoured both by wet weather which saturates the ground and by severe frost that makes it impermeable; on the other hand, dense vegetation and a dry soil or a deep cover of snow over unfrozen ground may entirely absorb five inches or more of rainfall. The fact that great floods are confined to the winter and spring is to be attributed to the vegetation that protects the summer and autumn by hindering run-off and rapidly using ground water.

### Young's Modulus Apparatus

THE August issue of the *Journal of Scientific Instruments* contains a description of an interferometer apparatus for the accurate determination of Young's modulus over a wide range of temperature, devised by Mr. J. W. Cuthbertson of the University of Manchester. A bar of the material about 9 cm.  $\times$  0.6 cm.  $\times$  0.3 cm. is supported symmetrically on parallel horizontal knife edges about 4 cm. apart; the

load is applied by needle points, near the ends of the bar, which support a bar to whose centre the load is applied by weights or by a lever. The rise of the centre of the test bar is transmitted by an invar wire to a tripod the other two legs of which are supported by hole and groove in a fixed plate. The tripod carries the lower plate of an interferometer the upper plate of which is fixed. The interference bands in reflected light are observed in a microscope and the number which pass a fixed line, as either load or temperature is gradually changed, is counted to get the rise of the centre of the bar. The bar and its supports are suspended in an oil bath by rods of invar bolted to horizontal iron beams which carry the interference apparatus. A few typical results are given.

#### Detection of Destructive Larvæ in Timber

IN the National Physical Laboratory Report for 1936 (London: H.M. Stationery Office. 2s. 6d.) Dr. R. L. Smith-Rose, the head of the radio department, describes an acoustic-electrical equipment for detecting destructive larvæ in timber. At the request of the Forest Products Research Laboratory, he explored the possibilities of applying microphone and amplifier technique to the detection of larvæ in specimens of timber. The first experiments showed that there was little likelihood of the successful application of a method of this kind to the detection of larvæ in buildings or growing timber, owing to the faintness of the sounds concerned relatively to the associated background noises. Further experiments carried out when the specimens were housed in a sound-proof container were promising. A suitable equipment was designed and constructed. The specimen of timber to be examined was placed in a sound-proof container with a suitable control specimen and a microphone was laid on each. When the specimen contained larvæ, the noises made by these could in general be readily distinguished from the more uniform background noise of the amplifier itself. In some instances different larvæ could be distinguished by the differences in the sounds they made. A description of the equipment used has been prepared for publication.

#### Reflection of Radio Waves in the Atmosphere

THE well-established reflection of radio waves in the upper atmosphere takes place at apparent heights of 100-200 km. and it is generally believed that the damping effect of atomic collisions on ionic motion prevents reflection from ionized layers much lower than this. R. A. Watson-Watt, A. F. Wilkins and E. G. Bowen (*Proc. Roy. Soc., A.*, **161**, 181) have now observed reflection from much lower levels. They used the pulse technique, refined so that a very short pulse was transmitted upwards and echoes of very short delay could be observed on a cathode ray tube. Continuous records and 'snap' observations were both used. The observers were able to detect a series of reflections which they interpret as arising from a few layers at height about 10 km., possessing reflection coefficients of the order 0.7 (for 50 m. waves and vertical incidence). The layers are fairly persistent in time and occur both by night and by day. The records also reveal reflections from the Appleton *D* region (50-90 km.) and from stratospheric layers at about 30 km. A feature of *D* region reflection is the occurrence of sporadic bursts of reflection lasting a few seconds. The appearance of

a 30 km. reflecting layer has on several occasions been correlated with thunderstorms, and an appendix to the paper shows that the 'runaway electrons' predicted by C. T. R. Wilson should be bent round by the earth's magnetic field and might produce ionization of the type required. The occurrence of these low reflecting layers may have some practical bearing on short-wave transmission and in particular on television phenomena.

#### Concentration of Nitrogen Isotope

By using the exchange reaction between ammonium sulphate and ammonia gas, H. C. Urey, M. Fox, J. R. Huffman and H. G. Thode (*J. Amer. Chem. Soc.*, **59**, 1407; 1937) have been able to concentrate the heavy isotope of nitrogen,  $^{15}\text{N}$ , for use in biochemical and chemical investigations. A solution of ammonium sulphate was pumped into the top of a fractionating column under low pressure, ammonia was liberated from the salt at the bottom by addition of caustic soda, and the ammonia gas stripped by a packed column. This ammonia was fed back to the bottom of the column and escaped at the top. As a result of a 13-day run, nitrogen containing 2.54 per cent of  $^{15}\text{N}$  was obtained, an increase of concentration of  $6\frac{1}{2}$ -fold. The samples were analysed by the Bleakney mass spectrometer, giving an accuracy of 0.02 per cent  $^{15}\text{N}$ .

#### Structure of Water

THE open tridymite-like structure of ice as regards the distribution of the oxygen atoms appears to have been definitely established by Barnes, and Pauling's explanation of the discrepancy between the entropies of ice calculated by Nernst's theorem and statistical methods indicates that the hydrogens are unequally spaced between the oxygens. Present theory, as developed by Bernal and Fowler and modified by Katzoff and others, considers liquid water at ordinary temperatures as having essentially a broken-down ice structure, permitting closer packing with a considerable amount of co-ordination persisting through hydrogen bonds. This co-ordination decreases with rising temperature or addition of electrolytes. According to Pauling, two of the four hydrogens which surround a four-co-ordinated oxygen atom tetrahedrally are bonded to it in much the same manner as in an isolated water molecule, while the other two hydrogens are at a greater distance (1.77 Å. instead of 0.99 Å.) from the oxygen and essentially bonded to other oxygen atoms. The oxygen nucleus in ice has four oxygens tetrahedrally bonded at 2.76 Å., with a proton along each O—O axis. An examination of the Raman spectra of ice at 0°, of water over a wide range of temperatures, and of deuterium oxide, has been made by P. C. Cross, J. Burnham and P. A. Leighton (*J. Amer. Chem. Soc.*, **59**, 1134; 1937). The results are interpreted on the basis of a model consisting of O—H oscillators perturbed by various types of co-ordination. A semi-empirical treatment indicates that in ice at 0°, the four-co-ordinated structure predominates, but appreciable amounts of three- and two-co-ordinated molecules are present. Water is rather more than two-co-ordinated at 25°-90°, and is slightly less co-ordinated than deuterium oxide, two-co-ordinated structures predominating in both liquids. Little significance is attached to the existence of definite polymolecular structures such as  $(\text{H}_2\text{O})_2$ ,  $(\text{H}_2\text{O})_3$ , frequently postulated as existing in liquid water.

## Egyptian University Scientific Expedition to South-West Arabia

By Dr. S. A. Huzayyin

**B**ETWEEN April and October 1936 the Egyptian University of Cairo sent out a scientific expedition to Yaman and Hadhramaut. It consisted of four members, and was intended to carry out researches in the fields of geology, physiography, archæology, anthropology and entomology. The expedition covered a distance of some 2,500 kilometres and was able to carry out intensive researches at various localities both on the High Plateau of Yaman and in the interior of Hadhramaut. The material brought back has not been studied in detail as yet; but a preliminary note can be given here.

### GEOLOGY

One of the expedition's main aims was to work out certain problems connected with the geological history of the southern borders of the Red Sea. We worked at a number of points along the lines of rifting both south and west of the Yaman Plateau, where the old crystalline rocks (schists and granites) of the base were exposed under later (secondary and tertiary) sediments and lavas. The successive horizons of the tertiary traps of the High Plateau were carefully examined and specimens collected. In north-east Yaman we worked chiefly on Jurassic limestones and Nubian sandstones, and a large collection of fossils was made from the successive zones of the former. The interior of Hadhramaut was found to have a relatively simple structure and to consist mostly of Eocene limestones on earlier unfossiliferous sandstones. We hope that new evidence from the lower part of the Eocene may throw useful light on the date of the trap volcanic series of tertiaries in south-west Arabia.

### PHYSIOGRAPHY

Pleistocene geology proved to be quite interesting. We worked chiefly on the middle parts of the valleys, which were relatively independent of changes in base (sea) level. Two physiographic cycles were established, the first being by far the more pronounced. Valleys with sloping sides were first cut and then filled with coarse gravels which now rise (usually in two or more terraces) to some 30 m. above the beds of the streams. During this stage there was a good deal of lateral wash and erosion in the middle parts of the valleys, and this erosion was probably responsible for the sloping sides of the V-shaped valleys. The gravels were examined at a large number of exposures, but unfortunately they produced only one or two specimens of pre-Chellean appearance.

The second physiographic cycle was associated first with the cutting of new steep-sided valleys *emboîtées* in the older gravels, and then with the filling in of these new valleys with soft sediments of silt. Deposition was much more regular and there was very little lateral wash in the middle parts of the new valley-beds. The discharge during the depositional phase of the second cycle was much less than that during the depositional phase of the first cycle, as only

soft silt could be carried to the middle courses of the streams. The two cycles were separated by a phase which was marked by extensive volcanic activity, especially in north-east Yaman, where the lava spreads always cover the old gravels and underlie the silts. The second cycle was followed by erosion, during which new torrential beds were cut into the silts (sometimes producing a series of erosional terraces). There has also been a still more recent (historical) outburst of volcanic activity (on a much more limited scale), the accompanying features of which are still noticeable in hot springs, etc.

We were able to associate the two physiographic cycles (or at least their depositional phases) with pluvial episodes. During Quaternary times this corner of Arabia seems to have had two major Pluvials separated by an Interpluvial. It was not possible to work out the stages of the first Pluvial, which was a prolonged one, and which must have had more than one sub-maximum (as shown by terraces); but there is presumptive evidence from one or two places that the second Pluvial may have had two sub-maxima separated by an Intrapluvial. In recent times there was a new wet phase (shown by archæological and other evidence), which we believe to have continued well into the Christian era (perhaps to the fifth century A.D.).

### ARCHÆOLOGY

The south-west plateau of Arabia proved to be singularly poor in prehistoric remains. Perhaps the great height (mainly above 1,500 m.) and the unfavourable climatic conditions during pluvial episodes contributed to this. It is to be recalled that very few remains have thus far been found at the high altitudes (above 6,000 ft.) of the opposite coasts of East Africa. We have carefully examined gravel exposures and have carried out experimental excavations at no fewer than fifteen caves and rock shelters in Yaman and Hadhramaut, but the results were largely negative. Surface specimens were looked for all along the route, but they were found only in very limited numbers and in particularly favourable localities; they belong typologically to Lower and Middle Palæolithic and rarely to the Upper Palæolithic. Whatever may have been the reasons, the scarcity of even surface finds shows that even if remains of prehistoric man may some day be forthcoming from this region, they will never be comparable in quantity with those from the African side. This reflects rather unfavourably on recent views put forward with regard to East Africa as a centre of cultural diffusion in Lower Palæolithic times.

Remains relating to the early historic phase of the area were, on the other hand, particularly abundant. Work and excavations at a number of places in Yaman and Hadhramaut have yielded fairly illuminating results. New light is thrown on relations between south-west Arabia on one hand and the Hellenistic East and Græco-Roman Egypt on the other, during the early centuries of the Christian era.

More than a hundred new Sabaitic inscriptions were copied and photographed. At three sites in the Aden and Hadhramaut protectorate, particularly the ruins of Reiboun (near Mash-had) there is, on the other hand, contacts with East Africa. Here we found an industry of obsidian (with some flint) in definite association with pottery and with Sabaito-Himyaritic inscriptions, all found in shallow kitchen midden-like remains and amongst ruins of ancient buildings and habitations. Some of the characters were actually inscribed on the pottery both before and after baking. The obsidian industry includes practically all the types and sub-types of the so-called final Palaeolithic and Neolithic cultures of East Africa—Wilton, Elmenteitan and Gumban. There are small nuclei, simple and retouched blades, truncated and notched ones, small backed knives, trapezoidal forms (in abundance), true lunates (less abundant), chisel-ended tools or *pièces écaillées* ('sinew-frayers' of Dr. L. S. B. Leakey), borers, medium-size and small burins (but not the micro-burin proper) and scrapers of various descriptions (nucleiform, round, at end of blade, etc.). Yet there can be no doubt about the Sabaito-Himyarite date of this industry in south-west Arabia (the few centuries centring round the beginning of the Christian era).

Apart from inscriptions (on stone and on pottery) there are metal elements and beads of dating value. The pottery here is much more developed and varied than in East Africa, but this is to be expected in a country with more progressive civilization. One cannot argue from the evidence we have for the separation of the obsidian industry from the rest of the datable remains which must all have belonged at least to one and the same culture phase\*. If this be so, the dates assigned by Dr. Leakey and others to the so-called final Palaeolithic and Neolithic industries of East Africa will have to be revised. It would be unreasonable to argue for a 'survival' into historic times of an obsidian and flint technique in south-west Arabia after it had been introduced from the African side at a final Palaeolithic date. It would be rather in this latter region (East Africa), which produced no such highly progressive civilizations as we know from south-west Arabia, that we should expect such 'persistence'. Perhaps many of the Microlithic elements of industries in East Africa may ultimately prove to be of comparatively recent historic date (Christian era).

We have also discovered, at a number of rock shelters in the Middle Wadi Hadhramaut, rock drawings (both animals and men) of both naturalistic and schematic styles. The former were associated with Himyaritic inscriptions (mostly names and cartouches), while the latter were of much more recent appearance. At the base of some of the rock shelters we found a flake and blade industry of flint which we have reason to associate with the first series of drawings.

#### ANTHROPOLOGY

Anthropometrical measurements were made of 1,350 male individuals, of whom 800 were studied in Yaman and 550 in Hadhramaut. More than 400 individuals were photographed full face and profile. The individuals are representative of the great majority of the tribes inhabiting the area, and useful light may be expected to be shed both on local distribution of anthropological features and types and on similarities and connexions with neighbouring areas in Asia and

Africa. Already interesting links are being worked out with Iran and the west Deccan. Local differences have also been worked out within both Yaman and Hadhramaut. The population of the northern part of the Yaman plateau is essentially mesocephalic, though it also shows certain features due to mixture. South Yaman, on the other hand, has broader heads. There is also a number of Jewish colonies in Yaman from whom representative groups were measured. In Hadhramaut we have a markedly brachycephalic type (very dominant, especially in the interior) and a mesocephalic one (especially on the coast). The broad heads of Hadhramaut show interesting anthropometrical features, and the roundness of their heads is primarily due to shortness (flattening of the back) rather than to width. Armenoid affinities among the broad heads of south Arabia are already known from previous observation and measurements (Bertram Thomas, etc.). The High Plateau of Yaman is practically free from prognathism, which becomes more and more marked as we go eastwards into Hadhramaut. We have reason to believe that this feature was not the result of crossing with Negroids from Africa, but represents an element brought from farther East. Special attention, however, has been paid to cases and areas of metisisation between Negroid and Arab types, especially in coastal regions. Some peoples of the coastal plains of west Yaman have been shown to have marked affinities with the Negroids of Africa, who, however, do not seem to have affected the High Plateau to any appreciable extent. Certain parts of the Hadhramaut coast are equally mixed, and even in the interior there are colonies of imported elements (for example, Negro soldier-slaves, Indo-Chinese and Chinese elements as slaves and wives brought back by enterprising merchants of Hadhramaut, etc.).

#### ENTOMOLOGY

Between five and six thousand specimens have been collected, and a large number of these were actually set in the field. They represent fauna from all the altitudes we have passed through (from sea-level to 3,500 m.). The identification of our specimens will inevitably be a long process, but it is hoped that fresh light may be thrown on the question of migration between adjacent parts of Africa and Asia in these regions. One of the chief topics we worked upon was the question of locust breeding-grounds and migrations, and already some useful results have been achieved in this direction.

In addition to these topics, members of the expedition carried out side-line investigations, such as the taking of a meteorological record during the journey (with as few breaks as possible), the collection of plants and small animals in localities which have not been visited before and of fishes and aquatic fauna from all streams and springs along the way, as well as the recording of observations on the general geography and ethnography of the lands and peoples in the areas visited.

\*Should there be any chance of such a separation, however, the only possibility would be that at a posterior date poorer tribes took shelter among the Sabaito-Himyarite ruins and left their obsidian industry thoroughly mixed with earlier remains. In that case the lithic industry would be still more recent than the Sabæan phase. There can be no possibility of the Sabaito-Himyarites having chosen for sites of their cities places where earlier obsidian and flint-using tribes left their kitchen midden and rubbish heaps.

## The Location of Industry

THE attention which is now being given to the location of industry was reflected not only in Prof. P. Sargant Florence's presidential address to Section F (Economic Science and Statistics) of the British Association on September 3, but also in the discussion by the same Section on September 2 of problems of labour transference. Mr. H. C. Emmerson, assistant secretary to the Ministry of Labour, who opened the discussion in place of Mr. Humbert Wolfe, described the work which the Ministry of Labour has been carrying out since 1928 to assist the unemployed. Men and women from the depressed areas are given the first opportunity of vacancies in other areas and are assisted if necessary by free travel, special allowances and a lodging allowance. In 1936, no fewer than 20,000 men and 8,000 women were placed through the exchanges. A juvenile employment scheme was started in 1928, and Mr. Emmerson also described a household removal scheme by which a man is assisted to take his family to the place of his new employment, and a family removal scheme which sends members of one family to work in one place. 10,000 removals have taken place under the two schemes.

The Ministry of Labour's present policy is largely directed to the movement of workers to specific vacancies, and this was severely criticized by Mr. S. R. Dennison, of the University of Manchester, who argued that in spite of the success achieved the basic policy is sometimes wrong. Employers expect a higher standard of work from men supplied by the exchanges than from those recruited directly. Mr. Dennison believes that transference should be accelerated not during boom years but when there is a slump, and urged that the Ministry should be filling 90 per cent of the vacancies instead of the present 25 per cent. In Lancashire, the existence of a family income is a strong deterrent, and Mr. Dennison also considers that with the present policy a depressed area is left heavily weighted with unemployed in the lower and higher age groups, and in consequence with more dependants, a falling income and increased depression. In that direction complete evacuation is the only logical policy.

The social consequences of industrial transference were discussed in a paper by Mr. A. D. K. Owen. For communities from which transference has taken place on an appreciable scale, the most obvious consequence is either a diminution in population growth or an actual fall in population. Up to the present, the high rate of natural increase (due to relatively low death-rate and high birth-rate) in the areas from which most transference has taken place has compensated to some extent for the loss of population by migration. More important, however, are the modifications in the age-structure of the population resulting from migration. Industrial transferees are mostly young people; there has in consequence been a marked ageing of the population in the depressed areas, and this tendency will increase in the next few years. Moreover, as the transference is voluntary, it acts as a selective process which tends to lower the average quality of the population left behind. With some important exceptions, it is the more active and adventurous elements in the community which tend to migrate. The immediate effect

of transference is to reduce unemployment in the depressed areas from which it takes place, but the ultimate effect may well be different, especially if skilled or potentially skilled workers are transferred. Denudation of skilled workers or of the most promising young workers may actually increase unemployment by impeding the development of new industries and in time depressing existing industries still further. The development of new industries in the depressed areas has already involved the return of some skilled transferees.

Where transference has resulted in an appreciable fall in population, it has considerably eased the problem of overcrowding as well as reduced the pressure on local social services, but there are losses in institutional life as well as in rate income. For communities to which transference has taken place there is a valuable gain in population, which provides a basis for industrial expansion but also raises many difficult problems for local government authorities in the expanding areas. Overcrowding is very serious, as well as transport problems and the provision of a sufficient number of new schools. In spite of difficulties of assimilation and social friction, the introduction of large numbers of new workers and their families into fresh areas is socially invigorating, and the redistribution of the labour supply in relation to economic opportunities represents a considerable economic gain. On the other hand, there is some reason to believe that subsidized transference is artificially distorting the industrial structure of the country. For the community as a whole the greatest gain from industrial transference has been the salvaging of young workers from the deteriorating effect of long-continued unemployment, and this must be set against the waste of social capital in the areas from which transference takes place and the devitalization of provincial or even national culture. Mr. Owen considered industrial transference should continue along different lines related to a broad plan of national development which takes account of both economic and social factors.

Dr. O. A. Oesser, in a paper on psychological and sociological aspects of labour transference, first reviewed the problems involved in relation to the condition of the material available for transfer. Highly skilled workers are more easily transferred, provided jobs are available for which their training is adequate, not only because transfer from a more skilled to a less skilled job is easier than the reverse, but also because of their frequent tradition of emigration and their higher intelligence level, wider knowledge, training and flexibility. The type of educational system may also be a factor. The social and economic conditions of the areas between which transfer is to be made must next be considered. People can be moved from areas of lower to areas of higher standards of living, but local patriotism and reluctance to move may be obstacles, as well as traditions and a subjective social status of occupation. Finally, Dr. Oesser suggested that the condition and state of industries in the area must be considered in relation to those of Great Britain as a whole, and he used the jute industry as an example to illustrate the growth of new social patterns among the unemployed and the mobility of labour between occupations.

## International Society of Leather Trades' Chemists

CONFERENCE AT COPENHAGEN

THE biennial conference of the International Society of Leather Trades' Chemists took place at Copenhagen on August 29–September 2, the meetings being held in the Technological Institute there. The president for the years 1938–39 is Mr. W. R. Atkin (England). It was announced that the Procter Memorial Research Fellowship Fund had reached a total of £3,400, and it was hoped to appoint the first research scholar in October 1938. It was also decided to institute a Procter Memorial Lecture to be delivered at all future conferences, and the first will be delivered in London in 1939. Dr. E. Schell (France) was made an honorary member of the Society.

Several combined sessions were held with the German Internationalen Vereins der Leder Industrie Chemiker, before which many interesting communications were made.

Dr. K. Linderström-Lang gave the opening lecture on the constitution of proteins as elucidated by enzyme studies. Dr. Dorothy Jordan Lloyd followed with a paper on the swelling of structured proteins with special reference to the influence of the reticular tissue on the swelling of collagen in alkaline solutions.

Mr. W. R. Atkin discussed the titration curves of gelatin and collagen, pointing out that, by the application of the Procter-Wilson theory to the titration curve of gelatin, it was possible to construct a replica of the swelling curve of gelatin in hydrochloric acid. It was also demonstrated that the second isoelectric point of gelatin postulated by Wilson could not exist. Dr. F. Schneider gave a paper on the hide proteins, emphasizing that various hide proteins could be distinguished by determining their sugar and amino-

acid contents. Dr. F. Stather dealt with the technical problems of fat-liquoring and stuffing of leathers, while several aspects of the chemical testing of vegetable tanned leather were dealt with by Dr. V. Kubelka.

Mr. G. Parsy discussed the pH values of sulphonated oils, and a new electrode for pH determinations was demonstrated by J. Haugaard. Dr. D. Burton described a method for determining the amount of neutralizing agent required by a chrome leather, and Dr. K. H. Gustavson discussed the concept of the chrome-collagen compound as an internal complex salt. The tanning effect of polytungstic acid was described by Dr. C. Riess, and Dr. E. Elöd pointed out in his paper the use of polyvinyl alcohol as a substitute for proteins in tanning research experiments. Dr. G. Otto compared the titration curves of synthetic tannins with those of natural tannins, and Dr. W. Grassmann described a nephelometric micro-method for the identification and estimation of tannins.

Mr. A. Dohogne discussed the relative water permeabilities of sole leathers tanned by slow and rapid methods, and Dr. A. Miekery described some work on the combination of lignin sulphonic acids with hide substance. The fractional extraction of pine bark was the subject of a paper by Dr. Vl. Nemeč, while Dr. L. Pollak explained methods for the chemical control of hide soak liquors.

During the official banquet which followed the conference, Dr. E. Stiasny was presented with the first copy of a special "Festschrift" volume published to commemorate his sixty-fifth birthday, to which contributions have been made by well-known leather chemists throughout the world.

## Metallurgy and the Aero Engine

THE sixteenth Autumn Lecture of the Institute of Metals was delivered by Dr. D. R. Pye, director of scientific research to the Air Ministry, on "Metallurgy and the Aero Engine", at the Sheffield meeting on September 6.

During recent years, there has been a remarkable increase in the power output from aero engines. A comparison of two engines of the same general type and cylinder capacity shows an increase in the last seven years of more than a hundred per cent. This increase has been achieved by improvements in the quality of the fuel, which allows the combustible mixture to be supplied by a supercharger at a higher pressure and temperature. A parallel improvement in the materials of construction to meet the severe conditions of temperature and mechanical loading has taken place, and there is scarcely one major component of the two engines of which either the material or its treatment has not been modified. The problems so far as they concern the metallurgist are both thermal and mechanical. It is fundamentally impossible greatly to increase the proportion of the heat generated which is turned into mechanical work.

The marked increase of power has, therefore, involved a corresponding increase in the waste heat which is to be removed. The piston, which must be receiving about forty per cent more heat, is a critical factor and the temperature attained on the piston is, from examination of the recrystallization of aluminium alloy pistons after use, of the order of 450° C.

The discovery of a new material of about the same specific gravity and thermal conductivity, but better able to maintain its strength at temperatures of 300° C. and above, would be one of major importance.

The increase of waste heat, combined with the chemical problems introduced by the use of lead tetra-ethyl in the fuel, has profoundly affected the metallurgy of the exhaust valve. In spite of great improvements in the steel, it is now necessary not only to transfer heat away from the valve head by means of hollow valves containing liquid, but also to coat the valve with special alloys to resist oxidation at the high temperatures involved. Improvements of sparking plugs involve interesting problems in which the engineer needs the help of the physicist.

On the mechanical side, the chief metallurgical problem of the aero engine is that of maintaining two surfaces rubbing together at high temperatures without seizure. This is essentially a problem of lubrication, but as the temperatures of the working surfaces increase, the viscosity of the oil gives less and less protection, and the nature of the metal surfaces themselves will play a more important part.

Working surfaces are never flat when considered in terms of molecular dimensions, and it becomes, therefore, of great importance to examine the possibility of the treatment of the surfaces in such a way as to render them less liable to seizure. The line taken by the engineer at present is to use one of the recognized methods of producing a hardened surface, but much further knowledge in this direction is still required. Beilby showed thirty-five years ago that during the polishing process the normal structure of metal is destroyed and the surface becomes amorphous. This conclusion has been confirmed by the recent work of Finch and Bowden. It has been shown that during the 'running-in' process a very thick Beilby layer of amorphous material is produced on the surface of a steel cylinder. Apart from the fact that observations have shown that a metal in the amorphous condition is harder and tougher than the crystalline variety, it is, in Dr. Pye's opinion, reasonable to suppose that an amorphous surface could be more easily protected from seizure by a thin oil film than could one of a crystalline character.

Such problems can only be successfully surmounted by the engineer with the advice of the physicist, and they are bound to assume a steadily greater importance where rubbing surfaces have to survive without seizure under high temperature conditions.

## Science News a Century Ago

Faraday and Schönbein

ON September 21, 1837, Faraday wrote to Schönbein, from the Royal Institution, "Your very pleasant and acceptable letter of the 9th of July with the accompanying books I received only last week, while at Liverpool, at the very meeting you refer to and I heartily wish that you had been there yourself. It is now five years since I have been able to attend any of these meetings but I was very pleased with the one to which I now refer. . . . As the Association forms no collection of books or apparatus I gave the said copy of your work to Professor Henry of Philadelphia in the United States with a view of extending what you have done as far and as fast as possible and wherever the English language is found. He was exceedingly obliged to me for it and I only wish that you and he had met at Liverpool. . . ."

"With regard to Mr. Crosse's insects, etc., I do not think anybody believes in them here except perhaps himself and the mass of wonder-lovers.—I was said in the English papers to have proved the truth of his statement, but I immediately contradicted the matter publicly. . . . It is but just of me to say that in conversation with Mr. Crosse I was very much pleased with him and with the readiness with which he received my critical remarks. As regards the crystallization supposed as real, he was lugged into view and must not be charged with having pressed himself forward. He is in fact a very modest man but has been dragged into an unkind situation. . . ."

David Uwins (1780-1837)

DR. DAVID UWINS, one of the first English converts to homœopathy, was born in London in 1780, the son of Thomas Uwins, a clerk in the Bank of England and brother of Thomas Uwins, the artist. He received his medical training in London and then went to Edinburgh, where he graduated M.D. in 1803. He then returned to London, where he was made L.R.C.P. in 1807. In 1815 he was appointed physician to the City Dispensary and afterwards to the Finsbury and Central Dispensary. In 1828 he became physician to the lunatic asylum at Peckham, and as the result of his experience in that institution published in 1833 "A Treatise on those Disorders of the Brain and Nervous System called Mental". In later life, owing to the influence of his friend Frederick Hervey Quin, he took up homœopathy, and in 1836 announced his conversion to that doctrine in a pamphlet entitled "Homœopathy and Allopathy, or Large, Small and Atomic Doses". As the result of this step he quarrelled with his former friends and his health broke down owing to the stress of controversy. He died in London on September 22, 1837, and was buried in Kensal Green Cemetery.

Uwins was a prolific writer. In addition to the works already mentioned his chief publications were "Modern Medicine, containing a Brief Exposition of the Principal Discoveries and Doctrines" (1808), "A Compendium of Theoretical and Practical Medicine" (1825) and "A Treatise on those Diseases which are either directly or indirectly connected with Indigestion, and on the Principal Ailments of Children" (1827). He also contributed medical articles to Gregory's "Encyclopædia" and the *Quarterly Review*, and was for some time editor of the *Medical Repository*.

Lyell to Leonard Horner

LYELL had spent the months June to September 1837 on the Continent and thus had not been able to attend the British Association meeting at Liverpool. Just before he returned home he wrote on September 23 from Paris to Leonard Horner (1785-1864), the geologist, "I am glad to receive your report of the meeting at Liverpool, and to hear the Association was so well supported. I must try to be at the next. I saw a very blundering account of my letter in the 'Athenæum'. I am anxious that when printed by the Association, it should be given as I sent it, and this principally because I have carefully avoided bringing prominently forward any collision with Von Buch, whom I like too well not to be sorry that I should fancy, as he has done before now, that I am always seeking to run against him. I only mentioned him as having been the first to announce the posteriority of the granite to the transition beds, which was a grand step at that time, and true; though perhaps he did not come at it by a strictly logical course. I knew how he drew his inferences, which were quite natural twenty-six years ago, before he had adopted the true theory of granite, but had I brought forward his errors, I should also have dwelt on his praises. Chancellor Brougham said of Serjeant Wilde, that it was rather hard to visit on the barrister the sins which he committed in the flesh as an attorney, and I should also think it hard to show up the mistakes which Von Buch the Huttonian fell into, in the youthful days of his Wernerianism."

## Societies and Academies

## Paris

Academy of Sciences, July 12 (*C.R.*, 205, 97-184).

ANTON E. MAYER: Groups of curves of three lines.

MME. CHRISTIANE PAUC: Further study of a group of infinitesimal transformations.

JACOB: Determination of the jump of a function by development in a Hermitian series.

CHI-TAI CHUANG: The behaviour of a holomorph function and of its derivatives in a circle.

PIERRE CHEVENARD and EUGÈNE JOUMIER: A mechanical magnifier with enlargement of more than 1,000. Application to recording the viscous deformation of metals at high temperatures.

MAX SERRUYS: Supplements to the nuclear inflammation theory of knocking in petrol motors.

F. J. BOURRIÈRES: The auto-oscillations of real jets in identical media by autofolds.

ALBERT MILHOUD: Concerning the inflammation of dirigible balloons. Discussion of the conditions producing an electric spark when the valve is opened to allow the hydrogen to escape.

ROGER MÉRIGOUX: The influence of a thin layer of oil on the motion of waves.

MARCEL PAUTHENIER, MOSHÉ FELDENKRAIS and LÉOPOLD VIGNERON: The absolute standardization of an apparatus for the measurement of very high voltages: the electrostatic valve. The indications of the rotating voltmeter standardized up to 50 kilovolts are in agreement with the results given by the electrostatic valve method, up to about 400 kilovolts.

THADÉE PECZALSKI: The production by electrolysis of coloured rings in the mass of a salt.

HENRI LACOSTE-TAYAN: Cycles of recoil in magnet steels.

SERGE NIKITINE: The dichroism of flow in solutions of fluoresceine.

LOUIS CARTAN: The focalization of corpuscular bundles by circular deviation in a transverse magnetic field.

MAURICE COTTE: The Gauss approximation for the general systems of electronic optics.

RAYMOND ROURE, LOUIS QUEVRON and RENÉ GENSE: A photo-electric comparator. The instrument reduces the measurement of a variation of length to the measurement of a variation of current. A displacement of 1 micron produces a change of 0.4 milliamperes.

RENÉ AUDUBERT: The ultra-violet emission spectrum of the slow thermal dissociation of silver nitride. The slow decomposition of silver nitride by heat is accompanied by the emission of light, corresponding to three narrow bands between 1950 Å. and 2600 Å.

EMILE RINCK: The diagram of solidification and electrical conductivity of the rubidium-cæsium alloys. These two metals form a continuous series of solid solutions, with a minimum solidification point at 9° C. The conductivity measurements proved that no definite compound of cæsium and rubidium is formed. These results are not in agreement with the earlier work of Gorja on the same subject.

MAURICE DODÉ: The reversible action of iodine vapour on dry potassium nitrite. The influence of the miscibility of this salt with the corresponding nitrate.

CLÉMENT COURTY: The diamagnetism of solutions of iodine and the purity of the alcohol. The law of additivity of coefficients of magnetization applies to a solution of iodine in alcohol only if the latter is pure, and such measurements can be used for detecting the presence of impurities in alcohol.

ANDRÉ DEBIERNE: A new mode of transformation. When hydrogen is brought into contact with purified carbon at the temperature of liquid nitrogen a large amount of heat is set free, higher than the heat of combustion of the hydrogen with oxygen. Helium shows a heat evolution of the same order of magnitude under the same conditions, but with other gases (oxygen, nitrogen, argon) the effect is small. The source of this heat energy is unknown.

MARC TIFFENEAU, PAUL WEILL and BIANCA TCHOUBAR: The order of addition of the hydracids to the epoxides and of the hypohalogen acids to the ethylene derivatives, methylene cyclohexane and methylcyclohexene, as well as their epoxides.

RAYMOND QUELET and MARCEL PATY: New methods of preparation of 5-bromo-2-methoxybenzyl alcohol and of 5-bromo-2-methoxybenzaldehyde.

ANDRÉ MEYER and HENRI DRUTEL: The 2,6- and 2,8-dimethyl-4-chlorquinolines. General properties. The reactions with amines.

HENRY GAULT and MATUS COGAN: Ethylol-formylglutaconic ester.

ALEXIS TCHITIBABINE and CHARLES HOFFMANN: A new (2,3,6) triaminopyridine.

LOUIS MARTINEAU and CHARLES PRÉVOST: The catalytic dehydrogenation of a tertiary alcohol into a ketone.

LUCIEN DAUTREBANDE, EDMOND DUMOULIN and PIERRE ANGENOT: Study of anti-aerosol esparto pulp filters. The perforation of anti-aerosol filters by the ageing test with steam.

PIERRE LEGOUX: The magnesian series of supra-crustal rocks of the west Ivory Coast.

JULIEN DURAND: The structure of the crystalline region of Rouergue and of Albigeois.

PIERRE BERNARD: The relation between the swell on the coast of Morocco and the microseismic agitation in western Europe.

EDMOND ROTHÉ and TH. KOPCEWICZ: The comparison of the radioactivity of Alsatian rocks by the method of (Geiger-Müller) counters.

ALBERT BALDIT: The influence of the terrestrial relief on the vertical movements of the air at Bannod'Ordanche (Massif of Mont-Dore). Studies of air velocities made in connexion with a school for gliding.

RENÉ SOUÈGES: The embryogeny of the *Violaceæ*. The development of the embryo in *Viola tricolor*.

LUCIEN LEROUX: The presence of allantoinic acid in the leaves of *Coryllus avellana*.

VINCENT, HERVIAUX and COIC: The measurement of the lime capacity of soils, and the liming of acid soils.

JEAN JACQUES BOUNHIOL: Premature metamorphosis by the ablation of the *corpora allata* in the young silkworm.

JULES ALQUIER and MME. ANDRÉE MICHAUX: Study of the calcium-phosphorus ratio in various tissues especially in the femurs of the growing rabbit.

JEAN LAVOLLAY and MME. FRANÇOISE LABOREY: The action of ascorbic acid (vitamin C) on the pigmentation of the mycelium of *Aspergillus niger* in the presence of magnesium in excess, and on the development of this mould.

RODOLPHE L. MAYER and CHARLES OECHSLIN: Antistreptococci. Extract from a sealed letter on the activity and toxicity of certain derivatives of benzene sulphamide.

EMILE ROUBAUD, JACQUES COLAS-BELCOUR and GEORGES JEAN STEFANOPOULO: The transmission of yellow fever by a palæartic mosquito common in the Paris region.



## Moscow

Academy of Sciences (C.R., 15, No. 4, 1937).

V. S. IGNATOVSKIJ : The Laplacean transformation (7).

G. V. PFEIFFER : Possibility of joining to a complete system of non-linear equations a linear equation or a system of linear equations.

B. LEWITAN : A generalization of inequalities of S. Bernstein and H. Bohr.

G. N. NEUJMIN : The elements of the orbit of Comet 'Neujmin II' as computed from the connexion between its appearance in 1916 and 1927.

B. J. SVEŠNIKOV : Dependence of the rate of photo-chemical reactions in solution on the concentration of reagents.

V. SUKAČEV and S. DOLGAJA : Fossil remains of plants in loess and loess-like clays in connexion with the problem of origin of these deposits.

K. A. VLASOV : The theory of desilification of granitic pegmatites.

E. S. BURKSER, N. P. KAPUSTIN and V. V. KONDOGURY : Helium, radium and thorium in beryllium minerals of the U.S.S.R.

D. MICHLIN and P. KOLESNIKOV : Influence of colloids and of electrolytes on the state of equilibrium in maltose.

D. J. VAKOLIN : Some data on the yield of essential oil by a new variety of dragonhead (*Dracocephalum moldavica* L. var. *hexagonum* D. Vakulin) from different seed samples.

E. M. ŠEPELEVA : Morphology of the chromosomes of some species of potato.

B. S. MOŠKOV : Photo-periodism and a hypothesis as to flowering hormones.

M. CH. ČAJLACHJAN and L. M. YARKUVAYA : New facts in support of the hormonal theory of plain development (2).

A. R. VERNER and V. F. ALTERGOT : The phenomenon of mycophagy.

## Sydney

Royal Society of New South Wales, July 7.

ADOLPH BOLLIGER : Red compounds formed by picric acid and creatinine in the presence of sodium hydroxide. Four compounds have been isolated. They are characterized by a varying sodium or sodium hydroxide content. Compound I, which is obtained *inter alia* by the addition of one molecule of sodium hydroxide to a mixture of one molecule of creatinine sodium hydroxide and one molecule of picric acid, consists of one molecule of creatinine, one of picric acid and two of sodium hydroxide. Compounds II, III and IV, obtained after the addition of larger amounts of sodium hydroxide, contain two and a half, three and three and a half molecules of sodium hydroxide for each molecule of creatinine picrate. Compound IV represents the maximum degree of saturation with sodium hydroxide and has been considered as the most likely cause of Jeffe's reaction.

## Vienna

Academy of Sciences, June 24

E. STEINACH and H. KUN : Conversion of the male sex hormone into a substance with the properties of the female sex hormone. Studies with young and old men. Injection of male sex hormone produces in the urine a substance with oestrogenic properties.

J. SCHINTLMEISTER : Redetermination of the range of  $\alpha$ -particles from thorium. The variation of the ionization along the range of the  $\alpha$ -particles from a thorium source of exceptional purity has been studied, and the extrapolated and mean ranges in air at 0° C. and 760 mm. pressure have been determined as 2.59 cm. and 2.56 cm. respectively.

R. WEISS : 4', 4"-dihydroxy-3', 5', 3", 5"-tetra-bromonaphthalene-2, 3-dicarboxylic acid anhydride.

O. REDLICH, T. KURZ and W. STRICKS : Spectrum of scattered light of some inorganic compounds.

BELLA BAUMINGER and F. LIEBEN : The sugar-formic acid combination in the oxygen current.

## Washington, D.C.

National Academy of Sciences (*Proc.*, 23, 295-349, June 15).

D. L. FOX : Carotenoids and other lipid-soluble pigments in the sea and in deep marine mud. Material filtered from sea water, including microplankton, faecal matter and other organic detritus, and also marine muds from 1,000 fathoms were found by chromatographic analysis to contain carotenoids, assuring a supply of these compounds even to deep-sea animal organisms.

H. D. BABCOCK : Internuclear distance in oxygen molecules. New determination based on measurements of twelve absorption bands of atmospheric oxygen.

J. M. BEAL : Bud development in *Lilium Harrisii* following treatment with indoleacetic acid. In another species, treatment with this substance in lanoline of a stem from which the terminal bud had been removed produced protuberances found to be adventitious roots; in *L. Harrisii* buds appeared in the axils of the upper two or three leaves. These buds closely resemble bulbils (vegetative reproductive organs) normally found near the base of the stem.

S. WRIGHT : The distribution of gene frequencies in populations. A mathematical discussion.

H. FRICKE and M. DEMEREC : The influence of wave-length on genetic effects of X-rays. Wave-lengths of 0.94 Å. and 2.2 Å. were used. *Drosophila melanogaster* males were treated individually in a chamber in which their abdomens were compressed to a thickness of about 0.15 mm. in order to reduce absorption of this soft radiation. The frequency of lethals per unit dose is found to be the same for both wave-lengths, suggesting that the genetic changes are not due to direct activations within a gene but are probably of the nature of sensitized reactions induced by neighbouring activated molecules.

M. E. REISSNER : Theory of beams resting on a yielding foundation. A mathematical discussion, from which it is claimed that, provided the deflection of the surface of the foundation due to a concentrated loading is known, then the problem of buckling of a beam of infinite length, resting on a yielding foundation and on an infinity of equidistant supports, can be solved completely.

G. A. MILLER : Groups having a maximum number of independent generators.

E. KASNER : Trihornometry : a new chapter of conformal geometry. A trihorn is defined as an ordered triplet of curves which pass through a common point in a common direction. Various relationships between the conformal invariants of this configuration are derived, including the analogues of the laws of sines and cosines of ordinary trigonometry.

J. v. NEUMANN : Continuous rings and their arithmetics.

## Forthcoming Events

INSTITUTE OF SOCIOLOGY, September 24-26.—Conference on "Social Stratification and Class Conflict" to be held at King's College of Household and Social Science, Campden Hill Road, W.8.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX, September 24-27.—Annual Conference to be held at Gonville and Caius, Cambridge.

## Appointments Vacant

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

LABORATORY ATTENDANT in the Science Department, South-East Essex Technical College, Dagenham—Clerk to the Governors (September 25).

LECTURER IN BIOLOGY in the Kingston-upon-Thames Technical College—The Principal (September 25).

HEADMASTER of the Bagdad Technical School—The Secretary (I.P.R./C.A.), Board of Education, Whitehall, S.W.1 (September 30).

TWO INSPECTORS FOR THE DEPARTMENT OF AGRICULTURE FOR SCOTLAND—Secretary (Establishment Branch), Department of Agriculture for Scotland, 29 St. Andrew Square, Edinburgh 2 (September 30).

ASSISTANT EXECUTIVE ENGINEER in the Public Works Department (Irrigation Branch) of the Government of the Punjab—High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (October 1).

ASSISTANT LECTURER IN MUNICIPAL ENGINEERING in the Manchester Municipal College of Technology—Registrar (October 4).

CHIEF LECTURER IN ELECTRICAL ENGINEERING in the West Ham Municipal Technical College—The Principal (October 9).

ENGINEER SUB-LIEUTENANT in the Royal Indian Navy—Secretary, Military Department, India Office, London, S.W.1, marked "Engineer Recruitment" (October 18).

ASSISTANT LECTURER IN MATHEMATICS in the University of Manchester—Registrar.

ENGINEER in the Public Works Department of the Government of Sarawak—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote M. 5419).

LECTURER IN PHYSICS in the University of Reading—The Registrar.

## Official Publications Received

## Great Britain and Ireland

Technical Publications of the International Tin Research and Development Council. Series A, No. 57: Mechanical Properties of some White-Bearing Metals and other Tin-Base Alloys at various Temperatures. By Dr. C. E. Homer and H. Plummer. Pp. 20+4 plates. Free. Series A, No. 58: The Tensile Properties of a Series of White-Metal Bearing Alloys at Elevated Temperatures. By H. Greenwood. Pp. 9. Free. (London: International Tin Research and Development Council.) [258]

Scottish Society for Research in Plant-Breeding. Report by the Director of Research to the Annual General Meeting, 22nd July 1937. Pp. 29. (Edinburgh: Scottish Society for Research in Plant-Breeding.) [268]

Norman Lockyer Observatory. Director's Annual Report, April 1, 1936-March 31, 1937. Pp. 6. Council's Report and Accounts and List of Council, Staff, Members, etc., June 1937. Pp. 12. (Sidmouth: Norman Lockyer Observatory.) [268]

Readers' Guide to Books on Electrical Engineering. Pp. iii+16. (London: Library Association.) [268]

London Shellac Research Bureau. Technical Paper No. 11: Viscosity of Lac and Hard Lac Resin Solutions. By Dr. Lal C. Verma. Pp. 20. Technical Paper No. 12: Modification of Lac with Higher Fatty Acids and their Mixed Glycerol Esters, Part 1. By Dr. R. Bhat-tacharya. Pp. 16. (London: London Shellac Research Bureau.) [268]

Department of Scientific and Industrial Research. Report of Test by the Director of Fuel Research on the Plant of the National Coke and Oil Company, Ltd., at Erith, Kent; Tests carried out 26th January to 9th February 1937. Pp. vi+54+2 plates. (London: H.M. Stationery Office.) 1s. net. [29]

Proceedings of the Royal Irish Academy. Vol. 43, Section B, No. 5: Turbellaria of Ireland. By Rowland Southern. Pp. 43-72. 1s. Vol. 43, Section B, No. 11: River Liffey Survey—The Chironomid Fauna of the Submerged Mosses. By Carmel F. Humphries and Winifred E. Frost. Pp. 161-181. 1s. 6d. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) [29]

Sir John Cass Technical Institute. Calendar, Session 1937-1938. Pp. 141+3 plates. (London: Cass Technical Institute.) [29]

The Prediction and Reduction of Occultations. (Supplement to the Nautical Almanac for 1938.) Pp. v+46. (London: H.M. Stationery Office.) 2s. net. [29]

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 7, No. 1, March 1935. Compiled by Agnes Elisabeth Glennie, assisted by Gwen Davies. Pp. xiii+371. (London: H.M. Stationery Office.) 5s. net. [39]

## Other Countries

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