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CONTENTS

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Social Surveys and Juvenile Unemployment

THE contrast between the unanimity with which the importance of adequate planning of the national life and resources in Great Britain is admitted, and the haphazard and opportunist methods which successive administrations adopt in dealing with such major problems as that of unemployment, is one of the most distressing paradoxes of the present time. It is rare indeed to discern an action dictated by a far-sighted policy which has due regard to the needs of posterity. The first condition of adequate action is exact and detailed knowledge such as can only be provided by an intensive study of a defined problem, and this study administrations have been slow to undertake. At times it seems, indeed, to have been undertaken less as a basis for wise action than as a means of further delaying measures repugnant to the administration or its supporters.

There have accordingly been few more welcome signs of the belief that accurate knowledge of a situation provides the soundest basis for wise action than the studies of industrial areas which have been conducted by various universities in the last two years. These studies carried out by the Universities of Glasgow, Cardiff, Durham, Liverpool and Manchester, provided an invaluable and impartial analysis of industrial conditions in the six areas covered, and indicated the high importance of the contribution which the universities can make to the welfare of the modern State. The implication in the very terms of reference of these surveys that the universities possess, not merely the capacity for conducting social research, but also the perspective and sense of values essential to the presentation of an authoritative and impartial analysis of the facts assembled, has been fully confirmed in the subsequent reports and is further endorsed by a recent publication of the Research Section of the Department of Economics and Commerce of the University of Manchester.*

The work by Mr. J. Jewkes and Mr. A. Winterbottom before us is the fourth of the publications of this Research Section, which was responsible for the surveys of the Lancashire area (excluding Merseyside) and of Cumberland and Furness, to which reference has already been made. The present study of juvenile unemployment is an

* "Juvenile Unemployment", by John Jewkes and Allan Winterbottom, of the Research Section, Department of Economics and Commerce, University of Manchester. (London: George Allen and Unwin, Ltd., 1933.) 5*s*.

admirable example of fruitful co-operation between the economists of a great university and men engaged in practical affairs to throw light on a problem which is national in scope as well as severe in local incidence.

Despite the grave injury inflicted on the adolescent population by prolonged unemployment, the absence of scientific studies of the subject has made it difficult for the layman to appreciate either the magnitude of the evil or the measures needed to cope with it. Fully as much as the lucid and impartial analysis and exposition of the situation contained in this report, the restraint and reasonableness with which the relevant factors and policies are discussed and assessed should commend it to all scientific workers who are concerned with national welfare.

The earlier survey of the Lancashire area had already directed attention to certain of the factors responsible for unemployment in Lancashire, such as the casualisation of labour in the cotton industry. The present investigation reiterates the earlier statements regarding persistent juvenile over-recruitment in this industry where unemployment is already so high, and emphasises the grave danger of the present position rotting the future man-power of the community and permanently crippling the industrial efficiency of the county. The danger of a complete dislocation of the labour market is accentuated by the introduction of the six- and eight-loom system of weaving as well as by the increased number of boys and girls who under present conditions will be leaving school in 1935–38 in the area surveyed.

No one concerned with either industrial efficiency or social progress can view without alarm the consequences which threaten to follow from such a situation. It is a truism, as Jewkes and Winterbottom remark, that in a competitive world our higher general standard of living can only be maintained by a superior industrial efficiency, for which we can no longer rely on our early start and plentiful supply of raw materials. Maintenance of our position demands either a more highly and efficiently organised industrial structure or a keen, intelligent and technically minded population, more efficient in production and more responsive in foreseeing, creating and meeting new demands on the part of the consumers of the world. To exploit the plight of our juveniles, to make them hewers of wood and drawers of water until they are replaced in the same work by a fresh flood of children direct from school, strikes a deadly blow at our attempt to build up a population capable of maintaining a high standard of living and efficiency.

Equally serious is the effect of the relatively higher unemployment rate among the children who have had the longest training. It speaks poorly for British industry, despite the policy of individual firms, that just when trained, flexible and imaginative minds are more than ever essential, it makes so little use of those who have had extended education. It is not the least merit of this survey that, without entering into the controversy as to the relation between educational policy and economic considerations, it emphasises the necessity for decision and for the discarding of prejudice in this matter. The fundamental contention, that many more children who have received higher education are required in many British industries if those industries are to survive, is unanswerable.

Similarly, this study brings us face to face with the problems of leisure and its relation to both employment and educational policy. It is questionable whether a study of the same facts undertaken by any authority than that of the research section of a university would have laid bare the fundamental principles with the same impartiality. The incisive frankness with which the issues are stated in the introductory chapter leaves no room for doubt that vacillation and lack of courage and vision have been important factors in allowing the present situation to develop.

The consequences of persistence in a short-sighted 'bread and butter' policy are too devastating to contemplate. The relation of the problem of juvenile unemployment to the national insurance scheme or to educational policy in the lengthening of school life are made unmistakably plain. Certain of the remedial measures advocated may be described as palliatives, including extension of the junior instruction centres both in scope and in financial resources, so as to induce or compel the bulk of unemployed children under eighteen years of age to take advantage of what is rightly described as a first line of defence which the State has established against loss of quality and morale.

However valuable the work of such centres, like the further policy advocated of entrusting to the labour exchanges the whole task of placing juvenile workers in employment, with the corollary that the notification by employers of vacancies for juvenile labour shall be made compulsory, and

simultaneously lowering the age of entry into insurance from sixteen to fourteen years, it only alleviates the situation. Control of the conditions of entry may assist to reduce casualisation of juvenile labour, to repress the worst forms of exploitation, and even within his official routine a juvenile employment officer should be able to exercise a powerful check upon the irresponsible and anti-social activities of the worst type of employer. The maximum effect of these measures would, however, still leave us with a surplus of juvenile labour which industry cannot absorb.

"The one positive, direct and certain method of abolishing some part of the unemployment of juveniles would be to raise the school-leaving age to fifteen years"—in this emphatic statement Mr. Jewkes and Mr. Winterbottom leave no doubt as to the policy which they regard as providing a solution. The facts assembled by them represent a damning indictment of phases of our national policy during the last two years. The decision to raise the school leaving age or not should be taken fundamentally on educational grounds, and not by an appeal to the facts of juvenile unemployment. The consensus of opinion on such grounds is, however, overwhelmingly in favour of lengthening the period of school life, and this report is a further witness to the dire effects on industry as well as on education of the reversal in September 1931 of the steady trend of educational organisation. The sudden check administered at that time under the plea of national economy has already proved a most costly mistake, whether judged from its effect on the present situation or on the morale and efficiency of the next generation.

The inquiries conducted during the present study have demonstrated that the serious consequences of this *volte-face* are already recognised in many quarters, and that many local authorities are prepared to take appropriate action, even if the immediate raising of the school age by legislation either in specified areas or in the whole country prove impossible, provided the present restrictions imposed on increased capital expenditure by the central authority through the Board of Education are removed. This lucid exposition of the issues at stake should enlist the interest and active support of all scientific workers. They at least should need little imagination to visualise the menace the problem of juvenile unemployment offers to industrial efficiency and national prosperity, and their support will be needed to ensure that the mistakes of the past are not repeated and the welfare of the community again jeopardised by the political or sectarian prejudices of a minority or a shortsighted and panic-stricken plea for economy. This whole investigation is one more reminder of the capacity of scientific workers for social service when their interest and zeal are aroused, and above all of their power to safeguard the community from selfish or prejudiced action, and it sounds a call to co-operation which should not be unheeded.

Diffusion and the Human Mind

The Diffusion of Culture. By Prof. G. Elliot Smith. Pp. x+244. (London: Watts and Co., 1933.) 7*s.* 6*d.* net.

WRITTEN by one who stands foremost in his knowledge of the human brain, this book affords us a study of the human mind, and especially of the minds of certain of the higher anthropologists. The author's views on the origin and spread of civilisation have met with strenuous opposition, and the facts and arguments he relies upon are often used as offensive missiles by his adversaries. He cannot complain, indeed, that he is disregarded; the controversies launched by himself and Dr. W. J. Perry remain persistently afloat. In view of the vast scope and content of his scheme, he can scarcely hope for more. If conversions are not spectacular, there has been at least a shifting towards the left—which may in time become the right—in so far as the general question of diffusion is concerned. It is, however, not only in solutions of religious faith that dogma crystallises out, as he himself has emphasised, and it is doubtful whether any nurture can so far chasten nature as to suppress the emotional element in scientific controversies, more especially in those that deal with human origins. The data of the anthropologist acquire a subjective bias more readily than do those of other disciplines: if indeed the study can be said to have as yet acquired a discipline, and it is not the author's fault if it has not.

Dispassionate discussion of early human history may also be hampered by the circumstance that many who pursue the study have not undergone that training in scientific method which is believed to make for clarity of thought, and perhaps for depth of understanding. This is not to suggest that impartiality is a product of a scientific training, and of no other, but it may perhaps be

admitted that, in the average case, a wide and detailed study of the less inexact sciences is a better preliminary for the anthropologist than is, for example, a devotion to the histories of Greece and Rome. But the question whether the 'scientific mind' is mainly born or mainly bred, must be left with the admission that there are 'scientific men' with unscientific minds, and other men whose minds are scientific, whether trained or not.

When we consider, therefore, how easily the best of minds may be deflected by internal and external influences, it is not surprising that what seems obvious to one wise man may be incredible to another. Facts, even admitted facts, speak in different tones to different mentalities, and the usual function of an argument is to strengthen the convictions of its fabricator.

With these considerations as a background, and discarding any fervour of advocacy we may suffer from, it is not difficult to accept without dismay Prof. Elliot Smith's accounts of the anti-diffusionist dogmatism of Principal Robertson; of the vacillation of Prescott, who denied his own conclusions in deference to authority; and of the internal conflict of E. B. Tylor, who put diffusion in the forefront for many years, only to renounce it towards the end of his life. The three chapters devoted to these honourable and distinguished men occupy more than half the book, though through them all runs the substantial thread of the author's thesis. In the first chapter, dealing with the nature of the problem, the spread of Islâm is given as an example of diffusion of culture within historical times. The final chapter, on "The Reality of Diffusion", is a brief summary of the views that the author has expounded at greater length in other works. It need scarcely be said that the book is written in the forcible and attractive style which we have become accustomed to expect from Prof. Elliot Smith.

That diffusion of culture is a valid explanation of similarities, and that independent evolution is only to be drawn on as a last resource, is so widely accepted as to be almost orthodox. So long, however, as the New World is regarded as an 'evolutionist' preserve, so long, that is to say, as the Americanist pins his faith, and perhaps his reason, to the cultural independence of the Amerind, the "common faculties of the human mind" will retain their transpacific lease of life. The upholders of the indigenous origin of all that is significant in Amerind culture reject, as a matter of routine, the diffusionist explanation of the conspicuous and admitted resemblances that exist with eastern and south-eastern Asia. Without entering into detail, it is only possible to suggest here, that Prof. Elliot Smith, by taking his Asiatic cultural elements across the Pacific by way of Polynesia, presents his opponents with an argument or two. The culture of Polynesia, and of Melanesia and Micronesia, was undoubtedly influenced by movements of peoples from Asia, but that it was through Polynesia that America received the elements of its higher cultures is not in accord with the paucity of distinctive Asiatic culture-traits in the islands. It would seem, rather, that the stream of culture into the Pacific by this route was a diminishing stream, and that it was by a more northerly course, with no oceanic culture-filter intervening, followed by a passage down the western coasts of America, that so much that is typical of south-east Asia was transplanted to American soil. This cannot be argued here—it needs a lot of arguing—but the view may be stressed, since some Americanists, by their concentration on the Polynesian aspects, appear to absolve themselves from the need to explain the Asiatic similarities. They can, of course, brand them as due to coincidence, or to the common mode of working of untutored Old and New World minds. That is, in fact, all that is left for them to do, except to contradict diffusionists.

There are many who are prepared to travel with Prof. Elliot Smith from China, or thereabouts, to Peru, by one route or another, but will not join him in the earlier part of the course that he prescribes, with Egypt as the starting-point. This is, however, the heart and arterial system of his diffusion scheme, and to it he and Dr. Perry have devoted many years of ardent advocacy. Why is it that their recompense—measured in disciples—is no greater than it is? Is it that acceptance of the Egyptian theory calls for too much faith from those who dare not judge for themselves—too much flouting of authority—and for too wide a vision from those who regard themselves as qualified to form an independent judgment? Are we timorous, or only narrow-minded, in our scepticism? Or are we, by any chance, wise in our caution? It must suffice to say here, that for some of us, diffusionists by implication or confession, the reserve which is demanded in the large-scale utilisation of archæological and other data for the production of a cultural cavalcade, allows us to accept the

Egyptian theory as a remarkable essay in reconstruction—bold, colourful, persuasive, but too good to be wholly true. It smacks of perfection. It embraces many conclusions which, however logical in their immediate ancestry, come of lines of argument in which inference and interpretation have played too large a part. To accept the theory as a whole would be an act of faith; to reject the parts one does not like would be to spoil its symmetry; to deny it root and branch would be to spite oneself. Perhaps, after all, to pick and choose is all that we can do, with apologies to the artists whose conception we despoil.

H. S. HARRISON.

Regeneration and Transplantation

(1) *La régénération et les problèmes de la morphogenèse.* Par Dr. Marcel Abeloos. (Collection des actualités biologiques.) Pp. xi+253. (Paris: Gauthier-Villars et Cie, 1932.) 50 francs.

(2) *La transplantation animale.* Par Dr. Raoul M. May. Pp. vi+352. (Paris: Gauthier-Villars et Cie, 1932.) 70 francs.

(3) *Regeneration und Transplantation.* Von Prof. Dr. E. Korschelt. Band 2: *Transplantation unter Berücksichtigung der Explantation, Pflanzenpfropfung und Parabiose.* Teil 2. Pp. 697–1559. (Berlin: Gebrüder Borntraeger, 1931.) 72 gold marks.

(4) *Experimental Analysis of Development.* By Prof. Bernhard Dürken. Translated by H. G. and A. M. Newth. Pp. 288. (London: George Allen and Unwin, Ltd., 1932.) 14*s.* net.

THE spontaneous repair of induced injuries has long been recognised as one of the more spectacular activities of living organisms. Probably all animals and all living cells can effect the repair of localised and superficial damage, but only in some cases can the replacement of lost parts take place on a large scale. Numerous attempts have been made to correlate this regenerative power with other physiological properties or with phylogenetic history. These attempts have met with little success, and too often the facts have thereby been concealed in a mist of uncritical theory or buried beneath an unwieldy terminology.

(1) Within recent years, comparatively little has been added to our knowledge of regeneration, if this term is used in its stricter sense, and it is through no fault of his own that Dr. Abeloos' book is concerned with facts many of which have been known for some years. In the philosophical treatment of his subject, Dr. Abeloos is neither very convincing nor concise, but he has provided on more than one occasion a basis for further work. The book contains no index, and the bibliographies are restricted to each chapter, so that it is not always easy to find individual references. For such references it is necessary to turn to the first volume of Prof. Korschelt's book, which appeared six years ago.

(2) The theoretical interest of regeneration is in striking contrast to that associated with the transplantation of organs or tissues from one part of an animal's body to another, for in the latter case it has become obvious that the biologist has acquired a most valuable weapon for the attack on the great problems of morphogenesis. The fundamental facts are no longer new, but progress has been extremely rapid, and it may be doubted whether all of it has taken place along sound lines of advance. It is not easy to disentangle fact from theory, and many workers in this field find it necessary to write at inordinate length. The time has come, however, when a critical and concise account of the more salient facts should be set forth clearly for the benefit of biologists whose work lies principally in other fields. In this difficult task Dr. May has succeeded in a most striking manner. He knows his subject, has arranged the facts in a logical sequence, and he writes concisely and well. Of necessity, he deals with many details of anatomical structure, but the reader's interest is always maintained by the argument and by the clarity of the exposition. Only two criticisms can be made: there is no index and the legends to the figures are not always quite adequate. This book can be strongly recommended to any biologist who wishes to know the essential facts without reading the numerous, and unnecessarily long, papers which have appeared in many languages during the past twenty years.

(3) Prof. Korschelt's work is now completed in three handsome volumes which, in the aggregate, comprise more than two thousand pages. It is not a book which can be read from cover to cover—it is essentially a work of reference. It is beautifully produced, has a complete bibliography and an excellent index. As a guide to research workers, it will long be of importance, although it is unfortunate that the material is not arranged under a larger number of sectional headings. Books of this type rightly adorn the shelves of all responsible librarians, but it would be interesting to know

how often they are actually consulted by working biologists. Prof. Korschelt's work is, as it were, the library edition of the smaller volumes of Dr. May and Dr. Abeloos; as a stimulus to further work, most people will prefer one of the more concise productions.

(4) For reasons which may be adequate, Dr. Newth has translated Prof. Dürken's "Grundriss der Entwicklungsmechanik". As a translation the work is admirable; but it is unfortunate that no revision of the subject matter was possible. The book attempts to cover a very wide field and it will be appreciated by comparatively elementary students. Its main theme deals with the principles of experimental embryology, with which Prof. Dürken is familiar, but to a significant extent the author strays into the field of cell mechanics, where he is by no means a sound guide.

Although they are not without blemish, the four books here discussed form a more than usually significant contribution to the literature of biology. J. G.

Chemistry of the Sea

Das chemische Beobachtungsmaterial und seine Gewinnung; Kalziumkarbonat- und Kohlensäuregehalt des Meerwassers. Teil 1: *Der Bearbeitung des chemischen Materials.* Von Dr. Hermann Wattenberg. (Wissenschaftliche Ergebnisse der Deutscher Atlantischen Expedition auf dem Forschungs- und Vermessungsschiff *Meteor* 1925–1927, herausgegeben im Auftrage der Notgemeinschaft der Deutschen Wissenschaft von A. Defant, Band 8.) Pp. ix+333+2 plates+27 charts. (Berlin und Leipzig: Walter de Gruyter und Co., 1933.) 48 gold marks.

THIS volume deals with part of the observations made by Dr. Wattenberg, chemist to the expedition, during the three years' voyage of the *Meteor* in the South Atlantic, and with much subsequent experimental work which was necessary for the full interpretation of these observations.

The first part deals with the methods used on board, the organisation for dealing with the great number of water samples analysed at sea, the equipment in a restricted space, and contains lists of analytical data which were obtained.

The second part of the volume deals in a very complete manner with the calcium carbonate in the sea. Relatively much calcium occurs in sea-water, a part of which—the 'excess base'—is held in solution in combination with carbonic acid. The observations made on board are expressed in terms which indicate the proportion of calcium carbonate to total salts in solution. This proportion is least in the upper layers in low latitudes where calcareous plankton organisms, such as *Coccolithophores*, utilise dissolved calcium to build their skeletons. A minimum is reached at about 100 m. depth. From some 1,000 m. to near the bottom the proportion remained constant. A significant increase was found near the bottom at great depths, suggesting solution from bottom deposits and dead organisms under great water pressure, which by making the water more acid in reaction increases the solubility of calcium carbonate.

The solubility of calcium carbonate was investigated and is shown to depend upon the partial pressure of carbon dioxide *in situ*, the concentration of neutral salts in solution, the temperature and water pressure Of these, the partial pressure of dissolved carbon dioxide is itself interrelated to the total dissolved carbon dioxide, the amount of 'excess base', the hydrogen ion concentration, the temperature and water pressure. The presence of a small amount of borate in sea-water also exerts a slight influence on the solubility.

Experiment and an exhaustive treatment of this physico-chemical system has enabled the author to present his observations in the South Atlantic in terms of saturation of the water with calcium carbonate. The upper layers are found to be supersaturated, particularly in low latitudes. Below some 100–500 metres the water is found to be nearly saturated, while in great depths undersaturation occurs in some areas, owing to the influence of pressure. It is of interest in this connexion that bottom deposits from great depths contain least calcium carbonate and that extensive deposits of structureless chalk occur in low latitudes, as off the coast of Florida.

The third part is devoted to hydrogen ion concentration and dissolved carbon dioxide. A series of charts and sections illustrate the *p*H and partial pressure of dissolved carbon dioxide in the South Atlantic, while an account of the physical chemistry of the carbon dioxide system in sea-water is given in the text.

The author's researches on calcium carbonate in the sea, and the clear and concise explanations of the theories involved, make this volume a noteworthy addition to the science of oceanography.

Short Reviews

Faune de France. 26 : *Copépodes pélagiques.* Par Prof. M. Rose. (Fédération française des Sociétés de Sciences naturelles : Office central de Faunistique.) Pp. iii+374+19 plates. (Paris : Paul Lechevalier, 1933.) 140 francs.

A NEW part of the "Faune de France" is always acceptable and the present volume appeals specially to marine workers, for here all the pelagic species are described and figured in a wonderfully small space and in a very desirable way. M. Rose is to be congratulated on this monograph, which deals not only with the species of the French fauna but also those of a large area beyond, including Great Britain.

The introduction begins with a clear account of the form of a copepod and the regions of its body with the appendages, the general organisation and biology. Then follow very useful directions for capture, determination and preparation, which include the author's own special methods for dissection and mounting; finally there is a full systematic survey with a key to the families and genera, and plates of clear outline figures illustrating points chosen as significant for the differentiation of the various forms. The fact that this key occupies 33 pages gives some idea of the scope of the work. The genera are defined and keys of the species given with descriptions and figures of each.

All the volumes of the "Faune de France" aim at simplicity and brevity. The present one certainly attains this object; it should be easy to run down any species by using the keys, figures and descriptions.

Modern Man in Search of a Soul. By C. G. Jung. Translated by W. S. Dell and Cary F. Baynes. Pp. ix+282. (London : Kegan Paul and Co., Ltd., 1933.) 10*s.* 6*d.* net.

THIS is a translation of a collection of eleven essays, of which ten were originally given as lectures, by Dr. C. G. Jung. They cover various not very closely related topics, to which a certain coherence is given by the general outlook of the analytical psychology of the author. With the exception of three, they are critical of the psychoanalytic views of Freud. The general purport of the book is given in the translators' preface, and may be summarised thus. We are on the verge of a spiritual rebirth. Some look in hope towards a renaissance of revealed religion. Others, rejecting institutional religion altogether, look to science for a new enlightenment of reason. The middle position is that of those who have outgrown the churches, yet feel that "a religious attitude to life is as essential to them as a belief in the authenticity of science". To such Jung's teaching will appeal, as "synthesising his knowledge of the soul, gained in his many years of practice as psychiatrist and analyst, into a fund of information available and applicable to everyone". It will be seen that the book moves largely on philosophical lines.

Psychology of Sex : the Biology of Sex, the Sexual Impulse in Youth, Sexual Deviation, the Erotic Symbolisms, Homosexuality, Marriage, the Art of Love ; a Manual for Students. By Havelock Ellis. Pp. xii+322. (London : William Heinemann (Medical Books), Ltd., 1933.) 12*s.* 6*d.* net.

THERE is no need to stress the fact that, upon the subject of this volume, Mr. Havelock Ellis writes as one having authority. Besides a number of smaller books, his work "Studies in the Psychology of Sex" stands as enduring testimony to his learning and insight. But, except for purposes of reference, the work is far too large for most people, including members of the medical profession. The author tells us that in his own medical student days, the most distinguished gynæcologists ignored the mental aspects of sex, and restricted their attention to its physical processes; and he is not sure that the opportunities of the medical student are in this respect much better to-day.

The book under notice, so eminently readable and so readily manageable, is meant primarily for the student, but is for the most part quite intelligible to any educated reader. The author writes of course as a man of science, not as moralist or theologian; but he tells them, as well as the ordinary adult, what ought to be known by anyone venturing to instruct other people.

The Anatomy of the Eye and Orbit : including the Central Connections, Development and Comparative Anatomy of the Visual Apparatus. By Eugene Wolff. Pp. viii+310. (London : H. K. Lewis and Co., Ltd., 1933.) 31*s.* 6*d.* net.

THIS book, written by an ophthalmic surgeon who has been also for ten years a demonstrator of anatomy, is a thoroughly reliable description of the eye, its appendages, most of the nervous structures concerned in vision, and their anatomical relations. It is more than this, for the dry details are enlivened by historical notes, and, even more useful, by implications bearing upon pathological conditions. As might be expected from one who has worked in intimate association with Prof. Elliot Smith, the parts of the brain concerned in vision are specially well done. Two chapters are devoted to the development of the eye and comparative anatomy; they are by no means exhaustive, but they are excellent summaries and whet the student's appetite for more.

Most noteworthy of all is the magnificent way in which the book has been produced. The selection of borrowed illustrations could scarcely have been bettered, and it would be difficult to overpraise the new drawings, many by Mr. A. K. Maxwell. They are extraordinarily clear, and the shading is so well done that the tridimensional relations are well indicated.

The General Nature of the Gene Concept*

By PROF. R. RUGGLES GATES, F.R.S.

THE conception of the gene has resulted from two lines of biological evidence: (1) The amazing stability of the germ plasm, as expressed in the facts of heredity; (2) its occasional instability, as shown by the occurrence of mutations. That external forces, such as X-rays, impinging upon the germinal material should produce changes, is not surprising but inevitable. That the resulting effects are inherited, however, shows that the organism is incapable of regulating against changes in this particular part of its cell structure.

It appears that these phenomena of stability and inherited change can only be understood by recognising that some substances or structures in the chromosomes must maintain in general their spatial relationships and chemical nature, not only from one generation of organisms to another, but also with only minor changes through thousands, and in some cases even millions, of years. However protoplasm grows, these substances must be self-reproducing, with a permanence equal to that of the species itself, for when they change the species changes.

While emphasising these conclusions, which seem inevitable from the modern genetical work, I do not wish to minimise the importance of the cytoplasm. It has been shown, for example, by the investigations of embryologists (for example, Conklin, Lillie) that the visibly differentiated substances in various animal eggs can be displaced and rearranged by centrifuging, without affecting the development, yet if the fundamental hyaline ground substance of the egg-cell is disturbed, distortions of development will be produced. This and the facts of egg polarity argue strongly for a more or less determinate spatial arrangement of the cytoplasmic materials, at least in many animal egg-cells. It has also been shown by reciprocal crossing of plant species that some species are differentiated only as regards their nuclear content, while in others the cytoplasm differs as well.

The spatial arrangement of the genic materials within the chromosomes is therefore not different in principle from that shown to exist in the cytoplasm of certain animal eggs. The main difference is that the chromosome is a thread-shaped structure and is believed to be differentiated only along its length, that is, its differentiation is regarded as one-dimensional rather than three-dimensional.

In what sense do genes exist? The gene is probably the last in the long series of representative particles beginning with Darwin's 'gemmules' and the 'pangens' of de Vries, which were formulated to account for the phenomena of heredity. With advancing knowledge, such conceptions have tended to lose their formal character as ultimate particles reproducing by fission, and to become more physiological and more closely related to the known structure and activities of the cell. They lost their morphological nature when the conception of the unit character was given up many years ago. Bridges's conception of genic balance is essentially physiological. As Sir Frederick Gowland Hopkins has said of all organic units, "The characteristic of a living unit . . . is that it is heterogeneous. . . . The special attribute of such systems from a chemical point of view is that these reactions are organised". What is the nature of the organisation which leads us to the conception of the gene?

In 1915, I first pointed out that a gene represents a *difference*—a fact so obvious that its importance is in danger of being overlooked. Johannsen, who invented the term 'gene', afterwards (1923) expressed the same point of view. Our actual knowledge of genes, apart from speculation, is derived entirely from their differential effects in development and from the phenomena of linkage and crossing-over. The visible difference in the developed organism is the product of an initial germinal difference which must have arisen at some time through a mutation. The great majority of biologists will agree in locating the genic materials in the chromosomes. In the endeavour to get a more intimate picture of the nature of the gene, we must therefore explore the structure of the chromosome. It is also necessary to remember that, like everything else in the organic world, the genes, as well as the chromosomes, must have had an evolutionary history.

There have been two main theories of chromosome structure. According to one theory, the core of the chromosome contains a continuous thread or chromonema, which takes on a spiral form in various stages of mitosis. Cytologists have brought strong evidence for the existence of chromonemata in plant cells. The investigations, particularly of Sharp and Kaufmann in the United States and of Hedayetullah (1931) and Perry (1932) in my laboratory, have given a clear and definite picture of the chromosome during the cycle of mitosis. These accounts agree in finding the chromosome to be a double structure throughout the mitotic cycle, containing two chromonemata which are spirally twisted about each other in anaphase, telophase and prophase, each chromonema splitting before the chromosome halves separate in metaphase. There is also much wider evidence for the existence of a chromonema as a continuous thread embedded in the matrix of the chromosome. The genes must then be contained in this thread, and they must undergo duplication into two series before these are separated by the longitudinal fission of the chromonemata. The duplication of

* From a paper read on September 12 at a joint discussion of Sections D (Zoology), I (Physiology) and K (Botany) at the Leicester meeting of the British Association on "The Nature of the Gene".

the chromonemata must then be the fundamental process on which the phenomena of heredity depend.

Another theory of chromosome structure which has been much in vogue in recent years and has found perhaps its strongest support in animal cells is that of the chromomeres. According to this view, the chromosomes in prophase and telophase are made up of granules or chromomeres strung together on a fine connecting thread. Various attempts have naturally been made to identify these discrete chromomeres with the genes. They are perhaps most clearly demonstrated in such work as that of Wenrich on grasshoppers. The chromomeres in cytological preparations, however, differ greatly in size, and their number appears to be smaller than present estimates of the number of genes. Bridges has spoken of them as the houses in which the genes live. If this is the case, it would appear that whole families or even villages of genes must live in one house. Belling (1928) endeavoured to count the number of chromomeres in certain plant nuclei and has arrived at 1,400–2,500.

In a posthumous paper recently published, as well as in earlier papers, Dr. Belling strongly supports the chromomere theory, from observations of smear preparations of pollen mother cells in various lilies. Not only does he deny that the chromosomes are split in telophase, but he also holds the novel view that the prophase split in the chromomeres is not accompanied by division of the thread connecting them. Instead, he thinks connecting threads are formed *de novo* between the new daughter chromomeres, thus linking them up into a new chromosome. The chief merit of such a view appears to be that it would obviate many of the serious difficulties which still exist with regard to all current theories of chiasmatypy and crossing-over. The fact that such diverse views can be held by competent cytologists, shows the extreme difficulty of crucial observation in this field.

Recent observations now in progress in my laboratory indicate that chromomeres may not exist, at least in plant cells. We are finding that, in some cases at any rate, the appearance of a string of beads or a moniliform thread, when critically analysed, is due to the presence of two spirally intertwined chromonemata, the nodes and internodes of which give the superficial appearance of a single chain of chromomeres. It is therefore desirable that a re-investigation, particularly of animal chromosomes, be undertaken, to make certain whether chromomeres actually exist or whether they will bear the general interpretation here suggested. In the meantime, it appears that the core of many plant chromosomes is a continuous structure, not broken up into visibly discrete bodies. As the imagination of many genetical investigators has been caught by the idea of discreteness both in the gene and within the visible chromosome, it is well to emphasise this point.

The absolute discreteness of the genes within the chromonemata does not appear to be an essential part of the gene theory. It is well known that many of the Protozoa have numerous chromosomes which undergo longitudinal fission and exhibit the usual features of the chromosomes in higher organisms. Are we to suppose that these chromosomes are as highly differentiated along their lengths as the evidence of crossing-over leads us to believe they must be in higher plants and animals? I find it impossible to accept such a view, which would be virtually a denial of evolution except in the embryological sense. The alternative is to assume that, when the mitotic mechanism first evolved in the Protista, the chromosomes were perhaps differentiated from each other but each was uniform along its length. From this point of view the mitotic mechanism would be a striking example corresponding with Berg's idea of nomogenesis.

The development of the mitotic figure may be regarded as one of the main evolutionary achievements of unicellular organisms. We may reasonably suppose that it appeared there in its simplest form and that the chromosomes in these groups of organisms remained more or less longitudinally homogeneous. We may then think of the evolution of higher plants and animals as having taken place through internal differentiation of the chromosomes, combined with adhesion of the products of cell division into multicellular aggregates. Thus would gradually arise the condition which has been postulated for higher organisms as a result of experiments in crossing-over, that is, a set of chromosomes not homogeneous but longitudinally differentiated. According to this view, all the developments of evolution in multicellular groups were foreshadowed or at least made possible by the mitotic mechanism achieved by the Protista. Just as the simplest cell aggregates consist of undifferentiated cells, so their individual chromosomes are internally homogeneous, each containing a different type of genic material.

The current view of genes, as developed particularly in connexion with *Drosophila*, tacitly assumes that all genes are of the same kind. If the views here expressed have any validity, then it seems more reasonable to suppose that a portion of an original chromosome, not necessarily of minimum size, underwent a mutation. Later, a portion of this would undergo a different change, and so on until a series of genes or chemically different segments of various sizes would result. This would lead ultimately to some genes of minimum dimensions, although others might be larger, and segments of the original unchanged chromosome might remain. It would appear probable, however, that in this process the majority of genes would ere now have reached the minimum size. (I find that East in 1929 also emphasised the view that genes are probably of various sizes.)

Some workers have of course taken an entirely different view of the origin and history of genes, regarding them as the primordial bodies or organic

units from and by which protoplasm has since been constructed. Numerous comparisons have been drawn between genes on one hand and bacteriophage and virus particles on the other, based on their supposed similarity in size and action. While such comparisons are suggestive, the view of the genes as differentiated at a later stage of evolution within the originally homogeneous chromosomes seems on the whole more probable, and on this view there is no need to regard them as indivisible, discrete bodies of uniform size and nature.

Various estimates of gene size have been made in *Drosophila*. One of the latest, by Gowen and Gay (1933), arrives at a minimum size of 10^{-18} cm.^{3}, the number of loci in the nucleus being estimated at more than 14,000. This maximum size would only allow space for about fifteen protein molecules. There is at present a large margin of error in such estimates. From measurements of spermheads and chromosome lengths, these authors draw the interesting conclusion that the chromosomes are all arranged end-to-end in the *Drosophila* spermhead.

The view of gene origin within the chromosomes as sketched above appears to be supported by the fact that the genes are now known not to be uniformly distributed in the chromosomes. The *Y*-chromosome has long been recognised as nearly empty of genes, but later work of Dobzhansky (1933) and others shows that one third or more of the length of the *X*-chromosome at the right or proximal end near the spindle fibre attachment is also inert. In this region only one mutation, 'bobbed bristles', is known to occur, and crossing-over apparently does not take place. Possibly these inert or 'empty' segments may represent an earlier unmutated condition of the chromosomes. The bulk of the chromosome is probably composed of thymonucleic acid, but it does not necessarily follow that the genes embedded in the chromonema axis are derivatives of that substance.

Although Belling believed that each chromomere contains a visible gene, yet the bulk of evidence leads to the conclusion that the genes are ultramicroscopic, and Bridges (1932) has recently expressed the view that they are unimolecular. It has been more usual to picture them as definitely organised bodies containing a score or a few hundred molecules and reproducing either organically by fission or chemically by duplication. The idea that each gene is a single molecule, while avoiding the possibility of its divisibility, appears to add difficulties of another kind. It is difficult to see why a tenuous chain of single unlike molecules should persist in the core of the chromosome, as it would be necessary to assume. Chemical forces alone could scarcely be expected to hold such a chain together, even if we rely upon the properties of the carbon atom. On the other hand, whatever physical forces give the chromosome its unity as a structure, might also be concerned (1) in organising each group of like or unlike molecules into a gene, and (2) in maintaining their axial arrangement in the chromosome. Could one molecule exert its catalytic effect while maintaining its position undisturbed in the chromonema? And could it duplicate itself when the row of genes divided? The mere asking of such questions shows that we do not know whether genes should be regarded as organic or inorganic groupings, and it indicates also that the time-honoured phenomena of growth and reproduction formerly associated with such bodies are in some danger of being lost, although it must equally be said that they have not yet been eliminated.

The 'scute' series of genes in *Drosophila* has become increasingly difficult to interpret on the prevalent conception of the gene as a body which can never be fractionated but can only undergo change (mutation) as a whole. On the other hand, the theory of step allelomorphism as developed by Dubinin (1932) and others is entirely in harmony with the view of gene evolution which I have outlined above. On the assumption that genes are indivisible in all circumstances, it has been necessary to make them smaller and smaller, until the limit is now reached in the single molecule. But surely, if the atom itself can be disrupted by suitable forces, it is not unreasonable to suppose that something of a similar kind may happen to a group of molecules constituting a gene.

The genetic study of variegations in plants has also led to the view that the genes involved are compound structures, the somatic segregation of which results in the variegated condition. The studies of Emerson on the varieties of maize with variegated pericarp, of Baur on *Antirrhinum*, Eyster on maize and *Verbena*, Demerec on *Delphinium* and *Drosophila* are notable in this connexion. Eyster (1928) adopts the hypothesis that the genes causing variegation are compound structures composed of a constant number of 'genomeres' which may or may not be of the same chemical or physical nature. Demerec (1931), however, explains the variegation in *Delphinium* as a result of highly mutable genes. It remains to be seen whether the divisibility of the gene in somatic tissues or the high mutability of such genes will supply the explanation.

We prefer to think of genes as differentiations of many kinds and sizes which have arisen in the core of the chromosome during its evolution, making it a nest of catalytic substances, most of them having specific effects mainly on the development of particular organs. By different processes of translocation in the nucleus, genes tend to become shifted from their original positions. The result is that genes affecting quite different organs come to occupy adjacent positions in the chromosomes. It seems quite likely that, from a historical point of view, mutation has been a much more orderly process than might be supposed from the present disorderly arrangement of the genes in *Drosophila*. The fact that the genes have been scrambled in this way seems to show that mere position within the chromosome is of little or no significance.

Early Astronomy and the Observatory of Leyden*

By PROF. WILLEM DE SITTER

THE Observatory of Leyden had really two founders, Golius in 1633 and Kaiser in 1861. I propose to make a comparison between these two epochs and the present time. Looking back from the point of view of the science of to-day at the past, the great differences between now and then are brought into sharp relief. Our times are distinguished by the great facility of communication; the steamship and railway, telegraph and aeroplane have made the world much smaller. We have our international organisations, our periodicals, and although influences outside science at present throw many difficulties in the way of international intercourse, still we men of science feel ourselves more and more to belong to a universal fraternity. In the seventeenth century it was otherwise. Although at that time scientific intercourse was more international than at present, as being much more independent of political influences, yet owing to the absence of periodicals and the slowness of communication, each individual student was in a much more isolated position than now, and international communication bore a much more personal character. Scientific intercourse was mostly by correspondence: people had time to write, and even to read and answer, letters. The period of the second foundation, 1860, is in this respect intermediate between the seventeenth century and our own time. There were few periodicals, communication was maintained much more by correspondence than nowadays and the scientific international organisations as we know them to-day were only just beginning.

If we look at the practice of science, the difference is, if anything, greater. To-day we live, so to speak, on photography; we cannot imagine astronomy without it. But the development of the application of photography to astronomical observations took place very slowly and gradually; in 1861 the photography of the sky had scarcely been begun, although the first photograph of a star had been taken about ten years previously. Perhaps some eccentric worker may have dreamed of a systematic photographic examination of the firmament, but it was not for a quarter of a century that the practical possibility of this on a large scale was generally acknowledged and undertaken.

The second great revolution in the aspect of science was wrought by spectroscopy, the origin of which lies in about the same period. In 1859 Kirchhoff and Bunsen laid the foundations of spectrum analysis: in 1863 Secchi published his first classification of the spectra of the stars. 'The new astronomy' was born at that time. It was the spectroscope that finally abolished the last vestiges of the old belief, a relic of antiquity and scholasticism, in an essential difference between 'corruptible', sublunary matter and the 'incorruptible', superlunary, divine or heavenly; and introduced, or at least confirmed, the conception of the fundamental unity of the universe.

The development of science is a gradual process. It is often impossible to fix the exact moment at which a new idea was conceived. But the history of science, like other history, can be divided into definite periods, even if these cannot be definitely limited, any more than the historian, I take it, can say exactly on what day the Middle Ages ended and modern history began.

The history of astronomy, I consider, may be divided into four periods. The first, to which Babylonian, Egyptian and the most ancient Greek science belongs, reached its climax in Aristotle and his immediate followers. The second, which we can perhaps best characterise as the Ptolemaic, begins with Hipparchus, and ends with Copernicus. The third period, which I would call the Newtonian, after the man in whose work it culminated, begins a century before Newton with Tycho Brahe, Kepler and Galileo. The fourth, modern astronomy, was, as we saw, opened in 1860 by the introduction of photography and spectroscopy, and it is to all appearance even now still in the first stage of its rising development.

The year of the foundation of the Observatory of Leyden, 1633, falls in the middle of the transition from the second to the third period. It was the year of Galileo's trial; Kepler died rather more than a year before (November 15, 1630); Huygens was a boy of four years old; Newton was not yet born. The "Novum Organon" of Francis Bacon was published in 1620, the "Discours sur la méthode" of Descartes (contemporary of our Golius, born in the same year) was to appear in 1637. A good idea of the standard of science then can be gained from the list of books of study given to the youthful Huygens by his teacher Stampioen de Jonge in 1645. Stampioen was not an independent scientific worker, but a teacher. His list of books may be taken to represent what at that time was common knowledge of all educated men. In mathematics, after mention of some elementary books, follows: "to read something more and to come to the highest step of mathematics . . . for this is needed the Book of the Elementa Conica Appolloni pergaei". Apollonius's conic sections, in which according to Stampioen, "the most subtle sciences [are] hid, that are possible to bethink on this earth", was the source to which, at that time, the greatest mathematicians went for help and information. Kepler pinned his faith on it when he was upon the threshold of his discovery of the elliptical orbits of the planets, and in the life of Golius it played an important part, as it was the inadequacy of the traditional

* From the address delivered at the celebration of the tercentenary of the Observatory on October 6.

Greek text that drove him to the study of Arabic, which was to be his life's work. Concerning astronomy Stampioen de Jonge says: "there is nothing better than all the books of Lansbergen", doctor and divine of Goes (later of Middleburg, who died on November 8, 1632) who enjoyed a great reputation in his day, which he well deserved. He was an adherent of the Copernican system, without Kepler's elliptic motion however, and from ancient observations, supplemented by those of Tycho and others, including his own and those of his pupil and admirer Hortensius, he deduced new elements for the planets and calculated tables which must have been good, as they enabled Horrox to predict and observe the transit of Venus on December 4, 1639. Yet there are in his book many arguments which to-day sound very strange to our ears. To give an example: the distance of the fixed stars is 28,000 astronomical units "because" their period of revolution round the sun is 28,000 years (through the precession)!

The peroration in Stampioen's advice to Huygens is worth quoting: "Not that the books aforenamed, will do it alone, but thereunto is moreover needed. In the first place a sharp intelligence. Further a continual application and finally also a sustained desire and industry for these sciences, which then . . . may be acquired through prolonged study. And moreover to put into practice that which has been learned, is of much more benefit than always and continually . . . to pore over your books."

It seems to me that father Huygens had chosen a sensible mentor for his son, and Christian certainly did not neglect Stampioen's further advice to do something else besides "always and continually . . . to pore over your books". To replace authoritative belief by individual research, book study by 'personal practice', especially *experiment*, is the characteristic which distinguishes the new period from the previous one. The discovery of the telescope in 1608, by which, primarily through the multitude of observations by Galileo, the number and nature of the known phenomena of the universe were suddenly immeasurably increased, is one of the most important moments, perhaps the most important, in the evolution of ideas then taking place. I cannot help pointing out incidentally that in all the discussions as to who should have the honour of this discovery, the name of the discoverer of the *astronomical* telescope, Kepler, is scarcely ever mentioned, while he, of all the more or less independent makers of telescopes, had by far the best insight into the problems of optics.

The sharp light which is thrown upon the opposition between the Copernican and Ptolemaic systems by Galileo's quarrel with the Church, his dialogue on the two systems of the universe of 1632 and his trial and condemnation in 1633, have contributed to the view that this opposition is the essential, typical difference between the old and the new science. This is a mistake. The human mind is a very complicated mechanism; the way in which it works is often very inconsistent and may be contradictory in external, formal matters, to its inward nature. The difference between the Copernican and the Ptolemaic system belongs to the externals. Thus, three quarters of a century after the appearance of Copernicus's book, the great Snellius, who although he loved to launch his publications under a classic flag (Apollonius Batavus, Eratosthenes Batavus, Tiphys Batavus) was one of the most modern spirits of his time, in the essential contents of his work overflowing with originality and entirely free from all tradition, even such a man as Snellius could be a convinced adherent of Ptolemy, while a figure in the second rank, Lansbergen, a highly meritorious, industrious and conscientious worker, but without originality, proclaimed the Copernican doctrine.

It was at this time that the Observatory of Leyden was founded. Its founder Golius, the Orientalist, was the pupil of Snellius, but he was a man of a quite different mental temperament. He possessed an exceptionally lively, versatile, even daring mind, but was more humanist than scientist, and was urged by a thirst for knowledge and insight, not into the wonderful mysteries of Nature, but into science as a product of human culture. Originally mathematician and astronomer, he was brought to the study of Arabic by the desire to read Apollonius in a better text than the extant Greek one, and in that study he found his true vocation. In his new observatory he now and then made observations of eclipses, comets and planets, which observations seem to have been of good quality, but he took no interest in the fresh marvels revealed by the new telescopes. The foundation of the observatory by Golius was not, as with the second founder, Kaiser, the crowning of a lifelong endeavour, but more an impulse, a concession as it were to the love of his youth, at the time almost extinguished, astronomy.

Looking from the past towards the future, we find a great resemblance between the two epochs. In both there is a rapid development of science, originating with an overwhelming mass of new observational data, then a result of the discovery of the telescope, now of photography and spectroscopy. In both, simultaneous with and after this phase of harvesting new phenomena, there is a rich growth of new theories, a complete breaking with the traditional points of view. At the close of the seventeenth century, fifty years after the period that we have been considering, there came a consolidation of the new theories into a system by Newton, whereby what had been revolutionary became orthodox. Our time is not yet ripe for this. We have had, and still have in our midst, our Kepler, Galileo, Descartes and Huygens; the Newton of the new epoch is still to come. That the consolidation and unification of the different tendencies of present-day astronomy, which appear at the moment to be wild and unrestrained, will come in good time is certain, for science is immortal.

Obituary

PROF. J. E. MARR, F.R.S.

THE death of John Edward Marr, emeritus professor of geology in the University of Cambridge, on October 1, at the age of seventy-six years, has removed from our midst one who will not only be remembered on account of his scientific eminence as a geologist, but will also be deeply mourned by all his colleagues and friends who felt the charm of his personality and knew his worth as a man.

Marr was born at Morecambe in Lancashire on June 14, 1857, within sight of the Lake District, which was to become the field of many of his scientific labours and achievements. He was educated at Lancaster Grammar School, a school with scientific traditions, which had been responsible for the early training of William Whewell, master of Trinity College, Cambridge, and president of the Geological Society in 1837, and of Sir Richard Owen, who was vice-president of the Society in 1857. He entered St. John's College, Cambridge, as an exhibitioner in 1875, but soon became a scholar. He obtained a first class in the Natural Sciences Tripos in 1878 and was elected a fellow of his College in 1881, which fellowship he retained until his death.

Marr's boyhood association with the Lake District and North Wales, and later at Cambridge the influence of Sedgwick, could not do otherwise than make him a devoted student of the Lower Palæozoic rocks, and quicken his interest in the physical and physiographical aspects of geology. Even as a 'freshman' he contributed papers on the Cambrian rocks of North Wales to the Geological Society and to the *Philosophical Magazine*. His first paper on the older rocks of the Lake District was published in 1878, and was the forerunner of a series of outstanding contributions that appeared at fairly frequent intervals throughout his life.

Immediately after taking his degree at Cambridge, Marr proceeded to Bohemia and Scandinavia to make comparative studies of the Lower Palæozoic rocks of those countries. In Bohemia, he spent some time investigating the so-called 'colonies' of Barrande, and the results of his work were communicated to the Geological Society in 1880. Although carried out at such an early age, this was one of Marr's most important contributions to science, for he proved conclusively that Barrande's view that a specific fauna could recur at different geological levels was based upon a misconception of the geological structure, and that the apparent repetitions were due to later earth-movement. The far-reaching consequences of this piece of work cannot be over-estimated, for until Barrande's idea of recurring 'colonies' was finally disposed of, the zonal division of strata, homotaxial relationships, and the evolutional progression of faunas could have no sure foundation or proper significance.

In 1885, with his colleague T. Roberts, Marr published a paper on the Lower Palæozoic rocks in the neighbourhood of Haverfordwest in Pembrokeshire. At this time little was known of the stratigraphy of this part of Wales ; the Ordovician rocks, except for the recognition of Llandeilo and Bala Limestones, were undivided and had quite indefinite upper and lower limits. This paper established a definite sequence of deposits, each with its characteristic fauna, and the divisions then made have been of the greatest value in all the more recent work on the Ordovician rocks, and in elucidating the geological structure of south-west Wales.

In the Lake District, Marr concerned himself primarily with stratigraphy, and practically every deposit and every part of the region at some time or other claimed his attention. Papers of the highest importance resulted from his labours in the field, and the Skiddaw Slates and their fauna, the Borrowdale Volcanic Series, the Coniston Limestone Group, the Keisley Limestone, the Dufton Shales, the Stockdale Shales, and the Coniston Grits all came under review, while with his friend Alleyne Nicholson he published original papers on the phylogeny of the graptolites. Few have rendered such service to Lower Palæozoic stratigraphy, and geologists owe him a particular debt for his detailed work upon the Upper Ordovician rocks, especially the recognition and definition of the Ashgill Series. This work has proved of the greatest value in furthering the study of Ordovician stratigraphy and tectonics.

Interested also in the abnormal character of certain developments of the Carboniferous Limestone Series in Yorkshire, Marr strove with some success to explain the origin of the 'reef knolls' of the Craven district. In this he had the collaboration of two of his oldest friends, first of R. H. Tiddeman of the Geological Survey and later of Prof. E. J. Garwood. With his colleague Alfred Harker, he made many valuable contributions to the petrology of the Lake District, more particularly in relation to the Shap Granite and the Cross Fell Inlier. In later years he revived his interest in the physiographical features of East Anglia, and did much to advance our knowledge of the late-Glacial gravels and post-Glacial deposits of Cambridgeshire.

In addition to his pursuit of stratigraphy, Marr was always attracted by the physical problems presented by the geological structure and relief of the Lake District, its glaciology and drainage. In a series of papers he discussed the origin of the lakes and tarns of Lakeland and showed that most of them were due to damming of the drainage by glacial drift, and that few if any were true rock-basins. Further, he demonstrated the radial character and superimposed nature of the Lake District drainage, showing that it is related to the now denuded anticlinal covering of newer

rocks and unrelated to the tectonic structure of the pre-Carboniferous deposits. Later, with Prof. W. G. Fearnsides, he extended his physiographic studies to the Howgill Fells.

As a writer and exponent of scientific facts and principles, Marr had a lucidity and ease of expression that made his work not only an education, but also a pleasure to peruse. His numerous separately published memoirs and textbooks all present this character, and it is only necessary to turn to his work on the "Scientific Study of Scenery" to see how great was his capacity for presenting essential facts in an interesting and attractive manner.

Although by virtue of his scientific achievements and the importance of his publications Marr takes a place in the foremost rank of British geologists, it is as a teacher, first as lecturer and then as Woodwardian professor at Cambridge, that he will be gratefully remembered by a host of past students and by a band of devoted and loyal colleagues. Marr's influence on the Cambridge school of geology since his appointment as lecturer in 1886 has been enormous. He was responsible for the teaching of all the stratigraphical and physical geology, both elementary and advanced, and with the then Woodwardian professor, T. McKenny Hughes, and with the able collaboration of Alfred Harker and Henry Woods, was largely instrumental in making Cambridge the foremost school of geology in Britain. He was appointed Woodwardian professor in succession to Prof. Hughes in 1917, a position which he assumed to everyone's satisfaction, and which he filled with traditional distinction. His failing sight, however, and an indisposition from which he never completely recovered, caused him to retire from the chair in 1930, but he retained all his mental vigour and his intense interest in geology and the Cambridge school until the end.

Outside Cambridge, Marr also played throughout his life an important part in geological activities. He served on the council of the Geological Society almost continuously for forty years, being secretary for ten years, president from 1904 until 1906, and foreign secretary from 1925 until 1928. He received at different times three medals from the Society in recognition of the value of his services to geology, culminating in the highest award, the Wollaston medal, in 1914. He was awarded a Royal medal by the Royal Society in 1930; he was elected a fellow of the Royal Society so long ago as 1891.

A naturally courteous and chivalrous nature coupled with an immensity of human understanding made Marr approachable in his official capacity, and a delightful host and companion. His students invariably received from him just that encouragement in their work and that individual interest which stirred them to endeavour. His house was open to them, and with the kindly assistance of Mrs. Marr this privilege of personal contact was enjoyed by generations of undergraduates, most of whom came as pupils and left as devoted friends. H. H. T.

Mr. E. Everett

Old students of the Cavendish Laboratory will regret to hear that Mr. E. Everett died on November 4 at the age of sixty-eight years. He went from the Chemical Laboratory to the Cavendish in 1888 as private assistant to the professor and remained there until 1930, when his health broke down. It was hoped that the rest might enable him to recover sufficiently to be able to enjoy the leisure he had earned so well, but it was not so, and he remained an invalid and suffered much pain and discomfort until his death.

Everett took a very active and important part in the researches carried on in the Laboratory, by students as well as by the professor. The great majority of these involved difficult glass blowing, which was nearly all done by Everett, as it was beyond the powers of most of the students. In addition to this, he made all the apparatus used in my experiments for the more than forty years in which he acted as my assistant. I owe more than I can express to his skill and the zeal which he threw into his work. He was a very skilful glass blower, a quick worker, very pertinacious; if the first method failed he would try another and generally succeeded in finding one which would work. He was also an excellent lecture assistant, and was a great help to me in my lectures at the Royal Institution. He took a personal interest in the success of each experiment and spared neither time nor trouble to make it come off.

In the early days of X-rays, before hospitals or medical men had any appliances for taking X-ray photographs, Everett and W. H. Hayles, another assistant at the Cavendish Laboratory and an expert photographer, organised a scheme for taking photographs at the Laboratory. Many medical men availed themselves of this, although the revelations made by the photographs as to the way in which bones had been set sometimes caused considerable embarrassment.

Everett's services to the Cavendish Laboratory were recognised by the University of Cambridge, which in 1931 conferred upon him the honorary degree of M.A. Of this he was rightly very proud, and it was, I believe, a great consolation to him in his troubles. J. J. Thomson.

We regret to announce the following deaths:

Mr. W. H. Fowler, C.V.O., consulting radiologist to Edinburgh Royal Infirmary, an authority on radium and radiology, on October 5, aged fifty-seven years.

Dr. Ernst Hartert, director of the Zoological (Rothschild) Museum, Tring, from 1892 until 1930, on November 11, aged seventy-three years.

Lieut.-Col. C. G. Nurse, a well-known entomologist, who published numerous papers chiefly on the Hymenoptera of India, on November 5, aged seventy-one years.

News and Views

Nobel Prizes for Quantum Theory Investigations

THE Nobel prize for physics for 1933 has been awarded jointly to Prof. P. A. M. Dirac and Prof. E. Schrödinger, both of whom have earned international reputations for their work on the quantum theory. The prize for 1932 has been awarded to Prof. W. Heisenberg, of the University of Leipzig. Prof. Schrödinger who, at the time of the publication of his paper on "Quantisation as a Problem of Proper Values", was at the University of Zurich, has since occupied a chair in the University of Berlin and is now at Magdalen College, Oxford. He had previously written a number of papers on various subjects in physics. Amongst them are works on the theory of pigments and on colour measurement, while one, "On the Coherence of Wide Bundles of Rays", is of an experimental character. One of his contributions in 1914 is of particular interest in that it seems to foreshadow his important work. This is on "The Dynamics of Elastically Coupled Systems", in which he considers a system of mass points which, in the limit, gives the partial differential equation of a vibrating string and in which considerations of group velocity play a part. Influenced by the ideas of de Broglie, Schrödinger developed wave mechanics as a coherent theory, the centre of which was the wave equation. The nature of the atomic problem appeared in a new guise, showing mathematically more resemblance to the vibrating string than to the planetary system. The methods of the new theory were classical in character, and gave the hope that the quantum theory might finally be absorbed into the classical doctrine. Schrödinger seems to have been imbued with this idea. The theory met at once with an enthusiastic welcome and made rapid strides. An important step was made when Schrödinger showed the relation of his theory to that of Heisenberg, and henceforth it was possible for the two theories to draw from each other in spite of the difference in their philosophic outlook.

PROF. DIRAC, who is Lucasian professor of mathematics in the University of Cambridge, approached the quantum problem from an entirely different point of view, his work being more closely allied to the Heisenberg matrix mechanics. His first great service was to establish the elements of the theory by an examination of the Poisson bracket expressions of generalised dynamics. Guided by their properties, he laid the foundations of an independent quantum algebra. Dirac stands out amongst his contemporaries in this field for his originality. Heisenberg originally proposed to banish from his equations the unobserved quantities that had come into atomic theory with mechanical models. He proposed to include in his theory only such quantities as could be observed. This was in effect a bid for freedom from old rules. Dirac went still further from earlier methods. He refused to be cramped by his symbols, holding that, if exact physical counterparts can be found for them, the time is not yet. Thus he builds up a mathematical analysis which is wider and more flexible than existing systems. It is this feature of the work which is peculiarly Dirac's. In his book "Quantum Mechanics" he gives what has been described as an adequate philosophy, as a background to his theory. This book will surely stand out as one of the monuments of mathematical physics of this generation. The actual details of his work, the problems he has conceived and the solutions he has given, are well known, but there can be no doubt that his greatest contribution is his discovery of the first order equations of the quantum theory. The discovery of these equations, known everywhere by his name, marks the greatest advance since the introduction of de Broglie's theory. The best-known result of their formulation is the inclusion of the 'spin term'. The particular degree of freedom, which is described in the model as the spin, finds a natural place in the theory. This is, however, merely an important detail in an advance which discloses new fields of research and may have far-reaching consequences in the theory of relativity.

Sir Richard Tangye (1833–1906)

ON November 24 the centenary occurs of the birth of Sir Richard Tangye, the most prominent of the five brothers who founded the well-known engineering firm of Messrs. Tangye, Ltd., of the Cornwall Works, Birmingham. From the humblest beginnings, the business, begun in one small workroom in Birmingham in 1855, grew into a great concern employing 2,500 persons supplying machinery to all parts of the world. Like his brothers, Tangye was born in Illogan, Cornwall, the parish in which Richard Trevithick was born, and was the son of a Quaker farmer of strong character. Through an accident he was debarred from mechanical pursuits, but during the greater part of his life he was the most active and enterprising of the family. Success first came to the firm when it supplied hydraulic jacks to Brunel for the purpose of pushing the *Great Eastern* into the Thames. The jacks were of an improved type invented by James and Joseph Tangye, and Sir Richard Tangye used to say, "We launched the *Great Eastern* and she launched us." Similar jacks were afterwards used for raising Cleopatra's Needle.

VARIOUS machines were brought out by the firm; it introduced into works the differential pulley block invented by Weston, and later on steam-engines and pumping plant were manufactured. From 1881, the concern was carried on as a limited company by Sir Richard Tangye and his younger brother George Tangye (1835–1920). Sir Richard, who was knighted in 1894, was also well known for his interest in social, educational and political matters, his travels and his benefactions to Birmingham. Among his hobbies was the collection of relics of Oliver Cromwell, resulting in the publication of his book "The Two Protectors—Oliver and Richard Cromwell". In a little book entitled "One and All", published in 1889, he gave an entertaining account of the growth of

the firm and of his own career. A biography of him by Dr. S. J. Reid appeared in 1909. He died at his house at Kingston-on-Thames on October 14, 1906, and was buried in Putney Vale Cemetery.

Protection of the Fauna and Flora of Africa

THE international conference which met recently in London for the consideration of measures "For the Protection of the Fauna and Flora of Africa" has completed its deliberations. At the moment, however, it is impossible to summarise the results arrived at. The need for such a conference has long been apparent. For the creation of reservations and the enactment of legislation by individual governments, have been, it must be admitted, no more than partially successful. The difficulties in the path of those charged with the enforcement of the regulations laid down have been many; and those who have found profit in the exploitation of big game have shown a high degree of ingenuity in evading these regulations, or by specious arguments have succeeded, on occasions, in securing their modification to enable them to achieve private ends. How far the present conference will defeat opposition of this sort will be seen when its deliberations have been carefully analysed. But we trust that, among other things, some means will have been devised to put an end to the exploitation of this game by professional hunters, who organise 'Safari trips' for the pleasure of amateur hunters, and the trophy hunter. We trust, too, that much closer scrutiny will be given to requests to shoot elephants, zebra and antelopes on the plea that they are damaging crops, or carrying disease; for such pleas have been advanced more than once, as a cover for obtaining the highly marketable commodities, ivory and hides.

AN urgent appeal has already been made by the French Government for some sort of control over aeroplanes flying above the haunts of big game with deplorable results; and it also complains, as the British Government has done, of shooting game from motor-cars. The fact that at long last a serious and determined effort has been made to retain what is left of the fauna of Africa, inspires us to hope for great things. For in this fauna we have a great heritage, and a grave responsibility rests upon all who have its control within their grasp. The formation of game reserves by the Governments of Great Britain, France, and Belgium was followed by the formation of the great Kruger Park at Pretoria, the largest of its kind in the world. It would seem that this generous and carefully considered scheme, thought out by men resident in Africa, is to be followed up after a similar fashion, so far as is possible, in other parts of Africa. Only thus, indeed, can these animals be saved from extermination.

Physico-Psychical Experiments

IN the third Frederic W. H. Myers memorial lecture, which was delivered before the Society for Psychical Research on October 25, and of which an English edition has just been issued ("Supernormal Aspects of Energy and Matter": London, 1933), Dr. Eugène Osty, the director of the Institut Métapsychique, Paris, reviewed the recent experiments with the medium, Mr. R. Schneider. He described the nature of the apparatus employed through the use of which it is claimed that the medium is capable of demonstrating his power of externalising a 'force', or substance, the effects of which can be registered at a distance from him. In the course of the address, the speaker maintained that Mr. Schneider possessed exceptional powers, which he was able to exercise over the material world when in a special physiological state designated as *trance*. In this condition his behaviour is as if he knew and could control "the primordial resources of life and processes of creation". The method of demonstrating this alleged action at a distance was to study its effect on infra-red rays which occupied a certain area. Interruptions and absorptions occurred which were registered photographically, and shown to be connected with the respirations of the medium. Attempts were made to photograph the invisible substance, but were not successful; Dr. Osty is of the opinion that plates sensitive enough to the radiations have not yet been produced.

IN defending the experiments against those who have ventured to criticise them, Dr. Osty is at pains to explain the reasons for his suppression of facts considered by his critics to be of some importance. He states that any attempt at fraud on the part of the medium would have been followed by an exposure *in flagrante delicto*. Moreover, the reliability of the results indicated that the publication of the full details was unnecessary. A tall screen cut off the apparatus and the infra-red field from all those present. If doubts were expressed, the experiments could be repeated and the results verified. In conclusion, Dr. Osty touched upon the philosophical significance of the phenomena of the occultation of the infra-red; and stated that it was the same as that suggested by the materialisations of other mediums, such as the late Mr. Guzik, although he can scarcely be unaware that this medium was caught *in flagrante delicto* and repeatedly exposed. In order to assist the reader to understand the disposition of the apparatus used in the experiments, a diagram of the laboratory is printed, although no scale is given and the position of the tall screen is not indicated.

Improvements in the Autogiro

AN improved model of the autogiro, demonstrated at Hanworth aerodrome recently, marks a decided advance towards the simplification of ordinary straightforward flying, landing in small areas, and safety in emergency landings. Change of orientation of the machine in any direction is obtained by tilting the universally-mounted rotating planes, there being no ailerons, elevators, or rudder. The machine swings pendulum fashion beneath the rotors as they are tilted, bringing the propeller thrust-line into any desired direction. Correct bank for a turn is thus quite automatic. The rotor universal joint is carried

on a standard above the body, and the control column hangs from this, convenient for the pilot's hand. Its movements are about 5° fore and aft and rather less laterally. It can be locked forward in such a position that it is impossible to put the machine into anything but a climbing attitude when leaving the ground. Normal landings are made by coming in to about 10 ft. above the ground at lowest gliding speed, lifting the nose, and opening up full engine power, which drives the tail down. When the tail wheel touches the ground the engine is shut off, lift is lost, and the front of the machine falls. Thus the forward momentum of the machine is negligible, and it stops practically dead. Landings without engine, that is, the most probable type of forced landing, are not so slow, and have to be made as with the conventional aeroplane, with a forward speed of about 25 miles per hour, at which the rotors have just sufficient lift at the gliding angle necessary to maintain this. The pull-up run is then about 50 yards. Full control is retained at this speed. An interesting secondary point has arisen from the fact that owing to the machine's great speed range, 25–120 miles per hour, it is inefficient at one end of this unless fitted with a variable pitch propeller. At present there is no suitable small-power airscrew available, development of these having always been directed towards those for high-power supercharged engines.

Micro-Methods for the Determination of Helium

IN the first of a course of three lectures arranged by the University of London and delivered on November 14 at the Imperial College, South Kensington, Prof. Fritz Paneth, until lately director of the Chemical Institute at Königsberg, described the micro-methods now available for the determination of helium. The special experimental technique evolved in the Königsberg laboratories permits the qualitative detection of so small a quantity of helium as 10^{-9}–10^{-10} c.c., and the quantitative estimation, with an uncertainty of about 1 per cent, of 10^{-5} c.c. Prof. Paneth discussed briefly the various problems in the solution of which this refined radium technique has been or may be employed—such as the concentration of helium in the stratosphere, the age of minerals, particularly those derived from the Kimberley diamond pipes, the origin of meteorites, and sundry questions connected with natural or artificial transmutation. The further lectures of this course, to be delivered on November 21 and 28, will be devoted to the consideration of the age and origin of meteorites, and the chemical detection of transmutation.

The Newcomen Society

THE annual general meeting of the Newcomen Society was held on November 8 at the Institution of Structural Engineers. The report stated that on October 1, 1933, the membership was 323, while during the year eight meetings had been held in London, two in New York, and one in London in conjunction with the Omnibus Society. As the outcome of one of the papers read, a Shetland water mill has been secured for the Science Museum, while through the paper by Mr. H. W. Dickinson on "Jolliffe and Banks, Contractors", the firm which built Waterloo, Southwark and London Bridges, the tomb of Sir Edward Banks in Chipstead Churchyard, Surrey, has been restored at the expense of Mr. J. J. M. Edwards, chairman of the Bridge House Estates Committee of the City of London. The Society took an active part in the bicentenary celebrations of Arkwright and Priestley and the centenary commemoration of Trevithick. During the year, an Extra Publication No. 3, and vol. 11 of the *Transactions* have been issued.

AT the conclusion of the business of the annual meeting of the Newcomen Society, a lecture was given by Mr. S. B. Hamilton on "The Place of Sir Christopher Wren in the History of Structural Engineering", the lecture being illustrated with many lantern slides of St. Paul's Cathedral. Prior to Wren's time, the only work on the strength of materials of which any record exists was that of Leonardo da Vinci, and the "Dialogues" of Galileo. The latter were discussed at the early meetings of the Royal Society, but Wren does not appear to have been interested in them. Neither did Wren write anything on materials, although he made a profound study of buildings, and exercised exceptional ingenuity in the combination of structural forms. His reports on old St. Paul's, Salisbury Cathedral and Westminster Abbey contained many interesting criticisms on their construction and the way the heavy loads were taken. What calculations Wren made of loads and stresses is not known; indeed exact calculation would have been useless to a designer who repeatedly altered his plans as the work progressed. One subject he was greatly interested in was the treatment of the arch, which was also dealt with by Hooke and David Gregory. Of great interest was Mr. Hamilton's review of the steps by which Wren was led to the construction of the dome of St. Paul's as it is seen to-day. This is the work which gives Wren enduring fame as a structural engineer. Though through the failure to provide adequately for shear, defects arose in the counterforts, necessitating the extensive repairs of a few years ago, yet the marvel is not that defects occurred, but that such a stupendous mass of intricately balanced masonry was ever made to hold together.

New Broadcasting Station at Budapest

THE authorities responsible for the broadcasting service in Hungary have always kept abreast of the latest developments in wireless technique; indeed, Budapest claims the distinction of being the first town in the world to inaugurate a system of broadcasting over wires so early as 1893. Budapest will again come into prominence in the near future on the opening of its new broadcasting station, with a transmitter power of 120 kw., and an aerial mast which is claimed to be the highest in the world. A brief description of this station and a photograph of the new mast is given in *World Radio* of November 10.

The mast is of trellis-work steel construction, supported by two porcelain insulators on a solid block of concrete about twenty feet square. The shape of the mast is that of two elongated square pyramids, set base to base, and standing on one of the points, the whole structure being guyed at the centre point where the cross-section is a maximum. The height of the mast is 932 ft., but a telescopic steel pole at the top extends this to nearly 1,022 ft. or 310 metres. This height surpasses that of the Eiffel Tower by some 40 ft. and makes the mast the highest structure in Europe. The new transmitter, which is of British design built in the contractors' factory at Budapest, is situated in a building about half a mile away from the aerial, the radio-frequency power to which will be supplied through a suitable transmission line. The station is designed to supply an unmodulated carrier-wave power of 120 kw. into the aerial, and it will take over the wave-length of 550 metres used by the present transmitter. The latter, which has a power of 18·5 kw., will be retained for use on another wave-length to supply an alternative programme of less general interest than that provided by the main transmitter. The new station has already started testing at midnight, and it is likely that Radio-Budapest, which employs three women and two men announcers, will be one of Europe's best-received signals this winter.

Prehistoric Society of East Anglia

At the London meeting of the Prehistoric Society of East Anglia held on October 25 at the Society of Antiquaries, Mr. J. B. Calkin described researches in the marine raised beaches of Sussex. The 135 ft. raised beach at Slindon Park has yielded rolled Clactonian, Chellean, early Le Vallois and early Acheulean implements, with little or unrolled late Acheulean in the top layer, which is thus dated to the Acheulean interglacial period and necessitates a sea margin at more than 100 feet above present levels. On the beach occurs a floor industry of a crude Le Vallois type covered by a layer of Combe Rock. The lower (80–90 ft. O.D.) beach is probably intermediate in age between the 135 ft. and the Brighton raised beach. Major E. R. Collins exhibited examples of an industry of Upper Palæolithic character in black chert from buried 'floors' in Nidderdale, Yorkshire. The well-worked cores and flake implements have been compared with Aurignacian types by Prof. H. Breuil, and with the Cresswell finds. Mr. L. S. V. Venables exhibited a series of remarkable 'curved points' of finely chipped flint from sites on the Sussex greensand. Mr. L. V. Grinsell described the results of a study of the forms and proportions of Bronze Age barrows of the 'bell' type, particularly those of Wessex. The survey showed that Thurnam's 'bowl', 'bell' and 'disc' types form an evolutionary series connected by intermediate forms. Excavation records support the view that the 'bell' form is intermediate in age between the 'bowl' and 'disc' types.

Endowment of Industrial Research

In an article contributed to the *Nineteenth Century* for November, Mr. H. W. J. Stone reviews the present position of the research associations in Great Britain at the exhaustion of the Million Fund, while industrial conditions are still difficult. Although in the current year the vote of the Department of Scientific and Industrial Research has been increased by £70,000 to enable it to facilitate the work of these associations, the existence of most of them remains precarious. Mr. Stone uses the recent vicissitudes of the Research Association of British Rubber Manufacturers as an example of the evils attending our present haphazard methods of financing such industrial research. He urges that true economy and efficiency in industrial research require a settled programme subject to long-range review, together with a stabilised system of finance, based on levies, block grants or similar expedients for a term of years, so as to place the industrial research associations in the position of institutions existing on fixed endowments, the programmes and endowments being reviewed periodically by Parliament at intervals of not less than five or more than ten years. In place of a compulsory levy, he suggests the allocation of £2,000,000 from the new tariff revenue, estimated at £24,500,000 in the current financial year, for the endowment of industrial research. By the allocation from this new revenue of that sum for ten years to create a capital fund of 20 millions, invested to produce a steady and regular income, industrial research would at once be stabilised and at the end of ten years endowed for all time. Mr. Stone ably pleads the value of research in periods of depression, its place in national recovery and the need of ensuring that tariffs do not foster industrial sloth and inefficiency.

Planning

In a recent number of a fortnightly broadsheet entitled *Planning*, issued by P.E.P. (Political and Economic Planning), 16, Queen Anne's Gate, London, S.W.1, the subject of "Community Services" is discussed. The administrative organisation of community services, it is argued, has become largely obsolete in view of the new technique elaborated in other spheres for managing large units, eliminating waste, co-ordinating effort and generally for giving better value to the consumer. The primary need is full and up-to-date information. While physical science has been classifying everything in the world, and producers have begun to appreciate the need for market research, community services are carried on largely in the dark. Possibilities of co-operation between education, health services and industry have been neglected; even simple totals of recruitment into each main industry are not directly obtainable. There is an immediate need for establishing a social research council enjoying official status, comparable to that of the Medical Research Council, with sufficient resources to investigate and co-ordinate the work hitherto undertaken by numerous official, semi-official and voluntary organisations. Such economic services as gas supply, water supply, transport and sewage, which have been developed with great ability and enterprise by many municipalities, have now reached a stage when they might

appropriately be transferred to special regional organisations. Relieved of these purely business functions, local authorities could devote themselves with greater efficiency to their remaining duties, for which they should be given greater responsibility and autonomy than in the past.

British Empire Cancer Campaign

AT the recent quarterly meeting of the Grand Council of the British Empire Cancer Campaign, the following grants for the calendar year 1934 were made for the continuation of research into the cause and cure of cancer: Middlesex Hospital, £5,400; Cancer Hospital, £2,700; St. Bartholomew's Hospital, £2,250; St. Mark's Hospital, £540; Marie Curie Hospital, £540; Radon Centre at the Middlesex Hospital (through the Medical Research Council), £350; Mount Vernon Hospital, £900; Strangeways Research Laboratory, Cambridge, £350; Westminster Hospital Annexe, £300; Mr. I. Hieger (at the Cancer Hospital), £550; Dr. P. R. Peacock (Glasgow Royal Cancer Hospital), £300 and Dr. Alexander Haddow (at the University of Edinburgh), £200. Prof. E. Mellanby, who has succeeded the late Sir Walter Fletcher as secretary of the Medical Research Council, was elected a member of the Grand Council. The Grand Council resolved that attention should be invited to the fact that essays on "The Biological Effects and Mode of Action of Radiations upon Malignant and other Cells" for the 1933 Garton prize medal should reach the offices of the Campaign not later than December 31 next.

Earthquake in the Santa Elena Peninsula, Ecuador

WE have received from Dr. George Sheppard, State geologist in the Republic of Ecuador, a brief account of the severe earthquake that occurred at 10.31 a.m. on October 2 in the Santa Elena peninsula, Ecuador. Off Salinas, the cable that runs southward was broken at a distance of 14 miles from land. At La Libertad, the sea receded immediately after the earthquake, rose to high-tide level at 11.30 a.m. (low tide having been at about 10 a.m.), fell to low water at noon, and rose again to the former mark at 2 p.m. At Ancon, the ground was seen by Dr. Sheppard to be slowly undulating, and the water in a large tank flowed over the north-east side, from which it is inferred that the origin lay towards the west and beneath the Pacific. Among the after-shocks was one at 5.36 a.m. on October 3, of only slightly less intensity than the principal earthquake. It would seem, from the above account, that the epicentre was not far from that of the Colombian earthquake of January 31, 1906, the first of the three great earthquakes of that year that occurred along the Pacific coast of America.

Cultivation of Raspberries

THE Ministry of Agriculture and Fisheries has recently issued Advisory Leaflet No. 180 to set forth the results of modern research upon the cultivation of raspberries. The characteristics of present-day varieties are enumerated, and general directions for cultivation are given. Organic manures are deemed to be more suitable for the raspberry crop than artificials. Pruning for heavy crops of good quality demands more than mere thinning of the canes; the methods are set forth in the leaflet. Insect pests are not described, as other leaflets do this with requisite detail. Blue stripe wilt, a *Verticillium* disease, and mosaic, are the chief diseases. The methods of combatting the latter malady are the best that can be recommended, but the leaflet perhaps does not take sufficient notice of the fact that some of the best commercial varieties are resistant to mosaic, and therefore menaces to more susceptible varieties in the neighbourhood.

Science in Poetry

FOLLOWING upon an article in NATURE of August 26 entitled "Nature and Science in Poetry", Mr. E. Heron-Allen contributed to our issue of September 16 a letter in which he gave further examples of poems on scientific themes, among them being an "exquisite and delicate fantasy" which he attributed to the late Sir Arthur Shipley. Mr. H. S. Webster, 53 Loraine Road, London, N.W.7, has, however, written to Mr. Heron-Allen to point out that the verses were from a poem entitled "Solomon Redivivus, 1886" by Constance Naden, published in the volume of her complete poetical works, reviewed in NATURE of October 18, 1894. The poem consists of sixteen quatrains, three of which read as follows:—

We were a soft Amœba
In ages past and gone,
Ere you were Queen of Sheba,
And I King Solomon.

Unorganed, undivided,
We lived in happy sloth,
And all that you did I did,
One dinner nourished both:

Till you incurred the odium
Of fission and divorce—
A severed pseudopodium
You strayed your lonely course.

National Radium Trust

OWING to a rise of 30–40 per cent in the price in sterling of radium, consequent on the departure of Great Britain from the gold standard, the National Radium Trust pursued a conservative policy during 1932–33 and purchased only 3·76 mgm. of new radium, the needs of radium treatment centres being met by a re-distribution of the stock held. The Radium Commission has published details of the general policy adopted with regard to radium therapy for cancer, and summaries of reports from radium treatment centres (Fourth Annual Reports of the National Radium Trust and Radium Commission, 1932–1933. H.M. Stationery Office).

Health in the Tropics

THE October supplement of the *Tropical Diseases Bulletin* summarises the medical and sanitary reports from British Colonies, Protectorates and Dependencies

for 1931. While primarily intended for medical, research and administrative officers, the information given should also prove useful for those visiting the Colonies and Dependencies for pleasure, or those intending to reside there. The vital statistics included should also prove of value to insurance offices and business houses.

Polar Year Book

THE "Polar Årboken" for 1933 is the first annual publication of the Norwegian Polar Club. It is a well-illustrated little volume containing a number of papers by well-known polar travellers on various aspects of Norwegian activity in north and south polar regions. Most of the articles are of general rather than scientific value, but they include much useful information about whaling, coal mining in Spitsbergen and hunting in various parts of the arctic.

Announcements

THE Organising Committee of the Sixth International Botanical Congress has decided to change the date of meeting of the Congress. The Congress will meet at Amsterdam on September 2–7, 1935. The secretary is Dr. M. J. Sirks, Wageningen, Holland.

LEVERHULME research fellowships have been awarded to Miss E. M. Denby, organising secretary of the Kensington Housing Trust, Ltd., to study slum clearance and rebuilding at home and abroad; and to Miss D. A. E. Garrod, for excavation of palæolithic cave sites on Mount Carmel, Palestine.

THE Secretary of State for the Colonies has recently made the following Colonial agricultural appointments: Mr. E. J. Gregory to be manager, St. Augustine Experimental Station, Trinidad; Mr. A. Thompson, assistant mycologist, to be mycologist, Agricultural Department, Malaya.

THE Williams prize of the Iron and Steel Institute has this year been awarded jointly to Mr. D. F. Marshall, of Sheffield, for his paper on "The External Heat Loss of a Blast-Furnace", which was presented at the last annual meeting of the Institute in London, and to Mr. A. Robinson, of Scunthorpe, for his paper on "Some Factors Leading to Greater Production from a Steel Furnace", which was presented at the autumn meeting of the Institute held in Sheffield in September last.

AT the annual general meeting of the Cambridge Philosophical Society, the following officers were elected:—*President*, Prof. J. Barcroft; *Vice-Presidents*, Dr. F. H. A. Marshall, Dr. F. W. Aston, Prof. E. K. Rideal; *Treasurer*, Mr. F. A. Potts; *Secretaries*, Mr. F. P. White, Dr. J. D. Cockcroft, Dr. H. Hamshaw Thomas; *New members of Council*, Mr. F. T. Brooks, Prof. J. E. Lennard-Jones, Mr. H. L. H. H. Green, Dr. O. M. B. Bulman, Mr. P. I. Dee.

THE following officers of the University of Durham Philosophical Society have recently been elected for the Session 1933–34: *President*, Prof. R. A. Sampson; *Hon. General Secretary*, Mr. W. M. Madgin; *Hon. Treasurer*, Mr. J. W. Bullerwell; *Editor*, Prof. G. W. Todd; *Assistant Editor*, Mr. J. F. Wood; *Hon. Librarian*, Dr. F. Bradshaw; *Assistant Librarian*, Mr. E. Patterson.

THE Institute of Metals now issues a monthly set of abstracts of the world's metallurgical literature, and follows this up by re-issuing these abstracts in volume form, with index, at the end of the year. In accordance with a scheme that has recently been adopted by the Council, the issue of separate 'pre-prints' of papers to be read at the two half-yearly meetings just before each meeting will cease. Instead, the advance copies will appear, two or three at a time, in the Institute's monthly *Journal* along with the metallurgical abstracts. As in the case of the latter, the papers will be re-issued in volume form later for permanent retention.

THE Food Group of the Society of Chemical Industry will hold a symposium on "Bread and Milk" in the Hall of the British Medical Association, Tavistock Square, London, W.C.1, on Thursday and Friday, November 23–24. The symposium is to be divided into three sessions under the chairmanship of Prof. W. W. Jameson, Sir John Russell, and Prof. H. E. Armstrong, respectively. Papers will be read by the following: Prof. H. D. Kay (Reading), Prof. A. J. Kluyver (Delft), Prof. A. D. Orla-Jensen (Copenhagen), Dr. E. T. Minett and E. J. Pullinger (London), Prof. J. R. Katz (Amsterdam), Holger Jorgensen, Prof. Max Samec (Czechoslovakia), Dr. H. G. Bungenberg de Jong (Utrecht), C. W. Brabender (Duisberg), Prof. J. C. Drummond (London), Prof. G. S. Wilson and M. P. Cowell (London), Dr. J. Vargas Eyre (Epsom), Dr. D. W. Kent-Jones (Dover) and W. Jago (Hove). Applications for invitations and further information should be made to the Secretary, Food Symposium, Society of Chemical Industry, 46, Finsbury Square, London, E.C.2.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in chemistry in Rhodes University College, Grahamstown—The Secretary, Office of the High Commissioner of South Africa, Trafalgar Square, London, W.C.2 (Nov. 30). A head of the School of Pharmacy in the Robert Gordon's Technical College, Aberdeen—The Secretary (Nov. 30). An engineer to the Essex Rivers Catchment Board—The Clerk of the Board, Dorset House, Duke Street, Essex (Dec. 1). A student probationer (zoologist or physiologist) at the Marine Biological Laboratory, Plymouth (Dec. 31). An assistant curator at the Raffles Museum, Singapore, Straits Settlements—Director of Recruitment (Colonial Service), Colonial Office, 2, Richmond Terrace, Whitehall, London, S.W.1 (Jan. 31). A director of water examination to the Metropolitan Water Board—The Clerk of the Board, Offices of the Board, 173, Rosebery Avenue, London, E.C.1 (Feb. 10). A chemist to the Sudan Government, Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.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.*]

Latitude Effect of Cosmic Radiation

IT was found for the first time by Clay[1] on voyages between Holland and Java that the intensity of cosmic radiation has a minimum in the neighbourhood of the magnetic equator. The extensive survey directed by Compton[2] confirmed the existence of this 'latitude effect' and showed it to be more pronounced at higher altitude. More accurate results at sea-level are due to an investigation of Clay and Berlage[3]. As this again refers to the line from Holland to Java, I thought it would be worth while to perform analogous measurements on a trip from Holland to South Africa. During this investigation Hoerlin[4] published results he obtained on the line Peru—Strait of Magellan—Hamburg. These results and those of the other authors as given by Clay are represented in Fig. 1 by continuous curves, my own results by open circles. Clearly the latter lie somewhat closer to Clay's curve than to Hoerlin's.

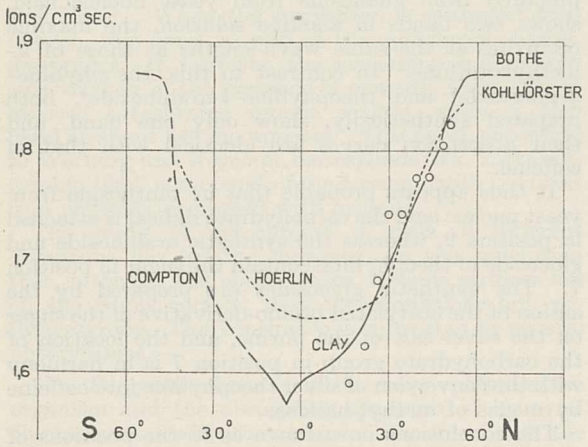

FIG. 1. Latitude effect of cosmic radiation. Circles indicate results of author. Vertical scale indicates number of pairs of ions in normal air.

Unfortunately, my apparatus broke down in the tropics, so I have not been able to get evidence on the remarkable difference between the southern and northern hemispheres as indicated by Hoerlin's results. Though we may feel satisfied that an equatorial minimum of the same order of magnitude is found by all investigators (indicating that the cosmic radiation consists largely of a cosmic rain of charged particles) it would seem that an accurate repetition of this kind of measurement to obtain the exact shape of the curve is not superfluous.

Regarding my observations, the following particulars may be given. The ionisation chamber had a volume of 3 litres and contained argon at a pressure of 30 atm. It was shielded by 8 cm. of iron and was placed in a hut on board the S.S. *Springfontein* of the Holland Africa line, the deck over it being of negligible thickness. The wall of the ionisation chamber was brought to 120 v. and the ionisation current collected on an insulated rod connected to a Lindemann electrometer and to a small capacity (4 cm.). To start an observation, the earthing key of the rod was opened and a stop-watch set running at the same moment. The electrometer was kept at zero by gradually applying a potential to the capacity so as to compensate the charge due to the ionisation current. After some time (about 6 min.) the potential (about 3 v.) was read on a voltmeter. From this the number of ions produced in the chamber per cm.^{3} per sec. may be deduced, assuming saturation. This number is called the 'intensity' of cosmic radiation. A small correction for barometric pressure was applied to it (2·4 per cent for 1 cm. mercury). In the graph in Fig. 1 these values (like those of Hoerlin) have been multiplied by such a factor (1/33·2) as to make the value at 50° coincide with the value given by Clay for normal air.

I wish to thank the Groninger Universiteitsfonds for a grant of money, Prof. Coster for allowing the apparatus to be made in the workshop of his laboratory, Prof. Clay for some kind advice and finally the directors of the Holland Africa line and the crew of the S.S. *Springfontein* for their kind collaboration.

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Oct. 19.

[1] J. Clay, *Proc. Amsterdam*, **30**, 1115, 1927; **31**, 1091, 1928.
[2] A. H. Compton, *Phys. Rev.*, **43**, 387; 1933.
[3] J. Clay and H. P. Berlage, *Naturwiss.*, **20**, 687; 1932. J. Clay, *Naturwiss.*, **21**, 43; 1933.
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Nuclear Moments of Xenon

FROM an investigation of the hyperfine structures of the lines of neutral xenon (XeI) which fall in the region λλ4200–8500, I have been able to show that the majority of the *s-p* transitions possess fairly complicated structures. These lines, therefore, are unsuitable as wave-length standards.

In a recent note, Kopfermann[1] reports that he has analysed a number of XeI line structures and finds that the isotope Xe^{129} has the nuclear moment $I=\frac{1}{2}$, while that of Xe^{131} is probably $\frac{3}{2}$, the $g(I)$-factors being of opposite sign. My analysis confirms this result for Xe^{129}, but nothing precise can be stated for Xe^{131}, except that $I>\frac{1}{2}$. The analogy between the structures of certain xenon lines and those of corresponding mercury lines is, however, so close as to favour the assignment of $I=\frac{3}{2}$ to Xe^{131}.

Hyperfine separations of the terms of Xe^{129} ($I=\frac{1}{2}$).

Term	Hyperfine separation	Term	Hyperfine separation
$1s_2$	− 0·290 cm.$^{-1}$	$2p_7$	− 0·065 cm.$^{-1}$
$1s_4$	− 0·057	$3p_6$	− 0·075
$1s_5$	− 0·198	$3p_7$	− 0·134
$2p_2$	+ 0·098	$3p_8$	− 0·078
$2p_3$	− 0·250	$3p_{10}$	− 0·076
$2p_6$	− 0·070	$4Y$	+ 0·069

The "−" sign indicates that the hyperfine levels are inverted.

The results of my measurements are summarised in the accompanying table of term structures, in which the hyperfine separations of Xe^{129} are given. Since Kopfermann gave no experimental results, nor any indication of the scope of his observations, a comparison of our data is unfortunately not possible.

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[1] H. Kopfermann, *Naturwiss.*, **39**, 704; 1933.

Magnetic Rotatory Dispersion and Absorption of the Cerous Ion in Solution

In a previous communication[1], we pointed out that in order to explain our results on the magnetic rotation of solutions of cerous sulphate in water, it was necessary to use two absorption wave-lengths in the Ladenburg paramagnetic rotation formula, namely, 2960 A. (actual) and 2390 A. (effective). This latter value seemed reasonable, as intense absorption bands were located with wave-lengths 2540, 2400 and 2230 A. in aqueous solutions of cerous sulphate.

We have extended our work to solutions of greater concentration, and have confirmed our previous experimental results. However, by using Rosenfeld's quantum mechanical theory of the Faraday effect[2], instead of Ladenburg's formula, we find that the rotation of the Ce+++ ion throughout the range 5780–3341 A. is, to our degree of accuracy, controlled by the two absorption bands with wave-lengths 2960 and 2540 A. For these absorption bands the transition assignments given by Bose and Datta[3] were assumed, namely, $4^2F_{5/2} \rightarrow 5^2D_{5/2}$ for 2960 A., and $4^2F_{5/2} \rightarrow 5^2D_{3/2}$ for 2540 A. For λ 3128 A., however, we find that the calculated value of the rotation does not agree within the limits of experimental error with the observed rotation, indicating the presence of a small effect due to the absorption bands with wave-lengths 2400 and 2230 A.

Throughout the range λ 5780–3341 A. our calculations of the strengths (f values) for the transitions $4^2F_{5/2} \rightarrow 5^2D_{5/2}$ and $4^2F_{5/2} \rightarrow 5^2D_{3/2}$ give $1{\cdot}40 \times 10^{-3}$ and $2{\cdot}29 \times 10^{-2}$ respectively. These results are in fair agreement with estimates which we have made directly from absorption data for dilute solutions of cerous sulphate.

So far as order of magnitude only is concerned, our larger f value is in agreement with calculations made by Gorter[4] and Serber (quoted by Gorter) on different grounds.

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I. T. Pierce.

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Oct. 23.

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[2] *Z. Phys.*, 57, 835; 1930.
[3] Nature, 128, 270, Aug. 15, 1931.
[4] *Phys. Z.*, 34, 238; 1933.

Spectral Absorption of Methylated Xanthines and Constitution of the Purine Nucleosides

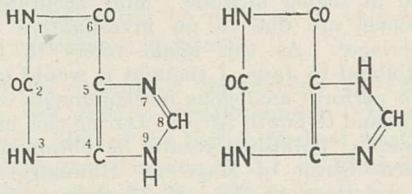
An examination of the ultra-violet spectral absorption of xanthine and certain methylated xanthines suggests that we possess a method of distinguishing between derivatives of xanthine (*iso*xanthine) which are substituted in the 7 or 9 positions, and that this method may be used to assign to one or other position the carbohydrate radical in the natural and synthetic purine glycosides.

Xanthine and its methyl derivatives may be divided into two groups, as follows:

(1) Those of which the absorption curves exhibit two bands in alkaline solution, namely, xanthine, 1–, 8–, 9–monomethylxanthines, 3 : 9–dimethylxanthine, 1 : 3 : 9–trimethylxanthine.

(2) Those of which the curves exhibit one band in both acid and alkaline solution, namely, 3–, 7–monomethylxanthines, 1 : 3–, 1 : 7–, 3 : 7–dimethylxanthines, and 1 : 3 : 7–trimethylxanthine.

It is evident that the presence of methyl in position 7 inhibits the appearance of the second band. A comparison of the spectra of methylated purines with those in which the hydrogen of the imino-group of the glyoxaline ring is unsubstituted suggests that in 3–methylxanthine and in theophylline (methyl groups in positions 1 and 3) this hydrogen is attached at position 7, whereas xanthine and 1– and 8–methylxanthines have the hydrogen linked to position 9, the reverse of the arrangement usually assigned to these compounds. The formulæ of xanthine and the hypothetical *iso*xanthine would therefore have to be interchanged.



Xanthine *Iso*xanthine

The spectrum of xanthosine (xanthine riboside), prepared from guanosine from yeast nucleic acid, shows two bands in alkaline solution, the maxima occurring at the same wave-lengths as those of 9–methylxanthine. In contrast to this, theophylline–*d*–glucoside[1] and theophylline–*l*–arabinoside[2], both prepared synthetically, show only one band, and their absorption curves are identical with that of caffeine.

It thus appears probable that in xanthosine from yeast nucleic acid the carbohydrate radical is attached in position 9, whereas the synthetic arabinoside and glucoside of theophylline contain the sugar in position 7. The synthetic glycosides are prepared by the action of the acetylated bromo-derivative of the sugar on the silver salt of the purine, and the location of the carbohydrate group in position 7 is in harmony with the conversion of silver theophylline into caffeine by means of methyl halides.

The conclusions now drawn as to the positions of the carbohydrate radicals in the natural nucleosides are opposed to those of Gulland and Macrae[3]. These were based on what appears to be less satisfactory evidence than that now presented, and it is hoped that an examination of the spectra of methylated xanthosines will allow a decision to be reached. This work is in progress.

A full account of these investigations will be published later, and we intend to extend the method to the examination of the position of the carbohydrate radicals in other nucleosides.

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E. R. Holiday.

The Medical Unit,
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Oct. 5.

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[2] Pryde and Williams, *J. Chem. Soc.*, 640; 1933.
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Supposed Direct Spectroscopic Observation of the "Oxygen-Transporting Ferment"

THE supposition as to the hæmatin nature of oxidase (or Warburg oxygen transporting ferment) has been based so far only on the photochemical absorption spectrum obtained from the study of the effect of light, of definite energy and different wave-lengths, on the oxygen uptake of cells poisoned with carbon monoxide. The concentration of the oxidase in cells is supposed to be too low for the direct spectroscopic observation of this enzyme even in the actively respiring yeast cells[1].

It was announced recently, however, by Warburg and Negelein[2] that in *Bacterium pasteurianum*, which has a very high respiratory activity (at 38° C. Q_{O_2} = 1,000), the absorption spectrum of the ferment can be seen by the direct spectroscopic examination of a thick suspension of these organisms illuminated with a strong light. Such examination, in the absence of oxygen, reveals, according to them, in addition to the two α-bands of cytochrome (band *a* being absent), a diffuse band in the yellow, which they believe to be the α-band of the ferment in its reduced state. When the suspension is saturated with carbon monoxide a carbon monoxide-ferment compound is formed, the band becomes sharper and lies at 593 mμ, that is, in the same place as the α-band of the photochemical absorption spectrum obtained by Kubowitz and Haas[3]. When the suspension is saturated with oxygen, this band, as well as the cytochrome bands, disappears. If, however, the suspension is saturated with oxygen in the presence of cyanide, the bands of reduced cytochrome remain visible, while a new band at about 640 mμ appears. This band, according to Warburg and Negelein, corresponds to a "methæmoglobin-like" compound of the ferment, with trivalent iron probably combined with cyanide.

The study of cytochrome in cells of different organisms has led me, however, to the conclusion that, although the observations of these authors are on the whole correct, their interpretations are certainly wrong. This conclusion is supported by several observations:—

(1) *B. pasteurianum* is a very polymorphic organism and the absorption spectrum of its cytochrome varies with the strain of the organism*, the culture medium and the age of the culture. Young cultures (grown on peptone-broth-sugar-alcohol agar) show a strong component *c* and a very feeble *b* with its α-band more or less fused with that of *c*. The band *a* which in baker's yeast lies at 603 mμ is missing, being here replaced by two very faint shadings one at about 590 mμ and the other, which can be seen in cultures of some strains only, lying at about 635 mμ. The intensities of these bands vary with the culture. All these bands disappear on shaking the suspension with air. The effect of carbon monoxide on the absorption spectrum also varies with the culture: in some suspensions saturated with carbon monoxide the shading at 595 mμ becomes more distinct (as was found by Warburg and Negelein); in other cultures, in addition to this change, the component *b* and a portion of *c* also combine with carbon monoxide; and finally, in some other cultures, carbon monoxide has no visible effect on the absorption spectrum. In other words, the property of the component with the band in the yellow to combine with carbon monoxide can be shared by other components of cytochrome.

(2) The shadings in the yellow at about 590 mμ and in the red at about 630 mμ or 636 mμ (replacing the typical band *a* of cytochrome) are found in other micro-organisms such as *Bacillus proteus* and *Azotobacter chroococcum*, where they can be easily seen on examination with a small dispersion prism spectroscope. Here the band in the red (630 mμ) is even more distinct than in *B. pasteurianum*. A similar band has been previously described by Yaoi and Tamiya[4] in several strains of *B. dysenteriæ* and *B. coli*, which are also devoid of a typical band *a* of cytochrome. Moreover, a diffuse band in the yellow at 588 mμ or 592 mμ exists also in brewer's yeast[5] where it replaces the usual band *a* of cytochrome, which in baker's yeast lies at 603 mμ.

(3) If the direct spectroscopic demonstration of the "respiratory ferment" depends on the respiratory activity of the organism, *Azotobacter*, which at 28° C. has Q_{O_2} = 8,000, would naturally form the most suitable material for such demonstration[6]. The thick suspension of this organism does not reveal, however, any visible change even if the suspension is saturated with pure carbon monoxide. Neither the shading at 590 mμ nor the other bands are affected by carbon monoxide.

(4) In *B. proteus* and in *Azotobacter*, where the band in the red (630 mμ) can be clearly seen, like all other bands of cytochrome, it fades away on shaking the suspension with air (or is replaced by a very faint shading at 645 mμ), and it reappears on standing or on reduction with sodium hydrosulphite. The band in the red belongs, therefore, to a reduced or ferrous state of the pigment and not to an oxidised compound with a trivalent iron atom.

(5) On acidifying gradually with normal hydrochloric acid, a thick (50 per cent) suspension of baker's yeast containing a little caprylic alcohol, and shaking the suspension with air, a stage is reached when, on reduction with sodium hydrosulphite, the band *a* (lying usually at 603 mμ) shifts towards the short wave end of the spectrum and becomes replaced by a shading in the yellow. This shading becomes distinctly darker and sharper only in the presence of carbon monoxide, forming a band at about 596 mμ, that is, in the region of the α-band of the photochemical absorption spectrum obtained by Kubowitz and Haas. In other words, a compound with the absorption band and other properties similar to those of the compound found in *B. pasteurianum* can be obtained from the component *a* of cytochrome, which as we know is extremely fragile and easily changes its absorption spectrum and other properties.

These experiments show clearly that the shading in the yellow (590 mμ) and the band in the red (630 mμ or 636 mμ) are not the absorption bands of the oxygen transporting enzyme but the bands of some derivatives of cytochrome and probably of its component *a*.

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Oct. 17.

* One of the strains of *Bacterium pasteurianum* was kindly given to me by Prof. A. J. Kluyver, of Delft.

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[3] Kubowitz, F., and Haas, E., *ibid.*, **255**, 247; 1932.
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Isolation of Hepatoflavin

SOME time ago, a water-soluble yellow-red pigment exhibiting a strong green fluorescence was found in purified catalase preparations from liver and pumpkin cotyledons[1]. Whereas a certain resemblance in respect to its physico-chemical behaviour with the enzyme led to the assumption of a possible intrinsic connexion between the pigment and catalase, later on it became possible to effect a separation of the two substances[2]. The purified pigment was then recognised as a member of the lately established class of biological pigments called 'lyochromes', the single

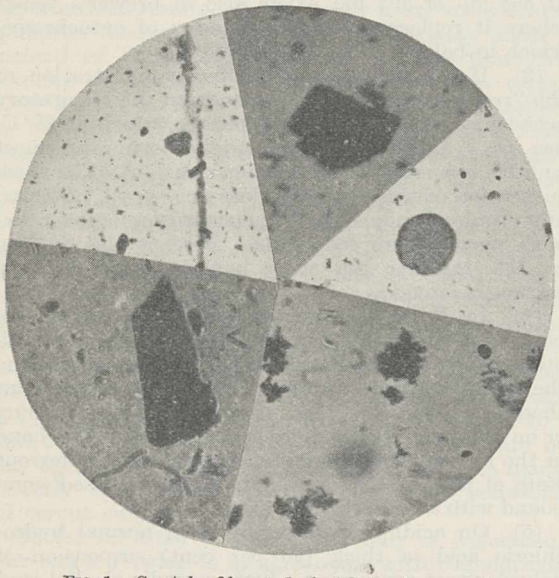

FIG. 1. Crystals of hepatoflavin (photomicrographs).

representatives of which bear the ending '-flavin' (Ellinger[3], Kuhn[4] and associates).

After numerous attempts, the isolation in a crystalline state of the lyochrome from horse liver, to be designated as 'hepatoflavin', has been achieved by means of a method very similar to Kuhn's procedure in isolating lactoflavin, the corresponding pigment of milk whey[4].

Rather concentrated watery extracts from fresh horse liver are freed from the bulk of proteins and hæmoglobin by precipitation with the same volume of alcohol. After acidifying to *p*H 4–5 by acetic acid, the flavin is adsorbed by fuller's earth and desorbed by a mixture of pyridine, methanol and water. After concentration *in vacuo*, the flavin is again adsorbed by fuller's earth or better by frankonit and desorbed by the mixture mentioned above. The desorbate is concentrated *in vacuo* to a small volume and many impurities are removed by ether extraction and subsequent addition of ten times the volume of acetone. On evaporation of the green fluorescent water-acetone solution *in vacuo*, a dark red-yellow residue is obtained which represents a crude crystalline mixture of flavin with some concomitant substances. These may be disposed of in the following manner which involves a certain loss of the flavin. On dissolving in water and addition of picric acid in excess, a heavy precipitate is formed leaving the flavin in solution. From the precipitate the well-defined picrates of three different substances, the nature of which is at present under investigation, may be isolated by fractional crystallisation. On evaporation of the flavin solution *in vacuo* the flavin is left behind, together with some colourless salt. The flavin is extracted with pyridine, the pyridine extract is diluted with water and the pyridine extracted with ether. The yellow solution of the flavin is again dried *in vacuo* and the residue consisting of microscopically fine brown needles mostly congregated to spherical masses is recrystallised from warm dilute acetic acid.

Fig. 1 shows some aspects of hepatoflavin crystals at different stages of purification. The solution of the pure pigment in water is lemon-yellow and exhibits a strong green fluorescence when irradiated with filtered ultra-violet light. The crystalline substance may possibly represent only the prosthetic group of the native pigment, the protein of which has been split off in the course of the preparation, especially by the acetone treatment. All fractions containing hepatoflavin with and without protein components show a strong absorption band in the short ultra-violet around 2600 A. The absorption in the range of longer wave-lengths seems not to be so uniform and seems to be dependent on *p*H and other factors.

Even from not highly purified flavin preparations, a photo-split product of the pigment is obtainable by intensive irradiation from a metal filament lamp in alkaline solution, which is removed from the acidified system by chloroform. The greenish coloured product, which fluoresces green and is a reversible redox-system like the mother substance, may be extracted from its chloroform solution by dilute alkali and can be easily obtained in a pure state by

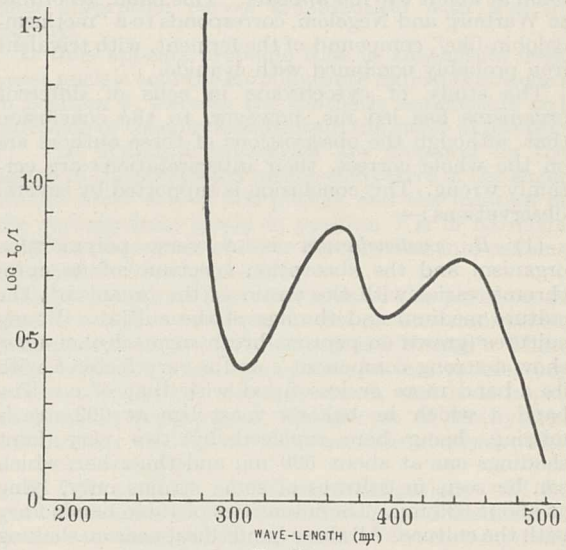

FIG. 2.

repeating the process. Spectrographic examination reveals three absorption bands at 2630, 3650 and 4420 A. Fig. 2 shows the shape of the absorption curve (kindly taken by Dr. E. R. Holiday) in the longer wave-range at *p*H 6. Spectrographic comparison reveals the identity in respect to absorption of light of our photo-hepatoflavin with the corresponding photo-split product of Warburg and Christian's "gelbem Oxydationsferment" from bottom yeast[5] and also with a similar substance obtained by Bierich, Lang and Rosenbohm[6] from various mammalian tissues by a rather drastic procedure.

Some properties of hepatoflavin which were observed with purified but non-crystalline preparations and were mentioned in a recent note[7] will be reinvestigated with the isolated pigment.

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[1] K. G. Stern, *Z. physiol. Chem.*, 212, 207; 1932.
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Extra Legs on the Tails of Crabs

DURING last August a female edible crab (*Cancer pagurus*) showing an interesting abnormality was brought into the Plymouth Aquarium and Dr. E. J. Allen, the director, very kindly handed it to me for examination. As will be seen from the accompanying illustrations, the abnormal region is the abdomen, which is exceptionally long and wide, and resembles that of a hermit crab in being twisted towards the right, and in that the pleopods are shorter on the right side than on the left. On the sixth abdominal segment (which bears the uropods in most decapods, but in crabs is usually limbless) there is, on the right side, a supernumerary limb composed of a protopodite, a stumpy endopodite and a two-jointed exopodite which ends as a hard, black claw. Although the general plan is thus that of a uropod, the limb resembles a walking leg in the shape of the joints, thickness of the cuticle, hairiness and particularly in the claw, which is better developed than that of any hermit crab.

FIG. 1.

There is an interesting case recorded by Bethe[1] of a similar abnormality in a female *Carcinus mœnas* which carried a fully developed walking leg on the left side of the sixth abdominal segment. Bethe did not remark on the size of the abdomen, but from measurement of his illustrations it appears that it was wider, relative to the carapace length, than that of any of the numerous females of this species examined by Huxley and Richards[2].

Bethe considered that it was impossible to explain his case on the assumption that differentiation is in any way a function of position: so that he could only conclude that the determinants of form are distributed by unequal cell division and that some cells containing determinants appropriate for a walking leg had become lodged in the tail. The interpretation which can now be given shows in a revealing way the progress which has been made during the intervening thirty-seven years towards an understanding of the factors underlying morphogenesis.

Huxley[3] has shown that the rates of growth of the segments of the abdomen of female crabs increase progressively passing backwards; that is to say, there is a 'growth gradient' with its apex in the sixth abdominal segment and running in the reverse

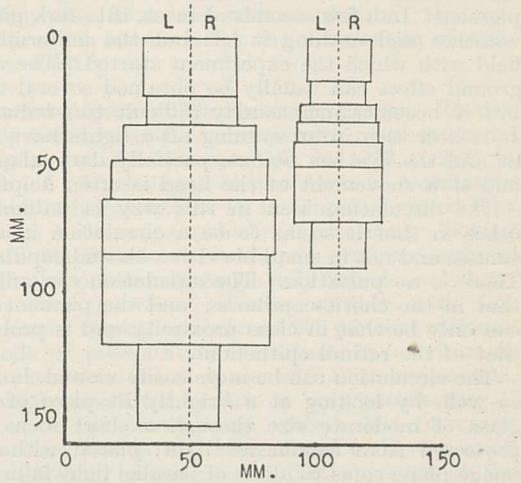

FIG. 2. Comparison of the dimensions of the segments of the abdomen of the abnormal crab here described (left hand figure) and of a normal female specimen of similar size measured by Pearson[4] (right hand figure).

direction to the main antero-posterior gradient of the body. He has also collected evidence showing that such growth gradients are connected with those gradients of obscure nature which are established in the early embryo, and thenceforth control morphogenesis. Thus the fact that the abdomen of the two abnormal crabs was unusually wide indicates that the reverse gradient in the tail rose exceptionally steeply, so that the absolute rates of whatever processes are concerned approached the rates usually found in the thorax and caused the supernumerary limbs to develop the characteristics of walking legs.

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Oct. 15.

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Looking Backwards—an Entoptic Experiment

IN a search for the cause of the visual effects experienced under the influence of Mescal Button, observations were made on entoptic phenomena associated with the retina, and from these it would seem that the human eye can function in a 'verted' as well as in an 'inverted' state: in other words, the sensitive part of the retina can see both ways.

If a microscope is set up to give the best lighting for resolution with the particular objective employed and one eye is applied to the eyepiece, the other

eye being closed, and the head shaken rapidly, the shadows of the retinal vessels and the position of the yellow spot will be seen. On cessation of the head movements, the perception of these vessels disappears; but if the uniformly lit field of the microscope is gazed at with relaxed accommodation, almost suddenly, it may become dark but alive with movement. Careful observation will show a well covered fern leaf-like pattern of a swirling circulation, dark reddish-grey in colour on a black ground. The circulating blood seems to fill nearly the whole field, the position of the yellow spot as elsewhere, and it will be seen to be dotted with numerous granules of pigment. In a few seconds at most, this dark picture vanishes and nothing is left but the uniformly lit field with which the experiment started. The dark-ground effect can usually be obtained several times but it becomes increasingly difficult to produce it. It is best seen in an evening after lights have been lit and the eye has become partially dark-adapted; and slow movement of the head is often helpful.

The circulation seen in this way is unlike any other in that it seems to be a circulation in small sinuses and not in small blood vessels and capillaries. There is no pulsation. The circulation can only be that in the chorio-capillaris; and the pigment seen can only be that in close proximity and is probably that of the retinal epithelium.

The circulation can be more easily viewed, but not so well, by looking at a brightly lit piece of opal glass of moderate size through a short focus lens protected from extraneous light, placed within its image plane so as to allow of parallel light falling on the rods and cones. I employ a 15-watt lamp surmounted by a piece of opal glass in 1½ inch diameter brass tubing which also carries a 1½ inch focus lens placed about 2½ inches from the light source. With such an arrangement, the dark-ground effect may appear within five seconds, although it usually takes longer, and may last ten to twenty or more seconds. At first there is usually seen nothing but blackness, then a sensation of circulation in a vessel occurs in one or more parts and then quickly the full picture develops, at least to those who are able to see it. A dark green glass screen is less helpful than might be expected, mainly owing to the circulation being viewed by reflected light of low intensity. A ruby-red glass has seemed to me more helpful.

It is probable that the chorio-capillaris will be seen by different eyes with varying distinctness. My left eye gives me the best picture. With my right eye the circulation seems more like an asparagus leaf than a fern frond in form.

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Tunny in the North Sea

DURING my investigations on tunny (*Thunnus thynnus* L.) in the North Sea this summer on Col. E. T. Peel's yacht *St. George*, I had occasion to talk to many fishermen and others interested in the occurrence of this fish; I have also consulted most of the relevant literature. Despite the almost unanimous agreement among the fishermen I met, that the tunny were not to be found in the North Sea before the War, it is impossible to avoid the conclusion that the migration of these fish into North Sea waters is not an occurrence of recent origin.

Dr. Delsman[1] suggests the warm summer of 1911 as the first year of the tunny's appearance. Against this, amongst other evidence, the following should be cited. Heldt[2] states that a tunny was caught by a French fisherman on the edge of the Dogger Bank in 1907 and that Redeke reported the occurrence of this fish off Warnemünde in the Baltic in 1903[3]: the records of Day[4] are numerous and go back so far as the year 1801, when three tunny were taken off Margate; he says they were numerous in the Moray Firth in 1850.

The many occasional records given by Day are surely evidence that the tunny were numerous in the nineteenth century. It is of interest also to bear in mind that, during such summers as that just past and that of 1911, unusually calm conditions prevail in the North Sea; such conditions are especially favourable for noticing tunny when they break the surface. It, of course, need scarcely be said that, as with other migratory fish, the tunny may be more numerous in some years than in others.

A good summary of the records of occurrence in the North Sea is given by Le Gall[5].

F. S. RUSSELL.

Marine Biological Association,
Plymouth.
Oct. 23.

[1] Delsman, H. C., NATURE, **132**, 640, Oct. 21, 1933.
[2] Heldt, H., *Off. Sci. Tech. Pêches Marit. Notes et Mem.*, No. 22; 1923.
[3] Heldt, H., *Comm. Int. Explor. Sci. Mer. Medit. Rapp. Proc. Verb.*, **6**, 192; 1931.
[4] Day, F., "The Fishes of Great Britain and Ireland": London, 1880–84.
[5] Le Gall, V., *Cons. Int. Explor. Mer. Journal du Conseil*, **2**, 309; 1927.

Mastacomys fuseus (Muridæ) Still Extant

THIS remarkable rat, which is distinguished from all other Australasian Muridæ by its ponderous molars and some curious features of their crown pattern, was described by Oldfield Thomas so long ago as 1882, but with one doubtful exception has never been recorded since, except from fossil remains, and its status in the Australian fauna has remained quite obscure.

I have now taken a series of specimens in Tasmania, whence came the type specimen in the collection of the British Museum. The animal was taken at an elevation of more than 3,000 ft. in the rugged north-western portion of the island. The locality is one of rigorous climatic conditions, and sparse 'Alpine' vegetation, and the runaways in the grass matt, in which the rat was trapped, are sodden with frequent rains in the cool summer which prevails there, and in winter are frequently buried feet deep in snow.

These conditions make a distinct approach to those of the Alpine meadows which form the station of many of the holarctic voles, and the animal in fact shows some morphological convergence towards the Microtinæ; a diagnosis which Lydekker made long before any details of its economy or the features of its habitat were known.

Examination of the new material shows that the type is immature; a redescription of the animal will appear in the current volume of the *Transactions of the Royal Society of South Australia*.

H. H. FINLAYSON.

South Australian Museum,
Adelaide.
Sept. 10.

Research Items

The Origin of Marriage. Prof. Westermarck in the *Rationalist Annual*, 1934, replies to the criticisms which have been directed against his theory of the earliest form of human marriage by Dr. Briffault. Prof. Westermarck in "The History of Human Marriage" expressed the opinion that marriage as a social institution developed out of a primeval habit for a man and woman, or several women, to live together, and for the man to be the guardian of the family, the woman the helpmate and the nurse of the children. The argument is based on the fact that in many species of the animal kingdom male and female remain together beyond the pairing season, the male acting as a protector of the family. To this group the anthropoid apes belong, although none of the apes are permanently gregarious. The family, consisting of parents and children, is found among the lowest savages, and we may suppose that the factors which lead to marital and paternal relations among the apes also operated among our earliest human or half-human ancestors. Dr. Briffault, however, argues that the tendency is for the female to segregate herself and to form an isolated group with her offspring, which the male has no share in forming, and of which he is not an essential member. Fresh evidence, which has come to light since the publication of "The History of Human Marriage", supports the view therein expressed, and shows that Dr. Briffault's denial of the facts relating to the anthropoids, upon which that argument was based, is erroneous: for example, Munnecke's statements relating to the orang utan of North Borneo, which live in families, the Duke of Mecklenburg's evidence relating to chimpanzees, showing that the old males often accompany the families, though at a distance, and Reichenow's conclusion that the gorilla lives monogamously, although it is most probable that the gorilla is also polygamous.

Irrigation and the Origin of Agriculture. Mr. Julian H. Steward, in the course of a study of the ethnography of the Owens Valley Paiute (*Univ. California Pub. Amer. Archæol. Ethnol.*, 33, No. 3), records the use of irrigation in connexion with the supply of wild plant seeds for food, which in view of the fact that the Paiute have not achieved agriculture, is unique and anomalous. The Owens Valley Paiute are the southernmost of that widely distributed Shoshonean group, the Northern Paiute, which occupies most of northern Nevada. Owens Valley falls within the geographical region of the Great Basin, which experiences little rainfall, and of which the few streams end in salt lakes. The population is estimated at about a thousand, a figure at which it appears to have remained for nearly eighty years. The Paiute are food gatherers, fishers and hunters. In addition to pine nuts and acorns, they eat the seeds of wild plants, of which the yield is increased by irrigation. An irrigator is elected at a popular meeting each spring. The district headman then announces the date on which irrigation is to begin and the irrigator becomes responsible, after the water has been turned into the main ditch, for the supply of water to the plots through the lesser ditches. The main dam, consisting of boulders, brush, sticks and mud, is built by the irrigator, assisted by about twenty-five men. The plots are chosen for convenience of irrigation and building dams, etc. Of two plots at Bishop's Creek, one measured four miles by one to one and a half miles, and the second was approximately two square miles, the two plots being annually alternated. The dam is destroyed at harvest time, fish being then gathered from the ditch. Irrigation may have been acquired by differential borrowing from the Pueblo, or it may have been a local independent invention which, as has been suggested by Spinden, may in a semi-arid country be "the conception which accounts for the very origin of agriculture itself".

Practical Aspects of Phenomenal Regression. In discussing some practical consequences of phenomenal regression (see also NATURE, Feb. 25, 1933, p. 261), in Section J (Psychology) at the British Association meeting at Leicester, Dr. R. H. Thouless stated that in using a telescope (which is practically looking down a blackened tube with one eye), one subject of high phenomenal regression only experienced about 3 per cent increase, whereas another with low phenomenal regression obtained 200 per cent increase. Methods of presentation of pictures in television or in the cinema are linked up also with this phenomenon. A visually presented picture is only satisfactory if seen on a sufficiently large scale. The television screen 5 in. × 5 in. has been stated to be too small for satisfactory presentation. Yet observed at the ordinary distance for comfortable vision of 10 in., such a screen will project a picture on the retina considerably larger than that at a cinema performance. The stray light in the theatre, which makes the screen a definite object at a definite distance, also makes it seen as an object of relatively large phenomenal size. Looked at through a blackened tube, everything on the screen appears in miniature. For the small near television work, stray light will have no such effect. For many subjects, in fact, at such a distance as 10 in., monocular observation with totally black surroundings will give a phenomenal magnification of up to 50 per cent. Other observers will get no such advantage, and may even experience a slight loss by this condition of observation. Resistance to the effects of lateral distortion is also a function of the stray light in a cinema. The retinal image can undergo considerable distortion without more than a small fraction of this appearing in experience.

A Large Miracidium. J. E. Lynch (*Quart. J. Micro. Sci.*, 76, Pt. 1, June 1933) describes the anatomy of the miracidium of the monostome trematode, *Heronimus chelydræ*, noteworthy for its large size; this miracidium may extend to a length of half a millimetre. The epithelial cells, which form the outer wall of the larva, are in four tiers and present a notable variation in number which suggests that the number and arrangement may not safely be used in determining family relationships. On the apical anterior end are three kinds of openings which are probably also represented in other miracidia; the large central pore, usually called a mouth, is the aperture of a gland, and the minute scattered pores probably represent glandular orifices or nerve terminations. The openings of the cephalic glands are in the lateral region of this area. The structure usually designated an intestine is

shown not to be an alimentary structure but an apical gland, and it is not in relation with the so-called mouth. The excretory system consists of one anterior and one posterior flame-cell, each with a separate duct, but a considerable proportion of the miracidia exhibit one or two supernumerary flame-cells in the posterior part. The flame-cells are unusually large; in fixed material each flame-cell is cap-like, about 20μ wide and 10μ–15μ in height, and bears a tuft of cilia about 17μ long. In one living specimen the flame cilia were 30μ long. Two large accessory excretory cells right and left are associated with the excretory ducts which open near the posterior end. The aggregate of germ-balls or germ-cells in this miracidium is enclosed in a membranous cellular envelope from which partitions pass in to enclose each germ-cell in its own compartment. An excellent figure, showing the structure of the miracidium, is given.

Giant Cells in the Liver of the Mouse. E. Enzmann (*Peking Nat. Hist. Bull.*, vol. 7, p. 219) has studied the megakaryocytes or giant cells in the liver during the embryonic life of the mouse and after birth, with the view of tracing the manner and time of their disappearance. He concludes that the disappearance of these cells follows a definite law which may be expressed by an exponential equation, and that the giant cells of the liver do not migrate when the change of function of this organ takes place, but degenerate *in situ*. In a strain of white mice, no giant cells could be found in the liver on the fourteenth day after birth and in agouti mice none was found after the twelfth day. In a note which follows (p. 229), Dr. A. B. D. Fortuyn points out that these times must not be taken as being generally applicable, for in another strain of mice, giant cells could be found in the liver so late as the twenty-third day and in another on the forty-fourth day. Not in all strains do megakaryocytes disappear at a well-defined age, and they may reappear in the liver of females during pregnancy; they were present in two pregnant mice 233 and 242 days old respectively.

Equine Schistosomiasis. S. C. A. Datta (*Ind. J. Vet. Sci.*, 3, Pt. 1, March 1933) records observations on a number of cases of liver cirrhosis in the horse in India. Calcareous nodules have long been known to occur in the liver of equines in India and the author has been able to show that they are due to the presence of the eggs of *Schistosoma indicum*. The eggs are deposited chiefly in the distal portions of the intestine, particularly the large colon and rectum, and in the liver, where they cause changes and degeneration in the neighbouring tissue and the deposition of calcareous salts, often in concentric rings, resulting in the formation of pearl-white nodules.

Insect Transmission of Plant Viruses. H. H. Storey (*Proc. Roy. Soc.*, B, 113; 1933) has described experiments in the mechanical inoculation of insects with plant viruses by puncturing the abdomen or leg with a needle or a micro-pipette. The inoculation of active races of the leaf-hopper, *Cicadulina*, the vector of streak disease of maize in East Africa, was successful when the inoculation introduced was the juice of diseased maize seedlings, fresh or kept for four but less than eight days, undiluted or diluted with distilled water. By inoculation of the appropriate fluids, it was shown that the virus was present in the ineffective leaf-hopper (*a*) in the contents of the rectum if the insect has recently fed on a diseased plant, but not otherwise, (*b*) in the contents of the thorax and abdomen, and (*c*) in the blood. The virus was not found in the fæces. The appearance of the virus in the blood preceded in time the development of the power to cause infections. Infective races of the leaf-hopper, normally unable to transmit the virus, were made infective by needle inoculation with the streak virus. It is concluded that the streak virus, entering the intestine by the mouth, passes through the intestinal wall into the blood, and that, in the inactive insect, the cells of the intestinal wall resist the passage of the virus. There may be some secondary mechanism of resistance; nevertheless, in many inactive individuals, once the barrier of the intestinal wall has been passed, the virus behaves as in an active insect.

Farrer's Three-penny-bit Rose. A short paper by Mr. W. T. Stearn in the *Gardeners' Chronicle* for September 23, pp. 237–238, clears up the taxonomy of a very beautiful garden plant, 'Farrer's three-penny-bit rose'. It is apparently an abnormal form of a wild species originally brought by Farrer from China in 1915, and not a variety of *Rosa graciliflora*. *R. Farreri* has a much more prickly habit than the wild plant and bears a deeper salmon-coloured flower of greater beauty. A detailed Latin diagnosis is given.

Dutch Elm Disease in the United States. The fight against the spread of Dutch elm disease in the area round New York harbour is being conducted with great vigour. It was recently reported that no immune species of elm were known, and now details are published of the manner in which the disease is spread, and how it entered the United States. Mr. R. K. Beattie, of the U.S. Department of Agriculture, states, according to a mail report issued by Science Service of Washington, D.C., that some elm logs imported into the United States from France harboured the fungus. Certain beetles which carry it from tree to tree were also found. Hot water treatment is not effective in killing the beetles, which may also fly away before any treatment can be applied. It is very unfortunate that the infinitesimally small import trade in 'burl' logs of elm for veneer purposes should endanger the United States' own larger supplies of home-grown timber.

Geology of Tanganyika. In Bulletin No. 6 of the Geological Survey of Tanganyika Territory, the director, Dr. E. O. Teale, has published a useful provisional geological map in colours (24 in. by 24 in.) with a chronological table of the formations and principal geological events, and explanatory notes on these and on the physical features and mineral wealth of the country (Dar es Salaam: Government Printer. 4*s*.). The map is based on information collected by German investigators prior to 1914, with copious additions due to the valuable work carried out by Dr. Teale and his colleagues since the establishment of the Survey in 1926. The Basement complex includes augen-gneisses *G*1 and microcline gneissose granites *G*2 and was followed by widespread intrusions of a third granite *G*3. The Muva-Ankolean sediments followed and were in turn succeeded by intense tectonic disturbances accompanied by a set of younger granites *G*4 and *G*5. Flat-lying Bukoba and Kasanga sandstones probably correspond to the Katanga and Waterberg systems. The latter are referred to the Palæozoic, but the Katanga beds are

more probably late Pre-Cambrian. A long period of denudation ushered in the important Karroo deposits. These are followed by Jurassic and Lower Cretaceous sediments, largely marine. Intrusions of dolerite and kimberlite are known of probably Cretaceous age. The early Tertiary saw the Rift valley movements well started and active vulcanism was initiated. These spectacular processes have continued up to the present day, for though vulcanism is now largely extinct, there are still occasional outbursts and earth tremors are of frequent occurrence, especially near the Rift zones. The Survey is to be congratulated on the progress made during its six years of active work.

Radio Apparatus for Studying the Upper Atmosphere. In a paper printed in the *Journal of the Institution of Electrical Engineers* of October, Dr. Builder describes radio apparatus which has been developed to give the equivalent heights of the ionosphere quickly and easily. It has been experimentally confirmed that the 'echo' and 'frequency-change' methods give concordant results for the heights at which reflection of the waves occur. Particular attention is given to the equipment at King's College, London, and that of the British Polar Year Radio Expedition. In all cases the sending station is sufficiently close to the receiving station to give a direct ground signal comparable in strength with that of the signals reflected by the upper atmosphere. The echo method has several advantages over the frequency-change method. In complex cases the latter method produces interference patterns which are very difficult to interpret. The development of a 'pulse polarisation analyser' at the Radio Research Station at Slough now permits the state of polarisation of each separate echo signal to be specified with accuracy. The rapid determination of the relations between frequency and equivalent height is essential if the nature of the ionosphere is to be seriously studied. The resolution of successive echo signals which follow each other closely in time requires that the pulses used in the echo experiments should be as short as possible. The extent to which this can be done depends on the equipment of both the receiving and the sending station. In general, the receiving apparatus will not handle pulses of less than 0·0001 sec. in duration. Examples are shown of automatic 'snapshot' registrations and of automatic strip registrations.

New Wilson Cloud Chamber. Prof. C. T. R. Wilson has recently described (*Proc. Roy. Soc.*, A, Oct.) a new form of cloud chamber which represents a notable simplification of this beautiful and useful technique. The cylindrical chamber is separated from a chamber just below it by a fixed wire gauze, and the pressure in this lower chamber is suddenly changed. A thin rubber diaphragm separates the gas in the lower chamber from atmospheric air and the wire gauze checks the spread of turbulence from the lower chamber to the region where tracks are formed. In this type of chamber the operation involves a definite pressure change followed by an increase in volume, while in the ordinary piston apparatus the volume change is definite and the pressure rises as the temperature increases after an expansion. The new apparatus is very simple to construct and allows great freedom of shape and position; it gives good track photographs and will probably be of very great service.

Colloidal Silver. A silver sol prepared by Bredig's method contains a large proportion of silver oxide, and is hence unsuitable for some purposes. Taylor and Cone (*J. Amer. Chem. Soc.*, Sept.) have described a method of preparing relatively pure silver sols by precipitating silver nitrate with potassium bromide and then reducing with alkaline formaldehyde. Reduction is immediate and a sol with a clear reddish-yellow colour by transmitted light is obtained. This sol may be dialysed. A stable sol was also obtained by replacing potassium bromide by potassium iodide, but not when potassium chloride was used. The proportion of silver when potassium bromide was used was more than 98, and there was very little, if any, silver oxide present.

Walden Inversion in the Glucose Series. Mathers and Robertson have recorded a new example of Walden inversion in the glucose series (*J. Chem. Soc.*, August). The alkaline hydrolysis of 2 : 3 di-*p*-toluene sulphonyl 4 : 6 dimethyl α methylglycoside yielded, instead of 4 : 6 dimethyl α methylglycoside, a mixture of a crystalline anhydro methylhexoside and a syrup of the empirical composition of a dimethyl methylhexoside. This latter gave a crystalline di-*p*-toluenesulphonyl derivative differing from the starting material. The isomerism is explained by the assumption that a Walden inversion has taken place at carbons 2 and 3 during hydrolysis. The authors give reasons for their preference of an altrose configuration for the new sugar. The work recalls that of Kunz and Hudson in 1926, who found that in the chlorination of lactose octa-acetate in the presence of active aluminium chloride, the octacetate of *neo*-lactose is produced which has the structure of 4-galactosido-altrose, the altrose arising by the inversion of carbons 2 and 3 in the glucose molecule. The results are important in connexion with the suggestion of Robinson in 1927 that galactose and ribose might owe their natural origin to a Walden inversion during the hydrolysis of appropriate phosphoric esters of glucose and xylose respectively. The hypothesis gains no support from the actual positions of the phosphoric acid groups determined by Levene in the nucleosides containing ribose, but is not necessarily thereby invalidated.

Detonating Fireball of August 13, $10^h\ 30^m$ p.m. At 10.30 p.m. on August 13 a detonating fireball was observed at Widnes (J. R. Platt), and near Markyate (H. Webber). At Widnes the object was so bright as to render trees, etc., about a mile away clearly visible and was followed after an interval of something more than eighty seconds by a loud report coming from an easterly direction. Mr. A. King sends the following particulars of the real path of the fireball:—Began: 72 m. over 4 m. W.N.W. of Nantwich; mean deviation, 2·2 m. Ended: 16 m. over 5 m. S.E. of Leigh; mean deviation, 2·1 m. Earth-point: 3 m. S.E. of Bolton. Length, 61 m.; speed, 15 m.p.s.; radiant, 290° + 30°. The radiant, corrected for zenith-attraction and diurnal aberration, became 289° + $28\frac{3}{4}$°; theoretical parabolic speed, $15\frac{3}{4}$ miles per second. The interval between sight and sound for Widnes works out at $1\frac{3}{4}$–2 min., which agrees fairly well with Mr. Platt's rough estimation. Mr. Webber heard no sound, but as the corresponding interval was of the order of 11 minutes it is scarcely likely he would wait so long, even supposing that the report would be audible.

Painted Fabrics from India and Iran*

ALTHOUGH the Indus civilisation has been known and its relation with the west recognised for more than ten years, its comparative study has scarcely begun. An attempt is here made to define more precisely the problems raised by its western relations.

A common tradition in the potter's craft between Mesopotamia and Sindh-Punjab can be traced back to the fourth millennium B.C. in the Uruk period. By the middle of the third millennium, this had been given a very specialised and individual expression in the Indus valley, the peculiarity of which is a free use of repetition motives, which has no parallel elsewhere in the third millennium, except perhaps in the Middle Minoan of Crete. In a random sample of sherds from Mohenjo-daro, 35 per cent of the designs were based on vegetation motives and the remaining 65 per cent were repetition motives. Indus pottery is accordingly the specialised product of a sophisticated civilisation. Moreover, it displays an astonishing uniformity over a vast territory, extending from Amri in southern Sindh to Harappa on the Ravi, five hundred miles north, which corresponds with the economic and geographical unity of the area watered by the Indus.

Sir Aurel Stein has collected a great deal of pottery from the hill country west of the Indus; but the native pottery of the hills is stylistically barbarous and shows a bewildering variety of local styles. This is due to the character of the country, broken by gorges and steep ranges. But nevertheless the wares of Baluchistan and Waziristan seem closely allied to one another and to the Indus wares, both technically and in motive. On the other hand, there are more prominent western elements than are discernible in the Indus ware, such as the sigma pattern, common in southern Baluchistan, and the 'goat motive'. These features may be due to archaism —elements which had not survived in the busy cities where a more sophisticated style had been elaborated.

Nevertheless in the funerary pottery from Shahi-tump connexions with the west that are more than mere survivals can be discerned; but these connexions are with Susa I and Samarra, not with the later cultures that flourished in Mesopotamia in the second half of the fourth and the beginning of the third millennia. The connexion with Susa I is to be seen both in forms and in specialised motives, such as the 'Maltese' square decorating the centres of dishes at both sites and also at Samarra. Sherds illustrate the transition from the prevailing grey to pink, and in Sistan the same transition is illustrated, as well as that to the green tint common at al 'Ubaid. The Shahi graves reveal an extension eastward in a very pure form of Frankfort's 'Highland Culture' and precisely that form of it represented at Susa. This is no mere survival at Shahi-tump, and as all the burials are at least a thousand years later than those at Susa I and Samarra, the direction of the migration is unambiguously defined: it must have come eastward. But this affords no clue to the sources of the common elements in the Indus and Sumerian ceramic traditions.

Light will be shed on this problem when Mr. Majumdar's excavations at Amri in southern Sindh have been published. The results promise to clarify the connexion between the ceramic technique of the Indus valley and that of Mesopotamia in the fourth millennium; and they also offer a solution of some of the obscurity surrounding the Baluchi wares. It will appear that the pale-slip group is not contrasted with that of lowland India, but that the same tradition lies behind the classical Indus ware. The Amri evidence will also explain the character of the pottery from Nal and Nundara in Baluchistan, which is more sophisticated and shows a deliberate style. This might be regarded as a development of the black-on-red-on-pale-slip ware from Amri which is older than the classical Indus ware, and in turn has technical and stylistic affinities to the Jemdet Nasr ware of Mesopotamia.

* Substance of a paper read by Prof. V. Gordon Childe on September 12 to Section H (Anthropology) at the Leicester meeting of the British Association.

Atomic Weights of Potassium and Carbon

HÖNIGSCHMID and Goubeau in 1928 described experiments on the analysis of potassium chloride and bromide leading to an atomic weight of potassium of 39·104, which agrees with a value found by Richards and Archibald in 1903, but is nearly 0·01 unit higher than the value, 39·096, obtained in 1907 by Richards and Staehler and by Richards and Mueller. Since the discrepancy is much greater than the apparent experimental error of the comparatively simple analytical operations involved, a redetermination was desirable. Zintl and Goubeau in 1927 confirmed the higher value by the conversion of potassium nitrate into the chloride. The ratio determined from the weights in air corrected to vacuum, however, and that determined from the weights of material actually weighed in vacuum, fall on opposite sides of the value to be expected from the results of Richards, Staehler and Mueller (N = 14·008).

Baxter and MacNevin (*J. Amer. Chem. Soc.*, August), in a long series of analyses of potassium chloride, by comparison with silver, using potassium salts of different origin, find a value in satisfactory agreement with that of Richards, Staehler and Mueller, and they conclude that the atomic weight of potassium is very close to 39·096. No indication of a higher atomic weight was found, and the authors also report that unpublished experiments by Titus show no appreciable adsorption of air by potassium chloride and nitrate. The values found with one specimen of potassium chloride (39·084 — 39·098) were low and irregular, a result not explained. No evidence of variation in the isotopic composition of potassium assimilated by plants was found by the examination of material from wood ash.

In a second paper in the same journal, Baxter and Alter report that the atomic weight of 'heavy' potassium prepared by von Hevesy by 'ideal' distillation in 1928 is 39·109, which is in exact agreement with the value for this material found by

Hönigschmid and Goubeau, whose value 39·104 for ordinary potassium could not, as stated above, be confirmed. A further check on the value of ordinary potassium gave 39·096. The difference between the two values is thus 0·013, as contrasted with 0·005 found by Hönigschmid and Goubeau. The maximum difference to be expected in the distillation had been calculated as 0·010, but this was based on a percentage of K^{41} in ordinary potassium of 5·2, from an atomic weight 39·104, and integral values of the isotopes. A recalculated value is 6·6, whilst the experimental result leads to 7·3.

Since the discovery of the isotope C^{13} it has become clear that the value for the atomic weight of carbon accepted by the International Commission, namely, 12·00, is too low. The atomic weight of C^{12} on the old O^{16} basis, according to Aston, is 12·0036, which, when reduced to the chemical standard [isotopic mixture] oxygen = 16·000, becomes 12·0010 or 12·0023, depending on the factor used for conversion from O^{16} to O = 16·000. The chemical value found by Richards and Hoover in 1915 from the ratios Na_2CO_3 : NaBr : Ag varied in individual measurements from 11·997 to 12·008, the mean being uncertain by ±0·011 per cent of a unit. Physico-chemical methods depending on the densities and compressibilities of gaseous compounds of carbon have given values from 11·996 to 12·008.

It is obvious that the uncertainty in this important constant is considerable. Woodhead and Whytlaw-Gray (*J. Chem. Soc.*, July) now report a range of measurements at a series of pressures of the relative densities of oxygen and carbon monoxide by the use of a microbalance in such a way that no values of the compressibilities were required. Very concordant earlier density measurements by Leduc, Rayleigh, and Pire and Moles exist, and the new value gives an atomic weight of carbon, 12·011, in close agreement with Rayleigh's, but considerably higher than the accepted chemical value. The compressibility had also been fixed between narrow limits by Bateucas, Maverick and Schlatter. The density ratios of carbon monoxide and oxygen of Rayleigh and Leduc, and the compressibilities at 0° $(1+\lambda)$ 1·00048 and 1·00094, give 12·011(8) and 12·015(5), respectively; Pire and Moles' value, with the weight of a normal litre of oxygen, 1·42892, found by Moles and Gonzalez, gives 12·008(5). There was, therefore, already little doubt that the value was nearer 12·01 than 12·00, and the new value 12·011 confirms this result and is in agreement with other observations. The proportion of the C^{13} isotope must, therefore, be so high as 1 per cent, in close agreement with the results recently obtained by band spectrum methods by Jenkins and Ornstein.

Lamarckian Inheritance and Learning in the Rat

ONE of the most interesting papers read before Section J (Psychology) at the recent British Association meeting at Leicester was that by Prof. F. A. E. Crew, of the Department of Animal Genetics, University of Edinburgh, on "An Attempt to determine the Factors operating in Professor McDougall's Lamarckian Experiment". Prof. McDougall's findings are that:

(1) his experimental rat stock has, in the course of many generations, come to differ from his control stock in that the average number of errors made per rat by the individuals of the experimental stock is now significantly less than that made by the individuals of the control stock;

(2) that with the passing of the generations the average number of errors per rat made by individuals of the experimental stock has decreased gently and progressively; and

(3) that the rats of the control and of the experimental stocks respectively are to be readily distinguished by marked differences in their behaviour in the water tank.

Prof. Crew complained that the details regarding the performances of the rats which Prof. McDougall has published have never been given in full and that for this reason it has been impossible for anyone to gather from them whether or not the figures themselves are significant. He maintained that the method of recording adopted by Prof. McDougall could not possibly be expected to allow anyone to determine whether or not genetic factors are operating in the production of the increased facility for mastering the task. He showed the records of six generations of tank-trained rats and of a large number of control groups, and demonstrated that there is no significant difference between the performances of any of these generations amongst themselves or between the experimental groups and the controls, and that whatever improvement has been achieved can be explained as a result of deliberate and favourable selection. The first generation of tank-trained rats in respect of the average score was equal to the twenty-third generation of Prof. McDougall's, whilst the average score of some six hundred controls was also equal to that of this twenty-third generation.

Prof. Crew showed that, in the case of his own stock, though in respect of behaviour in the tank individual differed from individual, it is quite impossible to distinguish between control and tank-trained stocks. So that out of the results of three years' experimentation, involving nearly one thousand individuals, nothing emerges which supports Prof. McDougall's conclusion that in the case of his own stocks the results are only to be explained on the assumption that modifications acquired by the parents as a result of training have become transmitted to their offspring.

Prof. McDougall took part in the discussion which followed. He pointed out that the actual conditions of Prof. Crew's experiments were different from his, that the tank was different, and that the intensities of the lights used were different. He also defended the method of averages which he had used.

A paper on an allied subject was that by Prof. E. C. Tolman, who described three investigations which are in progress at the University of California. The first is an experiment on the genetics of maze-learning ability. Using a 17-unit *T*-maze as the measure of the rat's learning ability, Prof. R. C. Tryon has been selecting for a strain of 'maze-bright' rats and also for a strain of 'maze-dull' rats. In the *F*9 generation, the two strains had become so separated that only one or two of the bright strain proved duller than the brightest of the dull strain. No evidence for a Lamarckian effect, such as Prof. McDougall claims, has been found; that is, the rats

as a whole do not show any tendency to become brighter simply because of the training of their parents.

The second experiment described was one by Dr. I. Krechevsky on "Hypotheses" in rats. Using some of Prof. Tryon's bright and dull strains in a discrimination box which has four successive choices, Dr. Krechevsky has found that the maze-bright rats tend to establish 'spatial' position-habits first, whereas the maze-dull rats tend to establish 'visual' position-habits first. This seems to indicate that Prof. Tryon has been selecting not for an absolute *g*, in Spearman's sense, but for some more specific ability to be called perhaps 'spatial ability'. Dr. Krechevsky's experiment is also theoretically important because it indicates that what in the past were considered as mere blind 'position-habits' in rats have really the properties of 'hypotheses'. They are adopted one at a time and are persevered in or abandoned as they prove to be successful or otherwise.

The third experiment reported was one carried out by Prof. Tolman himself, and is to be regarded as a further analysis of the rat's spatial abilities. Two food-boxes were used, one reached by a short path, and one by a longer path. After the rats had learned to go very consistently to the nearer of the two boxes, they were put into this box by hand, and received there unexpectedly an electric shock. When they were placed at the starting point immediately afterwards, only some thirty per cent proved sufficiently aware of the relationships involved in that they refused to go towards this box, and took the path to the other box instead. If, however, they were run into the nearer food-box just before receiving the shock in it, practically all of them refused to go to it in an immediately subsequent trial. It appears that the ability to recognise a given path as leading to a given result—in this case an electric shock—is much easier when the actual sequence has been just experienced, than when the sequence has to be inferred, so to speak.

Prof. Tolman also discovered that if the rats found themselves unexpectedly blocked in all directions, they exhibited emotional breakdowns very similar to those reported by Prof. Lewin when working with children and adults in similar situations.

A National Academy of Sciences for India

IN our issue of September 23 last, support was given to the movement to establish a national Academy of Sciences in India. Reference was made to the Academy of Sciences of the United Provinces, which its founders hoped might develop into an All-India organisation, and to the Asiatic Society of Bengal, which will celebrate its 150th anniversary in January next. There is a strong feeling in India in favour of the formation of a national academy, to represent so far as possible all scientific interests in the country, but difficulties are likely to arise in deciding upon the most suitable centre for the new organisation. We outlined the position in the article already mentioned, and have now received from Dr. S. L. Hora, of the Indian Museum, Calcutta, a copy of twelve resolutions adopted at a general meeting of men of science in Calcutta held on September 17, and therefore before the issue of NATURE of September 23 reached India. Dr. L. L. Fermor, director of the Geological Survey, seems to have taken a leading part in preparing a constitution for the proposed Academy, and he has been empowered to put the views of Calcutta scientific workers before the Indian Science Congress when it meets at Poona.

We have not space to print the resolutions in full, but the following abridgement represents fairly the views of a large body of men of science in India in support of both the proposal for the foundation of an All-India Academy of Sciences and also upon the claims of Calcutta for recognition as the centre of such an organisation.

In view of the rapid advances that scientific research has made, and continues to make, in India, a Central Body should be organised capable of co-ordinating research, safeguarding the interests of scientific workers, advising both the Central and Provincial Governments regarding the application of scientific methods to ameliorating the condition of the masses and to establishing contact with other International scientific bodies. In view of the above, the proposal for the foundation of an Indian Academy of Sciences was unanimously approved and strongly supported.

All departments of science, both pure and applied, such as Mathematics, Physics, Meteorology, Chemistry, Geology, Zoology, Botany, Medicine, Anthropology, Psychology, Agriculture, Forest Research, Engineering, Veterinary Research, Geography, etc., should be included in the scope of the Academy and allowed effective representation in the proposed constitution.

The Academy should undertake to encourage scientific research in all its aspects by holding meetings, by publishing results of research of outstanding merit, by providing suitable library facilities, and by such other means as may appear conducive to the advancement of science in India. It should further be the object of the Academy to stimulate research in less-developed sciences and to arrange for provision of equal facilities for research in all the departments of science included in its scope.

The existing scientific bodies in India should be represented on the Academy with a view to ensuring co-ordination of research and the much needed co-operation of all scientific workers in India. This will enable scientific knowledge in the country to be pooled and applied to the practical needs of the nation.

The Academy should be of an All-India nature and represent as far as possible all scientific interests in the country. It should be so designed as to command the greatest respect and influence both in India and in International circles. It was, therefore, considered desirable to associate the new body, when founded, with the Asiatic Society of Bengal. Such an association is desirable for several reasons, such as facilities for meetings offered by this Society, its rich library, its existing relations with outside academies and societies, its influence with the Central and Provincial Governments and, above all, because a strong *liaison* with the various branches of Letters will thus be preserved, for it is most desirable that Science and Letters should not lose the benefit of healthy intellectual co-operation.

With a view to bring about intimate relationships between the proposed Academy and the Asiatic Society of Bengal, the Council of the Asiatic Society of Bengal should be requested to modify and alter its constitution so as to provide full scope for the activities of the proposed Academy.

In selecting the original members of this Academy it is desirable to find some formula that will utilise the already recorded opinion of scientists in India. For this reason the past General and Sectional Presidents of the Indian Science Congress resident in India should be invited to form the initial foundation members. In addition, the heads of Central scientific departments and institutes, the Presidents of All-India and Provincial Scientific Societies, with representatives of the Universities, should be included as *ex-officio* Additional Members. This initial body of members should annually elect not more than 10 new members.

Calcutta is the most suitable place for the location of the proposed Academy in view of its having been a centre of scientific research for more than a century. Further, the presence of a very large number of scientific men in Calcutta, the fact that Calcutta is the seat of various scientific departments and surveys, its unrivalled facilities for research work in the form of libraries and laboratories, its facilities for interchange of thought, its central situation, and above all, the existence in Calcutta of the veteran scientific and literary society of the East, the Asiatic Society of Bengal, are very cogent reasons in support of the Committee's recommendation.

University and Educational Intelligence

CAMBRIDGE.—The Vice-Chancellor has announced that a donor who wishes to be anonymous has presented the sum of £1,000 for the furtherance of the work which is being done in the Sub-Department of Experimental Zoology.

Trinity College, Cambridge, has announced its annual offer of a research studentship open to graduates of other universities who propose to go to Cambridge in October next as candidates for the degree of Ph.D. The value of the studentship may be as much as £300 a year if the pecuniary circumstances of the successful candidate require so large a sum. Applications must reach the Senior Tutor not later than July 1, 1934. The College also offers Dominion and Colonial exhibitions to students of Dominion and Colonial universities who wish to go to Cambridge next October as candidates for the degree of B.A., M.Litt., M.Sc., or Ph.D. These exhibitions are of the titular value of £40, but their actual value may vary with circumstances. The Council has power, if funds are available, to award additional payment. Candidates must apply through the principal authority of their university, and applications should reach the Senior Tutor (from whom further particulars may be obtained) by July 1, 1934.

The Isaac Newton studentship has been awarded to J. A. Edgar, of Sidney Sussex College.

LIVERPOOL.—The Frazer lecture for 1933 will be delivered by Prof. C. G. Seligmann, professor of ethnology in the University of London, on November 30, who will take as his subject "Egypt and Negro Africa—Divine Kingship".

LONDON.—Mr. and Mrs. C. J. Courtauld have given £25,000 for the endowment of a "Courtauld Chair of Animal Husbandry".

ST. ANDREWS.—The portrait of Sir James Irvine, vice-chancellor and principal of the University, painted by Mr. Oswald Birley, and the portrait of Dr. E. S. Harkness, of New York, painted by Mr. Frank O. Salisbury, will be received by the Rt. Hon. Stanley Baldwin, chancellor of the University, on behalf of the University, in the Younger Graduation Hall, St. Andrews, on Saturday, November 18, at 5.30 p.m.

SHEFFIELD.—The following appointments have recently been made :—Mr. W. J. Lytle, to be lecturer in surgery ; Mr. W. J. Mitchell, to be junior research assistant in glass technology ; Mr. H. Laithwaite, to be research fellow in glass technology.

THE Carnegie United Kingdom Trust has agreed to set aside a further sum of £10,000 for the extension of the new regional library service.

DR. M. H. MACKEITH, dean of the Medical School in the University of Oxford, has been appointed dean of the British Postgraduate Medical School. The foundation stone of the new School, which will adjoin, and be associated with, the London County Council Hospital at Ducane Road, Hammersmith, London, was laid by the Right Hon. Neville Chamberlain, on July 17. It is hoped that the School will be open to students towards the end of 1934.

DR. D. H. INGALL has been appointed principal of the Borough Polytechnic, in succession to Mr. J. W. Bispham, who has been promoted to Assistant Education Officer (Technology) under the London County Council. In 1919–21 Dr. Ingall was senior lecturer in the Department of Metallurgy of the University of Birmingham ; in 1921–28 principal and head of the Department of Metallurgy of the Staffordshire County Technical College, Wednesbury. Since 1931 he has been assistant director and research manager of the British Non-Ferrous Metals Research Association.

IN the Calendar of University College, London, for 1933–34 forty pages are devoted to a programme of post-graduate courses of lectures and arrangements for laboratory work of advanced students in forty-three departments. Conspicuous among these, by reason of the fact that similar opportunities are offered by few, if any, other institutions, are advanced courses in phonetics, Egyptology, the history, methods and principles of science, town-planning, statistics and eugenics. In the Department of Chemical Engineering, a special feature of the first year of post-graduate work is the provision for maintenance of active contact with industry by means of visits to some twenty-five selected works and factories during the session and lectures in the Department by representatives of different industries on Saturday mornings throughout the session ; the second year will be devoted entirely, with the exception of occasional lectures on special topics, including the lay-out of factories, administration and economics, to original research in the laboratories or at industrial works.

Calendar of Nature Topics

Birds Lightest in November

Careful weighings of the North American house-finch (*Carpodacus mexicanus frontalis*), carried on throughout the year, show that in November the adults reach the minimum average of weight. J. L. Partin made more than 1,000 weighings of 800 individuals, and although the differences are not large, the lowest average (in November) being 93·7 per cent of the maximum which occurs in February, they point to a definite seasonal rhythm (*Condor*, 35, 60; 1933). From December to February, during which period the weight of both sexes surges upwards, the male birds were the heavier, but from April to July the weights of the females were consistently greater than those of the males, a difference due to the relatively greater increase of ovaries during the breeding season. Linsdale found a similar preponderance of weight in female fox-sparrows (*Passerella iliaca*) during that period.

In addition to the seasonal weight rhythm, there is a daily variation in the weight of the house-finch which amounts to about 3·5 per cent. There is a steady increase during the forenoon and a more erratic fluctuation in the early afternoon, when the maximum weight for the day is reached between 2 and 4 p.m. Thereafter the weight declines steadily until the onset of the morning's rise. The weight of adult house-finches at their heaviest is 21·58 gm., but there are indications that territorial variations occur in weights, which may be due to food influences, or heredity, or both.

American Passenger Pigeons

In the autumn of 1813, J. J. Audubon recorded one of the largest of the immense migrations of the passenger pigeon (*Ectopistes migratorius*) in Ohio, when birds migrating filled the air in an area of more than fifty-five miles from daybreak to sunset for three days; the last passenger pigeon died in Cincinnati Zoo in 1914. Such is the tragic story of a species that was, a hundred years ago, the commonest bird in North America. Audubon describes the passage: "In the autumn of 1813 I left my house at Henderson on the banks of the Ohio on my way to Louisville. In passing over the Barrens I observed the pigeons flying from north-east to south-west, in greater numbers than I thought I had ever seen them before; and feeling an inclination to count the flocks that might pass within the reach of my eye in one hour, began to mark with my pencil a dot for every flock that passed. In a short time, finding the task impracticable as the birds poured in in countless multitudes, I rose, and counting the dots, found 163 had been made in 21 minutes. I travelled on, and still met more the farther I proceeded. The air was literally filled with pigeons; the light of noonday was obscured as by an eclipse, and the continued buzz of wings had a tendency to lull me to repose. Before sunset I reached Louisville; the pigeons were still passing in undiminished numbers, and continued to do so for three days in succession." One flock he estimated to be one mile in breadth and 180 miles in length, taking three hours to pass, nor was it an unduly large one. In 1876–77 a large nesting colony extending 28 miles by 3–4 miles existed near Petosky (Ogilvie Grant).

The passenger pigeon has frequently been recorded in the British Isles—Fifeshire, 1825 (Fleming, *Hist. Brit. An.*, p. 145), and Hertfordshire, July 1844—but many were obviously escapes from aviaries, as a Berwickshire specimen in Turnbull's "Birds of East Lothian", p. 41. About 1840, Audubon sent specimens to the thirteenth Earl of Derby for his zoological collection at Knowsley, which, after a few years, increased to such an extent that the doors of the aviary were opened to let them fly away (T. J. Moore, *Proc. Liverpool Biol. Soc.*, 6, 1891), some of them being recorded so far away as Leicestershire (Brown, "Vert. Fauna of Leicest.").

Burrowing of the Burrowing Toad

In November 1928 the tenth known specimen of the rare burrowing toad of India and Ceylon (*Cacopus globulosus*) was discovered in a northern suburb of Calcutta, buried to a depth of eight feet in the soil at the bottom of a tank. It is not known whether the burrowing is seasonal or not, but it seems to account for the scarcity of this toad in collections. The Calcutta specimen was kept in captivity by D. D. Mukerji, who observed its mode of burrowing (*J. Asiatic Soc. Bengal*, 27, 97; 1931). The earth was dug up by alternate quick outward and upward propelling movements of the two hind limbs.

The metatarsal shovels, which have fairly sharp outer edges, do all the cutting and scraping of earth, while the digits of the hind limbs, which are slightly webbed at their bases, sweep away earth on the sides of the burrow. By a forward push on the soil in front by the fore limbs, the toad gradually forces its way backwards and downwards in the burrow. These operations continued until finally the toad reached the bottom of its cage, where it rested quietly and never returned to the surface of its own accord except when the soil became too dry. But its habits in captivity may not have been quite normal, for in spite of the presence of food, it fasted for 390 days and then died.

The specific name describes the globular shape of the toad, and this the author discovered to be due to a temporary inflation of the lungs by which the abdomen was distended for considerable periods.

Electricity on the Farm

In the dark mornings of November the advantage of electric light in and around the farm buildings begins to be realised. Even the best of barns and buildings are not adapted to make the most of the dull light of a winter's morning; and milkers, horsemen and cattlemen grope about their duties in semi-darkness. The convenience of a well thought out lighting system at this period is worth much to the running of the farm, and is a real aid to efficiency. On the majority of farms supplied with electricity, the service of lighting forms the biggest item in consumption, but motor driven barn machinery is increasing and forms a further source of convenience—one might almost say luxury—on cold winter mornings, when an obstinate oil engine can exhaust much time and patience to induce it to start. With the progress of rural electrification, we may look forward to still another step towards the removal of some of the inconveniences that are associated with farm work—minor discomforts accepted as a matter of course and without complaint by agricultural workers, which will gradually disappear as it becomes economic and feasible to overcome them.

Societies and Academies

LONDON

Royal Society, November 9. SIR ARTHUR EDDINGTON: The masses of the proton and electron. The mass m of an elementary particle (proton or electron) is given by the quadratic equation

$$10\,m^2 - 136\,m\,m_0 + m_0^2 = 0,$$

where $m_0 = h\sqrt{N}/2\pi cR$; N being the number of particles in the universe and R the 'de Sitter radius' of empty space-time. The ratio of the roots is 1847·60; and the resulting value of $\sqrt{N}/R$ gives a speed of 780 km. per sec. per megaparsec for the recession of the nebulæ. Apart from a change in the identification of N and R, the above formulæ agree with those suggested in preliminary papers. The principle of the theory is that, since we can only observe relations, the wave-packets created by our observations are formed in the double wave function of the two bodies related, and are artificially analysed into separate wave packets in the single wave functions. The conditions governing this analytical separation lead to a quadratic equation that must be satisfied by the mass (or coefficient of dispersal) of the simple wave packet; when the reference body is the ideal uniform system presupposed in the current equations defining the mass, the quadratic takes the above form. In order that quantities occurring in microscopic physics (quantum theory) and macroscopic physics (relativity theory) may be expressed in the same measure, the same comparison system must be used for both. W. T. ASTBURY and H. J. WOODS: X-ray studies of the structure of hair, wool and related fibres. (2) The molecular structure and elastic properties of hair keratin. The X-ray photograph of stretched hair (β-keratin) is analogous to that of silk fibroin, whether stretched or unstretched. Stretched hair is therefore built up of extended polypeptide chains, while unstretched hair (α-keratin) must consist of the same chains in a folded state. The limiting extensibility of hair is about 100 per cent of its unstretched length. By linking this fact quantitatively with the X-ray data, a reasonable stereochemical arrangement can be found for the folds in the main-chains of α-keratin. These folds appear to be transverse to the general direction of the side-chains, which are roughly co-planar and serve to unite neighbouring main-chains by a variety of cross-linkages. The structure of β-keratin is thus one of flat polypeptide 'grids'. During the hydrolytic modification of β-keratin by steam or dilute alkalis, spacing disturbances occur in the direction of the side-chains. These disturbances are the intramolecular basis of the phenomena of 'set' and 'supercontraction' (see NATURE, Nov. 4, p. 709). J. M. ROBERTSON: The crystalline structure of naphthalene. A quantitative X-ray investigation. The structure is refined by a double Fourier analysis carried out for the zones of the three chief crystal axes, and the results expressed in absolute units. Naphthalene differs from anthracene chiefly in the larger inclination of the long axis of the molecule to the (010) plane. The interatomic and intermolecular distances are very nearly the same as in anthracene, but the electron distribution does not show any marked falling off in the peak values on passing out from the centre of the molecule as in anthracene. The electron count is again in good agreement with the chemical structure.

PARIS

Academy of Sciences, October 2 (*C.R.*, 197, 661–720). GABRIEL BERTRAND and GEORGES BROOKS: The latex of the lac tree of Cambodia. The lac examined was obtained from *Melanorrhœa laccifera*. A preliminary examination of the latex showed that its composition and general properties resemble those of latex from lac trees of the genus *Rhus*, but that the oily phenol substance named moreacol is different, the latter possessing an additional CH_2 group. D. V. JONESCO: The generalisation of an equation of E. Goursat. J. C. VIGNAUX: A generalisation of a summation of Borel. J. SOLOMON: The effect of internal conversion. CHARLES DUFRAISSE and RENÉ CHAUX: The mechanism of shock, or knocking, in internal combustion motors. Discussion of a recent communication by Dumanois, with reference to a question of priority. E. O. LOVETT: The problem of two bodies of variable masses. MICHEL ANASTASSIADÉS: A new rectifier with a stopping layer. Studies of the electrical behaviour of the system CuS, Cu_2S. LÉON and EUGÈNE BLOCH: The spark spectrum of iron in the extreme ultra-violet. The lines tabulated extend over the range 1350–300 A. Comparison with the data published by Millikan, Bowen and Sawyer shows anomalies, especially as regards intensities, which require elucidation by further research. MLLE. Y. CAUCHOIS and HORIA HULUBEI: The characteristic X-emission of elements in the gaseous state. Weak lines in the K-spectrum of krypton. J. E. VERSCHAFFELT: The displacement of equilibrium by variation of mass. Discussion of a recent note by Etienne on the same subject. F. HAMMEL: Manganous sulphate. Contrary to the views expressed by J. H. Krepelka and B. Rejha, the author finds that the properties of solutions of manganous sulphate do not depend on the mode of preparation of the salt employed or on its hydration. P. RUMPF: The electrometric titration of sulphurous, selenious and α-oxyalkylsulphonic acids. R. RAMBAUD: The action of PBr_3 on the ethylenic α-oxynitriles. Under the action of phosphorus tribromide, the nitrile $CH_2 = CH.CH(OH).CN$ is converted into the isomeric compound propionyl cyanide, $C_2H_5.CO.CN$. Analogous results were obtained with the higher homologue $CH_3.CH = CH.CH(OH).CN$. ENDERLIN: Researches on the dissociable organic oxides. A second isomer of oxytetraphenylrubene. V. AGAFONOFF: The red Mediterranean soils of France and their mother rocks. Researches in the field and in the laboratory show that the typical red Mediterranean soils of France are formed on pure limestones and dolomites under the influence of the Mediterranean climate. R. DUGHI: The formation and the rôle of *papilles scortéales* in lichens. ALPHONSE LABBÉ: The Oncidiadeæ, molluscs with silica. The presence of silica, often up to one-tenth of the weight, is characteristic of this group of molluscs. ESCHER DESRIVIÈRES, ROBERT FAILLIE, JONNARD and VIAL: Visual psychomotive reactions in relation with dazzling by a motor head-light. It is stated that a yellow tinted glass gives effective protection against dazzling. EMILE F. TERROINE and MLLE. GERMAINE BOY: The distinctive characters of the specific minimum nitrogenous consumption and of exogenous protein metabolism. The method is based on the study of the distribution of the urinary nitrogen, especially in the forms of creatinine and creatine. Data are obtained for nitrogen as urea, ammonia, amino-acids, allantoin,

purins, creatinine and creatine. MLLE. GERTRUDE PARISET: The synthetic formation of creatine at the expense of the tissue proteins. MLLE. ANNA RAJZMANN: The comparative biological value of the proteins in various species of animals. The biological value of a protein or of a mixture of proteins, calculated by the formula of Martin and Robison in the form given by Terroine, from the results of the experiments described, appears to be the same for all the species considered (rat, rabbit, pig). H. TRIMBACH: The liability of various species of animals to ketonuria and ammonuria. The ketone production, reduced to unit weight, is extremely variable in various species of mammals under the same food regime. For a milk diet, most extensively studied, the ketonuria varied between 1 for the calf to 10 for the rat. Similar variations were shown for ammonuria. A. POLICARD: The fixed mineral matters of the seminal elements in the course of spermatogenesis. Results of the method of micro-incineration applied to the testicle of the rat. MICHEL VOLKONSKY: The assimilation of sulphates by the Fungi: euthiotrophy and parathiotrophy. Most species of moulds and yeasts are able to synthesise their organic sulphur compounds starting with the sulphate. The Saprolegniaceæ, however, cannot utilise the sulphate ion as a source of sulphur (parathiotrophy) and form an exceptional group. H. VIOLLE: The bactericidal power of sodium ricinoleate. Sodium ricinoleate possesses a high antiseptic power, greater than that shown by oleates, stearates, palmitates or laurates. But this action is specific towards certain micro-organisms only. Bacilli found in the alimentary canal are not destroyed, but bacilli developed in the pharynx, nasopharynx, the bronchials and in pulmonary tissue show, *in vitro*, a remarkable sensibility towards this soap. It would appear that solutions of this soap could be used as a reagent in microbial diagnosis. ANDRÉ SERGENT: A new agent for the natural transmission of recurrent Spanish-African fever: the dog tick, *Rhipicephalus sanguineus*. J. REENSTIERNA: First results of the treatment of leprosy by an experimental serum. Description of the mode of preparation of the serum and of its application to two cases of advanced leprosy. The results are promising.

Forthcoming Events

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

Monday, November 20

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. Bernard Ashmole: "The Place of Art in the Study of Man".*

ROYAL SOCIETY OF ARTS, at 8.—Hesketh Hubbard: "Colour Block Prints" (Cantor Lectures. Succeeding lecture on November 27.)

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—J. Hackin: "Through Persia and Afghanistan with the Citroen Central Asian Expedition".

Tuesday, November 21

ROYAL INSTITUTION, at 5.15.—Sir William Bragg: "Liquid Crystals" (succeeding lectures on Nov. 28, Dec. 5 and 12).

Wednesday, November 22

ROYAL SOCIETY OF ARTS, at 8.—V. E. Pullin (Director of Radiological Research, Woolwich): "The Radiographic Use of Radium".

Thursday, November 23

BRITISH SCIENCE GUILD, at 4.30—(in the Goldsmiths' Hall, Foster Lane, London, E.C.2).—Prof. E. V. Appleton: "Empire Communication" (Norman Lockyer Lecture).

Friday, November 24

UNIVERSITY OF LONDON, at 5.30—(at University College).—Prof. Othenio Abel: "Palæobiology and Evolution" (succeeding lectures on Nov. 27 and 29).*

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS, at 5.30—(at the Royal Society of Arts, John Street, Adelphi, W.C.2).—Prof. S. Chapman: "The Sun's Magnetism".*

ROYAL INSTITUTION, at 9.—Sir William Bragg: "Liquid Crystals".

SOCIETY OF CHEMICAL INDUSTRY (FOOD GROUP), Nov. 23–24.—Symposium on "Bread and Milk" to be held in the hall of the British Medical Association, Tavistock Place, London, W.C.1.

Official Publications Received

GREAT BRITAIN AND IRELAND

Proceedings of the Royal Irish Academy. Vol. 41, Section A, No. 8. On Composite Surfaces in Higher Space. By J. G. Semple. Pp. 69–93. 2*s*. Vol. 41, Section A, Nos. 9–10: On some Permanent Arrangements of Parallel Vortices and their Points of Relative Rest, by W. B. Morton; Characteristic Properties of certain Systems of Paths in a Riemannian Space, by C. H. Rowe. Pp. 94–110. 1*s*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

University College of North Wales. Calendar for Session 1933–34. Pp. 454. (Bangor.)

Imperial Bureau of Plant Genetics: Herbage Plants. Bulletin No. 10: Grazing; Papers read at the Meeting of the British Association for the Advancement of Science at Leicester on September 11th, 1933. By P. F. Astill, William Davies, M. G. Jones and A. Bridges. Pp. 22. 1*s*. 6*d*. Bulletin No. 11: Technique employed in Grassland Research in New Zealand. Pp. 49+11 plates. 3*s*. (Aberystwyth: Agricultural Buildings.)

OTHER COUNTRIES

Report of the Twenty-first Meeting of the Australian and New Zealand Association for the Advancement of Science, Sydney Meeting, August 1932. Edited by Dr. A. B. Walkom. Pp. xlviii+550+5 plates. (Sydney: Government Printer.)

Memoirs of the Geological Survey of India. Vol. 62, Part 1: The Pyu Earthquakes of 3rd and 4th December 1930, and subsequent Burma Earthquakes up to January 1932. By Dr. J. Coggin Brown and P. Leicester. Pp. v+140+ix+6 plates. (Calcutta: Central Book Depot.) 4.2 rupees; 7*s*.

Census of India, 1931. Vol. 1: India. Part 1: Report. By Dr. J. H. Hutton; to which is annexed an Actuarial Report by L. S. Vaidyanathan. Pp. xv+518+13 plates. (Delhi: Manager of Publications.)

Annual Report for the Year 1932 of the South African Institute for Medical Research, Johannesburg. Pp. 71+2 plates. (Johannesburg.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 85. 1ere partie: Procès-verbaux (Mai). Pp. 60. (Copenhague: Andr. Fred. Høst et fils.) 3.00 kr.

Science Reports of the Tokyo Bunrika Daigaku, Section B. No. 12: A New Genus and some New Species of Crabs from Simoda. By Tune Sakai. Pp. 137–144. 25 sen. No. 13: On the Parallelism between the Distribution of Lizards and of Anurans in the Japanese Empire. By Yaichirô Okada. Pp. 145–153. 25 sen. No. 14: Some Observations of Japanese Crayfishes. By Yaichirô Okada. Pp. 155–158. 10 sen. (Tokyo: Maruzen Co., Ltd.)

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