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## The Government and Inland Water Survey

THE short official statement published in NATURE of July 21, p. 93, of the reception by the Minister of Health of the joint deputation from the British Association and the Institution of Civil Engineers, in reference to the memorial previously addressed by those bodies to the Prime Minister on the urgent need for the institution of a National Inland Water Survey, will have been read by those most keenly interested in the subject with a sense of profound disappointment. Despite the assurance of Sir Hilton Young that the suggestions of the memorialists would receive the most careful consideration of the Government, the underlying implication of his remarks that the sources of information at the disposal of the Ministry of Health are considered (with some possible slight amplification in detail) adequate for meeting the requirements of the situation, has created a feeling of serious misgiving. There is a growing conviction that the matter is being side-tracked for departmental reasons, and that the real nature of the application and its vital importance are not properly realised.

In the first place, it is difficult to understand why the deputation was referred by the Prime Minister to the Minister of Health. The memorialists had clearly indicated and given reasons why the matter should be dealt with by the Department of Scientific and Industrial Research. Apart from other considerations, the scope and aim of the survey contemplated is far wider and more comprehensive than the interests of the Ministry of Health. It is true that the Ministry is intimately concerned with, and exercises supervision over, questions of public water supply, and that the legislative proposals of water undertakers are referred to that department for investigation and approval. But a water survey, if it is to be of national utility and value, must transcend the relatively narrow limits of public health and take account not merely of supplies of water for domestic consumption but also the no less important needs of industry and commerce, the possible creation of hydro-electric motive power, the requirements of fisheries, irrigation and navigation, the drainage of low-lying lands and the prevention of floods and safeguarding of lives and property, with a score of other matters which do not come, or only come very indirectly and remotely, within the purview of the Ministry of Health.

This department of public health, moreover,

despite the assurance which we have stated is implied, if not definitely expressed, in Sir Hilton's speech that it is capable of dealing with all the requirements of the case, will, as he himself admits, be dependent for the major part of such information it may require on various external organisations, such as the Catchment Boards and the Geological Survey. The Catchment Boards, created under the Land Drainage Act of 1930, are undoubtedly in a position to render very effective and valuable service in the gauging of rivers and streams (this was pointed out in a leading article in *NATURE* of November 5, 1932) as it is indeed one of their primary duties and responsibilities, but they report to the Ministry of Agriculture and Fisheries and not to the Ministry of Health. Similarly, the Geological Survey comes under the Department of Scientific and Industrial Research, and is in no sense a branch of the Ministry of Health. The Ministry of Health cannot supervise and control the operations of these bodies, or lay down rules for their guidance.

The fact is that in Government circles there is some confusion of thought on the matter. Replying to a question in the House of Commons, on July 16, asking whether a survey of the water supplies of the country would be instituted, Sir Hilton Young made the statement that: "A survey of water supplies is undertaken by the Ministry as part of their ordinary work, and a special organisation is not necessary." We have no wish to be discourteous, and we are not charging Sir Hilton with intentional misrepresentation, but we are obliged to point out that in the strict technical sense of the word, the statement is not true. There is no survey of the kind contemplated in the question, nor in the sense in which it is used by the deputation, in operation at the present time. This is the whole point of the report of the investigational Committee of the British Association. Sir Hilton Young probably had in mind certain returns and records supplied to the Ministry of Health by various water companies, and others, but these are necessarily fragmentary and incomplete, relate to established undertakings, and do not in any way meet the considered finding of the British Association Committee "that a systematic survey of the water resources of Great Britain is urgently required".

It is essential to proper appreciation of the situation that the sense in which the word 'survey' is used, both by the British Association and the

Institution of Civil Engineers, should be clearly understood. Here are the *ipsissima verba* contained in the British Association Committee's report:

"The scope of a water survey to meet the requirements of civil engineers and others interested in water conservancy should include observations and measurements and the preparation of continuous records in standard form, in connection with rainfall, surface storage and flow, and underground storage and flow—in conjunction, in each case, with the physical and geological characteristics of the area. The records from all sources should be collated, brought into harmony and made available."

The report goes on to show, as a result of the Committee's widespread inquiries, that, while "some bodies take gaugings and measurements and keep records for their own purposes, so far as it has been possible to ascertain, these form a small minority and, in general, there is an entire absence of co-ordination or of any organisation for systematic recording of data". Hence the need, and it has become a clamant need, for a properly organised national survey "of all water received in these islands from its first arrival in the shape of rain and dew to its final disappearance in the ocean".

The Department of Scientific and Industrial Research is, as was stated in the memorial to the Prime Minister, particularly suitable for instituting and supervising a scientific investigation of this kind. It would be able to advise on methods and operations, on instruments and appliances, in a way that no merely administrative bureau could be expected to do. Assistance in the taking of observations and measurements will have to be enlisted from various quarters, private as well as public, and it was pointed out in the article in *NATURE* to which we have already alluded, that there must be some centralised authority of high technical standing to supervise and unify the methods and systems of measurement, otherwise the records will tend to be of different values. The Department of Scientific and Industrial Research, comprising as it does such related branches of work as the Geological Survey and Water Pollution Research, is specially adapted for the purpose, and, moreover, it has the outstanding merit of being entirely independent of interest of any sort in the use and control of water. This is a most important consideration and is a qualification for the body to be entrusted with the survey

specially emphasised in the report of the British Association Committee.

From the half-forgotten lore of one's school-days one recalls an incident in the Fables attributed to Æsop which may give point to these observations. It is the story of the ox, who, desiring to feed at its stall, found a dog in possession. Despite all reasonable argument to induce it to go, the dog obstinately refused to give way. We should hesitate to affirm that the Ministry of Health is deliberately pursuing the policy of the "Dog-in-the-Manger", but there is a danger that its action may be so construed, and it is to be hoped that wiser counsels will prevail. With its onerous duties and responsibilities in many directions, the Ministry will find it advantageous to waive any particular concern it may have in the present question in deference to the wider interests involved, and, at the same time, it will be able, from the undoubted store of records and returns which it possesses relating to existing undertakings, to render invaluable aid to the Department of Scientific and Industrial Research in an investigation which will call for the earnest and painstaking co-operation of everybody concerned.

The matter is too vitally important to the nation at large to be shelved or ignored. Great Britain lags behind the practice of other countries, which have long since recognised the necessity of investigating and conserving their water resources. The Dominion of Canada, the United States, Germany, Italy, Switzerland and many other nationalities have inaugurated special departments to deal with the control and administration of water within their respective territories. Unless the British Government is prepared to follow their example it will fail to provide for the developments which are impending in civic and industrial life and the nation will continue to find itself involved in unpleasant predicaments, which must accompany a short-sighted policy.

The question of the systematic allocation and distribution of the water resources of Great Britain raises, however, a number of subordinate issues for the discussion of which the present occasion is not opportune. The matter of supreme importance at the moment is the establishment, on lines of scientific accuracy, of a complete survey of the national water resources. This, it is urged, is not a duty germane to the functions of the Ministry of Health: it can only be undertaken effectively through such a body as the Department of Scientific and Industrial Research.

### The Passing of Rural Crafts

- (1) *Change in the Farm*. By T. Hennell. Pp. x+201. (Cambridge: At the University Press, 1934.) 10s. 6d. net.
- (2) *The Wheelwright's Shop*. By George Sturt ('George Bourne'). Reprint. Pp. xii+236+8 plates. (Cambridge: At the University Press, 1934.) 7s. 6d. net.

MANY of us who are immediately associated with scientific work are in certain respects very fortunate. Our horizon is continually expanding and we can look back to the past with a feeling of confidence that the work put in hand by our forefathers has been carried steadily forward in the way they would have wished. This state of happy confidence is sadly lacking in many directions, conspicuously so in the field of economics and international politics. But we can find the same feeling of uncertainty much closer at hand in our own countryside. Are the changes which have come about in our rural economy during the last half century changes for the better?

(1) It was in the hope of getting some new light on this problem that we eagerly scanned Mr. Hennell's book. Certainly there is here much information which it is satisfactory to have collected together between two covers. The book is a compilation of notes on sundry matters rather than a narrative, and for this reason does not leave any very clear impression on the mind except perhaps that the writer resents the passing away of the practices he describes. His readiness to quote the opinion of farmers who see objections to new departures, such as the use of 'artificials' and the cultivation of sugar beet, further reveals his prejudices. The principal praise he can find for the county organisers is that they have been the means of introducing into the eastern counties of England the more thorough methods of hedging which have been developed traditionally in the Midlands. It would, perhaps, have been better to omit altogether a reference to these admirable men than thus to praise their work so faintly.

In any event, Mr. Hennell does not take us to the root of the matter. The changes in the farm that really matter are not the alterations in a hundred and one details, but the gradual changes which have taken place in the relationships of the farm labourer to his work and to his employer. On the material side, he has reason to thank the effects which the industrialism of the towns has

had upon his life. His wages are higher and his hours shorter, and there is much more that he can do with his spare money and spare time. Intellectually also he is able to scan, at least in part, the widened horizon of the modern townsman.

(2) The price he has had to pay, however, is readily appreciated on reading "The Wheelwright's Shop", a photographic reprint of which has recently appeared. George Sturt does not set out in this book to be a social philosopher. At the same time it is quite clear that he is keenly aware of the human side of recent changes in rural life. Nine-tenths of the book are devoted to a graphic description of the wheelwright's trade as he had experienced it, and fascinating is his telling of it. It is the personal side, however, which makes the work such a satisfactory whole, and it is this side also that leaves the most lasting impression. One cannot but be moved by his description of the men with whom he worked. It may be that he idealises them, but there can be little doubt that modern conditions are not so favourable to the emergence of the fine qualities he so greatly appreciated. We are also guided towards an understanding of why the change has occurred.

Under the conditions which prevailed when Sturt took over the management of his father's wheelwright shop in 1884, no power was available beyond that which human muscle could provide. In such circumstances success depended more on skill than brawn, and skill is only won by early apprenticeship and long experience. Years of application to their trade made his men masters of the crafts that had been handed down to them in the minutest detail by an older generation. Although as regards the method of receiving their weekly pay they were employees, yet they held an unassailable place in the village community. They knew how the work should be done, not from an employer's instruction, but because they had through long-sustained effort become the inheritors of an ancient lore.

Economic pressure led Sturt in due course to introduce power-driven machinery, but he recognised this as something which cut at the roots of the old system. When a lad tending a machine can do work that could formerly only be done through the skill of a craftsman, how is one to retain that respect for the old wisdom which was formerly the basis of country life? Yet how are traditional methods to survive in a world that regards them as too expensive? The old craftsmen were not of course uninfluenced by economic

forces, but it was undoubtedly the aim of the best of them to do their work as well as they could afford to do. While this spirit is by no means dead, it must be admitted that the man who can do the job most cheaply is nowadays counted the most successful. We have grown so accustomed to a world of profit-making, in which success and social position are so largely conditioned by money, that it is salutary to be reminded that this is after all a very modern innovation, and may neither be a good nor a lasting phase of human evolution. There was, after all, something very satisfactory about a system in which money was of rather secondary importance, and in which a man won the respect of his neighbour by the excellence of his craftsmanship and the soundness of his domestic life.

There is, therefore, ample justification for resentment which Mr. Hennell evidently feels at the passing away of the many country practices which he describes. In a great many cases the newer methods are no better than the old—in some cases they are definitely worse—but they have been adopted of necessity because they are cheaper. The writer of "The Wheelwright's Shop" is also resentful, and pours out his soul in describing the ruthless cutting of woodlands which occurred during the War. He is, however, ready to admit that some of the newer practices are undoubted improvements, such as the substitution of tyres for strakes; and that some of the work that can now be done by power-driven machinery did involve the consumption of an amount of physical exertion that made those parts of the work very irksome.

It is emphasised that there was no 'science' behind the traditional methods of the wheelwright, or of any other rural craftsman for that matter. There was a well-established method of carrying out each of the operations, and it did not occur to anyone to reason out why it was best to do it in that particular way. The 'dish' of a cart-wheel is a case in point. Everyone knew that the spokes must not lie in a plane but must describe an obtuse cone. Cases could be cited where wheels with insufficient 'dish' had collapsed. But no one could explain just why this was; it was accepted as a fact. The dished cart-wheel embodies a very ingenious solution of a complex problem. The more straightforward solution of straddling the spokes on the hub (or stock), which is quite usual now, was not practicable under road conditions in which ruts were sometimes two feet

deep. It was necessary that the spokes should not touch the sides of the rut cut by the rim, and this meant that they must all come from the same circle on the stock. The stability of the wheel had therefore to be secured in a more subtle way, and it is possible that even George Sturt has not completely laid bare the 'science' of the cart-wheel.

R. KENWORTHY SCHOFIELD.

### Evolutionary Tendencies

*Early Forerunners of Man: a Morphological Study of the Evolutionary Origin of the Primates.* By Prof. W. E. Le Gros Clark. Pp. xvi+296. (London: Baillière, Tindall and Cox, 1934.) 15s.

**N**ON-COMMITTAL though it may be, the very title of Prof. Le Gros Clark's book excites curiosity. Forerunners are not necessarily ancestors; and in fact these pages introduce animals which stand in varying relation to the true line of human descent. It must not be supposed that the author avoids discussion of that subject. The preface is perfectly explicit in this matter, and ancestral trees, though not unduly prominent, figure clearly enough towards the end of the volume. But a wider issue is submitted, namely that of the evolutionary history, not of man alone, but of his associates as well. The clear statement of this aim, and the steadfastness which ensures its maintenance throughout the inquiry, are the essential factors of the book's outstanding merit.

It is a pleasant and easy part of the present survey to refer to the author's special qualifications for so ambitious a task, to recognise the ability with which he has marshalled the relevant evidence and to commend the delicacy of touch which has provided numerous illustrations combining anatomical accuracy with tasteful execution. As his record proclaims, Prof. Le Gros Clark is highly qualified by reason of his very thorough knowledge of human anatomy. He has also enjoyed the advantages of field-work in tropical surroundings, favourable to the existence of many of the animals he describes, and even more distinguished as part of that circumscribed area which provides the only refuge for one particular example. Since his return from the tropics, Prof. Le Gros Clark has worked assiduously for ten years on the anatomy of the various forms collected by him. Nor has he neglected the palæontological aspects of his problems, for as his published work shows, he has supplemented a general survey by a special investigation of the important fossil *Pronycticebus*.

In arranging the evidence he has summarised his own extensive researches, and has amplified these by the inclusion of recent contributions made by several contemporary workers. Among the latter, the names of Sir G. Elliot Smith, Prof. Wood Jones, Prof. H. H. Woollard, and Dr. Beattie are prominent in regard to the study of existing forms, while those of Prof. W. K. Gregory and Prof. O. Abel, Mr. Simpson and the Abbé Teilhard de Chardin appear in respect of palæontological studies.

The evidence is drawn from the animals commonly acknowledged as associates of mankind, whatever opinions may be held in regard to their exact relations to man or even to one another. Thus it is that the lemurs and monkeys have figured in classifications since the Linnean scheme appeared in the eighteenth century. The earlier specifications included bats. But whereas these are now excluded, two important additions demand special mention, namely, the aberrant lemurine form *Cheiromys*, and the remarkable *Tarsius*, both unknown in the time of Linnæus. Sundry examples, represented only by fossil remains, are included, and the whole group thus constituted forms the order Primates. The approximation of the order Insectivora to the Primates has been recognised in so far as the animals are concerned though not as regards their comprehensive name, since the publication of John Ray's "Classification" (some two hundred years ago). Originally, the approximation was based on the claims of a few anatomical data. Not only have embryological data supplemented them, but also the anatomical evidence has been vastly increased by the work of Prof. Le Gros Clark himself and those whose names are given above, particularly Sir G. Elliot Smith. One noteworthy result has been the proposal to detach certain animals formerly included with the Insectivora, so as to transfer them to the order Primates. On the side of palæontology too, the researches of Mr. Simpson have revealed the existence of an insectivorous form possessing distinct resemblances to the lemurs. Again, and within the Primates, M. Teilhard de Chardin has discovered European tarsoids differing from the previously known American examples, in that the European forms exhibit features suggestive of an approach to the subdivision of the Primates called Anthropoidea.

Prof. Le Gros Clark has had to condense and summarise all these researches, and he has done so with a success which carries his book far ahead

of anything previously published in this particular sphere. If the book be regarded as the exposition of a particular thesis, it is fair to state that it culminates in twofold fashion, namely, the exhibition of certain "ancestral trees" and in the second place, the tables of *specifications*.

In regard to the ancestral trees, comparisons are inevitable, and in the present instance it is impossible to ignore the remarkable degree of correspondence between the diagram given as Fig. 89, p. 275, with part of that published in Sir G. Elliot Smith's book, entitled "Essays on the Evolution of Man", 1927, Fig. 2, p. 3. The chief differences seem to consist first in the nomenclature. Thus Prof. Le Gros Clark sets Prototarsioids in the place filled by Tarsioids in the older scheme, and again he sets Tarsioids where the older scheme has *Tarsius*. Secondly, the older scheme doubtless includes *Parapithecus*, but does not mention this fossil by name. Unless these divergences are more important fundamentally than they appear to be, Prof. Le Gros Clark confirms what may be termed the prevalent view of the relations of the various forms represented in the two schemes. Particular agreement appears in that the human stock is connected with those representing monkeys in a position to be described as more recent than the tarsioid or prototarsioid stage. Whether this provides material for discussion or not, it must suffice here to refer once more to the greatly enlarged store of information which lies at the base of the more recent exposition.

Inspection of the specifications discloses at once that the method employed is systematic in the strictly anatomical sense, inasmuch as the distinctive traits are drawn successively from the bones, the teeth, the nervous system or the urogenital system. But it would be an error to pass them over as mere lists. Their essence and value consist in the attempt here made to define a given group of animals in terms not simply of anatomical conformation, but rather of certain trends or tendencies in evolution manifested by the assemblage considered as a whole. Such an attempt certainly confers distinction upon the book, and may well mark the inauguration of a new method of classification more profitable than those in vogue. Some implications of this method are mentioned by the author in his introduction, and it would seem that occasionally the tendencies in question may find expression as instances of parallel development, of which some examples are cited.

Moreover, the comparison of such trends seems to lead to the conception that some of them are predetermined, so that evolutionary progress may follow certain lines to the exclusion of all others. Consequently the influence of a variable environment in promoting evolutionary changes must be correspondingly discounted in those instances.

The introduction of such considerations is a novel and welcome supplement to the descriptive part, and though they may incur criticism of an adverse kind, they will assuredly assist in the solution of difficult problems, provided the distinction between facts and theories be kept in mind. Here the contrast must be drawn between a concept (orthogenesis) based upon a conclusion, and the facts. And the latter emerge from the specifications in their natural form, namely, as anatomical details. This brings out another fundamental principle enunciated by Prof. Le Gros Clark (p. 4), when he records his conviction that degrees of genetic affinity are assessed by noting degrees of resemblance in anatomical details. Such support to the value of anatomical records is the more welcome in an epoch marked by the inception of physiological and psychological alternatives. Lastly, another pronouncement will almost certainly command attention, namely, that in assessing affinities, all anatomical characters must be taken into account (p. 8).

In conclusion, it may be remarked that these pages leave several subjects (such as the real nature and significance of *Parapithecus*) open to discussion and invested with doubt. But there is no doubt as to the general excellence of Prof. Le Gros Clark's book.

#### Progressive Biochemistry

- (1) *Organic and Bio-chemistry*. By Prof. R. H. A. Plimmer. Fifth edition. Pp. x+624. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1933.) 21s. net.
- (2) *Fundamentals of Biochemistry: in relation to Human Physiology*. By T. R. Parsons. Fourth edition. Pp. xii+435. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin Marshall, Ltd., 1933.) 10s. 6d. net.

(1) **P**ROF. PLIMMER'S book has for many years been regarded as a classic. The first edition was published under the title of "Practical Physiological Chemistry" in September 1910, and fresh editions were called for in 1915,

1918 and 1926, the third edition having also a second impression in 1920.

The seven years that have elapsed since the last edition of the book have been far from barren ones in biochemistry, and comparison with the fourth edition would undoubtedly reveal that most of the important additions to knowledge in this science have been brought into their appropriate places by the author. The scope of the book is difficult to indicate in a few paragraphs, but it may be mentioned that some thirty-five chapters are devoted to discussion of different classes of organic compounds, while separate chapters discuss the fats, oils, waxes and lipines, with a special chapter on the estimation of carbohydrates. There are also special chapters on the alkaloids, pigments, the proteins, protein derivatives, colloids, milk, fermentation, digestion, metabolism, the composition of foodstuffs, respiratory exchange, urine and fæces. The three chapters on the special chemistry of proteins are particularly interesting, in view of the author's position as an original investigator in this field. The introductory paragraph and note on the "Recognition of an Organic Compound" precede chapters on the "Isolation and Preparation of Pure Organic Compounds", and on the "Composition of Organic Compounds", with a note on identification.

It is clearly impossible in any real sense to review a book of this sort; all the reviewer can do is to dip here and there in a search for inaccuracies, if he is that type of reviewer, or in the conviction of finding useful and clearly expounded knowledge, if his temperament is of another kind. It can at once be said of the reviewers of this book that the former kind would be disappointed, and the latter kind well content.

It is a pity that the publishers have not given practical expression to their realisation—and they surely must realise—that Prof. Plimmer is one of the leading world figures in biochemistry, for the typography of this volume leaves very much to be desired. In particular the printing of the benzene nucleus in its various manifestations and compounds is often slovenly in the extreme. Opening the book more or less at random, one finds unpleasant examples of this fault on pp. 204, 255 and many others.

In spite of these blemishes, which we urge the publishers to remedy in subsequent editions, a whole-hearted welcome can be given to this, as to each previous, new edition of "Plimmer".

(2) Dr. Parsons's little book is another

reprinted work of a rather different kind. Only eleven years have elapsed since it was first published, and it is still without exception the best elementary exposition of its subject that I know. It must not, however, be imagined that it is a 'popular' book in the ordinary sense, as it certainly demands a knowledge of elementary chemistry, being intended primarily to teach the young medical idea to shoot in the biochemical field; its effect should definitely be to enable those readers to score the necessary number of marks.

Unlike the first book noticed in this review, it is produced in a manner both creditable to the publisher and worthy of the author. This is not a matter to be regarded lightly in textbooks or introductions to scientific subjects, for chemical formulæ are notoriously repellent, and the least that can be done to encourage their understanding is to present them clearly.

Dr. Parsons's book is not entirely devoid of minor errors; for example, the statement that in piperazine a nitrogen atom replaces a carbon atom in piperidine (it actually replaces a  $-\text{CH}$  group), and the transposed formula for the biuret reaction giving protein-group on p. 24.

I must also again direct Dr. Parsons's attention to a statement that I criticised in reviewing an earlier edition of his book, namely, that the rats in Hopkins's classical experiments were suffering from vitamin A deficiency. This is entirely inconsistent with the fact, made perfectly clear in Hopkins's paper, that they could be cured by water-soluble extracts from yeast and other substances. In general, however, his statement of the position in the vitamin field is admirable, and he has avoided most of the pitfalls that lie in wait for the unwary simplifier.

The extraordinarily rapid pace of vitamin research is well illustrated by the fact that, although this book appeared in time to chronicle the identification of vitamin C with ascorbic acid, it was too early to record the synthesis, details of which have now been available for several months, of ascorbic acid from entirely inactive substances. Such omissions are the inevitable handicap of those who write about active and growing sciences. One of the tests of the value of such chronicles is whether they encourage the reader to keep eyes and ears open for still later developments, and to understand them when he hears them. Judged by such a criterion, Dr. Parsons's book should be an unqualified success.

A. L. BACHARACH.

## Short Reviews

*The Butterflies of the Malay Peninsula: including Aids to Identification, Notes on their Physiology and Bionomics, and Instructions for the Collection and Preservation of Specimens under Tropical Conditions.* By Dr. A. Steven Corbet and H. M. Pendlebury. Pp. v+252+vi-xxiv+18 plates. (Kuala Lumpur: Kyle, Palmer and Co., Ltd., 1934.) 4.50 dollars.

THIS handbook, though primarily designed for the Malayan collector, contains biological and bionomic matter which should be of service to students of the Lepidoptera of other regions. In the portions of the work that are concerned with the collecting, preparation and preserving of specimens, the tropical conditions prevailing in the Malay Peninsula are fully recognised, and the directions given bear the stamp of practical experience.

The authors do not attempt to describe or illustrate more than a selection of the commoner Malay species; they give, however, a complete list of all the species at present recorded from the Peninsula. In the remainder of the book space has been found for matters of wider interest, such as the external anatomy and classification of butterflies, their life-history and geographical distribution. A chapter is devoted to protective resemblance and mimicry; and a brief, but within its limits adequate, account is furnished of the phenomena of Mendelism. This chapter, if read with attention, will provide the field naturalist with ample suggestions for advancing knowledge materially by experimental breeding.

The book will encourage collectors to use their opportunities to scientific purpose. The photographic plates are a good help to the identification of species.

*Grondbeginselen van de Hedendaagse Natuurkunde.* Door Dr. J. A. Prins. Pp. 240. (Groningen, Den Haag, Batavia: J. B. Wolters, 1934.) 4.90 guilders.

IF teachers of elementary physics are to keep up to date and to render their courses of instruction attractive, it is essential that they should be able to obtain accurate information of recent advances and their incidence on old knowledge, in a readable form. This little book appears to provide such information. It deals with the fundamental concepts of physics in a way which undoubtedly has great pedagogic value. The subject matter is attractively arranged, nicely set forth, very well illustrated, and the book provides a singularly neat introduction to present-day physics, in which practically all the important results of modern research have been incorporated.

If it can be translated into English and put on the market at a reasonable price, it should find a warm welcome. In this case it is to be hoped that the excellent tables now inserted in the cover band will also be included.

*Conjugate Functions for Engineers: a Simple Exposition of the Schwarz-Christoffel Transformation applied to the Solution of Problems involving Two-Dimensional Fields of Force and Flux.* By Prof. Miles Walker. Pp. v+116. (London: Oxford University Press, 1933.) 12s. 6d. net.

BY means of a transformation due to Schwarz and Christoffel, the interior of a polygon can be mapped on an infinite half-plane. Problems of two-dimensional flow (of liquids or electric currents) can thus be transformed into problems more amenable to treatment. The present book gives a quite elementary discussion of this transformation and an ingenious method of visualising the process. A variety of illustrative problems are then worked in great detail so that the engineer can at once appreciate the practical application of this powerful method. The book can be heartily recommended to those who have to deal with such problems in engineering practice.

*Organic Syntheses: an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals.* Vol. 14. W. W. Hartman, Editor-in-Chief. Pp. vii+100. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 10s. 6d. net.

AMONG the twenty-six preparations given are decamethylene glycol (from ethyl sebacate),  $\beta$ -diethylaminoethyl alcohol (from diethylamine and ethylene chlorohydrin), 2:6-dimethylpyridine (from acetoacetic ester, ammonia and formaldehyde), glycine ester hydrochloride (from methyleneaminoacetonitrile, made in turn from formaldehyde, sodium cyanide and ammonium chloride), and *dl*-methionine (from  $\beta$ -chloroethyl methyl sulphide and sodium phthalimidomalonate). Vol. 14 includes later references to preparations described in earlier volumes, and the index covers the contents of vols. 10-14. J. R.

*Our Primitive Contemporaries.* By Prof. G. P. Murdock. Pp. xxii+614. (New York: The Macmillan Co., 1934.) 14s. net.

As an account of 'primitive' man intended for the general reader and the student, this book is written on a novel plan. Instead of attempting a generalised account, the author has taken eighteen peoples—not all contemporary or primitive in the strict sense—and describes their life as they live it day by day in its framework of material, social and religious organisation. It is scarcely necessary to say that the author does not claim first-hand knowledge. His account of the Haida of north-west America, however, has been checked by his own personal field-work. In other instances his material has been drawn from authoritative descriptions. The bibliography appended to each chapter indicates a critical appreciation by the author of his authorities.



## Early Man in the Nile Valley\*

IT is a commonplace of archæological writing to refer to the part played by the great river systems of Egypt and Mesopotamia in the origin and development of civilisation; yet it is only recently that any systematic attempt has been made to ascertain how far the Nile Valley, which has afforded precise evidence of the development of culture in its relatively early stages, might not also, by an examination of geological conditions and their correlation with archæological data, help to solve some of the problems of man's earliest beginnings.

Preliminary reports of the work of the expedition to the oasis of El-Khargeh conducted by Miss Caton-Thompson and Miss Eleanor Gardiner indicate that by the discovery of stone implements in sealed deposits a substantial advance has been made towards an accurate dating of early stages of man's progress in Egypt; but of this the precise extent will be appreciated only when the final report of the expedition is available. In the meantime, Messrs. Arkell and Sandford in the volume now under notice put forward an instalment of what they hope eventually will be a complete survey of the evidence, here pieced together for the first time, to be found in the Nile Valley from the Second Cataract to the Mediterranean, which bears upon its earliest inhabitants up to known pre-dynastic times.

The work was begun in 1926-27 with a survey of both banks of the Nile from Luxor to Kom Ombo and a study of the First Cataract region at Assuan. The following seasons were devoted to the Faiyum, the Nile Delta and then again to Upper Egypt, when the areas around Luxor and southward from Kom Ombo towards Assuan were again examined. It is the work of the first season and the last, the fourth, which is embodied in this volume, covering the ground from Semnah to Luxor.

The Pleistocene period, which is the authors' main concern, has left its mark indelibly on the landscape of Egypt. As they point out, it was a period of copious rainfall. Forest and grassland covered the landscape, and the wadies were running streams. The signs of rainfall are everywhere apparent in deeply dissected plateaux, cliffs torn by gullies, which are often filled with huge boulders, and in the pot-holed and polished beds of dry waterfalls. A brimming Nile has left its traces in the terrace gravels. These now stand at levels, remarkable for their uniformity throughout their length, of 50 ft., 100 ft. and 150 ft., or more, above the present bed of the river. In some,

but not all, of these terraces, implements of palæolithic man are found.

Artefacts first appear in the 100 ft. Pleistocene terrace. Prolonged search in the Pliocene gulf deposits and the Plio-Pleistocene gravels has produced nothing that can be regarded as humanly fashioned; but in the 100-ft. terrace, rolled and unrolled early and late types of Chellean implements appear together. The discovery of Lower Palæolithic implements in the northern Sudan and through Nubia is an addition to our knowledge of the distribution of these types. In the earlier implements there is a marked tendency to make use of pebbles as the raw material, and the implements are mostly triangular in form. A flake industry shows a close resemblance to the English Clactonian. This is especially to be noted in the cores. Except in one locality, Dhimit, where there is an intermediate terrace at 75 ft.; the next stage is at 50 ft. Here implements belonging to a later or Acheulean age occur on a number of sites.

It may not be out of place at this point to direct attention to the principles of selection which the authors have followed in describing and figuring implements of Lower and Middle Palæolithic age in this volume. The specimens have been selected from those found on rich sites rather than from sporadic finds, material from the newly discovered Nubian and Sudanese localities being given the preference; in order to illustrate the skill in their manufacture, implements of chert and ironstone, a particularly intractable material, have been chosen rather than those of flint; and only artefacts which can be illustrated natural size are figured. It is to be noted that the assumption is involved that the specimens with which the authors deal are typical of the industries represented.

In the Middle Palæolithic period, the river entered the Second Cataract apparently for the first time, and two terraces, one at 30 ft. and one at 10 ft., poorly preserved, yield early Mousterian and 'typical' Mousterian of Upper Egypt respectively. Then in later deposits of fine gravels, Mousterian flakes give way to the descendant industry of Lower Sebilian, followed by Middle Sebilian from habitation sites which appear when the deposit of silt had passed its maximum and the falling river-level drained the marshes on the Kom Ombo plain. The Middle Sebilian was followed by a very considerable interval, not necessarily connoting, as Dr. Sandford points out, that the country was uninhabited, before the Upper Sebilian appears on sites of which the lowest, south of Edfu, is 35 ft. above river-level.

For more reasons than one, the Upper Sebilian—an unfortunate term, as Dr. Sandford notes—must be regarded as an industry of no little importance in Egyptian prehistory. At present it is

\* *Paleolithic Man and the Nile Valley in Nubia and Upper Egypt: a Study of the Region during Pliocene and Pleistocene Times.* By K. S. Sandford and W. J. Arkell. (University of Chicago Oriental Institute Publications, Vol. 17: Prehistoric Survey of Egypt and Western Asia, Vol. 2.) Pp. xvii+92+44 plates. (Chicago: University of Chicago Press; London: Cambridge University Press, 1933.) 28s. 6d. net.

known from surface flaking floors only, except at Dibeira West in Nubia, where there are the relics of a riverside industry at the 40-ft. level, which shows little dissimilarity from that newly discovered south of Edfu. It is an industry of little but microliths. Its cores are of two forms: one, a double-ended type, can be traced through Middle and Lower Sebilian; the other, essentially a neanthropic form, is made from a small elongated pebble, from which the two ends have been removed. Geometric forms are common, but the burin and the "Aurignacian retouch" are absent.

It is evident that the series has little in common with Lower and Middle Sebilian; and Dr. Sandford concludes that notwithstanding the view of M. Vignard, who holds that Middle Sebilian forms lead up to Upper Sebilian, a new and outside influence entered the culture of Egypt in Upper Sebilian times. This he associates with Capsian, holding as a necessary corollary that in Egypt

Mousterian forms and technique lingered late\*.

A point of further interest in connexion with Upper Sebilian and its possible Capsian affinities is suggested by the rock-drawings at Wadi el-Arab and near Abu Simbel which are here described. The oldest of these drawings, depicting giraffes, are compared with the oldest of the series at Uweinat, in the Libyan Desert, in which the Abbé Breuil finds Bushman affinities. This is interesting in view of the fact that our authors would deduce for the earliest of the drawings at Wadi el-Arab a dating which would equate them with the Upper Sebilian.

It remains only to say that an excellent piece of work has been worthily produced by the Oriental Institute, with a selection of well-chosen and admirably reproduced illustrations.

\* For the discussion of a similar problem in an analogous context reference should be made to M. R. Vaufrey's communication on the Capsian in Tunisia in *L'Anthropologie*, 43, 5-6 (see also *NATURE*, 133, 107, Jan. 20, 1934).

### A New Opportunity for Museums

IF Government museums and a relatively small number of municipal and private museums be set on one side, it may be said that the others have struggled along, many fighting but to retain a place, without much encouragement or help from the public, the education authorities, or indeed from any of those who stand to gain most from the use of museum exhibits. Financial encouragement was lacking, so that collections (often free gifts) could not be properly developed or attractively displayed, but even more disabling was the lack of interest, which tended to drive the curator and his staff (if any) back upon themselves, and to repress efforts and schemes which even a modicum of outside interest would have caused to bud and blossom.

Three years ago an opportunity arose for the bettering of museums through the generosity of the Carnegie United Kingdom Trust, which had been led to see the educational possibilities lying hidden to most eyes in the rich stores of galleries and lockers. Grants were offered for the suitable development of collections from an educative point of view, but the grants were limited to municipal museums and to these in the smaller towns, with populations between 10,000 and 70,000, provided they received a due proportion of financial aid from rates and other local sources.

The restrictions proved to be hampering, and now, at the suggestion of the Museums Association, which has been intimately associated with the scheme in planning and in the allocation of grants, the restrictions are to be modified in the direction of allowing more easy access to grants. The original scheme was planned to run a five years' course; three of the years have passed, and the remaining two years will test the new arrangements.

Put generally, the object of the Carnegie United

Kingdom Trustees is to encourage curators of museums and governing bodies to improve the museum service in their own and in neighbouring areas, and this object is being furthered in two directions, by grants for development and grants for rural service. The grants are no longer confined to municipal museums, nor are they limited to areas falling within definite population limits. They are intended to encourage the working out of any new scheme which will increase the effectiveness of the museum concerned in relation to the community. There are, of course, certain restrictions. It is only fair that the locality should make its contribution, and so no museum need apply unless it receives from rates, income from endowments, or subscriptions, a sum equal to at least threepence a head of the local population. It must have besides (or be about to have) a competent curator, and if the town in which the museum is situated is a large town, the museum must have, in addition, at least one full-time scientific or technical assistant for every 60,000 of the population.

Development grants, which are not meant to be expended on the ordinary running or maintenance costs, but on new endeavours, will not exceed £250 each, and may be considerably less.

Grants for rural service are new, and ought to spread, more than any other effort, an appreciation of museum collections and museum possibilities. The notion, which was effectively illustrated at a special Exhibition of Museum Specimens in the County Hall, London, in 1931, is that the larger museums may well assist rural areas by extending to them the use of loan collections, especially of those circulating loan collections which are adapted by their labelling and by their construction for the use of schools and for safe transport from school to school. To encourage the extension of

such services beyond the boundaries proper of certain urban museums, the Carnegie United Kingdom Trust is prepared to give grants, any one of which is not likely to exceed £200.

The Museums Association is closely identified with the scheme, and applications or enquiries concerning these grants should be made to The Secretary, Museums Association, Chaucer House, Malet Place, London, W.C.1.

We would remind our readers in the Colonies that their museums also stand to benefit from the activities of the Museums Association, for the *Museums Journal* states that the Association is now prepared, through its Empire Secretary, at the above address, to receive applications for grants towards museum developments in the Colonies. These grants will be made from a fund of 54,000 dollars placed at the disposal of the Museums Association by the Carnegie Corporation of New York.

No single grant is likely, in the early stages of this interesting and highly-important experiment, to exceed £1,000, and although no limitations are placed upon the purposes for which a grant may be given, there is an understanding that it will be used towards purely scientific purposes, such as investigation of original collections and publication of results, or towards general museum organisation, such as the employment of expert help in reorganising collections and the purchase of cases for organised collections, or for educational work, on behalf of the people and on

behalf of the curator himself, so that he may learn by visiting the best museums.

Here again there must be some sort of limitation; but the restrictions are very reasonable. No grant will be given to any museum which has not a qualified curator, whether paid or honorary; and no grant will be given to any museum unless there is definite proof that the authorities concerned intend to continue their active support of the institution.

In these provisions for the museums of the British Isles and of the Colonies, museums have placed before them such opportunity as has never before offered, and such as may not offer again. It is for them to show, by the devising of methods of arrangement and exhibition and of peaceful penetration which will create new links of interest between them and the people, that museums can become effective forces for the instruction and intelligent pleasure of the community, so that no man dare ignore their services. When museums have carried their progress so far, the Carnegie United Kingdom Trust can withdraw, having completed its mission; for from that time onwards public authorities will see to it that the museum is retained in its proper place in the framework of education. But if municipalities and museums allow these opportunities to slip through their grasp would the plain man not be justified in thinking (as some think) that many museums ought to take their place on the stage of life beside the "Sleeping Clergyman"? J. R.

### The Engineer and Modern Civilisation\*

By SIR FRANK SMITH, K.C.B., SEC.R.S.

#### REFRIGERATION AND FOOD SUPPLY

TO pass from the prime mover to food, the prime necessity of life, may seem a very big step. Indeed, so far as our food supply is concerned, many may wonder what particularly notable achievements, apart from transport, are to be credited to the engineer.

If we attempt to conjure up a picture of our food supply our view must include not only the produce of our own farms and fisheries, the great wheat fields of Canada, the sheep farms of Australia and New Zealand, the cattle ranches of the Argentine, the orchards of South Africa and other countries, but also the great ships which bring much of the food to our shores, the refrigerated stores in the docks, and in the market, the great chemical factories which turn out fertilisers and the products of a lesser known man who may be described as a biological engineer. To make the picture even more complete we might examine the contents of a grocer's shop with its hundreds of eggs in varying stages of freshness, a portion of Smithfield market with hundreds of carcasses of New Zealand lamb, or even a hawker's barrow on a winter's day crammed with fruit which in

former times would have been regarded as out of season.

To put a quantitative touch to the picture let us examine the returns of the Board of Trade. In 1932, we find that we imported on an average about one million pounds' worth of food every day. Of those eggs in shells which we saw at the grocers' shop we imported 2,000 millions. Those carcasses of lamb we all know come mostly from New Zealand. How many carcasses in all New Zealand sent us in 1932 I do not know, but the value of them was more than seven million pounds, and this represents but a small proportion of our imports of meat, which in 1932 were valued at more than 78 million pounds. What of those apples on the hawker's barrow? If they weigh from 3 to 4 to the lb. it is easy to calculate from the figures given by the Board of Trade that about 3,000 millions were imported; and there were about the same number of oranges.

The people of London could not be fed in this way in olden times. In the summer, food was of good quality and usually plentiful; in the winter it was poor and often scarce; sometimes very scarce; meat and fish were kept by curing with salt, and many vegetables such as carrots and turnips were preserved with honey to form a jam.

\* Continued from p. 129.

During the last fifty or sixty years, and particularly during the last fifteen years, there has been a new outlook on food, and the outlook is in part that of the biologist and in part that of the engineer. Let us for a moment consider that New Zealand mutton in Smithfield Market. There was none such a hundred years ago, or even eighty years ago. It was not because New Zealand could not produce the mutton or because we did not want it; it was because it could not be transported. There was no engineer's ice in those days. In 1860, an attempt was made to bring a cargo of meat from Australia to England. The meat was preserved for as long a time as possible with natural ice, but the ice failed to last through the journey and the meat was thrown overboard. The engineer got over the difficulty; he made ice on the ship, and with this engineer's ice the first cargo of frozen beef and mutton reached us in 1877 from Australia. It may be truly said that there would be no New Zealand mutton eaten in England to-day were it not for the engineer learning how to produce cold by the application of heat. To-day, practically all the ice used for preserving food is engineer's ice, and it is to the engineer that the refrigerating machinery in ships, in the docks, in trains, and in the home is due. In ships alone, the freezing space carrying cold stored produce to Great Britain amounts to about 100 million cubic feet, equivalent to a cold store 20 feet high, 50 feet wide and 20 miles long, and the capacity of the public cold stores of Great Britain is approximately one half of this. Half a million tons of ice are made by the engineers for domestic and commercial land purposes, and three-quarters of a million tons are made for the sea fishing industry.

Let us look at this picture of refrigeration and see how it commenced. Exactly how long cold in the form of ice has been used to preserve food we do not know. Macaulay tells us that a little more than three hundred years ago Francis Bacon on a very cold day in spring bought a fowl and stuffed it with snow. He caught a chill and died about a week afterwards, but before he died he stated in the last letter he ever wrote that the experiment with the snow had succeeded "excellently well".

To the refrigerating engineer, however, the most interesting figures in the background are those of Count Rumford and Joule, whom we see once again demonstrating the convertibility of heat into work, and proving that heat is a mode of motion. It follows directly from these principles that since a particle of water vapour has more energy of motion than a particle of water of the same mass and at the same temperature, that if the vapour is continually removed by a vacuum pump or by absorption by sulphuric acid, and the water continues to give off vapour, that is, to evaporate, it will not only cool, but ultimately it will freeze owing to the loss of energy which has been transferred to the vapour. Here is a simple freezing machine based on the Rumford-Joule principle.

In the case of the prime mover, the working medium may be one of many fluids. It is usually steam, and in the internal combustion engine it is what Sir Dugald Clerk called 'flame'. Similarly, with the refrigerating machine, practically any medium which is liquid at ordinary temperatures and has a reasonable vapour pressure may be used, but for efficient and economical working the choice is limited to such fluids as ammonia, sulphurous acid, ether and carbon dioxide.

As with the steam engine, the first refrigerating machine was an atmospheric one and the medium was water and its vapour. It was made by William Cullen, who used a vacuum pump to remove the vapour. More and more heat was given up by the water to replenish the vapour above its surface, and eventually the water froze. Later, Leslie invented the sulphuric acid absorption machine which was developed by Carre and Windhausen.

The development of the steam engine was in the direction of increased pressure and that of the refrigerating machine was in a corresponding direction. It follows that if work is done on a gas by compressing it heat is produced; the heated gas may be allowed to cool or it may be cooled artificially. When it is cool it is allowed to expand; in the process it does work, loses heat and falls in temperature. A repetition of this cycle of changes produces a lower temperature than before, and a rapid series of such cycles constitutes the modern compression refrigerating machine.

I do not propose to deal with the developments of refrigerating machinery, but as some indication of the growth of the engineer's importance in this field it is of interest to note that in the United States alone there are more than 150,000 refrigerated cars, and in that country more than 8 million tons of meat are submitted to mechanical refrigeration before reaching the consumer. In Great Britain our debt to the refrigerating engineer is more simply expressed by saying that on an average every person consumes per day 6 oz. of food which has been subjected to refrigeration. As a nation, I suppose we produce little ice-cream compared with the United States of America, but in 1933 the total consumption of ice-cream was about 30 million gallons.

To the engineer there is, however, an even more interesting feature of food preservation than that of refrigeration. If we go back to the hawker's barrow the biologist will tell us that those apples are alive and to freeze them means death. When frozen apples are thawed they become pulp and are only fit for jam. Like other kinds of fruit, the apple is a living structure whose preservation demands that it shall be kept alive. Sir William Hardy described the apple as a biological internal combustion engine with a large store of available fuel, and to keep it alive the external conditions must be such as not to stop it functioning in a normal fashion. The apple takes in oxygen from the air just as an internal combustion engine does, and it gives out carbon dioxide and other products

as a result of the chemical changes taking place. I do not wish to suggest that there is a close comparison between the internal combustion engine invented by man and that far more perfect one designed by Nature for the apple, but there are parallels of interest. Conditionally that there is an ample supply of fuel—as there is in an apple—an internal combustion engine will consume that fuel faster, get hotter, and wear itself out more quickly the greater the supply of oxygen. The same is largely true in the case of the apple; the rapidity of change is largely dependent on the atmosphere in which it is kept; if the atmosphere surrounding the apple contains too much carbon dioxide the apple will die, and decay known as brown heart sets in. If, on the other hand, the carbon dioxide is maintained at a somewhat higher rate than that present in a normal atmosphere the rate of change is delayed and the apple loses weight at a reduced rate. This very roughly is the basis of the method of preservation known as gas storage. The fruit subject to a certain amount of refrigeration is contained in an atmosphere containing a certain percentage of carbon dioxide, the optimum percentage like the optimum temperature varying for different kinds of apples.

It is a simple method and presents no great difficulty to the engineer. Temperature and carbon dioxide recorders must be installed, and there must be some cold storage arrangements. The carbon dioxide is supplied by the apples themselves; and the engineer has devised arrangements which ensure that the concentration shall not rise to a level which will kill the apples. In Great Britain during the coming season there will be about thirty of these gas stores and very good results are being obtained. Unfortunately the best temperature of storage of apples varies with the variety; thus for Newton Wonder it is 1° C. and for King Pippin 4.5° C. and the best conditions for each variety have to be worked out.

Let us now consider the engineer's task in 1932 when he brought here 84,000 tons of apples from Australia and 28,000 tons from New Zealand in refrigerated ships. Roughly speaking, apples keep best at about 3° C., and the ship's engineer had to keep each ship's hold, packed with boxes of fruit, at about that temperature. To the walls of each hold refrigerating pipes were fixed and through these pipes cold brine was pumped to carry off the heat. Each unit of the cargo was alive and giving off heat, water and carbon dioxide, and the refrigerating plant had not only to absorb all the heat passing into the hold from external sources but also absorb that produced by the cargo. It was important therefore to know the amount of heat produced per hour by the apples. The heat produced rises with the temperature of storage, and an apple attacked by fungus gives off much more carbon dioxide and much more heat. It is due to the engineer's skill in controlling the average temperature, in preventing large temperature gradients and in arranging for appropriate ventilation to prevent

an excessive accumulation of carbon dioxide at any point that such large consignments of apples can be shipped to us every year from Australia and New Zealand in comparative safety. Of course, disasters do occur at times, and suffocation by carbon dioxide has cost in a single year more than one hundred thousand pounds.

I have not time to tell you about the engineer's share in the care and transport of other fruits, but in 1932 more than 100,000 tons of oranges and 7 million bunches of bananas were brought here in refrigerated ships. It may therefore be said with truth that without refrigerating engineers we should have neither plenty of fruit nor much of good quality.

Normally, one example, such as that of the apple, should suffice to show the part the engineer has played in preserving food, but during the past two years there has been a development in the meat trade which promises to be of great importance.

Notwithstanding its apparent advantages, freezing has been applied to very few foodstuffs with complete success. Lamb, some kinds of fish and butter may be frozen with success, but freezing has been applied to beef with only partial success. It has been urged that freezing entails the separation in the tissues of a solid ice phase and that in the complex structure of food mere mechanical shattering will account for the damage. While it is certain that this is not the complete story, the damage done to beef by complete freezing is such that when the thawed carcass is cut the flesh is wet and a red fluid drips from it. Chilled beef, that is, beef kept a little above the freezing point, undergoes no such change, and it is not surprising therefore that of the 560,000 tons of beef we imported in refrigerated ships in 1932 about 80 per cent was chilled. Of the frozen beef, Australia sent us 47,000 tons; of the chilled beef none. The reason for this is that chilled carcasses of beef can be maintained in good condition for only about four weeks, and that suffices to bring them from South America but not from Australia.

The biological engineer has, however, made the discovery that if chilled beef is kept in an atmosphere containing 10 per cent of carbon dioxide the growth of moulds is inhibited and the 'life' of chilled beef is increased to such an extent that after a 65 days' voyage from Australia in a 10 per cent carbon dioxide chilled atmosphere beef might be delivered in London free from moulds and in good condition. In the *Times* Trade and Engineering Supplement of May 19 last the engineer no doubt read with interest that the steamship companies are alive to this method of transportation, and that three ships of one company alone are being fitted with carbon dioxide chambers. Thus the engineer with his refrigerating machines and automatic regulation of the carbon dioxide content of the chambers has enabled increased supplies of chilled beef to be placed at the disposal of the consumer of Great Britain. He has, in fact, increased both quantity and quality.

## Obituary

DR. L. COCKAYNE, C.M.G., F.R.S.

THE death, in Wellington, of Dr. Leonard Cockayne early in July at the age of seventy-nine years is recorded with deep regret.

Dr. Cockayne was born in Derbyshire in 1855, the youngest son of the late Mr. W. Cockayne. He went to Australia in 1879 and to New Zealand in 1880. At first he was engaged in teaching, but in 1887 he commenced his botanical exploration which he continued almost to the time of his death. The geographical position of the Dominion must in itself make a study of its flora and vegetation of supreme importance to all interested in the distribution of plants. Its richly endemic flora has attracted the attention of botanists from the time of Banks and Solander (1769-70) to the present day. Thanks to the activity of a large number of collectors, many of whom were, or are, resident in New Zealand, its flora has been relatively well investigated.

Cockayne's great contribution to New Zealand botany was his pioneer work in the ecological study of the vegetation, and the problems of plant evolution as presented by the native flora. His synecological publications commenced in 1899 with a paper on the burning and regeneration of sub-alpine scrub (*Trans. New Zeal. Inst.*, 31, 398; 1899), although he had already published accounts of the freezing of New Zealand alpine plants and of the seedling forms of New Zealand phanerogams. The titles of the scores of papers published by Cockayne indicate both the wide and original nature of his research and something of the stimulus he gave to the study of plant-life in the southern hemisphere. His extensive botanical travels in the Dominion and its dependencies gave him that wide knowledge which enabled him to write his *magnum opus*—"The Vegetation of New Zealand"—which was published, as vol. 14 of Engler and Prude's "Die Vegetation der Erde", in 1921. The first edition of this was disposed of within one year of its appearance, and a second edition was published in 1928.

Cockayne's special interests were undoubtedly centred in the study of plants as living organisms, and hence in the major problems of biology. Apart from vegetational studies he delighted in considering plant morphology from a dynamic point of view. His early investigation into the form of seedlings, his research on the variation of leaves, the significance of spines, and his field-studies on hybridism (carried on latterly in conjunction with Dr. H. H. Allan), indicate not only the intensive and extensive nature of his research, but also his desire to answer the how and wherefore of every problem connected with the botany of his adopted country.

In 1912, Cockayne published an important paper under the title "Observations concerning Evolution derived from Ecological Studies in New Zealand" (*Trans. New Zeal. Inst.*, 44, 1;

1912). This was followed by various other papers in which the evolutionary aspect was stressed. The significance of hybridisation as the immediate cause of polymorphism, which is a conspicuous feature of a very large number of genera in the New Zealand flora, was urged with justified conviction from the results of detailed field-studies of 'hybrid swarms'. His criticisms of taxonomic practice have, like much of his other work, an application far outside the study of New Zealand plants, and should be considered by all who believe in the fundamental importance of taxonomy.

Two other aspects of Cockayne's life-work must be mentioned. It was, perhaps, his early teaching experience which enabled him to produce a book so admirably suited as an introduction to New Zealand plant ecology as "New Zealand Plants and their Story". In this work the underlying idea is that of "the plants telling their own story", but the interpretation of this story discloses the master mind. A remarkable feature of the book is the simplicity of its language with its avoidance of the absurdities usually associated with over-popularisation. It is for New Zealanders themselves to estimate and acknowledge what they owe to Cockayne as a teacher in that broad sense of the term as one who by inspiration and example leads the way. It is obvious to others that the influence of such a textbook, of wide appeal, well produced and illustrated and yet of low price, must continue through many generations.

The application of ecology to economic problems was another feature of much of Cockayne's research. Forests, sand-dunes and pastures, especially the last, were investigated with the view of preserving, stabilising and improving them. That his own words—"it seems clear that New Zealand is attempting to do its economic ecological duty" (Report Imperial Botanical Congress, p. 266; 1925)—are true, is mainly due to Cockayne himself. His wide botanical knowledge made his advice of inestimable value on the Royal Commission on Forestry (1913), the Cawthron Commission (1919), the Royal Pastoral Commission (1920), as well as in his position of honorary botanist to the New Zealand State Forest Service.

Numerous honours were bestowed on Cockayne—the Hector Medal and Prize, the Hutton Memorial Prize, the Mueller Memorial Medal and Prize, the Darwin Medal of the Royal Society (1928), the Veitch Memorial Medal (1932). He was elected a fellow of the Royal Society in 1912 and created C.M.G. in 1929. He was a fellow and past president (1918-19) of the New Zealand Institute and in 1932 he received the honorary degree of D.Sc., New Zealand. The British Ecological Society fittingly recognised the importance of his contributions to ecological botany by making him an honorary member in 1933.

W. B. TURRILL.

PROF. B. D. STEELE, F.R.S.

THE death occurred at Brisbane on April 12 at the early age of sixty-three years of Bertram Dillon Steele, emeritus professor of chemistry in the University of Queensland. Prof. Steele was forced by ill-health to relinquish active teaching in 1928 and was given the title of emeritus professor in 1930.

Prof. Steele was brought up in England, but went to Australia with his family in early youth. First qualifying as a pharmacist, he later took his science degree in the University of Melbourne. He returned to Europe in 1899 with an 1851 Exhibition Scholarship. Following this, he held posts in McGill University, Montreal, and Heriot-Watt College, Edinburgh. He returned to the University of Melbourne as lecturer in chemistry in 1905. In 1910 he was appointed as first holder of the chair of chemistry in the University of Queensland. His scientific work in connexion with the determination of transport numbers of electrolytes and the electro-chemistry of non-aqueous solutions was carried out before his return to Australia. After his return to Melbourne, he designed in conjunction with Kerr Grant the very sensitive micro-balance later used by Ramsay and Gray for determining the density of radon.

The duties associated with a chair in a new university, however, left Prof. Steele little time for scientific work in his later life. He acted as first president of the Board of Faculties of the University, which was largely responsible for the organisation of the institution. Perhaps his most valuable contribution to public welfare in Queensland was his association as chairman with Government Commissions for the control of the prickly

pear. As a result of the activities of a Royal Commission, the pear, which was formerly encroaching on hundreds of thousands of acres of good land annually, is now actually being driven backwards.

During the War, Prof. Steele proceeded to England on leave from his University and entered the service of the Ministry of Munitions. He was responsible, among other activities, for the design and successful running of a synthetic phenol factory at Ellesmere Port, Cheshire.

PROF. GEORGE CARY COMSTOCK, emeritus director of the Washburn Observatory and professor of astronomy in the University of Wisconsin, formerly dean of the Graduate School, died on May 11, aged seventy-nine years. He was known for his determination of the constant of aberration, for studies of atmospheric refraction, for long-continued work on double stars, and especially for one of the first determinations of the proper motions of faint stars.

WE regret to announce the following deaths:

Prof. J. M. Aldrich, associate curator of insects in the U.S. National Museum, an authority on the Diptera, on May 27, aged sixty-eight years.

Prof. Harriet W. Bigelow, professor of astronomy at Smith College, Northampton, U.S.A., known for her work on comets and the positions of stars, on June 29, aged sixty-four years.

Prof. M. S. Pembrey, F.R.S., formerly professor of physiology in the University of London, known for his work on respiration, on July 23, aged sixty-eight years.

## News and Views

### Lessons of the Drought

THE *Times* Trade and Engineering Supplement of July 28 contains a special section devoted to a consideration of "Water Economy and Supply". In view of the continued predominance of the topic of the drought, the appearance of a symposium of the opinions of various competent authorities, including engineers and men of science, on the subject is undoubtedly opportune and appropriate, though it appears that the publishers, when the idea was first mooted, entertained misgivings lest a change of weather might destroy the basis of the number before its publication. The first article on "Lessons of the Drought", by Sir E. Hilton Young, the Minister of Health, is generally of the nature of a reassuring statement calculated to allay public anxiety. "There is," he says, "great need for care and attention to the situation, but none for alarm." He counsels economy in the use of water "where reserves are not abundant", and recommends water undertakers to look ahead and "assume that the drought will continue in large measure until the rains of November and December

and that even then there may not be more rain than last year, when it was much below the normal". The Water Shortage Act, passed in May last, has proved of signal service in enabling water authorities to augment their supplies.

SIR HILTON YOUNG discusses the question of future water policy, and, while conceding that measures could be taken to obviate economies during even severe drought, feels that the cost would be inordinately great and too heavy for the rate-payer to bear. It is, he says, a matter for careful thought how far to go in increasing permanently the cost of water in order to ensure against very exceptional scarcity. On the subject of lessons from the drought, survey and distribution indicate, in his opinion, the most fruitful field for improvement, but the survey he has in mind is not the survey now being pressingly urged on the Government by the British Association and the Institution of Civil Engineers. It is merely "that water undertakers should form as accurate an estimate as they can of their future needs, bearing in

mind the trend towards increase of consumption as well as the trend of the population". It is shown in the leading article of this issue of NATURE that this view of the situation is quite inadequate, and that something much more fundamental and drastic is required to meet the ever-increasing demands on the water resources of the country. Sir Hilton closes his contribution with a note on rural supplies in which he says that schemes costing a million sterling are "already in sight" and many more schemes are on the way.

#### Water Resources and their Administration

IN a succeeding article on "National Water Resources and the Need for a Comprehensive Survey", Mr. R. B. Dunwoody takes a much sounder and more practical view of the matter, recalling the investigation of the Royal Commission (1906-1911) on Canals and Waterways, which showed "a striking absence of statistical information as to the flows of rivers and streams, and consequently of the water available in different parts of the country". On the completion of the investigation, as secretary of the Commission, he submitted in 1911 to the President of the Local Government Board a scheme for a comprehensive survey of the water supplies of England and Wales. Considerable extracts are quoted from the memorandum, all indicating that it has much in common with the proposals for a survey now being urged on the Government. Mr. Clemesha Smith, in his article on "Regional Water Supplies", presses the need for co-ordination. Amplifying the policy of the appointment in several parts of the country of regional advisory committees, he considers that committees in respect of suitable areas should be set up covering the whole of England and Wales. He outlines the functions of the two sets of bodies he proposes, as follows: (a) regional committees, consisting of representatives of authorities, charged with the duty of supplying water for domestic purposes, empowered to demand the necessary information and able to raise funds to enable them to check statistics and examine and put forward proposals relating to water supply; and (b) water commissions, the duties of which should include considering the tabulated statistics prepared by the regional committees and advising them on the schemes submitted and as to improvements, amalgamations and variations. Mr. Smith emphasises that if problems of water supply are to be solved on rational lines, the first step must be the accumulation of accurate information, and the second the examination and consideration of the facts by recognised authorities.

#### The 24-Hour Time System

THE question of the 24-hour time system was raised in the House of Lords on July 27 by an inquiry from Lord Lamington whether a report on the working of this system by the British Broadcasting Corporation would be laid on the table of the House. Lord Templemore, speaking for the Government, said that no formal report has yet been received from the Corporation, but the Postmaster-General understands

that the Corporation will, before very long, make a statement on the subject. In the light of information given by the Corporation, the Government has had under consideration the question of extending the use of the 24-hour method of expressing time. Lord Templemore added that he was authorised to say that the Government, after carefully reviewing the whole question of adopting the 24-hour notation for official purposes, has come to the conclusion that there is still no sufficient evidence of a general public demand for any change to justify it in taking any action in the matter.

#### The British Broadcasting Corporation Experiment

THE B.B.C. has stated that there has been no evidence of either widespread opposition or support to the experimental use by it of the 24-hour system. An announcement will be made in due course to what extent, if at all, it will continue the use of the system for other than internal purposes. The experiment was intended to familiarise the public with the 24-hour notation, but has been widely misrepresented in a certain section of the Press as an attempt to impose the 24-hour system for the purposes of everyday life. One paper published photographs of the well-known 24-hour clock at the gate of Greenwich Observatory, and of an ordinary 12-hour dial, and held what was stated to be a plebiscite on the question of the 24-hour system. The voting paper required a cross to be placed against whichever dial was preferred, and the result was announced as a large majority against the 24-hour system. An increasing number of engineering, electrical and other organisations, which are in continuous operation by day and by night, are using the 24-hour system owing to its conveniences and no difficulties of any sort have arisen from its use. The use of the system by the B.B.C. should have educated the public sufficiently for time-tables using the 24-hour notation to be understood. It is to be hoped that the railway companies and road transport organisations will not wait any longer for a Government lead, but that they will introduce the 24-hour system in their time-tables by mutual agreement.

#### Scientific Research on Works of Art

THE forthcoming academic year will witness an important new development at the Courtauld Institute of Art, University of London. Since its inception, the Institute, which is under the directorship of Prof. W. G. Constable, has recognised the necessity for systematic and scientific research into the physical constitution of works of art: and a new Department and Laboratory of Scientific Research has now been brought into being at the Institute, at which such lines of investigation will be actively pursued. Such problems as the nature of the changes undergone by works of art on cleaning and renovation, and on exposure to atmospheric moisture and light, and the advantages of different methods of treating 'diseases' of works of art, will receive systematic investigation. So far, work in Great Britain has been carried out for the most part



by private investigators, though various laboratories abroad, such as those at the Fogg Art Museum, Harvard University, and at the Technical High School, Munich, have attacked the subject systematically. One of the main aims of the new Department will be the co-ordination of its results, with the view of publication, with these obtained in other centres, with which close relations will be cultivated. The head of the new Department and Laboratory is Dr. P. D. Ritchie, who will have the benefit of the knowledge and experience of a permanent advisory committee consisting of a number of prominent men of science and art experts. It is hoped that the Department will be in active operation by October, though no problems can be dealt with before that date.

#### International Anthropology and Ethnology

THE first session of the International Congress of Anthropological and Ethnological Sciences was opened by H.R.H. Prince George at University College, London, on July 30. The Congress is the outcome of a movement initiated more than twenty years ago, when in 1912, after the London Meeting of the International Congress of Americanists, a small international committee was appointed by the Royal Anthropological Institute to organise such a Congress. As a result of no little negotiation and correspondence, it was then arranged that a Congress should take place in 1916. Owing to the War, the Congress did not meet, and the proposal fell into abeyance, until in the course of the discussion of arrangements for the International Congress of Prehistoric and Protohistoric Sciences, which met in London in 1932, it emerged that the need for an international meeting ground for the discussion of the problems of ethnology was urgently felt. Experience gained by the inclusion of an ethnological section at the archaeological congresses organised after the War by the French Institut d'Anthropologie had proved to the satisfaction of most of those who had taken part that nothing short of an independent congress would prove satisfactory. Many, with good reason, were reluctant to add to the already large number of international scientific congresses; but the almost overwhelmingly heavy programme submitted at this first session is a sufficient proof of the wisdom of the decision. Not merely the number and the variety of the communications, but also the number of joint discussions between two or more sections—thirteen discussions in all—shows that, even within the limits laid down by those responsible for the organisation of the programme, the debatable questions in ethnology, which it is felt desirable to ventilate by open discussion, are numerous.

On the opening, the Congress numbered more than a thousand members, and delegates from no less than forty-two different countries were present when Lord Onslow delivered his presidential address at the inaugural meeting. America, both North and South, was well represented, owing to the approximation of the date to that of the forthcoming European session of the International Congress of Americanists

later in the month. This is a coincidence which the promoters had in view as a regular recurrence every four years, when the present year was chosen to initiate the series. As the presence of so many foreign anthropologists of distinction is not likely to occur again for a long time to come, every effort had been made to show them as much as possible of the ethnographical and archaeological treasures of our public and private collections, while a number of special exhibits had been arranged. Among these, one of the most striking was the exhibit of material brought back by Miss G. Caton-Thompson and Miss E. W. Gardiner from their investigations on behalf of the Royal Anthropological Institute at El Khargeh in Egypt. The exhibits illustrate the classification of stone implements into seven periods of the Stone Age, the fossil mound springs which have demonstrated the existence of two pluvial periods, and have afforded evidence not only of the character of the water supply but have also provided data bearing on the relation of prehistoric tools to fossil vegetation, of which the exact period and determination had hitherto defeated investigators. This exhibition will be on view to the public after the Congress for a period of three months. The British Museum also arranged an exhibit especially for American visitors, which included the famous Maudslay Maya plaster casts and examples of the antiquities obtained by the Museum's expeditions to British Honduras. Special interest also attached to the prehistoric pottery brought by Sir Aurel Stein from Baluchistan and Persia, in view of the subject of the Huxley Memorial Lecture, which he delivered on July 31, before the Congress.

#### Exhibits from Tell Duweir, Palestine

IN order to afford those attending the International Congress of Anthropological Sciences in London an opportunity of viewing the antiquities from Tell Duweir, the Exhibition of the Wellcome Archaeological Research Expedition in the rooms of the Palestine Exploration Fund, Manchester Square, remained open until August 3. Much interest was aroused by the exhibits, the inscribed ewer naturally attracting a great deal of attention. Further fragments of the ewer have been found among the material brought from Palestine, and these have added definition to its form, while the line of decoration is now almost continuous. A card exhibited with the ewer gave the alternative readings which have been proposed. Even more impressive were the relics from the sanctuary shrine in the fosse, of which the destruction is dated by the Rameses II plaque as not earlier than the first half of the thirteenth century B.C. The preservation *in situ*, and in some instances intact, of the appointments of the shrine gives the find a unique character. These objects, including the benches for offerings, the libation jar and offerings bin and the like, were displayed in and around a model reconstructed from squeezes. This exact record of a remarkable cult-object reflects the greatest credit on the initiative and technical skill of the members of the expedition.

THE significance, in an archaeological sense, of the shrine and of its extra-mural location as a non-urban cult, was much enhanced by the accompanying material, both that from the floor, such as the remains of the ivory toilet appliances, and that from the adjacent waste-heap, among the latter, more particularly, by the ivory carvings and inlay. The occurrence of an inscribed sherd, on which one character is conjecturally read *Aton*, if it should prove to be decipherable, may serve to throw an important light on the position of the reformed religion outside Egypt; while the ivories afford material for examination and discussion of no little moment for an understanding of the relations of artistic development in Egypt and Palestine. The resemblance of the ivory incense vase in the form of a female with a spoon attached to the head to that depicted in the British Museum fresco of *circa* 1415 B.C. from the tomb of Sebekhetep as being carried by an Asiatic tributary lends strong support to the view put forward by Mr. J. L. Starkey in his lecture at the Palestine Exploration Fund that these specimens afford evidence for the existence of a local school of craftsmen, of which later examples are to be seen in the products of Samaria. Of the remaining exhibits, little need be said. Their importance, especially in the instance of the pottery and metal objects from the Copper Age cave-dwellings and cemetery, was patent. The peculiar form of the copper darts, or javelin points, calls aloud for an analogy, which some technologist at the Anthropological Congress should have been able to furnish. This, though a lesser problem, is by no means the least intriguing of the material brought back by what must be judged by its material to have been a most successful expedition.

#### Climate and Health

THE one hundred and second annual meeting of the British Medical Association was held at Bournemouth last week under the presidency of Dr. S. Watson Smith, who took as the subject of his presidential address "Climate and Health". In the choice of this subject, he said, Bournemouth seemed a fitting place from which to speak. There are those who believe climate to be the most influential of the natural causes controlling the destinies of mankind. Apart from the secondary causes, biologically concerned, such as temperature, humidity, altitude, winds, soils, etc., the chief factor governing climate would seem to be insolation. The world distribution of sunlight, and the resulting variations of temperature, appear to determine the differences between coastal, plain, and hill climates; as also such matters as diversity of colour types of man. The importance of sunlight to life and health cannot be over-estimated, but it is desirable to impress upon the community that, whilst the sun is our greatest natural friend, it can, if regarded with disrespect, become an equally potent foe; for an excessive exposure to light rays, whether natural or artificial, not only entails fatigue and exhaustion, but also produces early degeneration of the skin. In the British Isles, all gradations exist

between the bracing and tonic, and the sedative and relaxing, climates, and a careful study of an invalid's general state of health and mental traits should be made before recommending the suitable place.

#### Medicinal Baths and Springs

WATERS and baths are to be looked upon as factors accessory to climate, over which they may have a dominating therapeutic influence. Spas frequently specialise in the treatment of particular ailments, and should be classified not only according to type of climate, but also upon their therapeutic indications. Whatever the chemistry of medicinal waters, their effects are several and complex. The biochemical action of medicinal waters is perhaps of greater moment than hitherto generally believed. Calcium, iodine, bromine, iron, salines, sulphur—all occur in readily assimilable form as a dilute solution of electrolyte in different spa waters, thereby providing a means of restoring to the individual what has been lost by dysfunction and disease. Medicinal springs and baths should be under a public control, ensuring regular analyses, purity, and the preservation of the natural amenities. These resorts should also provide a wide range of electrical, physical, and other accessory means of treatment for the re-education of body functions and structures. Britain being a most favoured land as to spas and health resorts, it is now generally recognised that there is seldom, if ever, medical necessity to winter abroad, unless it be to obtain by altitude, or by dry or sea air, a suitable climate for the tuberculous or asthmatic. On the other hand, there is no doubt that Continental or foreign travel, giving a complete change to body and mind, may often be beneficial in cases of mental strain and nervous trouble, producing a detachment from insular home prejudices, and encouraging an interchange of visits and courtesies from country to country.

#### Control of the Whaling Industry

THE Whaling Industry (Regulation) Bill, which passed almost unobserved through all its stages in the closing days of the parliamentary session, gives effect to one of the most hopeful attempts yet made to secure international action for the protection of animals. The great destruction of whales in antarctic seas has caused anxiety not only to those who would deplore the possible extermination of those great creatures, but also to those concerned for the future of the industry itself. In recent years, the use of 'floating factories', which can operate outside territorial waters, has rendered it impossible for individual Governments to control the industry in the way in which it could be controlled when the factories were on land. By a convention signed in 1931, the Governments represented on the League of Nations at Geneva bound themselves to introduce a system of licensing for all whaling ships registered in their respective countries, and to attach to the licences conditions giving partial or complete protection to certain species of whales. Several other nations have already ratified this convention by passing the

necessary legislation, and some surprise has been expressed abroad at the long delay in obtaining ratification by Great Britain.

THE Bill, which is about to pass into law, like that which has been passed in Norway, actually goes beyond the terms of the convention in one or two respects. Not only does it prohibit altogether the capture of what are known as 'Right' whales and of whales below certain sizes, to be prescribed for the different species, as well as of females accompanied by their young, but it also gives power to the licensing authority to establish a close season should this be deemed advisable. Furthermore, while the Geneva convention applies only to the whalebone whales, the present Bill gives authority for extending its provisions to any other species of whale, should such extension be internationally agreed upon. This clause might possibly become of great importance if, at any time, there should be a revival of the sperm whale fishery.

#### Recent Acquisitions at the British Museum

THE Department of Zoology has received as a donation from the Rowland Ward Trustees a crab-eating opossum (*Didelphys cancrivorus*) and a rat-tailed opossum (*Metachirus nudicaudatus*). A rare tree-kangaroo (*Dendrolagus ursinus*) from New Guinea is the gift of Sir Frank Colyer. The Study Collection has been enriched through the gift from Col. J. Hamilton Leigh of a collection of fifty mammals, mostly from Scotland. The most important specimens in this collection are a series of Scottish wild cats. The Department of Entomology has received as a gift from Dr. G. Arnold, Director of the Rhodesian Museum, the very valuable collection of ants which formed the basis of his "Monograph of the Formicidæ of South Africa" published in the *Annals of the South African Museum* (766 pp., 9 plates, 1915-1924). The collection contains upwards of 7,000 specimens, comprising examples of 653 species many of which have hitherto been unrepresented in the Museum. In the economic life of most tropical countries ants are an important factor, principally in the control of other insects, especially the so-called white ants. In this connexion, Dr. Arnold states that the food of one large group of ants consists of 80 per cent at least of these very serious pests. The Department of Botany has purchased sixty-four bundles of plants from the Saffron Walden Museum. There are about 3,500 foreign specimens many of which were purchased by W. Gibson at A. B. Lambert's sale. The most important of these are about 150 plants collected by the Rev. E. D. Clarke on his travels in the Crimea, Greece, Troy and elsewhere. It is probable that additional historical material will be recognised, as the collection is worked through.

FRAGMENTS weighing  $4\frac{1}{2}$  lb. of meteoric stones which fell on April 8, 1932, near Temiki on the north-eastern border of the Gash delta (about 250 miles east of Khartoum) have been presented to the Department of Minerals by the Director of the Geological Survey of the Anglo-Egyptian

Sudan. This is the first meteorite to be recorded from the Sudan, and it appears to be of an unusual type. Pieces of two notable iron meteorites, one from the meteorite crater recently recognised near Odessa in Texas, and the other from the 15-ton mass at Mbosi in Tanganyika Territory have been presented respectively by Mr. George C. Fraser of New York and Mr. H. V. B. Lloyd-Phillips. The latter has also given a rich specimen of gold quartz from a newly discovered reef in the Lupa goldfield, Tanganyika Territory. Gold specimens from three mines in the Tati district, Bechuanaland Protectorate, and a nugget of platinum from Abyssinia, have been given by Mr. Hugh S. Gordon. Metajarlite, a new mineral from Greenland, is presented by Dr. Richard Bøgvad of Copenhagen, and lusakite, a new cobalt mineral named after the new capital of Northern Rhodesia, by Mr. A. C. Skerl. A faceted gem of olivine from Burma, of a rich colour and weighing 101.75 carats, and some tektites 'rizalites', recently discovered in the Philippine Islands, and of unknown origin, have been purchased.

#### Liver Rot and the Drought

THE Ministry of Agriculture and Fisheries points out that, as a result of the prolonged drought, the breeding places of the water-snail which is responsible for the early stages of development of the liver fluke, which causes 'liver rot' of cattle and sheep, have been considerably reduced, large areas of wet land having dried and only small wet patches and pools left. An opportunity is thus afforded for taking decisive measures for the eradication of the liver fluke from the farm. It is recommended that the remaining haunts of the snail should be dressed with a mixture of finely powdered bluestone and dry sand, in the proportion of 1 to 4, at the rate of one-quarter to one-half hundredweight to the acre. A second dressing should be applied, if possible, after an interval of three weeks, animals being kept away from the treated ground until after rain has fallen. A further measure is to treat all adult sheep with carbon tetrachloride or with extract of male fern, which will expel any mature flukes the animals may be carrying. Further particulars are given in Leaflet No. 89, which may be obtained free of charge from the Ministry, 10 Whitehall Place, S.W.1.

#### American Ascent into the Stratosphere

THE ascent of an observation balloon into the stratosphere, organised by the National Geographic Society and the U.S. Army Air Corps, described in NATURE of July 28, p. 132, took place over Rapid City, North Dakota, on July 29; but, after rising 60,000 ft., the balloon ripped open and dropped to earth. The pilot, Major W. E. Kepner, and the observers, Capt. A. W. Stevens and Capt. O. A. Anderson, however, were saved by means of parachutes. The gondola, with the remnants of the balloon, fell into a field near Loomis, Nebraska. According to the *Times* report, it was much damaged, but most of the scientific instruments escaped harm.

### New Gliding Record

ACCORDING to a *Times* correspondent, the world's long-distance record for motorless flights, set up on July 27 by Herr Wolfgang Hirth, who flew to Görlitz, in Silesia, about 212 miles, in six hours was beaten by Herr Heini Dittmar, of Darmstadt, on July 29. Leaving the Wasser Kuppe at 11.30 a.m., Dittmar reached Liban, in Czechoslovakia, about 235 miles distant, at 6.30 p.m. It was Herr Dittmar's first flight on a new type of glider called the Fafnir No. 2, newly built by the Research Institute for Motorless Flying at Darmstadt.

### Indian Research Expedition

It is announced that an expedition, of which Dr. Quaritch Wales is field director, will leave England for India in October next for the purpose of archaeological exploration in Lower Burma and Siam. His Highness the Maharajah Gaekwar of Baroda has contributed £500 towards the expenses of the expedition, which will be known as the Gaekwar of Baroda Greater Indian Research Expedition. The work of organisation has been in the hands of a small committee of the Royal Asiatic Society, the India Society, and the School of Oriental Studies, under the chairmanship of Sir Francis Younghusband. The area which the expedition proposes to explore is one of the few districts of Further India and beyond which is still unexplored, and it may be anticipated that the expedition, under the leadership of Dr. Wales, who has already done valuable work in Siam, will yield material which will throw light on artistic and religious development in Further India and Siam and the cultural relations of these countries to the art, culture and religions of ancient India.

### Sixteen Element Oscillograph

IN research into electrical engineering problems, the analysis of circuit performance and of the related physical phenomena frequently demands the simultaneous recording in correct time relationship of a large number of transient electrical quantities. The Research Department of the Metropolitan-Vickers Electrical Co. Ltd. has recently completed the design and construction of an electromagnetic oscillograph for recording no less than sixteen quantities simultaneously on a single film. Films up to 12 in. wide and 36 in. long may be used. The operation of the oscillograph is initiated automatically. The instrument requires the attention of one person only.

### Mendeléeff Periodic Law

REFERRING to Prof. B. N. Menshutkin's letter in *NATURE* of June 23, Dr. G. Rudolf, 46, Lanchester Road, Highgate, N.6, writes to point out that German translations of Mendeléeff's papers are readily available in Ostwald's "Klassiker" (No. 68). A German translation of Mendeléeff's second long paper also forms part of supplement vol. 8 (1871) of Liebig's *Annalen*. Mendeléeff published a third table in 1880 (*Ber. chem. Ges.*, vol. 13, p. 1796).

### Announcements

At a special meeting of the Trustees of the Carnegie Trust for the Universities of Scotland held in London on July 27, Sir Arthur Rose was appointed chairman of the Trust in succession to the late Lord Sands.

THE City of Leicester has published a guide to the works in its libraries dealing with science and its applications. The list is a classified catalogue of 65 pages, and contains a selection of the more modern books, and those considered by the compilers as likely to be of greatest help to serious readers.

At a meeting of the Royal College of Physicians of London on July 26 the following appointments were announced: Sir Henry Dale, as Harveian orator, 1935 (the forthcoming Harveian oration in October next will be delivered by Dr. James Collier); Dr. Daniel T. Davies as Bradshaw lecturer, 1935; Dr. J. S. Bolton as Lumleian lecturer, 1935; Dr. A. A. Moncrieff as Goulstonian lecturer, 1935; Dr. J. D. Rolleston as FitzPatrick lecturer, 1935; Dr. C. R. Harington as Oliver-Sharpey lecturer, 1935; Dr. C. G. Seligman as Lloyd Roberts lecturer, 1935; and Sir Bernard Spilbury as Croonian lecturer, 1936. The Murchison scholarship was awarded to Stanley G. Browne, of King's College Hospital Medical School.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A professor of physics in the Royal School of Engineering, Giza—The Vice-Principal, c/o The Director, Egyptian Education Office, 39, Victoria Street, London, S.W.1 (Aug. 7). A civilian education officer in the Royal Air Force Educational Service—The Secretary (A.E.), Air Ministry, Adastral House, Kingsway, London, W.C.2 (Aug. 10). An inspector for the purposes of the Diseases of Animals Act, 1894–1927 in the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1 (Aug. 13). An assistant in the Electrical Engineering Department of the Coventry Technical College—The Director of Education, Council House, Coventry (Aug. 14). An adviser in agricultural zoology in the University College of South Wales and Monmouthshire, Cardiff—The Registrar (Sept. 1). A director of research of the Research and Standardization Committee of the Institution of Automobile Engineers—The Secretary, Watergate House, York Buildings, London, W.C.2 (Sept. 1). An engineer and ship surveyor—The Senior Staff Officer, Establishment Department (Mercantile Marine Branch), Board of Trade, Great George Street, London, S.W.1 (Sept. 12). Readers in medicine, surgery, obstetrics and gynaecology, pathological chemistry and bacteriology at the British Post-Graduate Medical School—The Academic Registrar, University of London, S.W.7 (Sept. 17). A university professor of pathology and a professor of medicine at St. Bartholomew's Hospital Medical College—The Academic Registrar, University of London, S.W.7 (Sept. 18). A professor of anatomy in McGill University, Montreal—The Secretary, Faculty of Medicine (Nov. 1).

### Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

#### Radioactivity induced by Bombardment with Neutrons of Different Energies

FOLLOWING the announcements of Fermi and his collaborators<sup>1</sup> on the radioactivity induced in many substances by bombardment with neutrons, we have undertaken some similar experiments. Using sources containing 50–100 millicuries of radon mixed with finely powdered beryllium, we have been able to confirm in general the results reported by Fermi, in addition to obtaining a few results independently similar to some which have since been, or are now being, published by him.

With the help of Dr. Oliphant, we have also been able to examine the effects induced by the neutrons produced by bombarding various substances with 200–250 kv. diplons<sup>2</sup>. This gives some very interesting information as to the effect of neutrons of different energy. The table given below gives the general trend of our measurements, although the figures are at present only very approximate.

Element bombarded	Period of decay	Source of neutrons			
		Be + Rn	Li + D	Be + D	D + D
Fluorine	8 secs.	100	10	<1	< $\frac{1}{2}$
Silicon	2½ mins.	100	50	<1	<1
Phosphorus	2½ mins.	100	30	<1	<1
Phosphorus	2½ hours	100	50	30	30
Silver	40 secs.	100	10	15	15

Relative rate of production of active atoms by neutrons from different sources (the effect from Be + Rn taken as 100 in each case).

The number of neutrons from each source was estimated using a paraffin-faced ionisation chamber and a linear amplifier of the Wynn-Williams type connected to an oscillograph. The above figures have been calculated so as to correspond to sources giving an equal number of oscillograph deflections definitely greater than the unavoidable background. This is the simplest method of estimating the relative number of neutrons, but may be subject to error when comparing neutrons of different energies.

It will be noticed that in no case was the efficiency of production (for equal numbers of neutrons) as great with the newer sources as with the original Be + Rn source, but nevertheless the behaviour of the Li + D neutrons was not very different. With the other two neutron sources, however, several of the effects do not appear to be excited at all; the case of phosphorus, where the long period is strongly excited while the short period is undetectable, even with a short exposure to the neutrons, being very striking. The neutrons from Be + Rn and Li + D are both believed to be heterogeneous with energies up to nearly fifteen million electron-volts, while the neutrons from D + D are believed to be nearly homogeneous and of energy about two million volts. It would appear from our results that the proportion of high energy neutrons from Be + D must be small, in contrast with the recent results of Livingstone, Henderson and Lawrence, and also of Kurie<sup>3</sup>, using three million volt diplons. It is also interesting

to note that the reactions which do not appear to occur with the last two kinds of neutrons are those which from general considerations, such as the hardness of the emitted  $\beta$ -rays, would appear to require more energy for their excitation.

We wish to thank Dr. M. L. E. Oliphant for his assistance, and for putting his apparatus at our disposal for these experiments, and Lord Rutherford for his continued interest in our work and for much helpful advice. The experiments are being continued, and fuller details will be published later.

T. BJERGE.

C. H. WESTCOTT.

Cavendish Laboratory,  
Cambridge.  
July 21.

<sup>1</sup> See, for example, NATURE, 133, 757, May 19, 1934.

<sup>2</sup> Oliphant, etc., Roy. Soc. Proc., A, 141, 722; 1933; and A, 144, 692; 1934. Also Lauritsen, etc., Phys. Rev., 44, 692; 1933.

<sup>3</sup> Amer. Phys. Soc. Proc., Berkeley Meeting, June 18, 1934, Abstract 12, and private communication to Dr. Oliphant.

#### Development of the Lightning Discharge

WE should like to give a brief account of some further results obtained with the Boys lightning camera, which has now been modified so as to include a means of determining the order of the component strokes of a discharge.

The material available refers to 55 lightning flashes from eleven different thunderstorms, and the total number of separate strokes photographed is 145. Of these, 65 show clearly the two-fold character which we have previously reported<sup>1,2</sup>, namely, a downward-moving leader stroke which at the moment it strikes the ground causes the development of a faster and more intense upward-moving main stroke. If we exclude those strokes photographed under definitely bad conditions (too great a distance, obscured by rain, etc.) the fraction of the strokes showing the leader mechanism is raised from 45 (65/145) to 82 per cent (41/50). Similarly, while 62 per cent (34/55) of the separate flashes show one or more examples of leaders, the fraction is raised to 86 per cent (18/21) if we consider the better photographs only.

The results thus suggest that the leader-main stroke sequence is the most common type of development in the discharge to ground. We have not yet met with more than one or two cases which may be considered significant exceptions. The polarity of the cloud-base in the majority of these flashes is negative, and cases of the reverse polarity are too rare in South Africa for us to have much evidence as to their behaviour. In the case of flashes which do not strike the ground, we do not observe the second or main part of the stroke.

An interesting feature of this new material is that it establishes the general manner in which branches are formed. We find that the downward-moving leader blazes these branches as well as the main trunk of the discharge and that the subsequent main stroke, in its upward course, turns aside to follow the branched leader down such a branch until it catches up with it. We have now 20 cases of downwardly branched leaders, taken from 16 different lightning flashes.

The most important point, however, which emerges from a consideration of these new photographs is that there is a characteristic difference between the leader to the first stroke of a discharge

and the leaders to subsequent discharges along the same track. While the latter are of a continuously-moving, dart-like character followed by fainter luminosity, the first leader is a luminous streamer extending in a discontinuous step-by-step manner from cloud to ground. The length of each step is about 50 metres, and, after completing a step, the streamer luminosity practically disappears for a time of the order of  $10^{-4}$  seconds. After this extinction period, the streamer travels downwards over the old track without developing much light, but as it enters virgin air at the end of the old track it blazes a fresh step very brightly and appears to stop. Since it is difficult to photograph much more than the bright fresh step at the tip of each streamer, the record of this type of leader is usually only a series of elongated dots extending from cloud to ground and separated considerably from one another along the time axis by the camera motion during the extinction period.

This 'stepped' leader is shown on 22 out of the 55 first strokes on our records and is so difficult to see that we consider it must have been present in many other cases. It is shown on 74 per cent (14/19) of our better records. It has not been found associated with any strokes other than the first of a series along the same track. Conversely, no continuous dart-like leaders have been found blazing the way for first strokes.

Owing to numerous pauses in its progress, a stepped leader takes a comparatively long time to reach the ground, sometimes more than one-hundredth of a second, though the velocity of the extending streamer itself is very high. Electromagnetic radiation from such steps would be on a wave-length of approximately 30 km., which is that of the ripple on many atmospheres. The sound waves emitted would have a frequency of about 10,000 and could produce the sound of tearing linen sometimes reported for a close discharge.

We wish to thank the Lightning Research Committee of the South African Institute of Electrical Engineers for permission to publish this letter.

B. F. J. SCHONLAND.

University of Cape Town.

H. COLLENS.

Victoria Falls and Transvaal Power Co.

D. J. MALAN.

University of the Witwatersrand.

<sup>1</sup> NATURE, 132, 407, Sept. 9, 1933.

<sup>2</sup> Proc. Roy. Soc., A, 143, 654; 1934.

### Constitution of Carbon, Nickel and Cadmium

DURING recent years considerable controversy has taken place over the atomic weight of carbon, the values obtained by chemical methods and by density determinations ranging from 12.000 to 12.010. At the same time, the abundance of the rare isotope C13 first supposed to be about 1 in 400, has recently been estimated to be as high as 1 per cent.

I have now applied the methods of photometry of mass-spectra to the problem. This could only be done by the use of the comparatively weak second order lines of the element at 6 and 6.5. With alternating exposures of 15 minutes against 5 seconds consistent results were obtained but unfortunately three corrections due to the position of the lines, photographic efficiency and a background effect were all large and rather uncertain. After applying these

the most probable ratio of abundance appears to be  $140 \pm 14$ . Allowing for the packing fraction of C12 and change of scale we get:

$$\text{Atomic Weight of Carbon} = 12.0080 \pm 0.0005.$$

The analysis of nickel by means of its carbonyl has been repeated, and the more intense mass-spectra obtained reveal two new isotopes 62 and 61. Lines at 56 and 64 present to less than 1 per cent are probably due to isotopes, but this is not yet certain.

Further work with cadmium has yielded much more intense mass-spectra. These confirm mass-numbers 114, 112, 110, 111, 113, 116 and reveal three new faint ones 106, 108, 115 in this order of intensity.

Svensson<sup>1</sup> has already claimed to have demonstrated the presence of isotopes 118 and 108 by observations on the band spectra of cadmium hydride. The new mass-spectra show that the former cannot be present even to the extent of 0.3 per cent. This discrepancy, and his failure to detect the more abundant isotope 106, suggest that the arguments on which his claim is based are not strictly valid.

F. W. ASTON.

Cavendish Laboratory,

Cambridge.

July 21.

<sup>1</sup> NATURE, 131, 28, Jan. 7, 1933.

### A General Equation for Induced Polarity

ORGANIC reactions, of which the speed can be affected by the presence of a 'polar' substituent in a molecule, have been classified into two groups<sup>1</sup>, for each of which Nathan and Watson<sup>2</sup> have suggested, from analysis of experimental data, an empirical equation to correlate the energy of activation with the dipole moment of the polar substituent. For Class A reactions, accelerated by electron access to the point of attack, they suggest  $E = E_0 - C(\mu - \alpha\mu^2)$ , and for Class B reactions, accelerated by electron recession from the point of attack, they suggest  $E = E_0 + C(\mu + \alpha\mu^2)$ .

I have pointed out<sup>3</sup> that the field of a dipole operating on any other pole or dipole, whether in the same or any vicinal molecule, will bring about an energy change  $\Delta E$  varying as  $\mu\mu'$  or as  $\mu e$ , and that induction of a secondary dipole in a covalent link will bring about an energy change  $\Delta E$  varying as  $\mu^2$ .

If the sign of the energy changes enumerated above be considered, it will be seen that the effect of electrostatic induction in a molecule will be to reduce the energy content of the covalent links, since electrons, etc., will tend to move from their unperturbed states to an environment of lower potential energy in the field of the neighbouring dipole. Hence the induction term will always be positive in the activation equation, in which  $+E$  represents energy that must be gained before the requisite activation can occur. In contrast, the energy change due to the field of the dipole can be of varying sign, according as the terms  $\mu\mu'$  and  $\mu e$  give a positive or negative product. One general equation  $E = E_0 + a\mu\mu' + b\mu e + c\mu^2$ , in which  $a\mu\mu'$  and  $b\mu e$  represent vector sums, will therefore fit all cases of induced polarity.

For Class A reactions,  $(a\mu\mu' + b\mu e)$  becomes negative; and for Class B reactions it remains positive. Qualitative study of general induced polarity has shown how, in the majority of cases,

the resultant sign of this 'field effect' term can be decided from inspection of a structural formula.

In connexion with a recent note published by Ingold<sup>4</sup>, one must point out that the perturbation of the electronic state of a covalent bond by the inductive effect of another pole or dipole should not be regarded as involving any exchange degeneracy of the normal state of the bond. One may suggest that a criterion for the existence of this 'exchange degeneracy' between different parts of a molecule may be that chemical reactivity at one of the points so affected does not proceed at the rate required by the simple activation hypothesis<sup>5</sup>.

W. A. WATERS.

University Science Laboratories,  
Durham.  
June 26.

<sup>1</sup> Ingold and Rothstein, *J. Chem. Soc.*, 1217; 1928.

<sup>2</sup> Nathan and Watson, *J. Chem. Soc.*, 1248; 1933. *NATURE*, 133, 380, March 10, 1934.

<sup>3</sup> Waters, *J. Chem. Soc.*, 1551; 1933.

<sup>4</sup> Ingold, *NATURE*, 133, 946, June 23, 1934.

<sup>5</sup> Cf. Hinshelwood, *J. Chem. Soc.*, 1360; 1933.

### Magnetron Oscillations of a New Type

DURING the last year, a new type of magnetron oscillations has been widely used in the Philips' laboratories. These oscillations are obtained by raising the magnetic field above the critical cut-off value in a split anode magnetron. Preferably four anodes are used, which are connected together in opposite pairs, in order to obtain two outside connections.

It can be shown theoretically that when once a small oscillating potential is set up between the two anodes of an ordinary split-anode type, or between the two pairs of anodes of a four-plate magnetron, electrons can reach the anodes after a spiral path with constant angular velocity (equal to  $2\pi f$  in the two-plate magnetron, and equal to  $\pi f$  in the four-plate magnetron), with a linear velocity much smaller than that which corresponds to the D.C. potential of the anodes, so that strong oscillations can be built up. The frequency is determined approximately by the following equation:

$$\omega = 2V_a/ra^2H \text{ for a two-plate magnetron, and} \\ \omega = 4V_a/ra^2H \text{ for a four-plate magnetron.}$$

(Note the inverse proportion to  $H$ .)

These theoretical formulæ are well confirmed by experiment.

In the case of a four-plate magnetron, the filament or the filaments should preferably be arranged eccentrically to facilitate the starting up of the oscillations. More than four anodes would yield a still higher frequency, but would require more eccentricity of their filaments. Hitherto four anodes have been found to be the most preferable configuration and efficiencies of 50 per cent and more with energies of 50 watts can be easily obtained for a wave-length of 60 cm. With a diameter of 1 cm., strong oscillations of this type are obtained down to 40 cm. (output 30 watts). There is no doubt that decreasing the diameter will yield much smaller wave-lengths, though with less energy.

K. POSTHUMUS.

Natuurkundig Laboratorium,  
N. V. Philips' Gloeilampenfabrieken,  
Eindhoven.  
June 30.

### Atomic Constants deduced from Secondary Cathode Ray Measurements

IN a recent paper<sup>1</sup> published under the above title by Andrews, Irons and me, values of the kinetic energies of secondary cathode rays were tabulated and compared with the values to be expected theoretically (that is, from the Einstein photoelectric equation and the accepted data of X-ray spectroscopy).

Our values of the kinetic energies were deduced from measurements of  $rH$  ( $r$ =radius of curvature of the path of an electron in a field of  $H$  gauss perpendicular to the plane of the path). In order to deduce the kinetic energies from the magnetic deflections, and to express them in a form suitable for comparison with X-ray data, it is necessary to assume values of the fundamental constants  $e$ ,  $e/m_0$ , and  $h$ . In the paper we took  $e=4.770 \times 10^{-10}$  e.s.u.,  $e/m_0=1.759 \times 10^7$  e.m.u./gm., and  $h=6.543 \times 10^{-27}$  erg. sec. Our energy values came out, on the average, and on the whole very consistently, about 0.5 per cent higher than those deduced from X-ray data. For the latter we took the standard 'crystal' values; if 'ruled grating' values are used, the discrepancies are still greater.

It is the main purpose of this note to point out that a remeasurement of our instrumental constants has revealed a small, but appreciable, error affecting all the measurements listed in the paper. There appear to have been two sources of error, each less than 1 part in 2,000, but unfortunately both in the same sense, namely: (1) a small error in the setting of the field coils, and (2) an error in the allowance made for an uncompensated component of the permanent magnetic field in the laboratory. The combined effect of these, expressed as a percentage of  $rH$ , obviously varies with the field in use, but 1 part in 1,250 (0.08 per cent) may be taken as a satisfactory average value for the fields used in the greater part of the work. Repetitions have been made of typical experiments at different stages of the earlier work, and it seems certain that the experimental conditions and instrumental constants have remained unaltered throughout the whole series.

In the region with which we are dealing, kinetic energy is very nearly proportional to  $(rH)^2$ , therefore the quoted energies, as determined in our experiments, all require to be reduced by 0.16 per cent. This reduces the discrepancy between 'photoelectric' and 'crystal' values to a little more than 0.3 per cent.

It may also be pointed out that if we take  $e=4.768 \times 10^{-10}$ ,  $h=6.547 \times 10^{-27}$  (Birge's later values) and  $e/m_0=1.757 \times 10^7$  (a value which is low compared with those accepted until quite recently, but which is now showing definite signs of becoming fashionable), the discrepancy is still further reduced by another 0.22 per cent—that is, to an order of magnitude compatible with quite optimistic estimates of experimental errors.

I have pleasure in thanking Profs. R. T. Birge and A. E. Ruark for their kindness in communicating to me privately some of their results bearing on this work.

H. R. ROBINSON.

East London College.  
July 3.

<sup>1</sup> Robinson, Andrews and Irons, *Proc. Roy. Soc., A*, 143, 48; 1933.

### Ratio of the Magnetic Moments of Proton and Diplon

RECENT investigations of Farkas and Sachsse<sup>1</sup> have shown that the ortho  $H_2 \rightleftharpoons$  para  $H_2$  transformation is catalysed by paramagnetic gases such as oxygen or nitric oxide. This effect is due to the inhomogeneous magnetic field of the oxygen or nitric oxide molecules acting on the magnetic moment of the protons. The fact that a similar process is observed in the case of diplogen shows that the magnetic moment is also in this case different from zero. From the ratio of the reaction velocities in hydrogen and diplogen, A. Farkas, L. Farkas and P. Harteck<sup>2</sup> have calculated, using the theory of Wigner<sup>3</sup>, the ratio of the nuclear magnetic moments. They found the magnetic moment of a diplon to be 5.5 times smaller than that of a proton.

In an investigation which will be published shortly, we have considered some details of the theory of this reaction in order to determine with the greatest possible accuracy the ratio of the magnetic moments. Owing to the special interest in the numerical value of the magnetic moment of the diplon, we mention here the main results.

In the paper by A. Farkas, L. Farkas and P. Harteck, the influence of the different mechanical nuclear moments on the transition probabilities was not taken into account. Including this effect in the calculations, one can show that the probabilities of ortho  $\rightarrow$  para and para  $\rightarrow$  ortho transitions are propor-

tional to  $\left(\frac{S}{2S+1}\right)\left(\frac{2S+1}{S}\right)^2$  and  $\left(\frac{S+1}{2S+1}\right)\left(\frac{2S+1}{S}\right)^2$

respectively, where  $S$  is the nuclear spin. Using the values  $S = \frac{1}{2}$  for a proton and  $S = 1$  for a diplon, we obtain for the ratio of the magnetic moments the value 4 instead of 5.5.

In Wigner's calculations, however, rather special assumptions concerning the spatial distribution of the perturbing forces are involved, so that this new value is also to be regarded as tentative. Therefore, we should like to direct attention to the fact that results of greater reliability can be obtained if the experiments are performed at the absolute temperature  $T$  for  $H_2$  and at  $T/2$  for  $D_2$ . In this case nuclear spins  $S$ , magnetic moments  $\mu$  and reaction velocities  $k$ , which are to be compared at the same molar volumes, are connected by the simple relation:

$$\left[\frac{2\mu_D S_P (2S_D + 1)}{\mu_P S_D (2S_P + 1)}\right]^2 = 2 \frac{k^{T/2}_D}{k^T_P}$$

This formula can be derived without assuming any special mechanism of collision, and by neglecting only the minor effects of the intermolecular Van der Waals forces and of the motion of the paramagnetic molecules. Therefore the ratio  $\mu_D/\mu_P$  can be obtained with an accuracy of a few per cent as soon as the reaction velocities  $k^T_P$  and  $k^{T/2}_D$  have been measured.

F. KALCKAR.

E. TELLER.

Institute for Theoretical Physics,  
Copenhagen.  
June 30.

<sup>1</sup> *Sitz. Ber. Preuss. Akad. Wiss. Berlin*, 268; 1933. *Z. phys. Chem.*, B, 23, 1, 19; 1933.

<sup>2</sup> *Proc. Roy. Soc., A*, 144, 481; 1934.

<sup>3</sup> *Z. phys. Chem.*, B, 23, 28; 1933.

### X-Irradiation of Fused Silica

IN experiments which involved the exposure of fused silica to X-rays, it was observed that the fused silica discoloured. The colour was a very dark violet, and disappeared on heating. The silica was of the clearest and most homogeneous optical quality and presumably very pure. We thought it conceivable, therefore, that the coloration might be due to a reduction of silica to silicon and, since silicon is an excellent reflector in the ultra-violet, that the discoloured irradiated surface might reflect better in the ultra-violet than an unirradiated surface.

Part of the surface of a piece of fused silica was, therefore, irradiated for four hours by radiation from a Shearer tube with a silver target carrying five milliamperes at 70 kilovolts. The relative reflection from the irradiated and clear parts was found by illuminating with light from a quartz mercury vapour lamp, and measuring the intensity of the reflected beam by a photocell with a sodium cathode and a quartz window combined with a Wratten filter No. 18a which transmits only over the range 3000-4000 Å. The intensity of the beam reflected from the irradiated part was nearly six per cent greater than that from the clear part. Irradiation for a further four hours was carried out, and the irradiated part was then found to reflect above nine per cent more than the clear part. To test whether similar properties appear in the visible, a filament lamp was used as a source and the reflected light was measured with a photronic cell the maximum sensitivity of which was in the region of 0.6 $\mu$ . It was found that the reflection from the irradiated part was not measurably greater than that from the clear part.

A piece of crystalline quartz was similarly irradiated for a total of eight hours. Only a very slight discoloration occurred in this case, and experiments showed that there was no detectable difference between the reflecting powers of the irradiated and non-irradiated parts of the surface.

It is intended to carry out the measurements on reflection farther into the ultra-violet, including the vacuum region.

F. TWYMAN.

F. BRECH.

Research Department,  
Adam Hilger, Limited,  
98, Kings Road,  
Camden Road,  
London, N.W.1.  
July 11.

### Glutathione and Vitamin C in the Crystalline Lens

ESTIMATIONS of the ascorbic acid (vitamin C) content of the crystalline lens, by the indophenol titration method of Tilman, indicate that the crystalline lens contains about 0.26-0.46 milligrams ascorbic acid per gram of lens. Von Euler and Martius<sup>1</sup>, Birch and Dann<sup>2</sup>, and Müller<sup>3</sup> are of opinion that a considerable amount of the iodine-reducing substances in the crystalline lens, hitherto considered to be glutathione, is actually ascorbic acid.

Because of the importance of these facts in the consideration of the etiology of cataract, I should like to point out three facts obtained by our study of the sulphhydryl system of the crystalline lens—



the data being secured in collaboration with Drs. Hess and Sullivan, of the Chemo-Medical Institute of Research, Georgetown University.

Our data for the glutathione content of the crystalline lenses of cattle, as determined by the Okuda method<sup>4</sup>, are in the neighbourhood of 0.330 per cent. Considering that there was no cysteine-containing substance other than glutathione in the sulphosalicylic extracts of the crystalline lens, it was reasoned that acid hydrolysis of an aliquot part should allow us to determine the cysteine liberated from the hydrolysed glutathione. This was actually a fact; the highly specific Sullivan method<sup>5</sup> indicates that fully 91 per cent of the theoretically available cysteine from the titration value for glutathione is accounted for in the hydrolysate. The Sullivan test, when applied directly to the sulphosalicylic extract, is negative, indicating that there is no free cysteine or cystine present in the crystalline lens. The close correlation between the figures for glutathione obtained by direct titration and the cystine values for the hydrolysates indicate to us that the Okuda titration method is fairly accurate for estimating the glutathione content of the *crystalline lens*.

Because of the obvious difficulty in further correlating our data for glutathione with the figures published for the vitamin C content of the lens, I added 2.5, 3.5 and 5.0 gm. of fresh crystalline lens daily to a basal diet lacking vitamin C of each of three groups of guinea-pigs. The experimental animals survived no longer than the controls. This indicates that the crystalline lens contains only small amounts of ascorbic acid and that there is possibly another iodine-reducing substance in the crystalline lens, other than glutathione or ascorbic acid. This likewise appears to be the case in the cancerous tissues examined by Boyland<sup>6</sup> for glutathione and vitamin C.

Our data have led me to these conclusions:

(1) Because of the negative Sullivan reaction of direct extracts, the crystalline lens contains no free cysteine or cystine.

(2) The iodine-reduction titration method of Okuda, when applied to extracts of the crystalline lens, determines fairly accurately the reduced glutathione content.

(3) Although the indophenol reagent indicates that there is considerable amount of ascorbic acid (vitamin C) in the crystalline lens, biological feeding experiments indicate that the addition of 2.5, 3.5 or 5.0 gm. of fresh crystalline lens daily will not support growth of guinea-pigs on a diet lacking vitamin C.

EVERETTE I. EVANS.

Department of Physiology,  
University of Chicago.

### Microchemical Analysis of Plane Polished Surfaces by means of Monochromatic X-Ray Images

THE usual methods of X-ray spectroscopy only permit the chemical analysis of objects of homogeneous composition. In the following note a new method is described which makes possible the

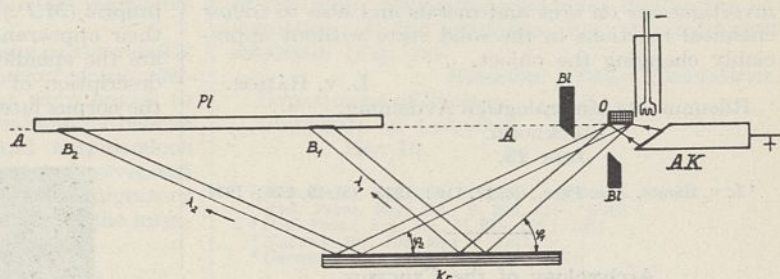


FIG. 1.

examination of surfaces with locally variable chemical composition.

The apparatus used is shown diagrammatically in Fig. 1. The surface of the object *O* to be examined is exposed to the X-ray radiation emerging from the target *AK*. This primary radiation gives rise to

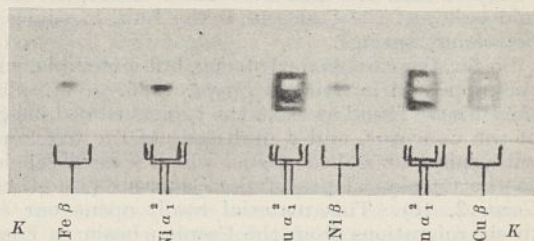


FIG. 2.

characteristic secondary X-ray radiation the wavelength of which varies with the chemical composition of the surface elements from which it originates. The sodium chloride crystal *Kr* curved to a cylindrical surface with the axis *A-A* forms by reflexion<sup>1</sup> a series of monochromatic images corresponding to

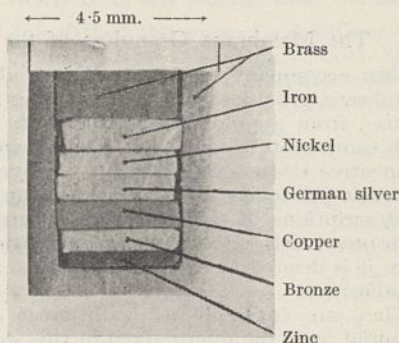


FIG. 3.

each secondary wave-length on the photographic plate *Pl*. Each of these images is due to a definite chemical element, and consequently shows the distribution of this element over the surface to be examined. Fig. 2 shows part of the X-ray image spectrum obtained by this method from the metal

<sup>1</sup> Von Euler and Martius, *Hoppe-Zeylers Z. Physiol. Chemie*, 222, 65; 1933.

<sup>2</sup> Birch and Dann, *NATURE*, 131, 469, April 1, 1933.

<sup>3</sup> Müller, *NATURE*, 132, 280, Aug. 19, 1933.

<sup>4</sup> Okuda, *J. Dept. Agri. Kyushu Imp. Univ.*, 2, 133; 1929.

<sup>5</sup> Sullivan and Hess, *U.S.P.H.S., Public Health Reports*, Suppl. 86; 1930.

<sup>6</sup> Boyland, *Bioch. J.*, 27, 802; 1933.

surface illustrated in Fig. 3. It may be mentioned that the images formed by the  $K\alpha_1$ - and  $K\alpha_2$ -radiations are partly superimposed.

It is expected that the resolving power of the method, which at present lies at about 0.1 mm., can be appreciably increased, and that the use of the method can be extended to elements emitting softer characteristic radiation. Work in this direction is now being done. The method can be applied to investigations on ores and metals and also to follow chemical reactions in the solid state without appreciably changing the object.

L. V. HÁMOS.

Riksmuseets Mineralogiska Avdelning,  
Stockholm.  
June 23.

<sup>1</sup> L. v. Hámos, *Ann. Phys.*, (5), 17, 716; 1933. (5), 19, 252; 1934.

### Archæology of the Caucasus

REFERRING to the article with the above title in NATURE of June 16, p. 919, the view of Prof. Fessenden has been extended since. On extracting every place name from the Egyptian mythology (Book of the Dead), I found that all appeared in their relative position in the Caucasus. For example, the capital of Osiris was Akret, the Greek capital of the Caucasus was Ekretike. The blessed fertile land was the valley of Iaru in which were lakes of fire, the fertile mid valley of the Caucasus is the Iora, in which are petroleum springs.

So far, the case seemed strong, but incredible, when this appeared in *Ancient Egypt*, 1926, p. 41. Since then I have found at Gaza the typical ribbed daggers of the Caucasus, and a multitude of the toggle-pins with spiral or ribbed stems, which specially belong to the Caspian slopes of the Caucasus (see *Ancient Gaza*, 2, 16). This material result opens our eyes to six migrations from the Caspian basin to Egypt, which have taken place ranging from the Badarian age to Salah ed Din. Exploration of early sites there is urgently needed, ignoring the late material which has attracted attention hitherto.

FLINDERS PETRIE.

University College,  
Gower Street, W.C.1.

### The Membrana Granulosa of the Mouse

THE accompanying figure (Fig. 1) illustrates the membrana granulosa of the developing follicle of the mouse, from a preparation fixed with chromic acid and osmium tetroxide and stained with Mallory's connective tissue stain. As the darkly staining cells shown in particular at S.C. are not commonly stressed in descriptions of this tissue<sup>1,2</sup>, apparently because their presence is regarded as symptomatic of degeneration, it is desired to direct attention to some of their peculiarities.

They are to be found with great constancy in material from the mouse fixed in this way. They are extremely difficult to see in material fixed in Bouin's fluid or in formol. They are of irregular shape, their nuclei are dense and ovoid, their cytoplasm is darker, both before and after staining, than that of the granulosa cells, and they contain sometimes minute granules of fat and commonly a number of small vacuoles. They are to be found in follicles of every

size; in the smallest, one of these cells may reach from the egg to the theca.

Against the view that they are a mark of degeneration may be adduced these considerations: they have every appearance of activity themselves, and they occur in follicles the granulosa cells of which are dividing (see D.C. in Fig. 1). That they are recently intrusive elements seems to be negated by the fact that they occur inside the complete membrana propria (M.P.) with no sign of this growing in. From their appearance there seems little doubt that they are the spindle cells mentioned by Deansley<sup>1</sup> in her description of the early stages of the formation of the corpus luteum in this form.

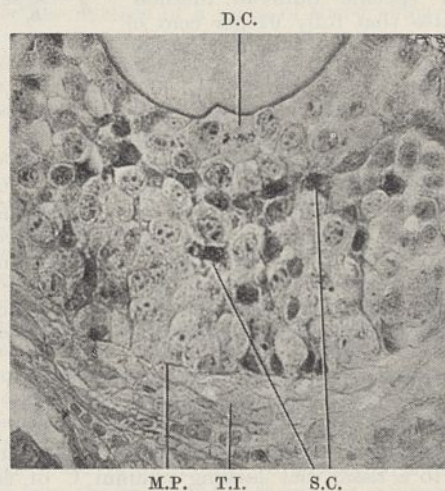


FIG. 1. Membrana granulosa of the mouse.  $\times 500$ .

They have little in common with the cells of the theca interna (T.I.), and it is suggested that they are among the original inner group of cells which is formed round a developing oocyte, and that there are normally two sorts of cells in the membrana granulosa, one of which, the granulosa proper, forms later the luteal cells, while the other forms the reticulum of the corpus luteum. Similar elements are to be found in similarly prepared material from the cat, the guinea-pig, and, to a less extent, the rabbit.

PAUL G. 'ESPINASSE.

Department of Zoology and Oceanography,  
University College,  
Hull.  
June 29.

<sup>1</sup> Deansley, *Proc. Roy. Soc.*, B, 107, 60.

<sup>2</sup> Brambell, "The Development of Sex in Vertebrates". Sidgwick and Jackson. 1930, p. 121.

### Causes of Formation of Different Forms of Vertebræ

IN Vertebrata we generally find three forms of vertebræ, namely, procœlous, ophisthocœlous and amphicœlous. In the case of fishes, we get exclusively the amphicœlous form. In birds and mammals the vertebræ approach more nearly to the amphicœlous form than to other types. In the case of Amphibia and Reptilia we get all the three forms in different species, and in the latter class sometimes we get all the three forms even in one individual. The importance of the question is self-evident, as different forms of vertebræ furnish characters diagnostic and useful for classification.

Contrary to the opinion of previous authors<sup>1</sup>, I hold the view that different vertebrates follow a general basic principle in the formation of the vertebral centra. After the formation of the notochord and its sheaths, the skeletogenous layer aggregates round them, forming an outer jacket known as the perichordal tube. The intervertebral portion of the perichordal tube remains membranous or procartilaginous for a long time. Through these intervertebral zones of perichordal tube, the migratory connective tissue cells enter<sup>2-5</sup>.

Now the migratory connective tissue cells normally enter through the intervertebral portion of the perichordal tube, the direction being at right angles to the notochord and to the vertebral column. I believe that procelous, ophisthocelous and amphicelous conditions are produced by various types of movement of the embryos at the time when the migratory connective tissue cells are actively entering the intervertebral zones of the perichordal tube.

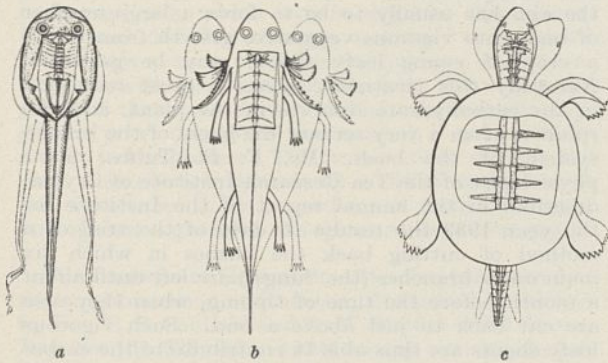


FIG. 1. Diagrammatic figures on which frontal sections passing through the centra of the vertebral column are superimposed. Oscillations of the embryos are shown by dotted lines. The paths of migratory connective tissue cells have been shown by two consecutive lines through the intervertebral zones of the perichordal tube indicated by arrows on both sides.

a, tadpole of *Rana temporaria*.  
b, post-embryonic stage of *Triton vulgaris*.  
c, post-embryonic stage of *Chrysemys marginata*.

It has been observed that a tadpole moves through the water oscillating the whole body except the head in such a manner that the greatest degree of oscillation will be at the free end of the tail, in both clockwise and anti-clockwise directions, and thereby changing the course of the migratory cells to the notochord, from the perpendicular direction to a curve, the concavity of which is directed towards the cephalic end, and thus leading to the formation of a procelous condition (Fig. 1a).

In the case of newts which were reared in the laboratory, it was observed that during their post-embryonic stage they move forward in the water by oscillation of their head ends and the migratory cells in this case therefore pass in a curve the direction of which is opposite to that of the tadpole; thus an ophisthocelous condition is produced (Fig. 1b). In the eggs of snakes which I examined a rhythmic movement of the embryos is perceptible even from outside the egg-shell, which is rather soft and papery. The vertebrae of snakes are generally procelous. It may be inferred that the particular mode of movement of the snake embryo is responsible for the formation of this type of vertebra.

So one may conclude that those animals that move their anterior end during the embryonic stage when the migratory connective tissue cells are entering through

the intervertebral zones of the perichordal tube have ophisthocelous, and those that move their posterior end, keeping the anterior end in a so-called stationary condition, generally have procelous vertebrae. Confirmation of this view is to be found in *Chelonia*, where the head and neck move in such a way as to present an ophisthocelous condition, the tail moves in a different direction so as to bring about a procelous condition, while the middle region of the body, remaining stationary due to the early formation of the carapace, has an amphicelous condition (Fig. 1c).

HIMADRI KUMAR MOOKERJEE.

Department of Zoology,  
University of Calcutta.  
May 16.

- <sup>1</sup> *Phil. Trans. Roy. Soc.*, B, 187, 1; 1896.  
<sup>2</sup> *Phil. Trans. Roy. Soc.*, B, 213, 415; 1930.  
<sup>3</sup> *Phil. Trans. Roy. Soc.*, B, 219, 165; 1931.  
<sup>4</sup> *NATURE*, 127, 705, May 9, 1931.  
<sup>5</sup> *Current Science*, 342-343, March 1934.

### Enteropneusts in the Clyde Sea-Area

THE following unpublished records from the Clyde sea-area help to extend the summary of the known distribution of British enteropneusts given in *NATURE* of June 16 by Prof. F. W. R. Brambell and H. A. Cole.

From time to time during the last twenty-five years, parts of enteropneusts, which appeared to be damaged *Dolichoglossus ruber* Tattersall, have been seen in mud dredgings. Undoubted specimens of this species have been dredged off Cumbrae, in December 1927, 20 fathoms, and near Loch Striven Head, in 1929, 7 fathoms.

On several occasions parts of what appears to be a brownish enteropneust, with the peculiar smell of *D. serpentinus*, have been seen in mud dredgings, but not accurately determinable specimens have been taken.

RICHARD ELMHIRST.

Marine Station,  
Millport,  
Buteshire.  
June 27.

### Fossil Insect from the British Coal Measures

IN 1922 I described the wing of a fossil insect with Odonate affinities, from the Upper Coal Measure of Ayrshire, under the name of *Tillyardia*<sup>1</sup>. My attention has been directed to the preoccupation of the name *Tillyardia*<sup>2</sup> in Coleoptera.

I therefore replace the genus name of *Tillyardia* Bolton, 1922, by that of *Truemanina* nom. nov., genotype *Tillyardia multiplicata* Bolton, 1922, in recognition of the admirable work done in recent years upon the fauna of the Coal Measures by Prof. A. E. Trueman.

The new name will appear in a list of Odonata shortly to be published by Mr. J. Cowley, of Cambridge.

H. BOLTON.

318, Tilehurst Road,  
Reading.  
July 11.

<sup>1</sup> "Monog. Foss. Insects of the British Coal Measures", p. 145, pl. x, fig. 2; text-figure 45. Palaeontographical Society, 1921-22.  
<sup>2</sup> Carter, *Proc. Linn. Soc. New South Wales*, 37, 489; 1913.

## Research Items

**Relational Learning in Chimpanzees.** Using the multiple-choice method, R. M. Yerkes (*Compar. Psychol. Monographs*, 10, No. 1; 1934) has studied in full detail the efforts of four young chimpanzees to solve a number of relational problems, such as choosing the right hand one of any set of compartments. He found that solution came by sudden discovery of the essential relation in about 50 per cent of the cases, and was fully retained in the control settings. Their ability to apply the correct solution to the control situations is markedly higher than that of other mammals, exclusive of other anthropoids and man, and their behaviour "obviously presages those expressions of human curiosity and originality which we call invention and discovery". The affective condition of the apes is of the greatest importance in relation to success or non-success. There is a general discussion of different types of 'learning'.

**Possible Recovery of Trumpeter Swan.** Few naturalists in Europe can have realised that during the last few years the magnificent trumpeter swan has been about that lower limit of numbers which generally heralds extinction. Probably the trumpeter swans in Yellowstone Park make up the majority of those now in existence, and of these there were in 1931 only 20 adult birds and 15 cygnets (Science Service, Washington, D.C.). The migrations of the species are limited in extent, and the fact that the Yellowstone individuals do not go beyond the protected area during the winter gives them a greater chance of survival. But even in the Park they have many enemies to contend with—coyote, otter, horned owl, golden and bald eagles—so that in a nest which has been under observation since 1925, not until 1933 did the pair successfully raise young at all. At present, the numbers appear to be at least holding their own; in 1932, there were 58 adults and 12 cygnets, and in 1933, 49 swans and 17 cygnets, against the 1931 total of 35; but until the increase is very much more marked it cannot be said that the trumpeter has escaped the danger of extinction.

**Insect Enemies of White Flies in Asia.** Mr. C. P. Clausen, of the U.S. Department of Agriculture, has published a paper on the insect enemies of Aleyrodidae or 'white flies' in tropical Asia (*Philippine J. Sci.*, 53, No. 3, March 1934). During a lengthy tour of the Eastern Orient, the author was able to accumulate a number of observations on this subject. Various species of the host 'white flies' are of economic importance, and a record of their natural enemies is of value in the event of projects, based on biological control, being contemplated. Up to the present, two species noted in tropical Asia have been effectively controlled by parasite introductions, namely, *Aleurocanthus woglumi* in Cuba and tropical America, and *A. spiniferus* in Japan. It is this genus which is perhaps the dominant one in tropical Asia. In number of species and general effectiveness, *Prospaltella* is the dominant genus of parasites in the region concerned and every species of *Aleurocanthus* shows attack by one or more species of *Prospaltella*. Second in importance, the parasite genus *Eretmocerus* requires mention, and, in general behaviour, its various species appear to be well adapted for purposes of attempting biological control. Of hyperparasites, the only species which were reared all

belonged to the genus *Ablerus* which attacks indiscriminately all of the primary parasites of *Aleurocanthus*. Of predators, Coccinellid beetles were observed from time to time, but they seldom exercised an influence comparable to that of internal parasites. Larvæ of Drosophilid flies and of lacewings (Chrysopidæ) were also observed as predators, the latter group of insects often being the dominant one in this respect. An occasional predator was also observed in the larva of the Pyralid moth *Cryptoblabes gnidiella*. The paper is accompanied by a list of all the known enemies of Aleyrodidae in the region concerned.

**Pruning of the Tea Plant.** In England, the main consideration of the grower in connexion with the practice of pruning has to be its effect upon flower and fruit production, but in the case of the tea plant the aim has usually to be to force a large number of buds into vigorous vegetative growth from which a crop of young leafy shoots may be gathered. Naturally this treatment means a great reduction in the carbohydrate reserves in the plant, and the result is often a very serious 'die-back' of the branch system of the bush. Mr. F. R. Tubbs, plant physiologist of the Tea Research Institute of Ceylon, describes in the annual report of the Institute for the year 1933 the results to date of the trial of a method of cutting back the bushes in which six main outer branches (the 'lungs') are left until about a month before the time of tipping, when they also are cut back to just above a bud. Such vigorous leafy shoots are thus able to contribute to the carbohydrate reserves of the bush before they are removed, and the result has been a considerable increase in the yield of shoots suitable for tipping and a reduction in 'die-back'. This last point is very important, as the withering snags are often places where disease organisms first obtain access. This preliminary report upon the experiments of the Institute is much in favour of the new practice which is termed 'rim lung' pruning. In Great Britain, snag production in the apple has recently been studied from the point of view of anatomy and development by Miss M. E. Wray (*Proc. Leeds Phil. Soc.*, 2, part 12, May 1934).

**British Rust Fungi.** Mr. W. B. Grove and his colleague, Mr. C. G. C. Chesters, have recently published the results of some investigations on British rust fungi (*Trans. Brit. Mycol. Soc.*, 18, Part 4, 265-275, April 1934: "Notes on British Uredinales, including one new to the British Isles"). *Uromyces sparsus*, the new British species, has been found on plants of sea spurrey (*Spergularia marina*), uredospores, teleutospores and æcidia being now known. *U. scirpi* produces teleutospores on *Scirpus maritimus* and æcidia on *Oenanthe crocata* (water dropwort), *Glaux maritima* (sea milk-wort) and possibly other plants. *U. acetosi*, *U. striatus*, *Puccinia Luzule-maximæ*, *P. cirsi-lanceolati*, *Melampsora euphorbiæ-dulcis* and *M. symphyti* are also described. The account is a useful addition to Mr. Grove's book, "British Rust Fungi", bringing several of the descriptions up to date.

**Translocation of Nitrogen.** Further information regarding the transport of nitrogenous materials in the cotton plant is given by T. G. Mason and E. Phillis

in No. 6 of the *Memoirs of the Cotton Research Station, Trinidad* (reprinted from *Ann. Bot.*, 58, 315-333; 1934). Curtailment of nitrogen supply to the roots of the plant in the vegetative condition limits the growth of the apical region, and the young tissues absorb nitrogen at the expense of the mature leaves lower down. The stem tissues continue to gain nitrogen from the mature leaves, and the normal negative gradient in the stem persists, even during pronounced nitrogen deficiency in the apical tissues. As the plant passes from the vegetative to the reproductive condition the developing bolls withdraw nitrogen from the bark, which results eventually in reversal of the negative gradient. This suggests a gradient of storage, rather than structural nitrogen. Concentrations in the bark depend apparently on the age of the tissue, a greater proportion of storage nitrogen being found in the older lower parts than in the younger upper ones. Variation of the nitrogen supply to the roots, from conditions of deficiency to excess, produces no significant change in the direction of the bark gradients, which remain negative throughout. It is concluded that nitrogen continues to be stored in the bark even in conditions of nitrogen starvation. The non-withdrawal of calcium from the vegetative parts of the plant during bolling confirms the suggestion previously made that calcium is not normally mobile in the phloem. The facts seem to support the view that nitrogen travels by a diffusion process in the sieve tubes down a gradient of mobile nitrogen, but against a gradient of organic storage nitrogen.

**The Cambrian of Shropshire.** The Cambrian rocks of the neighbourhood of Rushton, Shropshire, described by Drs. E. S. Cobbold and R. W. Pocock (*Phil. Trans. Roy. Soc.*, B, 223, 305; 1934) occupy a wedge-shaped area between the Wrekin fault on the east and the Church Stretton fault on the west. Structurally, the area consists of the broken core of an anticline in Charlton Hill, pitching southward, and the broken syncline of Rushton, also pitching southward. Lower, Middle and Upper Cambrian deposits are represented, and correspond closely with those of the well-known Comley area situated about 12 miles to the south-east, and almost all the faunal horizons found at Comley are represented at Rushton. A correlation table (pl. 39) shows the relation of the faunal horizons of Shropshire to those in the Cambrian deposits of other parts of the world. The main part of the paper, by Dr. Cobbold, deals with the palaeontology of the deposits, with descriptions of several new species; the groups represented are Annelids, Brachiopods, Hyolithids, Trilobites, Conchostraca, with one Gasteropod and possibly a Polyzoon.

**Annual Perturbation in the Range of Tide.** R. H. Cockran (*Proc. Roy. Soc.*, A, May) discusses an annual perturbation in the range of tide, obtained originally from observations at Liverpool but apparently existing all over the world and consistent from year to year. The method of analysis consists in comparing the semi-diurnal component of the observed tides calculated by Doodson's method with the semi-diurnal component of the 'synthesised tide' obtained from the harmonic constituents. The existence of the perturbation was further studied by independent analysis of hourly heights and of high and low waters. The cause of the perturbation is not established. In polar waters, the change of boundary conditions due to ice may account for an annual perturbation; in narrow channels, the perturbation

may arise from the superposition of an annual variation in the non-tidal current. These explanations are inadequate for the open ocean.

**The Inter-electrode Capacitance of Valves.** The introduction of the screen-grid valve has considerably increased the stability of the radio-frequency amplifier and the level of possible amplification. This improvement is attributable to the minuteness of the coupling between the input and output stages containing screen-grid valves, and is associated with the small value of grid-to-anode capacitance in such valves. Previous methods of measuring this small capacitance have required special apparatus and in particular a micrometer condenser. These limitations have been avoided in two methods developed at the National Physical Laboratory, and described recently by Mr. T. I. Jones in a paper entitled "The Measurement of the Grid-Anode Capacitance of Screen-Grid Valves" (*J. Inst. Elec. Eng.*, June). In the first method, the working value of the capacitance is deduced from measurements of the change in the input capacitance of the valve upon reducing the anode load from a known value to zero. It is necessary to know the amplification factor of the stage, and this is measured independently. The second method measures the grid-anode capacitance with the filament cold. The result is obtained in terms of the ratio of the readings of two voltmeters and the settings of a variable air condenser covering a range of capacitance over which it can be calibrated directly. Full details of the two methods and the results of typical measurements are given in the paper.

**Dipole Moments of Substituted Mesitylenes.** Some measurements of the dipole moments of halogen and nitro-substituted mesitylenes (F. Brown, J. M. A. de Bruyne and P. Gross, *J. Amer. Chem. Soc.*, June) are of interest in connexion with the theory of mutual interactions by induction of the substituent groups in a molecule proposed by Smallwood and Herzfeld in 1930 and tested in other cases. In mesitylene the inherent moments due to the three methyl groups symmetrically placed in the ring cancel one another, and the results thus allow of a study of the interactions between the methyl groups and the other substituents which is reasonably free from complication. The moments of the F, Cl, Br, I and NO<sub>2</sub> compounds are 1.36, 1.55, 1.52, 1.42 and 3.65, all in benzene (the last being 3.63 in CCl<sub>4</sub>). The calculated values are 1.42, 1.60, 1.58, 1.43 and 3.99, in good agreement except in the case of the compound containing the nitro-group, which also shows anomalies in other compounds. The agreement in the case of the iodine compound is particularly interesting, since the iodine atom, with its large size and deformability, might be expected to be considerably affected by the close proximity of two methyl groups in ortho-positions.

**The Imperial Standard Yard.** In the paragraph on page 147 of NATURE of July 28, on the Imperial Standard Yard, the following words should have been added at the end, "in air at 62° F.", as the conditions for which Dr. Tutton's number of Cd<sub>2</sub> wave-lengths in the yard, 1,420,209.8, was obtained. Messrs. Sears and Barrell give for air at 15° and 20° C. the numbers 1,420,210.81 and 1,420,204.02. They do not give the number for the official temperature 62° F. (16.66° C.), but by interpolation it would be 1,420,208.6, which is only 1.2 wave-lengths different from Dr. Tutton's value.

## South-Eastern Union of Scientific Societies

## ANNUAL CONGRESS AT READING

THE Annual Congress of the South-Eastern Union of Scientific Societies was held at Reading on July 11-14, under the presidency of Prof. H. L. Hawkins. By the courtesy of the Vice-Chancellor and Council and Senate of the University, the meetings were held in the various buildings of the University, the grounds of which were thrown open for the use of those attending. The president's address was entitled "Fossils and Men", and was in part a philosophical discourse on the lessons to be learnt from over-specialism in both ancient and modern life, and the invariable consequences resulting from such specialism, notably as regards human life. The address was a notable one. "To some the voice of Evolution is a birthday serenade, to others it is the tolling of the passing bell," was a passage which one might quote. "The Lords of Creation of one era are the fossils of the next," is another. "If numbers imply success, graptolites and ammonites were successful groups. We can scarcely guess what inborn impetus drives some groups to riotous evolution, leaving others almost static; but we can find an analogy in human temperament, where the mercurial and the stolid may appear for no apparent reason in the offspring of one marriage. Persistent stocks are not the actual ancestral types, but are the simplest derivatives from those types that possess all-round efficiency. *Cidaris* was not, by a long way, the first sea-urchin to appear; there were plenty of queer experiments in the echinoid world during the palæozoic eras; but it is, and since triassic times has been content to remain, the simplest expression of orthodox sea-urchinity. *Nautilus* came into being after a long succession of preliminary types had come and gone; it has proved more durable than scores of its less and more elaborate relatives.

"The efficiency of short-range types is that of the specialist, who is supreme in his own particular line and a hopeless fool in any other. The danger of undue specialisation is almost self-evident. An expert in the use of the crossbow would not find much scope in a modern naval battle; while a professor of Hellenistic Greek might starve on a desert island where an agricultural labourer could scrape an adequate living. The moral emerges that a specialized type is efficient only in special circumstances, and becomes like a fish out of water when circumstances change. A Jack of all Trades may not excel in any; but he is less likely to find himself stranded than the master of a single trade that goes out of fashion. In other words, to become thoroughly efficient in one respect is to be relatively incapable in others. This is, in effect, a restatement of the principle that simple, moderately efficient types last longer than those that are highly specialized.

"In the education of the young we must point to the pitiable failures of man the successful animal, and the glorious achievements of man the struggling soul.

"There is no precedent by which we can foretell the issue of the triumph of reason; but a million witnesses await us in the rocks and catacombs to testify to the outcome of uncontrolled specialization. Reason, and reasoned ideals, give outstanding qualities to individuals—An honest man's the

noblest work of God'. Surely it does not seem a hopeless experiment to try the effect of humanity for men, and to leave bestiality to beasts.

"And so the lesson of Palæontology is the same that has been taught by seers, sages and saints down the ages. They used their human faculty of imagination to find the truth; and few there were that heard it. But fossils are a sign for this generation; their evidence is open for all who care to see it. We must strive to avoid somehow the fate that has always overwhelmed animals like us. Looking around in despair, we find that only idealism is free from the taint of death. Pure thought and noble ideals alone can raise mankind out of its present mortal danger to a position where success, even if it cannot be commanded, may at least be deserved."

The ancient charters of Reading, which were on exhibition at the Museum, were explained by Mr. W. A. Smallcombe, the curator. Much interest was shown in the reproduction of the famous Bayeux 'tapestry' which is one of the chief features of the Museum, and in the Roman treasures from Calleva (Silchester). The extensive ruins of old Reading Abbey were visited, on one wall of which is a large reproduction of the canon, "Sumer is icumen in", one of the earliest musical compositions of the country, said to have been composed by a Reading monk.

In the Zoological Section, Dr. C. B. Williams, of Rothamsted, gave an address on "Insect Immigration in Great Britain", summarising the information to date, and incidentally mentioning that the present year has not been a good one from the immigration point of view. In 1933, eighty reports were received of actual movements to and across the country.

Major H. C. Gunton outlined a scheme by which amateurs in local societies can assist in the recording of the earliest and latest observations of fifty well-known insects, to which, it was stated, considerable importance is attached by the Entomological Department at Rothamsted. Mr. Smallcombe gave details of the "Local Vertebrate Fauna during the Human Period". In the absence of cave-deposits in the district, the gravels yielded evidence of such animals as reindeer, red deer, bison, woolly rhinoceros, hippopotamus, lion, sabre-toothed tiger, hyena, mammoth, and a lower jaw of Irish elk, the latter giving rise to some discussion. At the Kennet mouth, on the site of the gasworks, an Early Iron Age settlement revealed amongst other mammals the beaver.

Mr. F. H. Edmunds read a paper on "The Water Supply and Geology of the South-East of England", and gave instances of the long galleries, sometimes a mile or more long, which have been driven in the chalk in order to intersect drainage channels and fissures. The Eastbourne well at Friston is 110 ft. deep but has a heading 4,012 ft. long. The normal water-table under London is potentially above the level of the chalk surface, but cannot rise through the impermeable tertiary beds above it. Chalk water is, in effect, under constant pressure against the overlying beds, and, when bored into, the water overflows as artesian water. The water-table under London has, however, sunk considerably into the chalk of late years. At Slough a boring was put down in 1909, reaching the Lower Greensand at 1,021 ft.

from the surface. The pressure was so great against the overlying strata that the water in rising blew a hole in the factory roof, and flowed at the rate of 100,000 gallons an hour. Water under similar pressure was found at Virginia Water, where it rose 90 ft. above the ground. Instances were given where the flow of water was in the first place very great, but owing to the silting-up of the bore-holes with fine sand and clay the supply rapidly fell off.

Prof. E. B. Poulton gave a lecture on "The Power of Changing Colour as a Form of Protective Resemblance", and an address was given by Sir Lawrence Chubb to the Regional Survey Section on "The Rights of Way Act, 1932".

The excursions were of considerable value. Silchester was visited, and the Botanical Section explored Greenham Common and the Kennet Valley.

The valuable farms of the University at Shinfield, Sutton's Seed Trial Grounds, and Huntley and Palmer's factory were also visited. Prof. Hawkins led the geologists to Kingsclere, and to Theale and Pangbourne, in the latter showing how the Kennet water is to a great extent conveyed by underground channels to the Sulham stream and so to the Thames at Pangbourne, instead of following the main Kennet River to Reading, whilst the Pang itself is now almost dry. The final excursion was a long one to the Vale of White Horse, passing on the way the dolmen known as Wayland Smith's Forge, and Uffington camp, afterward reaching Uffington by way of the neck and body of the so-called White Horse, which, however, may be the hen-headed dragon of the Celts, said to have been slain by St. George on the flat-topped hill isolated below.

### A Quantitative Study of Trance Personalities

IT is well known that the Society for Psychical Research has for many years studied the variations of personality observed in the mediumistic trance. This has generally been done by means of historico-legal methods, that is, by estimating the evidential value of the statements made by the personalities alleged to be communicating through the medium under observation. This procedure is a perfectly valid one, and it would be entitled to full experimental status if a more reliable method than any used hitherto of computing the value of such free material could be devised. Nevertheless, it is obviously desirable that these trance personalities should be investigated by normal quantitative methods, and to this problem the Society for Psychical Research has now turned its attention.

Mr. Whately Carington (formerly Whately Smith) has attempted to apply to trance personalities the well-known technique of the word association test and the psychogalvanic reflex. A list of words is read out to the subject, who is supposed to react to each stimulus word with the first word that enters his consciousness; his response is recorded, together with the time taken by him in answering and the change in the electrical resistance of the subject's skin resulting from the 'excitement' produced in him by the stimulus word. There is good experimental reason for believing that the magnitude of this change (measured with a Wheatstone bridge and galvanometer) is a fair measure of such excitement. When the standard list of 100 words has been gone through in this way, it is rapidly read over a second time to test the subject's accuracy in reproducing his responses, failure to do so being regarded as an indication that an inhibitory complex is present. The whole process is gone through several (usually six) times to obtain a reliable mean, and the resulting data are regarded as characteristic of the subject's personality.

Such is the technique in general, on which Mr. Carington is an acknowledged authority, and which he has now attempted to apply to the problems of psychical research. If tests were to be applied to a medium in his normal state and then to a trance personality manifesting through the same medium's body, with his normal consciousness in abeyance, a comparison of the two series of data would clearly yield information as to the degree of likeness or

unlikeness between the two personalities. Thus, Mr. Carington argues, definite evidence would be obtained regarding the status of the trance personality.

In his present report (*Proc. Soc. Psych. Res.*, 42, 173-240, July 1934) Mr. Carington sets out the results of a first experiment on these lines, carried out with the mediums Mrs. Garrett, Rudi Schneider and Mrs. Leonard. Unfortunately, in each of these cases the circumstances were such that a full investigation was impossible. Mrs. Garrett turned out to be a very difficult subject for psychogalvanic reflexes, the electrical resistance of her skin being erratic to such a degree that the resulting material was inadequate for the application of Prof. R. A. Fisher's analysis of variance. In the case of Rudi Schneider, the subject did not fully co-operate, so that the results cannot be taken at their face value. In the case of Mrs. Leonard it was not possible to test the psychogalvanic reflex at all, the experiment being limited to reaction times and the reproduction test. From the fragmentary data obtained with these subjects, Mr. Carington concludes that in the case of Mrs. Garrett she and her 'control' Uvani are significantly different; that Schneider and his 'control' Olga are significantly similar; and that in the case of Mrs. Leonard, her 'control' Feda, and two other of her trance personalities, significant differences exist.

It will be asked of *what* these differences are held to be significant. On this point Mr. Carington expresses himself with due caution, but it is clearly his opinion that if Mrs. Garrett's and Mrs. Leonard's 'controls' were merely split-off secondary personalities, they would not have shown the differences they actually yielded. Unreserved acceptance of this conclusion would, however, be premature, for next to no information is available as to the amount of similarity or difference these tests would yield if actually applied to a pathological case of secondary personality, to a subject in hypnosis, or even to an actor playing a part. Moreover, the results seem far too dependent on the goodwill and free co-operation of the subject. Mr. Carington has undoubtedly made a valuable and thoroughly scientific contribution to psychical research, of a kind warmly to be welcomed, but a series of control experiments is essential before his results justify any generalisation with paranormal implications.

### U.S. Bureau of Standards

THE annual report of the U.S. Bureau of Standards for the year ended June 30, 1933, is very satisfactory, notwithstanding the industrial depression. New determinations of the values of the electrical units have been made by absolute measurements. In the case of the ohm, the inaccuracy was only of the order of about one in a million. The Bureau has fixed the visibility factors for commercial types of electric lamps by means of coloured filters. These values have been adopted internationally. A piezo-electric standard has been constructed which maintains a wave frequency constant within one part in ten million for several hours without adjustment. The accuracy of the 5,000 kilocycle radio transmissions which are disseminated periodically has been increased to one in ten million.

At the request of the Bureau of Fisheries, an investigation was made into the methods of gauging the mesh size of gill nets. The problem has a direct bearing on the conservation of fish particularly in the Great Lakes, where fishing is controlled by the bordering States and by the Dominion of Canada. A flexible standardised steel gauge has been found to give the accuracy required.

Another research was in connexion with doubtfully authentic documents and other objects. This work covers a very varied field. Seventy-seven identification tests were made, and on fifty-eight of these definite reports were given which enabled the Government to proceed with or discontinue the investigation. On the others, definite decisions by the Bureau were impossible owing to insufficient material or the difficulty in discovering satisfactory characteristics.

Research on commercial X-ray machines has

revealed that the effective voltage applied to an X-ray tube and the effective current through it are far better indicators of the quality and quantity of the X-rays emitted than the peak voltage and average current commonly specified. This has led to developments which will promote greater safety to hospital workers and probably lead in turn to lower insurance rates.

The temperature coefficients of the rigidity modulus and of Young's modulus for thirty-four samples of various metals and alloys have been determined. A knowledge of these coefficients is of great value in aeronautics. During the year, there was great popular interest in the reduction of noise. More than fifty different samples of sound-absorbing materials were tested for the public, and numerous samples of materials for use in Government buildings. The usefulness of the spark test for carbon and alloy steels was studied by testing 280 materials. The results proved that for sorting mixtures of steels of known composition, this test is by far the best.

The old methods of testing textile cloths by 'handle' and 'feel' will soon be obsolete. Two new instruments have been developed for this purpose. A more accurate method of testing for the presence of acid in leather, which often causes rapid deterioration, has been devised. Commercial standards have been agreed to after consultation with the many industries concerned.

Three encyclopædic volumes of specifications have been published and two more are in active preparation. This report will prove of value to everyone interested in the progress of industry.

### Autoxidation of Mineral Oils and Lubricating Value

AT a meeting of the Institution of Petroleum Technologists on January 9, Mr. R. O. King demonstrated the present point of view regarding blending of mineral oils. As a rule, mineral oils are blended for use under conditions where a complete fluid film is to be maintained. Thus separation of the lubricated surfaces, friction, and the prevention of wear are dependent upon certain physical factors, for example, viscosity of the oil, relative motion of the surfaces and mechanical design.

Under conditions, however, where the oil film is reduced to molecular dimensions, friction and wear are largely dependent upon an intangible property known as 'oiliness'. Recent investigations have contributed towards definition and promotion of this property. Experiments with unloaded, relatively thick oil films subjected to high rate of shear have shown that this particular property of lubrication depends upon the presence in the oil of certain active molecules or upon their formation as products of oxidation even at low temperatures.

More recent experiments with loaded oil films, under conditions conducive to great oxidation activity, have proved that high-temperature lubrication is dependent essentially on that activity and only indirectly on viscosity. Apparently, under conditions where extreme pressure and temperature are involved, blending cannot be successfully accom-

plished without regard for oxidation properties of the constituents. Autoxidation is initiated through chemically active compounds being formed from direct attachment of a molecule of oxygen to an oil molecule; hence to obtain optimum lubricating value at relatively low temperatures, one of the constituents should be capable of easy oxidation.

Results of experiments made with both single varieties and blended oils at high temperatures show that with unblended fluid improvement of lubricating value is slight and relatively short lived, while viscosity increases with oxidation at higher temperatures for a short period only and then decreases. With blended oils, however, viscosity increases under similar conditions and remains at the higher value over relatively long periods of oxidation. The difference in behaviour of the two types of oil can definitely be ascribed to autoxidation in the blended variety.

The conclusions are that blended mineral oils are better lubricants than single varieties having the same physical properties and that the successful blending of mineral oils for optimum performances in oxidising conditions, must depend upon the selection of constituents capable of maintaining the necessary oxidation activity over a specified temperature range.



## University and Educational Intelligence

CAMBRIDGE.—The E. G. Fearnside's scholarship, for the encouragement of clinical research among the organic diseases of the nervous system, valued at £100, has been awarded to J. B. Harman, of St. John's College.

MR. V. K. RANGA V. RAO, of Gonville and Caius College, Cambridge, has been awarded the Garton Foundation studentship in social sciences for 1934. The studentship was founded by the late Sir Richard Garton to help students in the universities of the British Empire to devote themselves to the study of social or economic problems.

THE following scholarships, valued at £100 or more, have been awarded by the Institution of Electrical Engineers for 1934: Ferranti scholarship, F. C. Williams; Duddell scholarship, S. I. Hollingworth; Silvanus Thompson scholarship, S. G. Bittles; Swan Memorial scholarship, E. Bradshaw; David Hughes scholarship, W. B. Hutchison.

ROBERT BLAIR fellowships, tenable during the session 1934-35, have been awarded to Mr. P. D. Holder, of Cranford Nailsea, near Bristol, who proposes to carry out an investigation in the United States of America of the design and erection of steel-frame buildings; and to Mr. David M. Tombs, of London, who proposes to carry out a study and research with Prof. Zenneck, at the Munich Technical High School, into methods of short-wave propagation and reception.

THE University of Leeds' annual report for 1932-33 sounds a note of optimism. Towards the second half of the session, signs of a revival of industry gave ground for the assurance that the worst of the financial anxieties of the Council were over. The student enrolment was approximately the same as in the preceding year, notwithstanding the important restrictions imposed by the Board of Education on the number of students in the training departments of universities—restrictions which are expected to result in a reduction in the number of such students at Leeds from 425 in 1931 to 325 in 1935. Substantial progress was made towards the completion of the great building scheme. It is anticipated that the Brotherton library may be finished by 1935. Other important developments were: the institution of new faculties of law and economics and commerce; the incorporation in the University of the work of the Leeds School of Pharmacy, providing courses leading to the qualifications of pharmaceutical chemist and chemist and druggist; modification of the ordinance for general honours in science so as to require candidates to offer two instead of three principal subjects; the launching, in co-operation with the Royal Bath Hospital, Harrogate, of a scheme for the investigation of chronic rheumatism and allied conditions; and a project for a part-time course in biology leading to a diploma, designed to meet the needs of teachers in schools. In answer to an appeal from the Academic Assistance Council on behalf of expatriated German men of science and scholars (mainly of Jewish origin) the University agreed to accept not more than three for a period of two years as 'special research students'.

## Science News a Century Ago

### Measuring Electricity

It is important to remember that no method of measuring electricity existed in 1831, when Faraday entered upon the great period of his electrical researches. The galvanometer, the outcome of Schweigger's invention of the 'multiplier' in 1820, was not yet the indispensable instrument it afterwards became; it was not until 1833, in a footnote to his Third Series of Experimental Researches, that Faraday referred to "the great and general value of the galvanometer as an actual measure of the electricity passing through it". The relation between the three quantities we now call current, electromotive force and resistance, upon which modern methods of measuring the electricity in a circuit depend, had been established by G. S. Ohm in 1827; but his work was neglected at first. His paper, 'Die Galvanische Kette', was mathematical, and written in German, circumstances which explain why Faraday apparently had no knowledge of it.

Faraday's conceptions involved the distinction between 'quantity' and 'intensity' which was common at the time, depending largely on the observed differences in the behaviour of electricity from the voltaic battery and from the frictional machine. He wrote in his Diary on August 5, 1834: "Quantity in Electricity appears to be analagous to the pitch in sound or the colour in light, and intensity in electricity to the loudness of the sound or the vividness of the light, i.e. to associate with increased energy of vibration but not with more numerous vibrations".

His own measuring instrument was the 'volta-electrometer' or voltmeter. It was based, characteristically, on an experimental principle, that of the chemical action of the electric current, and was described by him in 1834 as "the only actual measurer of voltaic electricity which we at present possess".

### Death of J. M. Jacquard (1752-1834)

On August 7, 1834, Joseph Marie Jacquard, the French inventor, died at the village of Oullins, near Lyons, at the age of eighty-two years. Though he made several inventions, the one he will always be remembered by is the Jacquard loom for weaving figured fabrics, an invention which for the first time enabled a weaver working single-handed to produce patterned materials according to a given design. This was a step forward of immense importance to Jacquard's native city of Lyons, where, a few years after his death, a monument to him was erected. The Jacquard loom, brought to a successful issue in 1804-5, was the result of a combination of several devices rather than a single invention, and is an example of the cumulative effect of mechanical progress.

Jacquard was born at Lyons on July 7, 1752. The son of a weaver, he received no schooling and at twelve years of age began work in a bookbinder's. From the bookbinder's, he went to a typefounder's, then to a cutler's and on the death of his mother joined his father as a weaver. Evidently gifted with mechanical skill far above the average, he was always endeavouring to improve on the tools of his trade. During the Revolution he was an ardent soldier, and at the opening of the nineteenth century a new chapter of his life began. A medal from the Industrial Exhibition of 1801 was followed by

the grant of a patent. In 1802 he invented a machine for making fishing nets and about the same time was given a post at the Conservatoire des Arts et Métiers, where among the models he found the loom of Vaucanson. Back again in Lyons, and encouraged by some of the manufacturers, he was able to develop his loom, and in 1806 Napoleon authorised the municipality of Lyons to purchase the invention. Jacquard was given a pension of 3,000 francs and the latter part of his life was passed in comparative ease. A man of simple habits, modest and dignified, he retired to the village of Oullins and it is there he is buried. His original loom is preserved in the Conservatoire des Arts et Métiers beside that of Vaucanson.

#### Zinc Sheathing for Ships

Several times, zinc has been tried for the sheathing of ships with the object of preventing fouling, and on August 9, 1834, under the heading "Mosselmans Zinc", the *Mechanics Magazine* said: "Mills for the rolling of this valuable metal have been erected at Dartford and commenced working on Saturday last. The event was celebrated by a *fête champêtre* which was attended by a number of the most distinguished merchants and shipowners of the city of London, several eminent engineers, men of science, etc. Mr. Ward, late member for London, in proposing the health of Mr. C. P. Chapman, the manager of the establishment, spoke in high terms of the service Mr. C. had rendered to the country by the introduction of so cheap and efficient a substitute for copper in the sheathing of ships, at a time when economy of expenditure is an object of such vital importance to the shipping interest. The demand for zinc for this purpose is, we understand, increasing with astonishing rapidity, and hence the importance of having rolling mills so near the metropolis, where sheets of any thickness or size can be turned out as fast as wanted. The machinery of the mills has been constructed by Messrs. Hall, the eminent engineers of Dartford, and is of a very complete, though necessarily simple, description."

#### Howard's Quicksilver Boiler

Among the inventions experimented with in the early days of steam navigation was the mercury boiler of Thomas Howard in which the heat of the furnace was communicated to a shallow closed pan containing mercury, on the upper surface of which a small stream of water was sprayed through a nozzle. The apparatus was fitted directly underneath the engine cylinder, and the steam evaporated by contact with the upper surface of the mercury vessel was passed into a casing around the cylinder, and then through ports into the cylinder. A fan was used for the draught for the furnace, and the steam leaving the cylinder was condensed in a copper vessel immersed in a cistern of water continually supplied from the sea. This arrangement was tried in H.M.S. *Comet*, 232 tons, in 1834, and on August 10 a correspondent described the apparatus in a letter to the Editor of the *Mechanics Magazine*. It was said that whereas the *Comet* used with the ordinary low-pressure flue boiler 6½ cwt. of coal per hour, with Howard's boiler the consumption would only be 3½ cwt. The quicksilver boiler was afterwards fitted in the paddle vessel *Columbus*, of 325 tons, but an explosion led to its abandonment.

## Societies and Academies

### DUBLIN

Royal Irish Academy, June 11. W. B. MORTON: The stability and oscillations of certain permanent arrangements of parallel vortices. The arrangements in question are those which formed the subject of an earlier paper, namely, any three vortices at the corners of an equilateral triangle and four, with a definite ratio of strengths, at the corners of a rhombus. The slightly disturbed motions are discussed, and the frequencies and modes of oscillation about the steady motions are determined. It is found that the triangular arrangement is stable when the centre of the vortices lies within the circle circumscribing the triangle and the rhombus when its acute angle exceeds a critical value,  $\arccos(1/\sqrt{3})$ .

### PARIS

Academy of Sciences, June 11 (*C.R.*, 193, 2033-2128). ELIE CARTAN: The tensorial calculus in projective geometry. H. DESLANDRES: A simple and general relation of the molecular spectrum with the electrons and rings of electrons of the constituent atoms. A discussion of a new formula with special reference to the infra-red frequencies of sodium chloride, nitric oxide and methane. L. CAYEUX: The difficulties of classification of the old limestone sediments. L. BLARINGHEM: Heredity in mosaic of *Geranium pratense*. JEAN LOUIS FAURE was elected a member of the Section of Medicine and Surgery in the place of the late P. Bazy. NIKOLA OBRECHKOFF: Univalent polynomials. I. POPA: Centro-affine geometry of skew curves. MAURICE FRÉCHET: The importance, in applications, of the nuclei to which the theory of Fredholm does not apply. G. VRANCEANU: The geometrisation of the systems of Pfaff. MIROSLAW KRZYZANSKI: Generalised absolutely continuous functions of two variables. STEFAN KEMPISTY: The totalisation of functions of two variables. E. REMES: On a convergent method of successive approximations for determining polynomials of approximation. GEORGES VALIRON: The singularities of holomorphic functions in a circle. O. YADOFF: The regulation of the power of hydraulic turbines having to work under variable heads. JEAN VILLEY: The permanent flow, in two dimensions, of a very rapid current of air round a cylindrical obstacle. P. SWINGS and B. EDLÉN: The presence of the forbidden lines of argon IV in the spectrum of nebulae. HENRI MARCELET: The capillary index of some vegetable oils. RENÉ LUCAS: A new type of powerful electromagnet for the study of double refraction and of atomic jets. The electromagnet described gives a field of 20,000 Gauss with an ordinary laboratory battery (120 volts, 4.4 amperes, or 530 watts). J. L. DELSAL: The polarimetric study of beryllium tartrates. There exists in solution only one beryllium tartaric complex,  $H_2C_4O_6(OH)_2Be_3$ , which is formed whatever may be the proportions of the reagents. ANDRÉ CHARRIOU and Mlle. S. VALETTE: The influence of antioxygen bodies on the sensibility of photographic emulsions. The lowering of the sensibility of a photographic emulsion by the incorporation of an antioxygen body confirms the view that these substances are, in a general manner, de-activating substances for molecules excited by radiations. V. DOLEŽEK and A. NĚMEJCOVÁ: The photographic inversion due to the simultaneous action of two different radiations. MME. ROY-POCHON: Photoelectric cells of the

boundary type. Cells possessing the same sensibility to light may be very different in rectifying power. Selenium cells with rectifying power practically zero have a very small temperature coefficient and the relation between current and illumination is nearly linear. E. VELLINGER and R. DELION: The superficial properties of certain colouring matters. The experimental results are given as a curve showing the relation between the interfacial tension of a solution of bromothymol blue and paraffin oil as function of the pH of the aqueous solution. FRANCIS PERRIN: The dissymmetry of the positive and negative  $\beta$  spectra and the intrinsic mass of the neutrino or ergon. On the hypothesis of an intrinsic mass zero for the ergon, it is possible to explain mathematically the dissymmetry of the  $\beta^+$  and  $\beta^-$  spectra. MME. IRÈNE CURIE, F. JOLIOT and P. PREISWERK: The radio-elements created by the bombardments of neutrons. A new type of radio-activity. A. MICHEL-LÉVY and H. MURAOUR: Experiments in micropyrotechny. The luminous effects accompanying detonation are not independent of the nature of the gas which surrounds the explosive. The effect of varying the gas surrounding the explosive (lead azide) is marked: two photographs are reproduced showing the light effects in argon and carbon dioxide. MARCEL GUILLOT: The iridescence of antique glass. The formation of Liesegang strata in the glass, in contact with solutions of bicarbonates, by the rhythmic precipitation of calcium carbonate. In the case of a periodic precipitation of the type of Liesegang rings, the glass behaves similarly to gelatine or other gels. ALBERT ROUX: Rapid tests for the determination of electrochemical corrosion of welded joints. JEAN SWYNGEDAUF: The action of the electric current on the fields of diffusion in colloidal gels. A. TRAVERS and YU KWONG CHU: Dimetaphosphoric acid. Description of a method of preparation of pure crystallised sodium metaphosphate,  $\text{Na}_2\text{P}_2\text{O}_6 \cdot 3\text{H}_2\text{O}$ . P. VIÈLES: The spontaneous resolution of racemic dilactyldiamide in aqueous solution. HENRI WAHL: The nitration of chloro-*p*-xylene. RAYMOND QUELET: The preparation of 2-methoxy-5-bromo-*o*-chlorotoluene and its action on organomagnesium compounds. GEORGES CORROY: The Oligocene under the molassic basin of Malauvène (Vaucluse) according to a recent boring. Summary of the results given by a boring to a depth of 402 metres. MME. F. FLOUS: An abnormal case of vascular evolution. CHADEFAUD: The morphological signification of the physodes of the Phaeophyceae. H. COLIN and MME. A. CHAUDUN: The composition of intercellular cement. MICHEL FLANZY: The presence of methyl alcohol in the foliar organs of plants. The relation between this alcohol and the chlorophyll pigment. Methyl alcohol was present in all the six plants studied, thus confirming the work of Maquenne. There was a marked parallelism between the variation of the methyl alcohol and production of chlorophyll. Green leaves are richer in methyl alcohol than etiolated leaves. MME. LUCIE RANDOIN and ROGER NETTER: The possibility of realising, in the absence of all known lipo-soluble vitamins, a food equilibrium permitting the growth and maintenance of the rat. J. VELLARD: Variations of the reactions of spider venoms. The acidity or alkalinity of spider venom depends on the temperature. In Brazil, venom of the same species is nearly always acid in winter, but in summer alkaline reactions predominate. The alkaline venoms are generally more toxic than acid venoms. ANDRÉ BOIVIN, MME. LYDIA MESROBEANU and ION

MESROBEANU: The toxic and immunising properties of a substance isolated from the Aerttrycke bacillus. R. ARGAUD and A. MOUGEOT: Neurogenic reactions of the isolated ventricle of *Helix pomata*: their anatomical substratum.

## CRACOW

Polish Academy of Sciences and Letters, April 9. T. NAYDER: The density of liquid iodine. The author has determined the density of liquid iodine by a hydrostatic method between the temperatures 114° C. and 184° C. K. DZIEWONSKI and J. MAYER: Syntheses of compounds derived from 2-phenylquinoline. MME. K. KRAINSKA: Studies on the development of *Eupagurus prideauxi*. Segmentation and gastrulation. S. HILLER: Contribution to the knowledge of the intimate structure of the hypophysis of the horse. THAD, VETULANI and ROBERT SCHULZE: The hypophysis of the small Polish horse representing the steppe tarpan type, especially that of the silvan tarpan (4).

## LENINGRAD

Academy of Sciences (C.R., n.s., 1, No. 9). N. CHETAJEV: A theorem on instability. A generalisation of the theorem of Liapunoff on the instability of movement and of the reciprocal of the Lagrange theorem. A. V. MITKEVICH: Some conditions increasing the phenomenon of magnetic viscosity. The conditions unfavourable for the intensified rearrangement of elementary magnets during the time of the change of magnetic force increase the subsequent manifestation of magnetic viscosity. When studying magnetic viscosity, it is quite indispensable to take into consideration the previous magnetic history of the metal. D. IWANENKO: Two remarks on the theory of  $\beta$ -radioactivity. I. STARIK and M. DEISENROT-MYSOVSKAJA: A criticism of the photographic method as applied to the investigation of the colloidal state of polonium. The method may produce incorrect results owing to the adsorption of radio-elements and should not be used in studies on the colloidal state of radioactive elements, but it can be of great value in studying adsorption phenomena. M. ROMANOVA and A. FERCHMIN: The hyperfine structure of the green krypton line 5570. The same ten components were observed by the authors as by Kopferman and Wieth-Knudsen (*Z. Phys.*, **85**, 353), except that instead of  $-0.0053 \text{ \AA}$ , a component  $-0.0130 \text{ \AA}$  was found, and an eleventh component  $+0.003 \text{ \AA}$  was observed. G. KRUTKOW: A proof of the theorems of statistical mechanics on the unification and the separation of two systems. S. GVOZDOVER and F. KONOVALOV: The action of a stream of slow electrons on a mercury arc. M. P. VOLAROVITCH and D. M. TOLSTOI: Studies on the influence of the temperature and of the electrolytes on the plastic properties of kaolin. M. VOLAROVITCH: Contribution to the study of the viscosity of molten rocks. Andesite proved to have the highest viscosity while it is progressively smaller in techenite, diabase and basalt. K. M. GORBUNOVA and Z. ADZHEMJAN: Electrocrystallisation of metals (4). Electrolytic sediments of aluminium from the molten salts of  $(\text{AlCl}_3 - \text{NaCl})$ . The optimum composition of the electrolyte is to be found apparently in the equimolecular mixture of sodium and aluminium chlorides. V. I. NIKOLAEV and S. A. GLINSKIKH: Calcium oxychloride,  $3\text{Ca}(\text{OH})_2 \cdot \text{CaCl}_2 \cdot 11\text{H}_2\text{O}$ . V. S. SADIKOV and E. V. LINDKVIK-RYSAKOVA: The behaviour of diamino acids of protein hydrolysates

towards permutit. E. ASRATJAN: The effect of a simultaneous cutting of both jugular sympathetic nerves upon food conditioned reflexes in dogs. The changes in the higher nervous activity of the dog after the first extirpation of the upper jugular sympathetic ganglia are due chiefly not to the extirpation itself, but to the interruption on the transmission of central impulses. N. UDOLSKAJA: Drought resistance of spring wheat varieties. The relative drought resistance of a variety is a variable quantity depending on the combination of external factors constituting the 'drought', on the growth conditions preceding the drought, and on the stage of growth. This accounts for the 'loss of drought resistance' on transferring a variety to another region. A. I. POTAPOV: New colorimetric methods for the determination of the toxic aluminium in the soil. A normal development of plants under sub-tropical conditions is often hampered by an excess of aluminium ions. Extracts from the fruit of *Rhamnus* and from the petals of *Tagetes* proved to exhibit very sensitive colour reactions suitable for the detection of very small amounts of aluminium in the soil. D. KOSTOV: Crossing-over in the species hybrids of *Nicotiana*. The crossing-over occurs between the maternal and the paternal chromosomes in the species hybrids.

## ROME

Royal National Academy of the Lincei, Feb. 4. G. A. MAGGI: Additions to the note on reflexion and refraction of harmonic electromagnetic waves of any form at a plane surface. L. PETRI: The cause of *court-noué* of the vine according to Viala and Marsais. Various criticisms are advanced against the results obtained by Viala and Marsais. L. SOBRERO: Theorems of the theory of hypercomplex functions (2). G. GHERARDELLI: Systems of doubly linear plane curves. D. GRAFFI: The eccentricity of the orbit in the problem of two bodies of variable mass. L. GIALANELLA: New determination of the latitude of the Royal Campidoglio Observatory, and determination of the instrumental constants of the 'Bamberg' meridian. L. SONA: The problem of the reflexion and refraction of electromagnetic harmonic waves. R. ZAICOFF: Generalised wave mechanics (2). F. PIRRONE: Investigations in the field of high frequency. Biochemical action of ultra-short electromagnetic waves (2). Although feebler and variable, the action of Lakhovsky oscillating circuits is analogous to that of radio apparatus capable of emitting waves of  $\lambda = 1.7$  metre. For a constant time the action of such waves is proportional to their intensity and is favourable to the life of simple organisms for continuous exposures of 10-40 minutes or discontinuous exposures up to 90 minutes. As the exposure is prolonged, the favourable effect on cell multiplication diminishes. M. AIROLDI: New investigations on the crystalline mass of Calizzano-Bardineto (Ligurian Alps). I. DELPINO: Meiotic divisions in *Telphusa fluviatilis* Latr. A. MESSERI: 'Intercalar' differentiation in radicular and hypocotylary bundles of conifer plantlets. V. ZAGAMI: Content of the E factor in leguminous seeds. Vitamin E is present in seeds of *Vicia arietinum* L., *Ervum lens* L., and *Vicia Faba* L. in sufficient quantities to ensure uninterrupted reproductive capacity in rats, provided that mineral salts and vitamins A and D are also supplied. Seeds of *Lathyrus sativus* L. also contains this vitamin, but to a lower extent.

## Official Publications Received

## GREAT BRITAIN AND IRELAND

Public Health Congress. Report of the Committee on Hospital Equipment, 1934. Pp. 47. (London: Public Health Congress Council.)  
 Proceedings of the Royal Society of Edinburgh, Session 1933-1934. Vol. 54, Part 1, No. 8: The Atomic Weight of the Calcium contained in very Old Potassium-rich Minerals occurring at Portsoy, Banffshire, and at Cape Wrath, Sutherlandshire. By William W. Smith and Thomas Tait. Pp. 88-101. 1s. 3d. Vol. 54, Part 2, No. 9: The Photoelectric Thresholds of some Turned Metallic Surfaces. By J. S. Hunter. Pp. 102-108. 9d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)  
 Water Supplies and Sewage Disposal in Rural and Small Urban Districts: a Report by the E.D.A. Rural and Agricultural Electrification Committee. Pp. 28. (London: British Electrical Development Association, Inc.)  
 Empire Cotton Growing Corporation. Report of the Thirteenth Annual General Meeting. Pp. 12. (London: Empire Cotton Growing Corporation.)  
 Philosophical Transactions of the Royal Society of London. Series A. Vol. 233, A723: Determinations of the Fundamental Standards of Length in terms of Wave-Lengths of Light. By J. E. Sears, Jr., and H. Barrell. Pp. 143-216. (London: Harrison and Sons, Ltd.)  
 The North of Scotland College of Agriculture. Guide to Experiments and Demonstration Plots at Craibstone, 1934. Pp. xii+72. Experiments on Lawns. By W. M. Findlay. Pp. 8. (Aberdeen.)

## OTHER COUNTRIES

Biologické Spisy vysoké Školy Zvěrolékařské. Svazek 11, Spis 151-165. Pp. 232. (Brno: A. Píša.) 50 Kč.  
 Práce Moravské Přírodovědecké Společnosti. Svazek 8, Spis 65-76. Pp. 332. (Brno: A. Píša.) 80 Kč.  
 Školský vysoké Školy Zemědělské v Brně. Sign D21: Přispěvek k znalostem rozšíření hub z třídy *Basidiomycetes* a *Ascomycetes* v ČSR. Napsal Prof. Emil Bayer. Pp. 135. (Brno: A. Píša.)  
 Ceylon. Part 4: Education, Science and Art (F.). Administration Report of the Acting Director of the Colombo Museum for 1933. By A. H. Malpas. Pp. 15. (Colombo: Government Record Office.) 15 cents.  
 The Indian Forest Records. Vol. 20, Part 1: Entomological Investigations on the Spike Disease of Sandal. (20): Studies on Insect Transmission. By Cedric Dover and M. Appanna. Pp. ii+25+3 plates. 1.2 rupees; 2s. Vol. 20, Part 2: Immature Stages of Indian Coleoptera. (14) (Curculionidae). By J. C. M. Gardner. Pp. 48+6 plates. 1.8 rupees; 2s. 6d. Vol. 20, Part 3: On the Biology of the Mantidæ (Orthopt.). By R. N. Mathur, with Notes by C. F. C. Beeson and S. N. Chatterjee. Pp. ii+25+1 plate. 12 annas; 1s. 3d. Vol. 20, Part 5: Entomological Investigations on the Spike Disease of Sandal. (22): Formicidæ (Hymen.). By Durgadas Mukerji. Pp. ii+15. 5 annas; 6d. (Delhi: Manager of Publications.)  
 Education, India. Progress of Education in India, 1927-32. By Sir George Anderson. (Tenth Quinquennial Review, Vol. 2: Statistical Tables and Appendices.) Pp. vii+246. (Delhi: Manager of Publications.) 3.4 rupees; 5s. 6d.  
 Memoirs of the Kyancutta Museum, Kyancutta, South Australia. No. 1: New Species of Archæocyathinae and other Organisms from the Lower Cambrian of Beltana, South Australia. By R. and W. R. Bedford. Pp. 7+6 plates. (Kyancutta.)  
 Department of Public Instruction: Technical Education Branch: New South Wales. Technological Museum: Curator's Annual Report for Year ended 31st December 1933. Pp. 8. (Sydney: Government Printer.)  
 U.S. Department of Agriculture. Circular No. 315: Changes in Composition of American Fertilizers, 1880-1932. By A. L. Mehring and A. J. Peterson. Pp. 20. (Washington, D.C.: Government Printing Office.) 5 cents.  
 The Indian Lac Research Institute. Bulletin No. 17: The Refractive Index of Shellac. By A. K. Thakur and Dr. R. W. Aldis. Pp. 4. (Nankum.) 1 rupee.  
 Canada: Department of Mines: Mines Branch. Investigations of Fuels and Fuel Testing (Testing and Research Laboratories) 1932. (No. 737.) Pp. ii+155+7 plates. (Ottawa: King's Printer.)  
 Annuario della Reale Accademia d'Italia. V, 1932-1933. Pp. 418. (Roma.) 25 lire.  
 Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 86. Zoological Results of the Third De Schauensee Siamese Expedition. Part 3: Amphibians and Reptiles. By Edward H. Taylor. Pp. 281-310. Part 4: Mammals. By Wilfred H. Osgood. Pp. 311-315. (Philadelphia.)  
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