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# Science and Culture

THE part played by science in modern life, and the greater part it should play, are themes that offer appetizing food for thought to those engaged in scientific pursuits; but most laymen "look up and are fed not", regarding science as something abstruse and esoteric, and remaining content to enjoy its benefits without inquiring into their past or future. All devotees of science will therefore welcome the renewed efforts which the British Association is making to bring home to the public the nature and magnitude of the services rendered by science to the community, and the ways in which science enters into, and maybe colours, their daily life.

The most obvious effects of science upon man are the directly material: food, clothing, shelter, and so on. Less obvious are its effects upon social and economic conditions, due largely to developments in the use of steam, water, electricity and mineral oil as sources of power. The least obvious influence of science upon man is the way in which it has revolutionized his general intellectual outlook (*Weltanschauung*). It is to this last aspect that we would here direct attention, our reflections thereon having been prompted by the address with which Sir Richard Gregory opened the discussion on "Cultural and Social Values of Science" at the Blackpool meeting of the British Association.

One of the handicaps under which the man of science labours in communicating his thoughts to the outside world is the necessity for using abstract terms that defy precise definition. He may use far too many of them, but he must use some; so to avoid misunderstanding and confusion of thought, it is always desirable to start with a preliminary explanation of the meaning of the chief abstract terms he intends to employ. The word 'science', for example, is used very loosely in everyday life: to some it signifies a kind of magic—sometimes 'black' magic; to the schoolboy it is 'stinks' or 'bugs'; to many educated people it is an esoteric and recondite activity that touches human life but fleetingly and tangentially; the journalist uses it in describing boxing, cricket and other pastimes, and the advertiser in any way that helps to sell his wares.

For most people, probably the best definition of a science is 'a body of accurate knowledge', obtained by observation, often under experimental conditions, and sound reasoning. It would be going too far to elaborate this definition by discussing experimental technique, the nature of theories and hypotheses, and the kinds of reasoning, inductive and deductive, used by the research worker; but in any event effort should be made to disabuse the mind that science is a dull, lifeless thing, and that scientific workers are merely highly organized automata. Success in scientific inquiry, it might be pointed out, implies the possession of some of the higher human qualities, such as courage to look facts squarely in the face and to accept conclusions even when they are unpleasant or subversive of established practice and belief; patience; a disciplined imagination; an open mind and a critical outlook; and, perhaps the greatest of all, the artist's sense of striving for perfection.

Culture resembles science in having its roots in accurate knowledge and in critical thought. It is, however, more than knowledge or learning (a small amount of learning is compatible with a high degree of culture), because in concentrating on "the *best* that has been thought and known in the world", it becomes essentially a study of

perfection. Culture has therefore close affinities to science, art and ethics. Matthew Arnold, the nineteenth-century apostle of culture, took the view that the pre-eminent part of culture is not "the scientific passion, the sheer desire, to see things as they are", but such ethical elements as love for one's neighbour, beneficence, the desire to remove human error, confusion and misery, and the noble aspiration to leave the world better and happier than we found it.

The distinguishing feature of science would thus appear to be accurate knowledge, and that of culture to be taste, judgment or discrimination between the true and the false, the good and the bad, the beautiful and the ugly. Were Matthew Arnold living to-day, he would readily acknowledge the benefits that science has conferred on humanity in the directions he indicated. Has it not exposed many causes of human error and dissipated confusion of thought? Has it not done wonders in preventing, alleviating and curing physical pain? Has it not provided man with the physical means towards a fuller and richer life? If science has not made man ethically better, that is not the fault of science, for it may be claimed that the golden rule of conduct—consideration for others—which is the foundation of morality and the non-material basis of happiness in communal life, is a valid scientific deduction from the data of experience. Emotion being a more potent factor in conduct than knowledge (*Pour faire quelque chose de grand il faut être passionné*), the contributions of science to "the good life" may compare unfavourably with those of art and religion, but it will be agreed that no conduct can in effect be good unless it conforms with the dictates of reason.

The influence of science upon the development of man, both as an individual and as a member of society, is apt to be overlooked by the historian. The pioneers of natural science, like Copernicus, Galileo, Bacon, Descartes and Darwin, by overthrowing the geocentric and anthropocentric doctrines of their times, and by establishing belief in the constancy of the order of Nature, freed the human mind from the fetters of dogma and unreasoning faith, and opened up possibilities of knowledge and attainment that we are now only beginning to realize and explore.

The services of these men, and of many others who have contributed to our knowledge of the universe and to the liberation of human thought, should be taught and discussed in our schools, and, generally, our educational curricula should be re-oriented in the direction of greater concentration upon the best that has been thought, known *and done* in the world, irrespective of time and geographical location. Our teachers need to be men and women of higher culture, seeking to emulate the great men of culture, who, as Matthew Arnold said, "have had a passion for diffusing, for making prevail, for carrying from one end of society to the other, the best knowledge, the best ideas of their time; who have laboured to divest knowledge of all that was harsh, uncouth, difficult, abstract, professional, exclusive: to humanize it, to make it efficient outside the clique of the cultivated and learned, yet still remaining the *best* knowledge and thought of the time, and a true source, therefore, of sweetness and light".

The question arises, therefore, whether bodies like the British Association and the Royal Society cannot, in conformity with their statutes, tread the path of the diffusion of natural knowledge with greater vigour than heretofore. Neither body issues a publication which really hits the educational bull's-eye. The Association, it is true, enjoys what is called 'a good Press', but unfortunately that Press, in pursuit of commercial aims, largely selects matter that is calculated to create a sensation, and which seldom leaves a lasting impression.

We therefore suggest that the Council of the Association be urged to consider the advisability of publishing on its own account a special volume, to be available at a low price, containing those addresses, lectures, papers and discussions, or parts of them, which have a direct bearing upon the life of the community, and including descriptions of discoveries and inventions, new light on old truths, economic and social problems, and contributions to higher thought. Authors could be advised in advance that their contributions were ear-marked for dissemination among the public, and that therefore they should be written so far as possible in non-academic language, with a non-academic approach, and with the express object of arousing interest in and appreciation of the social and cultural implications of scientific research among those who are still largely ignorant of or indifferent to it. The first quinquennial review of the progress of science, prepared for the Association by a number of authors, and shortly to be published, though not entirely of this character, should be of great service in extending interest in scientific knowledge and achievement. Our hope for the future lies in enlightened education of this kind.

# Petrology and Movements of Snow Deposits

Snow Structure and Ski Fields:
being an Account of Snow and Ice Forms met with in Nature and a study on Avalanches and Snowcraft. By G. Seligman; with an Appendix on Alpine Weather, by C. K. M. Douglas. Pp. xii+555. (London: Macmillan and Co., Ltd., 1936.) 25*s*. net.

OF all superficial deposits, that of snow is in its physical nature the most inhomogeneous and changeable, chiefly because it exists at temperatures so close to its melting point that melting, evaporation and sublimation are ever at work within the porous mass, modifying the characters of layers which were themselves distinctive when laid down. In consequence it is extremely difficult to predict the behaviour of snow on slopes, and losses in life and property due to avalanching are severe. Long experience has supplied a wealth of precepts to be followed by the wise snowcraftsman, but the reasons for them are imperfectly understood. The properties of the snow are determined by those of ice at the temperature involved, by the shape of the individual grains, their degree of interlocking and the cohesive force uniting them, whilst a further important control may be exercised by the presence of water. Mr. Seligman seeks to interpret avalanche lore in the light of our knowledge of the structure of the snow on deposition and its transformations under varying conditions, and he paints a vivid picture of the complexity of the problem.

The insufficiency of the available data is apparent, and it relates to both laboratory and field investigation. It is surprising that we should still be in almost complete ignorance of the properties and stability conditions of the vitreous state of so fundamental a substance as water, and much remains to be learnt regarding the internal structure and temperatures of accumulations of snow and ice. Only recently, Prof. H. U. Sverdrup has obtained evidence for the unexpected conclusion that in Spitsbergen, where the average annual temperature is − 12° C., the glaciers with the exception of a superficial layer subject to seasonal variation are at a temperature of 0° C. throughout, so that only the latent heat of fusion is wanting to remove them. The present work, which deals with the development of snow through all stages to compact ice, makes an opportune appearance in view of the increased attention now being directed to the subject as witnessed by the meeting of the International Commission of Snow in Edinburgh this year. Lavishly provided with beautiful illustrations, it should perform a valuable service in enlisting the interest of snow sportsmen in theory and observation.

Lack of precision in the terminology of the multitudinous forms of ice deposits has been responsible for much confusion in the past, and the author's definitions and analysis of foreign usages should pave the way for more fruitful discussion in the future. The classification and terminology adopted is on the whole satisfactory, although views will differ on details: thus the restriction of the 'glacier proper' to a moving mass of ice the surface of which is bare in summer, although convenient for the snowcraftsman, will not be acceptable to the geologist and physiographer. A somewhat careless employment of the terms 'condensation' and 'sublimation' will puzzle the non-specialist whom the book is cunningly devised to attract—the formation of super-cooled water drops is not a sublimation process—and it would be wise in view of the wide constituency addressed to limit 'condensation' to signify the passage from vapour to liquid only.

Mr. Seligman gives an admirable digest of the huge and undisciplined literature on snow and ice, and the arduous nature of his own field researches may be illustrated by his statement that on one occasion he spent two hours on a cornice in a fifty miles an hour gale attempting to make microscopic observations, all but a few minutes, however, being occupied in restoring circulation! The number of factors governing the form and interrelationship of the granules of a snow deposit is very great, and meteorological conditions exercise an important control over the processes active in the uppermost layers, whilst through the agency of freezing percolating melt waters, surface heat is delivered to the deeper layers and their structure modified. Snow phenomena provide Nature's greatest display of sublimation, and the author convincingly demonstrates the important role it plays in the development of structure, whereas regelation, which was formerly called in to explain many things, is now considered to be of minor application.

The origin of many avalanches is bound up with the stratification of the snow, in which beds laid down and altered under different meteorological conditions, and consequently of varied structure and properties, are insecurely welded to each other, and the elucidation of these matters properly belongs to the province of stratigraphical and

metamorphic geology. Mr. Seligman's book provides a stimulating record of the advances which have been made towards the solution of the problem of deducing meteorological history from the petrography of the deposits, and conversely the prediction of structure and mechanical properties from knowledge of past conditions. The perusal of Part 3, which treats of the different kinds of avalanches, the precautions to be taken in the hope of escaping them, and the procedure to be followed in attempting to rescue unfortunate victims, cannot fail to impress the reader with the hazardous nature of the snowcraftsman's exercise. The timid will keep away from the snow mountains, but happily for the growth of knowledge there are others. L. H.

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# Poverty, Malnutrition and Disease

Poverty and Public Health
By G. C. M. M'Gonigle and J. Kirby. Pp. 278. (London : Victor Gollancz, Ltd., 1936.) 6*s*. net.

IN producing the book under notice, Dr. G. C. M. M'Gonigle and Mr. J. Kirby have made a practical and notable contribution to the study of community and family nutrition, which should help responsible authorities and individuals to acquire a true perspective and a sound sense of values in regard to the many factors which collectively influence the health of the general public. The authors write with the authority of first-hand experience. For many years their official duties have brought them face to face with the realities of poverty, malnutrition, disease and death in the depressed areas, and in the course of their work for the health and welfare of the local community in Stockton-on-Tees, they have collected data, instituted inquiries and made original investigations into the nutritional state of children and family health and economics.

Such is the background of knowledge and experience behind the publication before us. It has appeared at a time when the national conscience is alive to the significance of diet to health, and the fact that malnutrition is not merely a problem to be solved by satisfying hunger. The health and fitness of the nation are primarily determined by the state of nutrition of the people, and of necessity the food consumed by the individual child or adult must be physiologically adequate in respect of quality, quantity and balance if optimum nutrition is to result.

The book opens with an examination of available information relating to the physical condition of the adult population and the health records of elementary school children. The findings of the Ministry of National Service (1917–19) are reviewed, and the data revealed by the routine medical examination of elementary school children and special investigations are dealt with in detail. It is pointed out that in 1933 no less than 3,094,926 children, or 61 per cent of the average attendance at elementary schools, were subjected to examination by school medical officers, and that of these, 1,140,445 children, or 36·8 per cent of those examined, showed defects requiring treatment or calling for careful observation. The chapter dealing with child welfare records is of particular interest. In it the authors have presented a careful analysis of the data of 741 children who attended the child welfare centres in Stockton-on-Tees. They have correlated the incidence of defects with the evidence collected in regard to satisfactory or unsatisfactory diets. Bone defects, pharyngeal conditions, dental decay and anæmia were markedly more prevalent among the children whose diet was judged unsatisfactory. Attention is directed to the common error of including an excessive amount of carbohydrate food in the diet of children, and it is recorded that in Stockton-on-Tees a reduction in carbohydrate food coupled with an increase in protein, fat and vegetable constituents was followed by a decrease in rickets and other defects attributable to sub-optional nutrition.

A large section of the book is devoted to a critical analysis of the data obtained in Stockton-on-Tees of 152 families subsequent to being rehoused on a new housing estate. The health, mortality records and economic circumstances of these families are compared with those of 289 families which were not transferred to the new housing estate. The dietaries of the families in the two groups are examined, and it is held that the increased cost of rent on the new housing estate accounted for the unsatisfactory diet purchased. The intimate details of family budgetary expenditure are examined with great care and thoroughness. It is pointed out that in addition to rent, many other items in the budget are unavoidable, and their payment of necessity limits the money available for the purchase of food. In particular, the case of the unemployed is dealt with, and the book concludes with the well justified suggestion that the data presented are of sufficient importance to warrant further investigation and inquiry.

# Quantum Electrodynamics

The Quantum Theory of Radiation
By W. Heitler. (International Series of Monographs on Physics.) Pp. xi+252. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 17*s*. 6*d*. net.

THE quantum theory of the electromagnetic field is without doubt the 'difficult child' of quantum mechanics, which in spite of many attempts at improving it, has retained all the disquieting and unpleasant characteristics which it showed from its birth. There is a number of physicists who refuse to discuss it because, as they would put it, (*a*) it is unnecessary, since all its correct results can be derived by simple means; (*b*) it is wrong, because its application to problems like the self-energy of the electron leads to contradictions; and (*c*) it is extremely complicated.

In face of this opposition, it requires courage to devote a book to an exposition of this theory and its main applications. However, Dr. Heitler has a strong case against the opposition; for as to objection (*a*), the 'simpler' methods, namely, the quasi-classical introduction of the field in calculating the absorption, which is then related to the emission by means of Einstein's law, is, in fact, completely equivalent to quantum electrodynamics, both in the assumptions and in the procedure. Indeed, Einstein's law is based on Planck's radiation formula and thus on the concept of the light quantum, and therefore contains no more and no less than quantum electrodynamics itself. If we applied the 'simpler' procedure consistently, we should arrive at the same contradictions as in the usual form of quantum electrodynamics. Which of these methods one prefers is a matter of taste, but quantum electrodynamics has the advantage that, instead of requiring a new 'recipe' for each new type of problem, one can develop a general scheme to deal with all kinds of radiative processes and, from this, solve special problems by merely inserting appropriate values into the general formulæ. The importance of such a general scheme is emphasized by Dr. Heitler, and this will make his book very valuable in dealing with practical problems.

As for the argument (*b*) that the theory leads to inconsistencies, this is undoubtedly true. But as Dr. Heitler points out, we can always pick out those terms in the solutions which are significant as opposed to those which are due to the self-energy and do not correspond to reality. Thus in all practical applications we can obtain a definite answer, provided we do not require an accuracy exceeding a limit determined by the ominous number $e^2/hc$ or 1/137. In all cases, except possibly where very high energies are involved, these predictions agree with experiment, and we believe that whatever may be the form of a future theory, it is not likely to alter these predictions except for corrections of higher order in $e^2/hc$. This fact in itself justifies an account of the theory and its applications.

Nevertheless, we should keep in mind that the theory is, strictly speaking, inconsistent, and if Dr. Heitler calls it "the reasonable quantum theoretical extension of classical electrodynamics in the same way as quantum mechanics is . . . the extension of classical mechanics" (p. 81) he is perhaps too optimistic.

As for the objection of being complicated, this only makes a clear and comprehensive treatment more desirable. Moreover, from a study of this book the reader will find that although one cannot exactly call radiation theory an elementary subject, it is very much simpler than it would appear from most of the original papers, which —with few exceptions—were unnecessarily complicated.

The book starts with a short account of the classical theory of radiation, emphasizing the difficulties connected with the structure of the electron. The second chapter deals with the quantization of the field *in vacuo*, and contains an account of Bohr's work on the uncertainty relations for the field strengths and the limits of accuracy with which these may, in principle, be simultaneously measured. Then the terms describing the interaction with matter are introduced, and general formulæ for the probability of any radiative process are derived. Emission, absorption, photo-electric effect, scattering, dispersion and Raman effect, etc., are then discussed as applications of these formulæ. Complete results are given for those phenomena that are of particular interest in dealing with hard γ-rays and fast particles. Chapter iv deals with the theory of the positrons and their creation and annihilation, while the last chapter deals with the passage of fast electrons and γ-rays through matter. The limitations and difficulties of the theory are then summarized again, together with a short note on Born's attempt to remove them.

The exposition is very clear. The reader is assumed to be familiar with ordinary quantum mechanics and classical field theory.

It is, of course, unavoidable that there should be a few minor points on which author and reviewer disagree (for example, the statement that the field fluctuations have no connexion with the zero-point energy, p. 67), and a few places which leave the reader puzzled (such as, for example, the dotted curve in Fig. 7, or that a formula which has been derived "agrees roughly with what we should expect", p. 170), but their number is small. They do not affect the value of the book, which will be indispensable to anybody interested in either the principles or the applications of radiation theory. R. P.

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# Chinese Materia Medica

**Chinese Medicinal Plants from the Pen Ts'ao Kang Mu, A.D. 1596**

Third edition of a Botanical, Chemical and Pharmacological Reference List. Compiled by Dr. Bernard E. Read. (Published by the Peking Natural History Bulletin, 1936.) Pp. xvi+389. (Peiping : The French Bookstore, 1936.) 6 dollars.

THE fact that this book, which gives the maximum of information in the minimum of space and therefore appeals only to experts, should have reached a third edition, is a striking testimony to the interest now being shown in the chemistry of plants. It is also a tribute to the learned author's success in accomplishing the remarkable literary and scientific feat of transmuting medieval Chinese materia medica into this thoroughly modern treatise on the medicinal plants of China. The data he has accumulated as a result of his labours are set out in tables giving the kind of information usually provided in books on materia medica, namely, botanical family, specific name, habitat, principal constituents, etc., but with the unusual addition of a bibliography of the chemical, medical and pharmacological literature of each drug.

Of the 898 drugs dealt with, many are either identical with, or closely related to, drugs still in use in Europe ; others have long been obsolete in medical practice, and there are many which seem to be peculiar to China. None of the recognized cardiatonic drugs seems to have been used in China at the date, A.D. 1596, when this list was compiled. An interesting feature of the list is the inclusion of a considerable number of foodstuffs, especially fruits, nuts and cereals, a point to which Prof. Read directs particular attention as possibly indicating that the early practitioners had a sound, if empirical, belief in the importance of an appropriate dietary in the maintenance of health.

It is well known that Prof. Read's labours have already had the practical outcome of extending enormously the use of the alkaloid ephedrine throughout the world, but he probably has small hope of achieving similar triumphs with other constituents of Chinese drugs. At the present time, the investigation of natural drugs on the basis of local belief in their therapeutical value seems to be almost confined to Soviet Russia, Japan, China and India, and though interesting results have been obtained in all these countries, results of practical value, so far as additions to therapeutical resources are concerned, remain unimportant.

In other countries, work in plant chemistry is being carried on on broader and, in the writer's view, better conceived lines, in the correlation of components in allied species, the determination of the constitution of plant constituents and the investigation of the biological processes by which these substances are produced in plants. By these less direct methods much new knowledge is gained, and they are equally certain to lead in due course to the discovery of any still unknown plant constituents of therapeutic value.

To both the direct and the indirect worker in these fields, Prof. Read's book is a gift, the value of which can best be appreciated by those who have had practical experience in assembling all the relevant chemical, medical and pharmacological data regarding a single drug. To repeat the process with nearly nine hundred drugs, as Prof. Read has done, is to exhibit scientific altruism as rare as it is welcome. The careful and critical compiler rarely receives the credit he deserves for his indispensable work, and it must be some satisfaction to Prof. Read to be able to begin his introduction to the third edition with these words : "The large number of researches upon Chinese Materia Medica undertaken during the last decade necessitates a new edition of this reference list", for he is undoubtedly the cause of most of these researches, and his book may be cordially recommended as a source of information to any new worker who thinks of pegging out a claim in this field. T. A. H.

### British Association for the Advancement of Science

A Scientific Survey of Blackpool and District. Prepared for the Blackpool Meeting, 1936, by various Authors. Edited by Arthur Grime. Pp. 152+3 plates. (London: British Association for the Advancement of Science, 1936.) n.p.

THE well-known British Association handbooks prepared annually for each centre visited have now for some years been issued in a uniform format, and if the appearance of the pamphlets is less impressive than the bound volumes of former days, the contents shows a marked improvement, and leaves little to be desired.

The handbook for the Blackpool meeting begins with an exhaustive survey of all aspects of the Fylde, illustrated by several useful maps. This includes chapters on the historical geography and the place names. A section of Lancashire sea fisheries follows. Then comes an account of the growth of Blackpool itself, from which we learn that there was a Blackpool of a few cottages so far back as the seventeenth century, and that the seaside resort began to be known in the eighteenth century. It was not, however, until the second half of the nineteenth century that the great growth set in. A full account is given of this growth and of the varied municipal activities of the borough. The coast defence works are also fully explained. Lastly come chapters on the geology and natural history of the Lake District, added no doubt in view of the excursions to that part of England. The book maintains the high standard of recent volumes in the series and reflects credit on its numerous contributors.

### A Method of Illustration for Zoological Papers

By H. Graham Cannon. Pp. x+36. (London: Association of British Zoologists, 1936.) To Members, 2*s*. 6*d*.; to non-Members, 3*s*.

ALTHOUGH so much illustration of scientific papers is now performed by photographic methods there are still many cases where the process fails, such as complicated anatomical subjects, or those that present difficult problems of lighting or where a semi-diagrammatic treatment is called for. These require a selection and emphasis of parts which can still only be done by hand. The comparative ease and accuracy of the photographic process has done much to kill many of the older forms of art. Lithography, which in the past has produced such magnificent work, is almost as much a thing of the past as the woodcuts of Bewick. But as handwork is not, and never can be, entirely superseded, the student and advanced worker will be glad of any help that will get him over the technical difficulties in making his drawings. Everyone should at least try to produce his own illustrations with his own hand.

Prof. Graham Cannon has written a small booklet, published by the Association of British Zoologists, in which he claims that "any zoologist as long as he can draw a reasonably straight line . . . can turn out drawings that are really convincing". The method advocated appears sound and the illustrations of the method also appear convincing.

### Bibliography of Soil Science, Fertilizers and General Agronomy, 1931–1934

Pp. xxxi+473. (Harpenden: Imperial Bureau of Soil Science, 1935.) 25*s*. net.

IN 1929–1930, eight Imperial agricultural bureaux were set up to act as clearing houses of information on different aspects of agricultural research and practice for the use of research and advisory officers in the Colonies and Dominions. One of their functions has been to issue abstracts of all the important papers and reports published in every country that bear on their respective subjects. The book under review is an index of all the papers abstracted by the Imperial Bureau of Soil Science, one of these eight bureaux, during the four years it has been issuing abstracts. It covers all the agricultural aspects of the work done in soil science, and in soil and crop management, but is only concerned with plant breeding, plant diseases or animal husbandry in so far as they depend on the soil or its management.

The book is an index of published papers. It gives the author, the title of the paper in English, the journal and the year in which it was published, but it does not give abstracts of the papers. The entries are grouped according to subject, or to the country to which they refer, and the subjects and countries are printed in the order of the numbers which they are given in the universal decimal classification. There is a detailed subject index running to fifty-five pages to enable one to find the number allotted to every subject, and it appears to be excellent.

There are three indexes, the subject index already noted, an index of all the journals quoted, and an author index. A minor criticism can be levelled at the author index in that it only gives one transliteration of a name from a non-Roman to the Roman alphabet, even though the author himself uses several.

E. W. R.

### Principles of Electric and Magnetic Measurements

Part 1: Electricity, by P. Vigoureux; Part 2: Magnetism, by C. E. Webb. (The Student's Physics, Vol. 7.) Pp. xi+392. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1936.) 20*s*. net.

THIS text has the advantage that the authors are at the fountain of standardization in electrical science at the National Physical Laboratory and their modern treatment of their respective subjects is thereby enhanced. They start off by carefully defining their units and one is pleased to note the adoption of the new scheme of units based on the kilogram-metre-second system which is to unify the theoretical electro-magnetic and practical electrical units throughout the world in a few years time.

The present interdependence of physics and electrical technology is illustrated by the space given to thermionic devices, quartz crystals, the precision measurement of frequency, and even the linear time-base is mentioned, although, for some reason, the latter is not included in the index. The text is made suitable for students and research workers, but the field is becoming so vast that one must be sympathetic.

L. E. C. H.

# A New Fossil Anthropoid Skull from South Africa

By Dr. R. Broom, F.R.S., Transvaal Museum, Pretoria

IT is nearly twelve years ago since Prof. R. A. Dart startled the world by the announcement of the discovery of a new type of fossil anthropoid found in a limestone cave at Taungs in Bechuanaland, South Africa. The specimen consists of most of the brain cast and the practically perfect face of a very young ape. The functional teeth are all of the milk set, though the first upper and lower molars have cut the gum but do not yet meet. Though the ape was only very young, Dart estimated the cranial capacity at more than 500 c.c., and considered that in an adult it might exceed 700 c.c. He believed that this little fossil ape is not very closely allied to either the chimpanzee or the gorilla, and that it is probably nearer to the ape from which man has been descended and thus to be practically the long sought for missing link.

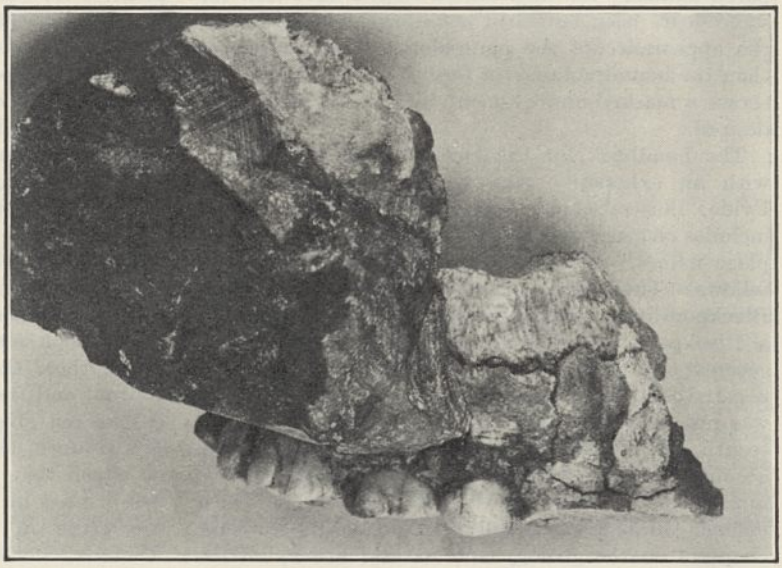

FIG. 2. Side view of right upper maxilla with the 2nd premolar and the 1st and 2nd molars. Parts of the roots of the canine and 1st premolar are shown. Slightly enlarged. Photograph by Mr. Herbert Lang.

Many European and American men of science considered that Dart had made a mistake, and that if he had had a series of young chimpanzee skulls for comparison he would have recognized that the Taungs ape is only a variety of chimpanzee. When after some years the lower jaw was detached from the upper and the crowns of the teeth could be examined fully, it was found that the milk teeth are not in the least like those of either the chimpanzee or gorilla, and that they agree entirely with those of man, though larger. In the gorilla and chimpanzee the first upper milk molars have each two cusps: in man and in *Australopithecus* there are three well-marked cusps in each. In the first lower milk molar of the gorilla there is only one large cusp; in the chimpanzee there is one large cusp and a second rudimentary cusp. In man and in *Australopithecus* there are four well-developed cusps.

FIG. 1. Half side view of the brain cast resting on the imperfect base. The brow ridges are shown with parts of the frontal sinuses exposed. Part of the left cheek bone is also shown. About ½ natural size. Photograph by Mr. Herbert Lang.

I have constantly maintained since I first examined the skull in 1925 that Dart was essentially right in holding *Australopithecus* is not closely allied to either the gorilla or chimpanzee, and is on or near the line by which man has arisen.

I do not know what is at present the opinion in Europe as to where *Australopithecus* ought to be placed. Gregory of New York regards it as fairly near to the origin of the human line ; and Romer of Harvard says it is "clearly not a chimpanzee or a gorilla". But the most important thing to do seemed to be to get an adult skull. For the last

FIG. 3. Crowns of right upper 2nd premolar and 1st and 2nd molars. × about ⅔. Photograph by Mr. Herbert Lang.

three months, I have been busy working on the bone breccia of the limestone caves of the Transvaal largely in the hope of getting either a new 'missing link' or a type of primitive man. I have so far found no trace of man, though I have discovered more than a dozen new species of fossil mammals, a number of which belong to new genera.

Two weeks ago [Dr. Broom's covering letter is dated August 8.—Ed.], when visiting the caves at Sterkfontein near Krugersdorp, Mr. G. W. Barlow, the very understanding manager of the lime works there and on whom I had impressed the importance of keeping his eyes open for a Taungs ape, handed me the brain cast of what appeared to be a large anthropoid (Fig. 1). It had been blasted out of the side of the cave a couple of days before. A search for some hours failed to find any other part of the skull, but we found the cast of the top of the head in the cave wall. A more extensive search on the following day with a large party of workers resulted in the discovery of most of the base of the skull, with the upper part of the face (Fig. 2). In the same matrix was found the detached right maxilla with three teeth, and the third upper molar was also found, though detached. The lower part of the face had been removed before fossilization ; and so far no mandible or lower teeth have been found, though parts may yet be discovered in a mass of crushed and broken bones near the side of the head. As the bones are very friable, no attempt has as yet been made to remove them from the much harder matrix.

Much of the cranial vault has been destroyed by the blast, but a large part of each parietal is preserved and a considerable part of the occiput. Unfortunately, the back of the brain cast is missing, and though the base of the skull is complete to the back of the foramen magnum, the contacts of the occipital fragment are lost.

The brain cast is perfect in its anterior two thirds. When complete it probably measured in length about 120 mm. and in breadth about 90 mm. ; and the brain capacity was probably about 600 c.c. The skull probably measured from the glabella to the occiput about 145 mm., and the greatest parietal width was probably about 96 mm.

The brow ridges are moderately developed and there are fairly large frontal sinuses. The auditory meatus is 73 mm. behind the brow. It will be possible to make out much of the detailed structure of the base of the skull, but as yet no attempt has been made to clean it out as the bone is very friable and the investigation cannot be done in a hurry.

In the maxilla there are three well preserved teeth, the 2nd premolar and the 1st and 2nd molars (Fig. 3). The canine and 1st premolar are lost but the sockets are preserved. The canine has been relatively small. At its base it probably measured about 10 mm. by 8 mm. The 2nd premolar is somewhat worn. Its crown measured 11 mm. by 9 mm. Its pattern is well seen in Fig. 3.

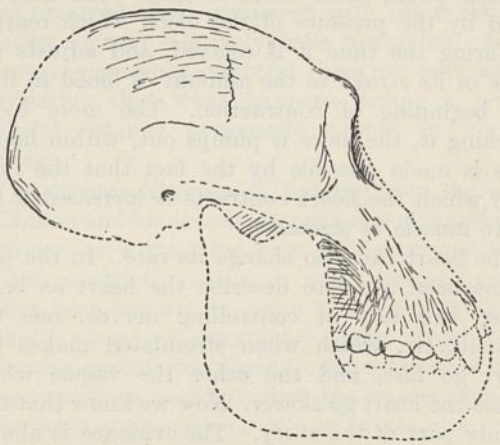

FIG. 4. Attempted restoration of skull of *Australopithecus transvaalensis* Broom. ½ natural size.

Sufficient of the cranium is preserved to show its shape with certainty. Most of the right maxilla is preserved, but it is not in contact with the upper part of the skull, and there is thus a little doubt as to the relations.

The 1st molar is moderately large. Anteroposteriorly it measures 12 mm. and transversely 13 mm. It is of the typical Dryopithecid pattern —four well-developed cusps with a little posterior ridge and a well-marked posterior fovea. The tooth agrees fairly closely with that of the first molar of *Dryopithecus rhenanus*. The 2nd molar is

exceptionally large. It measures 14·5 mm. in antero-posterior length and is 16 mm. across. It has four large cusps with a well-marked posterior fovea. The 3rd molar has been detached from the bone but it is preserved in perfect condition and unworn. It has three well-developed cusps, but the hypocone is relatively small owing to the invasion of the large fovea. The tooth measures antero-posteriorly 13·7 mm. and transversely 15·5 mm. The crown in this unworn condition is extremely wrinkled.

The whole premolar and molar series measures 59 mm.

This newly-found primate probably agrees fairly closely with the Taungs ape, but the only parts that we can compare are the brain casts and the 1st upper molars. The brain cast of the new form is considerably wider, especially in the frontal region, and the molar teeth differ in a number of important details. Further, the associated animals found at Taungs are all different from those found at Sterkfontein. I think the Taungs deposit will probably prove to be Lower or Middle Pleistocene, while the Sterkfontein deposit is most probably Upper Pleistocene. I therefore think it advisable to place the new form in a distinct species, though provisionally it may be put in the same genus as the Taungs ape.

This discovery shows that we had in South Africa during Pleistocene times large non-forest living anthropoids—not very closely allied to either the chimpanzee or the gorilla but showing distinct relationships to the Miocene and especially to the Pliocene species of *Dryopithecus*. They also show a number of typical human characters not met with in any of the living anthropoids.

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# The Control of the Circulation of the Blood*

By Prof. R. J. S. McDowall

## Variations in the Activity of the Heart

THE heart is not like an ordinary pump which sucks fluid from one tube and pushes it into another. The veins are so thin that any degree of suction would cause them to close. The heart is filled by the pressure of the blood which reaches it during the time it is relaxed, and adjusts the force of its stroke to the amount of blood in it at the beginning of contraction. The more blood reaching it, the more it pumps out, within limits. This is made possible by the fact that the force with which the heart contracts is increased if the heart muscle is stretched.

The heart can also change its rate. In the past it has been usual to describe the heart as being under two sets of controlling nerves, one the sympathetic, which when stimulated makes the heart go fast, and the other the vagus, which makes the heart go slower. Now we know that this is only part of the story. The evidence is almost complete that the heart is really under the control of two sets of reflexes which have this function. The difference between these statements is that the second involves an afferent pathway to the central nervous system, for the sympathetic and the vagus are constantly carrying down impulses to the heart, and if they are cut off the heart goes slow or fast as the case may be. In the case of the sympathetic, we do not know accurately as yet the exact source of the afferent impulses, but the fact that stimulation of any sensory nerves causes cardiac acceleration suggests that the source is stimulation from the outside world. This is not necessarily conscious, for it has been shown that a sound may accelerate the heart of a person who is asleep, but during waking hours the higher centres undoubtedly play a part in the acceleration. I shall refer to this further in relation to the vaso-motor centre. In the case of the inhibitory impulses which slow the heart, the source of the afferent impulses is known. These arise from certain sensitive regions within the circulation itself. These are situated in the left side of the heart, the arch of the aorta and the carotid sinuses, which are small dilatations at the bifurcation of the common carotid artery in the neck.

When exercise is taken, two changes occur : the sympathetic accelerator impulses increase and in particular the vagus impulses are reduced. The evidence for this rests on the effect of exercise and other procedures on the heart rate before and after section of the vagi, and with and without the sympathetic. It has been shown, for example, that if the vagus nerves have been cut the increase of the heart rate is, during the exercise, not nearly so great as it was before they were cut. It is not possible for me to discuss here how the change is brought about, except to say that it is in part due to the action of the higher centres and to a rise of venous pressure. The increased temperature of the blood and adrenaline liberated by the suprarenal gland enhance the effect of the nervous changes.

* From the presidential address to Section I (Physiology) of the British Association, delivered at Blackpool on September 11.

What I want to emphasize is that the range of acceleration is determined by the degree of activity of the cardio-inhibitory reflexes : indeed, it has been recently shown in Belgium that the capability of dogs to withstand sustained activity is apparently enhanced by removal of the sympathetic. The extent to which the animals have then to rely on the reduction of vagus activity is thereby increased. This, of course, does not mean that the maximum effort for short periods is increased. To show this it is necessary to time the running of the animal over short distances. It has been shown that in athletes during mild exercise the cardiac output is increased with a trivial increase in cardiac rate—that is, the increase is chiefly produced by an increased output per beat. I shall, however, return to this point. Meantime I should like to leave you with the question : The heart increases its output ; where does it get its blood ?

Experimentally it can be demonstrated that the vagus restraint of the heart is extremely variable—not only in different animals, but also in the same animal under different conditions, as may be seen if we block the vagi. For example, if we give an animal nitrogen to breathe, the normal vagus restraint can be shown to have disappeared. Or we can increase the restraint by previous sensory stimulation. This last experiment is of special interest, as it may give a clue as to how the normal vagus restraint is built up. We know that animals and human beings which take large amounts of exercise have slow hearts. How exactly this slow heart is produced is not yet clear. All we can say at the moment is that certain procedures such as sensory stimulation or asphyxia increase the heart rate, partly by reducing vagus activity, but that afterwards this reduction is followed by an increase in the activity of the vagus.

### Variations in the Calibre of the Blood Vessels

It may be taken as a general principle that in physical exercise the blood is distributed to the active tissues at the expense of the less active tissues. This local dilatation of vessels, combined with a rise in the general blood pressure which is the result of increased cardiac output and constriction of vessels in less active tissues, results in an enormous increase in blood flow through the active muscles.

*The cause of the chemical dilatation* has been a matter of considerable debate. It has been demonstrated that blood issuing from tetanized limbs has a vasodilator action. There are first to be considered the products of carbohydrate metabolism—carbon dioxide and lactic acid. Each of these has been observed to cause vasodilatation if applied in suitable concentrations to capillaries under the microscope. I emphasize the concentration, because larger concentrations have the opposite effect. It may be demonstrated also that, if the vessels of the hind limb of a chloralosed animal are perfused with the nerves intact and carbon dioxide is administered, the perfused vessels constrict because of the action of the carbon dioxide on the vasomotor centre, but the blood-pressure does not necessarily rise, presumably because there has been a compensatory dilatation of vessels in the rest of the animal. A number of workers, especially Fleisch, have demonstrated that vessels are sensitive to most minute changes of hydrogen ion concentration, even that which is produced by the addition of the normal amount of carbon dioxide to the blood, and personally I think that normally this is the most important factor concerned.

There is, however, evidence that certain substances of protein origin may be involved. Of these the most important is histamine. It has recently been shown by Anrep that the vasodilator substance which is liberated into the venous blood gives all the known biological reactions for histamine, and it is possible to demonstrate that extensive tetanization of muscles may produce a state which is a very similar one to histamine shock. There is at the same time a constriction of pulmonary vessels such as is produced by histamine. This liberation of histamine—if it be histamine—is of interest, as biochemists have reported that, compared with other tissues, muscles contain relatively little histamine. It is, however, somewhat doubtful if we are justified in considering that what happens during a severe artificial tetanus necessarily occurs in normal exercise.

*The nervous dilatation* is, judging from the work of Cannon and his associates, probably sympathetic. Here we see a dual function of the sympathetic, for its constrictor action is much better known. It has been known for some time that the sympathetic contained vasodilator fibres. In order to show the vasodilator fibres in the sympathetic, it is necessary to paralyse first the vasoconstrictor fibres with ergotoxine (Dale), or to use slow rates of stimulation. In this connexion it may be remarked that this slow rate of stimulation may be an imitation of what normally occurs, since presumably ordinary muscle contraction may give rise to similar stimuli.

Once the exercise has begun, it seems likely that local vasodilator reflexes, similar to Lovén reflexes, are set up by afferent impulses arising within the muscles themselves, possibly as a result of the mechanical and chemical changes which take place. The evidence is somewhat scanty, but it is impossible to ignore any longer the possibility of the

existence of a nutrition reflex as suggested by Hess and supported more recently by Fleisch. By this is meant the fact that oxygen lack in a part sets up afferent impulses which result in reflex dilatation.

*Capacity effects.*—Now it has been shown by Krogh that when a muscle is active an enormous number of hitherto closed capillaries open up. This opening up of vessels previously closed necessitates the provision of blood, and as there is only a limited amount of blood in the body, it must be provided from other regions, otherwise the blood pressure would fall and the circulation through the tissues be reduced.

It is probable that practically all parts of the body, except possibly the voluntary muscles, the heart muscle and the brain, provide the blood necessary for the active muscles. It has been shown that any exercise, actual or even contemplated, causes vasoconstriction. Constriction of the spleen and of the intestine in animals has been observed. In man it has been shown that the vessels of the skin constrict under any emotional stress or even anticipated activity.

In regard to the sympathetic constriction of the vessels, we are in the same difficulty as we were in relation to the sympathetic acceleration of the heart. We do not know how the actual nerve impulses which originate the constriction arise. For convenience we say that they begin in the higher centres of the brain. It is, however, probably preferable, it seems to me, to consider that it is a sensory stimulation from the outside world, which is the point in time determining the psychical reaction which results in motor movement. Certainly we know that stimulation of a sensory nerve causes generalized vasoconstriction and commonly a rise of blood pressure, and that similar changes but of lesser degree may be recorded in a sleeping man.

It has been usual to ascribe the shutting down of the blood vessels solely to sympathetic activity, just as it was usual to ascribe cardiac acceleration solely to such action. In the case of the heart we have clear evidence that the reduction of the vagus restraint is just as important by increasing the range of cardiac activity and creating a cardiac reserve. It has now become evident that there probably exists an exactly parallel mechanism which increases the range of vascular activity and similarly enhances the reserve.

### Maintenance of the Vascular Reserve

Just as we have the restraint of the heart by the vagus, which determines the range of cardiac acceleration, so we have in relation to the blood vessels a set of reflexes which determines the magnitude of the vasoconstriction of the blood vessels; that is, they maintain the vessels of the body generally in an actively dilated state. The afferent impulses which are concerned in these reflexes have an exactly similar origin to those responsible for the vagus restraint of the heart. They arise from the cardio-aortic region and the carotid sinuses, and pass up the medulla by the aortic and carotid depressor nerves. Like the cardio-depressor reflexes, the vascular-depressor reflexes are operated by the intravascular pressure in these regions.

It has been generally assumed that the primary function of this control of the vessels is to maintain the arterial pressure at a constant level, and this is quite reasonable, for a constant mean pressure is desirable to maintain a steady flow of fluid at rest from the capillaries to the tissues.

More recently it has become evident that these reflexes may have another and possibly more important function. Several facts led to this suggestion: (1) in physical exercise or mental stress, the blood pressure, like the heart rate, does rise in spite of the reflexes; (2) the response of blood pressure to posture may be normal if the reflexes are destroyed—a fact which shows that the maintenance of mean pressure is not wholly dependent on the reflexes; (3) as in the case of the vagus, different animals, or even the same animals in slightly different circumstances, show great variability in the activity of the reflexes—often it is possible to throw the reflexes out of action without affecting the blood pressure materially; and (4), as might almost be anticipated, the conditions which reduce the activity of the vagus also reduce the activity of the depressor reflexes.

Now since in exercise the venous pressure is increased and, if the stress of the occasion is sufficient, adrenaline is secreted, we may consider what happens to the circulation when the vaso-depressor reflexes are thrown out of action. As I have said, there is a rise of arterial pressure and a generalized constriction of the vessels. It has become usual to consider that this rise of arterial pressure is the result of an increased peripheral resistance to the flow of blood from the arteries. Were this wholly true, we should expect to find that there is a reduced flow of blood to the veins. If the animal, however, is in good condition, the reverse is the case: there is an increased flow to the veins. It is as if there were at the periphery a sponge-like reservoir which, when it is contracted, drives its store of blood into the veins.

When the depressor reflexes are cut off, the reverse, however, does not necessarily occur experimentally. An increased flow into the veins does not necessarily result in a rise of venous pressure, because at the same time the heart is stimulated and the increased pressure is rapidly

dealt with. It can, as might be expected, be shown at the same time that there is an increased output of the heart. It is not possible to measure the output of the heart by the cardiometer method without there being some degree of shock or permanent increased capacity of the circulation from the absorption of toxic products. As a result, the increased cardiac activity more than balances any increased flow in the veins, and the venous pressure may actually fall. Commonly it remains unchanged in such experiments. However, if the animal is not subjected to any severe operative procedure, a small rise of venous pressure is the rule. Perhaps I should say that several workers using the Fick method have shown an enormously increased output of the heart when the impulses from the carotid sinus are cut off.

What we can imagine happens in exercise or emotion is, then, that just as the vagus restraint of the heart becomes reduced, so also the depressor restraint of the vessels becomes reduced, more blood is thrown into the circulation and is dealt with by the heart, which at the same time increases both its rate and its output per beat. It is to be anticipated that we shall eventually get evidence that the extent of the activity of the vasodilator reflexes varies in different animals just as the activity of the vagus varies.

*The sympathetic and adrenaline.*—All the mechanisms which I have described are probably still further enhanced by the vasoconstrictor action of the sympathetic and the action of adrenaline, which is apparently secreted whenever the emotional stress of the occasion is sufficient. Adrenaline in physiological amounts constricts the vessels of the skin and splanchnic region and dilates the vessels of the muscles. Here I should like to emphasize that probably the physiological dose of adrenaline is minute, and may even be insufficient to raise the blood pressure. Certainly the dilatation of muscle vessels is not a result of the rise of blood pressure which may occur, for it can be shown that the dilatation occurs with doses which do not raise the arterial blood pressure. An increased blood flow through the limbs can also be shown to be brought about by doses which do not raise the blood pressure. In such circumstances the constriction just counterbalances the dilatation. Why adrenaline should constrict some blood vessels and dilate others is a major problem in the study of the circulation. Since so far as we know the vessels themselves have the same structure in different parts of the body, we must assume that the difference is due to the different environment. I had hoped by this time to have obtained some definite evidence on this point, but so far the experiments have not been completely successful.

It is interesting to observe the effect of adrenaline on the depressor reflexes. If the hormone is injected, it is found that some minutes afterwards, even after the usual rise of blood pressure has passed off, it is not possible to affect the heart by a degree of stimulation of the vagus which was previously effective, and at the same time the effects of cutting off the impulses from the carotid sinus are markedly reduced or completely abolished. This, of course, is exactly what would be expected if adrenaline were secreted in the same circumstances in which the action of the depressor reflexes and the vagus are reduced, as in exercise.

A further corroboration of this somewhat new view of the function of the vasodilator reflexes comes from a study of the effect of exercise and of emotion on man. It is well known that when a man takes exercise on a stationary bicycle his systolic blood pressure goes up, but falls even below normal the moment the exercise stops. This fall has been explained by Cotton, Slade and Lewis as due to the accumulation of blood in the vessels of the dilated muscles, but from what I have said in relation to the diminution of the peripheral resistance in muscle, it is evident that the fall is in part due to a diminution of this resistance. Now if a careful comparison be made of the psychical effect of intended exercise and that of exercise, it has been found by Gillespie that there is no difference. In other words, the rise of arterial pressure in exercise is the result of psychical changes.

If exercise could be taken without psychical zest being involved, we might expect the blood pressure to fall. This, indeed, has been found to occur in the horse. In man, too, it has been found that if the exercise is slight, although the systolic arterial pressure rises, the diastolic pressure falls. This means that more blood is being pumped out of the heart per beat, but that blood escapes from the arteries more rapidly than normally before the next systole. In other words, from psychical causes alone there is a rise of arterial pressure from an increased cardiac output per beat, which can only be the result of more blood reaching the heart. In emotion, too, it is known that the systolic pressure rather than the diastolic rises. Since we have seen from the experiments of Mosso with the plethysmograph, of Barcroft on the exteriorized spleen and of Florey and Florey on the exteriorized colon, that generalized vasoconstriction is an accompaniment of psychical effort, we must assume that the increased output of the heart is in part, if not wholly, the result of the vasoconstriction which calls into use the reserves of blood, and thus the circulation is maintained in spite of the greatly increased capacity of the active muscles.

# Chemistry and the Modern State*

By Prof. J. C. Philip, O.B.E., F.R.S.

IN relation to those essential activities of any society which is intellectually alive—the pursuit of new learning and the cultivation of the spirit of inquiry—chemistry is in the forefront. For the promotion of natural knowledge and the increase of our understanding of the universe, the chemist has laboured with extraordinary success, both in his own fields and in those borderlands where chemistry marches with other sciences. It is perhaps worth while glancing at one or two of the chief avenues in the region of chemical knowledge opened up by such fundamental research.

While our knowledge of atomic structure is to be credited mainly to the work of physicists, the chemist's technique has revealed the molecular architecture of the most complex natural products, and on the basis of this knowledge the same materials can be synthesized in the laboratory. One has only to think of the sugars, the alkaloids, the anthocyanins, to realize the astounding results which have been achieved in this field of investigation, while such elusive substances as the vitamins and the sex hormones are rapidly yielding their secrets to the strategy of the organic chemist.

Take, again, that region in the scale of size which lies between the molecule and the visible particle—the colloid region—the "world of neglected dimensions" as it was once described. In this region, as the physical chemist has shown, the relatively great extent of surface is marked by quite special behaviour, and the labile systems encountered exhibit peculiar characteristics—characteristics which are highly significant for the understanding of physico-chemical changes in the living organism. Our knowledge of this field of surface chemistry is still extending rapidly.

Once more, think of the tracking down of the factors which affect the rate of chemical change, and the elucidation of the mechanism of their operation: a little moisture, a speck of dust, a trace of acid, a roughened surface, a ray of light, a rise of temperature—any of these may have a notable influence on the rate of a reaction. The physical chemist has been remarkably successful in unravelling the role of these various factors and in interpreting their significance. It is in such a field as this—the field of kinetics and catalysis—that the progress of chemical science from the qualitative and descriptive way of treating phenomena to the rational and quantitative has been particularly marked.

These are only one or two of the directions in which the pioneering work of the chemist has opened the way to a fuller knowledge of Nature, especially in the more delicate aspects of her balance and her transformations. In the pursuit of natural knowledge for its own sake, the chemist has indeed travelled far, and his exploration has yielded an abundant harvest of discovery. For the pioneer himself it is an adventure, and original research may provide thrilling experiences. All this, however, is far from the common ways of men, and the investigator in the field of pure chemistry moves in a region mostly inaccessible to ordinary folk, and he speaks an unintelligible language, as indeed is true of specialists in other sciences. The so-called 'jargon' of science, inevitable as it is to some extent, presents a real difficulty in the transmission of knowledge and ideas from the specialist to the average educated man, but it should not be forgotten that other specialists besides scientific workers have a jargon of their own: to wit, lawyers, financiers, and even sportsmen.

It has been maintained that the pursuit of learning for its own sake is a selfish occupation; that knowledge should be a means to life, not an end in itself; that knowledge is of value only in so far as it leads to action, directly or indirectly. With this view I have much sympathy; but it has become abundantly clear, so far at least as knowledge and discovery in the realm of pure chemistry are concerned, that we must take a very long view indeed in assessing their practical value. Again and again in the history of the science observations and discoveries have been made, which at the time were of purely scientific interest but later received important practical applications. The laboratory curiosities of a former generation, such as aluminium and tungsten, have become the industrial commonplaces of the present.

The application of exact methods of measuring density revealed the presence of a new gas in the atmosphere—a discovery of purely scientific interest in the first place—which has led to a whole train of remarkable consequences, from a drastic revision of our ideas about the elements to the widespread development of illuminated signs. Just one hundred years ago, at the Bristol meeting of the British Association in 1836, Edmund Davy

* From the presidential address entitled "The Training of the Chemist for the Service of the Community" to Section B (Chemistry) of the British Association, delivered at Blackpool on September 10.

announced the discovery of a "new gaseous bicarburet of hydrogen", now familiar as acetylene. Decades passed, however, before the novel gas acquired any practical significance, and indeed it was not until 1892, when a large-scale method for producing calcium carbide was discovered, that acetylene became of industrial importance. Since then its applications have gone ahead rapidly, and its uses in illumination, in welding, in metal-cutting, and in the synthetic production of organic chemicals are widely known. In view of these lessons from the history of chemical science, one hesitates to apply the epithet 'useless' to any specific observation or discovery, however 'academic'. Reflection indeed suggests that the really big changes in the material conditions of human life have generally had their origin in a search for knowledge on its own account.

There is, however, much more to be said on this matter of fundamental or academic research. A solution of the most practical of chemical problems on rational and scientific lines is possible only because of our accumulated knowledge of natural phenomena and natural laws. It is only against the background provided by the pure research of yesterday that the technical problems of to-day can be viewed in their proper setting and tackled with a reasonable prospect of success. I would submit, therefore, that work in pure science, remote as it generally is from the practical issues of the moment, is building up a real reserve of knowledge and technique on which future generations of practical workers will be able to draw.

Apart from the chemists who are engaged, mostly in our universities and colleges, but to some extent also in the larger research institutes, in the general task of extending the boundaries of knowledge, there are many more who are carrying on what may be called 'directed' research. Their work aims at the solution of some specific problem, concerned, it may be, with the improvement of an industrial process, the elimination of waste, the safeguarding of health, the utilization of by-products, the synthesis of antidotes. More definitely, and by way of example, the object may be to discover a fast blue dye, to purify a water supply, to find a rustless steel, to produce petrol from coal, to isolate a vitamin, to make a non-inflammable film or a creaseless cotton fabric. The general public, however dubious about pure research, would probably admit that the satisfactory solution of any one of these problems would be of service to the community; but it must be emphasized once more that the chemist can do these things only by virtue of his inheritance of knowledge and technique. The attack on such problems, to have a reasonable chance of success, must be organized on the basis of what is already known and what has already been achieved; nay, more, one has abundant ground for belief that the attack, so organized, is bound to succeed, even though it may be 'in the long run'.

In the last twenty years, the amount of directed chemical research in Great Britain has increased enormously. Industries of the most varied description have begun to realize the potential value of the trained chemist in solving their special problems and putting their manufacturing processes on a more rational basis. In this general movement the State, through the Department of Scientific and Industrial Research, has taken a prominent part by fostering research associations. The work of these organizations—such as those dealing with rubber; with paint, colour and varnish; with cotton or wool; with non-ferrous metals; with sugar confectionery—is in many cases largely chemical or physico-chemical in character. The research associations have not only shown how general problems affecting an industry as a whole can be solved by joint research efforts, but also their existence and activities have induced a notable degree of 'research-mindedness' in the individual associated firms. Financially, the work is based on co-operation between the State and industry, on the principle that the State helps those who help themselves.

The State itself has founded a number of organizations for the study of chemical problems of national importance, and has thus formally recognized the significance of directed research for the community. The work carried out at the Chemical Research Laboratory, Teddington, has included the study of synthetic resins and low-temperature tars and the exploration of chemical reactions occurring under high pressure, as well as research on metal corrosion, chemotherapy and water softeners.

Fuel and food are two notable cases in which State-aided investigation is being carried out, and problems connected on one hand with pulverized and colloidal fuel or the low-temperature carbonization of coal, and on the other with the storage of fruit or the preservation of fish and meat, are being intensively studied at appropriate centres. Reference might be made also to the work of the Building Research Station, where, amongst other matters, the factors determining the weathering qualities of stone are being studied. Other experts than chemists are naturally concerned in the investigation of these problems, but the chemical and physico-chemical aspects are frequently the predominating ones.

Again, the serious question of river pollution has been taken in hand with State help, and some years ago a chemical and biological survey of the River Tees was set on foot, the Tees being chosen

for investigation because of the great variety of factory effluents discharged into it both in tidal and non-tidal reaches. Some of the newer industrial developments in Britain are presenting important problems in this direction. It has been estimated, for example, that if the waste waters from all the beet sugar factories in the country were discharged into our streams, they would cause as much pollution as untreated sewage from a population of four or five millions. The effluents from dairies and factories making milk products present a similar problem. Thanks, however, to research activity, largely at the instance of the Water Pollution Research Board, the disposal or purification of these and other trade effluents is being effectively achieved.

The question of river purification demands for satisfactory handling, as already indicated, the collaboration of other scientists with the chemist, and indeed the attack on many such problems, especially those affecting the health of the community, is likely to be successful only by the co-operation of teams of scientific workers from different fields. Smoke and fog, which not only present the scientific worker with interesting phenomena but constitute also a social and industrial problem of vital importance, concern the physicist, the physical chemist, the analyst, the fuel engineer and the meteorologist, and it is only when the knowledge and experience of these workers are pooled that there is any hope of interpreting the phenomena and solving the problem. Again, recent developments in cancer research make it clear that apart from the pathologist, who is mainly concerned, the chemist has a very definite contribution to make to our knowledge of this baffling disease. Some of the most fruitful scientific investigation, indeed, is co-operative in character.

Research, whether fundamental or directed, is by no means the only outlet for the chemist's knowledge and craftsmanship. The works control of chemical processes, the examination of factory products, the safeguarding of the purity of food, and the supervision of water supplies and sanitation, are examples of other activities of a more routine character in which large numbers of chemists are engaged. These are, so to speak, the general practitioners of the chemical profession, and their contribution to the smooth running of industry and to healthy living is far greater than most people suppose. I have myself been surprised, in a recent survey of the present occupations of my former students, by the extraordinary variety of the work in which chemically trained men may be engaged. This survey shows that photographic emulsions, beer, high-speed steel, printing ink, linoleum, dental cream, gramophone records, bank notes, and mineral waters, are a few of the materials with the production of which the chemist is concerned, either in the laboratory or the works. It is true to say that in the industry of the country the chemist is ubiquitous.

I have spoken of the 'chemical profession', and the phrase was used deliberately. A profession is a vocation demanding high educational and technical qualifications, and it connotes also the body of those who by virtue of their qualifications are able to serve the needs and welfare of society in some particular field. On all these counts, chemistry should have a place beside medicine, law and engineering. That the public is so slow in recognizing this claim may be due to the fact that the chemical profession is not yet unified to the same extent as the others mentioned ; but it is due also to a lack of realization of the fundamental and widespread character of the service which the chemist renders to the community.

A just estimate of the chemist's function is almost impossible for those who associate him chiefly with explosives and poison gas, and regard him as a particularly devilish kind of scientist. Such a picture is hopelessly out of relation with the facts. It is, of course, true that chemists have produced dangerous and poisonous substances, but most of these were discovered originally in the general quest for knowledge, and many have legitimate and valuable applications ; their use for destructive purposes is a perversion. Phosgene, for example, one of the so-called poison gases, was discovered more than a hundred years ago, and is an important material at the intermediate stage in the manufacture of certain dyestuffs. Nitrates, which are the basis for the manufacture of most explosives, play a prominent role as fertilizers in agriculture, and explosives themselves are indispensable in mining operations.

The truth is that the employment for other than beneficial ends of the substances discovered by the chemist is due, not to his especial wickedness, but to the weakness and backwardness of the human spirit. Like other scientists, the chemist normally has a constructive point of view, and he cannot but deplore the fact that, as Sir Alfred Ewing once said : "The command of Nature has been put into man's hands before he knows how to command himself". I think I speak for the vast majority of my fellow-chemists in saying that we dislike intensely the present world-wide prostitution of knowledge and skill to destructive ends. The sooner this is eliminated, and the less call there is for lethal and devastating materials, the greater will be our satisfaction.

There are, indeed, welcome signs that scientific workers are increasingly impatient at the extent

to which their knowledge is made to serve inhuman ends. The possibilities before humanity have been fairly set out by a recent historian, H. A. L. Fisher: "The developing miracle of science is at our disposal to use or to abuse, to make or to mar. With science we may lay civilization in ruins, or enter into a period of plenty and well-being, the like of which has never been experienced by mankind". To the clearing of this conflicting situation, the scientific worker has not always made the constructive contribution which he might have done: he has been content to adopt an objective and detached attitude, suggesting sometimes complete indifference to the wider human issues at stake, assenting too readily to the misuse of his knowledge and skill. Impelled by patriotic motives, most men of science have put themselves freely at the disposal of the State in time of need, but many are hesitating to admit that patriotism must always override considerations of humanity. Whatever be our individual attitude in this matter, it is time for chemists and scientists in general to throw their weight into the scale against the tendencies which are dragging science and civilization down and debasing our heritage of intellectual and spiritual values.

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# Obituary

## Prof. A. P. Karpinsky

PROF. ALEXANDER PETROVICH KARPINSKY, the greatest of Soviet geologists, president of the Academy of Sciences of the U.S.S.R., of which he had been a member for fifty years, died on July 15 in his ninetieth year. He was a foreign member of many learned bodies; the Geological Society of London elected him a foreign member in 1901 and awarded him the Wollaston Medal in 1916.

An entire epoch in the history of Russian geology, following that of Murchison (the forties of the past century), is connected with Karpinsky's name. Karpinsky compiled a new, much more detailed geological map of the European part of the U.S.S.R. and the Urals. This map was the ground-work of the Russian geological service, of which he was one of the creators, and which was then known as the Geological Committee. Being during many years practically the head and leader of that institution, the staff of which was mainly composed of his pupils, Karpinsky was the creator of the new stratigraphy of Russia. This, however, does not exhaust the significance of Karpinsky's work in the history of geology. He was the last of those geologists who embraced the whole of geological science, working with equal skill in every branch of it.

Karpinsky's personal field-work in stratigraphy concerned all the systems and various regions of the European part of the U.S.S.R., but mainly the Urals; he was the first to solve the enigma of the eastern slope of the latter. His contributions which demonstrated the tectonic structure of the Russian platform were only completed, never reconstructed by later explorers, and were of immense value. He first established the regularity of movements of the earth's crust. Only much later did his ideas receive wider development in the theory of geosynclines.

Karpinsky's palæontological studies are of no less importance. Of his works on invertebrates the most remarkable are those concerning the palæozoic ammonoids. He was one of the first to apply the ontogenetic method, and not to single forms, but to a whole fauna. This led to most important conclusions both zoological and geological (he proved the evolution of the Artinskian fauna *in situ*, whereas it was considered immigrant). A most remarkable study is that on *Helicoprion*, a primitive shark, to the study of which he applied the histological method with brilliant results.

Particular attention may be directed to his monograph on Trochilisks—tiny Devonian algæ. To write this monograph, Karpinsky had to become a botanist. It is curious to note that in a controversy with botanists who did not share Karpinsky's opinion of these fossils, the victory went to Karpinsky. In petrology, besides special studies by which began his scientific activity, it is worth mentioning that he was the first in Russia to introduce the microscope in the study of petrographic slides.

From the very beginning of his scientific activity, Karpinsky was interested in deposits of useful minerals. He forecast the discovery of salt at Bakhmut, he advanced the view that petroleum deposits exist in the Urals; this has been brilliantly confirmed by recent prospecting for petroleum at Ishimbaievo, exactly in the Artinskian deposits established by Karpinsky, as well as by that at Krasnokamsk in the Middle Carboniferous. Karpinsky was particularly interested in the problem of the origin of platinum deposits; he studied some iron deposits and so on. He may be justly called the founder of the practical geology of the Urals.

Karpinsky continued working to his last days, and on his death bed he asked for paper to write down a new idea. In Karpinsky we lose not only the greatest Soviet scientist, but also an excellent man and citizen. Despite his high position, he never ceased to be modest, simple, accessible to everyone, especially to young students, at whose disposal he readily put his knowledge and experience. Injustice and untruth alone aroused his anger, and he frequently expressed his sympathy with the Soviet Government, which he used to call "the most just in the world".

A. BORISSIAK.

## Prof. P. H. Stroobant

WE record with regret the death at the age of sixty-eight years, after a painful illness, of Prof. Paul Henri Stroobant, honorary director of the Royal Observatory of Belgium at Uccle. Prof. Stroobant had only recently retired from the directorship of the Observatory which, in May 1935, had celebrated the hundredth anniversary of its foundation. On the occasion of the centenary celebrations, which were honoured by the presence of King Leopold and attended by many foreign delegates, the new equipment of the Observatory was open to inspection. This equipment includes an elaborate Ascania meridian circle of 19 cm. aperture; a Cooke-Zeiss equatorial of 45 cm. aperture and 7 m. focal length, with micrometer; a double Zeiss astrograph, each telescope having quadruplet lenses of 40 cm. aperture and 2 m. focal length, covering a field of 72 square degrees; a Zeiss astrographic triplet of 30 cm. aperture and 1·5 m. focal length, covering a field of 81 square degrees; a 7° objective prism; a Zeiss reflector of 100 cm. aperture, equipped with two spectrographs; and also comparators and measuring machines. The modernization and reorganization of the Observatory was Prof. Stroobant's chief work as director, to which post he was appointed on May 1, 1925. He had previously been, since 1904, professor of astronomy in the University of Brussels.

Prof. Stroobant's astronomical work included the study of the personal equation in the observation of star transits; dynamical investigations on the planets and their satellites and, in particular, on the system of Saturn; researches on the distribution and number of the asteroids; investigations of the motions of the helium stars and of the solar motion. He was the first to establish that the apex of the solar motion and the velocity of the sun, with respect to the near stars, varies in a systematic manner with the spectral type of the stars. A volume entitled "Les Observatoires Astronomiques et les Astronomes", compiled in 1907 by Prof. Stroobant with the assistance of some of the staff of the Uccle Observatory, is a valuable reference work. A revised edition was published in 1931 under the auspices of the International Astronomical Union.

Prof. Stroobant was a *correspondant* of the Paris Academy of Sciences, of the Bureau des Longitudes, and of the Institut de Coïmbra. He was an associate of the Royal Astronomical Society, president of the Belgian National Committee of Astronomy and president of the Commission on Bibliography of the International Astronomical Union.

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## Dr. Edward Weston

BY the death of Dr. Edward Weston on August 20, the electrical industry loses one of its greatest pioneers. Born in 1850, on the border line between England and Wales, he went to the United States when fifteen years old and devoted his energies to studying the action of existing direct current dynamos and making improvements on them. If not the first, he was one of the first to realize the necessity of laminating the iron in the armature of a dynamo so as to obviate the heavy losses that otherwise occurred owing to the eddy currents induced by the alternating magnetic flux. Edison also worked on this problem, and the efficiency of the dynamo was soon raised from 50 to 90 per cent.

As a working method for the realization of the international volt, the Weston cadmium cell is used. At 20° C. its electromotive force is 1·0183 international volts. The researches made by Sir Frank Smith on this cell, and the modifications in the materials used to which these researches led, have made the Weston cell most trustworthy for the accurate measurement of voltages.

To electrical engineers, Dr. Weston's name is a household word in connexion with moving coil ammeters, voltmeters and wattmeters. The law governing a coil moving in a permanent magnetic field was used by Kelvin on his siphon recorders and by D'Arsonval in his galvanometer. In 1888, Weston, using this principle, developed and produced the first moving coil ammeters and voltmeters. Devices are now used by makers in all parts of the world for measuring amperes, volts and watts which use the essential principles of the original Weston instruments. In the original Weston D.C. ammeter, the coil is pivoted and is controlled by spiral springs which carry the current, but unlike the D'Arsonval galvanometer a pointer is substituted for the mirror. The ammeter can be converted into a voltmeter by using it in conjunction with a high resistance and into an ammeter for measuring large currents by shunting it with a low resistance.

Dr. Weston was the first to employ bakelite, so widely used to-day, on a commercial scale. Amongst his many inventions are a compensated thermo-couple instrument for high-frequency A.C. measurements, the rectifier bridge for A.C. measurements and the first commercially practical dry disk photo-electric cell.

Dr. Weston was a past president of the American Institute of Electrical Engineers, and received many honours from learned societies. In 1933 he was awarded the Lamme medal of the Institute for his achievements in the development of electrical apparatus, "especially in connexion with precision measuring instruments". At the time of his death he was a director of the Weston Electric Instrument Corporation and the Weston Electrical Instrument Co. Ltd., at Surbiton. He is survived by his son, Mr. E. F. Weston, the president of the American company. A. R.

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WE regret to announce the following deaths:

Dr. W. H. Harrison, formerly Imperial agricultural research chemist for the Government of India, lately acting agricultural adviser, on August 18, aged fifty-nine years.

Prof. K. K. Mathur, honorary professor of geology in the Benares Hindu University, and principal of the College of Science, Benares, on July 18.

# News and Views

## British Association Meetings

THE Blackpool meeting of the British Association closed on Wednesday, September 16, with the assembly of the general committee, when research committees were appointed and resolutions were passed gratefully acknowledging the obligations of the Association to the Mayor and Corporation for their hospitality and the ways in which they had contributed to the work and entertainment of the Association at Blackpool. The meeting has been notable in several aspects, and one which is unique of its kind was the opening of the famous autumn illuminations on Saturday, September 12, when Sir Josiah Stamp, president of the Association, switched on from a train the 300,000 coloured electric lights on pylons and archways which illuminated the whole length of the promenade. The day had been spent by a large party which travelled by special train to Furness Abbey, Windermere, Rydal Water and Grasmere; and upon the return journey the train was stopped at Oxenholme so that Sir Josiah could speak from his carriage to the people of Blackpool before he pressed the button which started the illumination of the five miles of the promenade. Sir Oliver Lodge, who was given an enthusiastic welcome at the opening meeting, when he expressed the thanks of the Association to Sir Josiah Stamp for his presidential address, attended a few other meetings before he left on Monday. His presence at Blackpool was much appreciated not only by his scientific friends but also by the people of Blackpool.

NEXT year's meeting is to be held at Nottingham under the presidency of Sir Edward Poulton. The general officers remain as this year; namely, general treasurer, Prof. P. G. H. Boswell, and general secretaries, Mr. F. T. Brooks and Prof. Allan Ferguson. The new members of Council are: Dr. F. W. Aston, Prof. F. Debenham, Prof. T. G. Hill, Mr. W. Campbell Smith, and Mr. J. S. Wilson. The meeting in 1938 will be held at Cambridge, on August 17–24. In January of the same year, it is proposed to send a limited party of the Association to India, when a joint session will be held with the Indian Science Congress, which will then be celebrating its silver jubilee. The 1939 meeting will be held in Dundee. The question of a meeting in Australia is still under consideration; but it will probably not be held there until 1942, as it has been found that 1940, originally suggested, is inappropriate on account of several important international congresses having been fixed for that year.

## Sir Edward Poulton, F.R.S.

THE election of Sir Edward B. Poulton to be president of the British Association for 1937 will cause great satisfaction, and is particularly apt in connexion with the renewed interest in Darwinism, and more especially in natural selection. This year's meeting has shown that there is a strong revival of belief in the efficacy of natural selection, and the presidential address to Section D (Zoology), and subsequent papers, demonstrated how much evidence is flowing along different lines to support the theory. The presentation to the world of Mendel's particulate theory of heredity in 1866 resulted in enthusiastic acceptance of the new doctrine and the belief that this process supplied the obvious means of evolution which would finally dispose of the less easily proved theory of natural selection. From this view, Sir Edward vigorously dissociated himself; but so prevailing was it that in the presidential address to the Association in 1913, Sir Oliver Lodge stated that not only was it not true that Nature does not make leaps, but that it was doubtful whether she ever does anything else. Now that the early conception of advance by large sudden changes has been so greatly fined down by the discovery of modifying factors, the two schools will be found to be less antagonistic. No one will rejoice in the reconciliation more than Sir Edward, himself eager to welcome and examine any new ideas on evolution, but always ready to hold the fort against new-comers with blaring trumpets acclaimed as the heralds of a new order.

SIR EDWARD POULTON is widely known for his exposition of the theory of natural selection as accounting for the colours of animals, particularly of insects; he has long been recognized as the chief authority on Darwinism in Great Britain. An Oxford man, having studied under Rolleston, he early distinguished himself as a morphologist; he was a vigorous supporter of Weismann's theory and took a practical part in making his views on the continuity of germ-plasm better known to the English-speaking public. But he became particularly interested in the problem of the colours of animals, and in his classical book, "The Colours of Animals", laid the foundations of his life's work. One general scheme was devised to cover all the manifestations of colour in animals, whether aggressive, protective, or for sexual attraction. The explanations by Bates and Müller of resemblances in colour between insects far removed in taxonomy found their keenest advocate in Poulton, who during forty years in the Hopeian chair of zoology at Oxford has been responsible for the accumulation of a mass of evidence for which no explanation has yet been put forward which covers so many points as does natural selection. Always ready to help in any work that would forward the study of evolution, he has consistently lectured and written as a supporter of Darwin's original views, as evidenced by his presidential addresses to the Linnean and Royal Entomological Societies, and to the zoological section of the British Association, which he has regularly attended since 1881.

### Discovery of a New Fossil Anthropoid in South Africa

IN another column of this issue of NATURE (p. 486) there appears a communication from Dr. R. Broom, of the Transvaal Museum, Pretoria, in which he records the circumstances of discovery in July last of the skull of a new type of fossil anthropoid in South Africa, and goes on to give a preliminary report on the more striking and significant anatomical characters of his find, so far as these are patent at this early stage of examination. The specimen, as was almost inevitably the consequence of its discovery in the course of blasting operations, is fragmentary; but fortunately for the student of the palæontology of man and the anthropoids, those parts which have been found, especially the teeth and the forward parts of the brain cast, are among the most significant for determining the relation of the new fossil to previously known forms. Further—and this is a matter of considerable moment—it is at once apparent that not only do these fragments belong to a new type of anthropoid, but also the teeth are those of an adult individual. Hence, as Dr. Broom points out, his find confirms the interpretation which has been placed upon Prof. Dart's Taungs skull, which is infantile, and establishes it by the side of this new and related specimen from the Sterkfontein caves, as "not closely allied to either gorilla or chimpanzee", but "on or near the line by which man has arisen". Dr. Broom, however, considers that he is justified in regarding his new form as differing specifically from *Australopithecus*, while it is probably later, belonging to the Upper Pleistocene. The further implication of his discovery is indicated when, referring to the resemblance in the teeth to those of *Dryopithecus rhenanus*, he emphasizes the fact that a South African Pleistocene form, showing "a number of typical human characters, not met with in any of the living anthropoids", stands in distinct relationship to the Pliocene fossil apes and especially to the Pliocene *Dryopithecus* of Europe, which some palæontologists have regarded as one of the most important links in the chain of relationship between the fossil apes of Europe, Egypt and Northern India and the earliest form of man.

### Science and Social Values

TIME and time again in these columns, reference has been made to the fact that men of science as a whole have, in the past, paid little attention to the social consequences of their investigations and discoveries, with the result that science has been widely blamed for the present-day world-wide unrest. While there is still a body of opinion that scientific workers should disclaim all responsibility for the use to which their discoveries are put, there is a growing feeling that men of science should take a more active part in public affairs. Sir Josiah Stamp, in his presidential address on September 9 to the British Association, referred to this topic, and went on to suggest that biological and social investigations should be given more attention than they are at present receiving. On September 10, Prof. J. C. Philip, in his presidential address to Section B (Chemistry) of the Association, part of which is printed in this issue of NATURE (see p. 492), roundly attacked those who find nothing in chemical science but explosives and poison gas, showing clearly the importance of the chemist in the modern State, though he found it necessary to urge upon his fellow chemists and other scientific workers the necessity of "throwing their weight into the scale against the tendencies which are dragging science and civilization down and debasing our heritage of intellectual and spiritual values".

ON the same day, September 10, President Roosevelt addressed a plenary session of the World Power Conference at Washington. According to the Washington correspondent of *The Times*, he said: "Your scientific and engineering genius is destroying one world—the world of relative scarcity—but has it yet undertaken to create the new world of abundance, which is potentially in your command, over natural energies? . . . Is enough attention being paid to 'human engineering'? In making a valuation of resources the physical and mental energies of human beings must be included." He added that a higher form of accounting is required which "takes the social values, now left to mere assumption, into its calculations and measures them". This frank statement from the leader of a great modern State, coupled with the movement from within their own ranks, will embolden scientific workers in their approach to the almost unknown fields which lie before them in social research.

### Joy in Scientific Discovery

DURING the past few days, a section of the lay press has been at pains to show by word and picture—apparently as a matter for comment—that scientific workers and others at the Blackpool meeting of the British Association have made use of the means of entertainment offered by that well-known resort, even as other folk do. That men of science can also feel and show emotion and pleasure in achieving success in their own special fields of work was the theme of Prof. D. F. Fraser-Harris's public lecture "Joy in Scientific Discovery" delivered at Thornton Cleveleys on September 15 in connexion with the Blackpool meeting. While it is true that scientific men must make an impersonal study of the laws of Nature, there is ample evidence from historical records of the joy they have felt on achieving their goal. Newton, it is said, was so agitated when his work on the law of gravitation approached completion that he had to beg a friend to complete his calculation. Faraday is well known to have greeted the successful conclusion of an experiment with boyish glee, and referred in writing of the life of the man of science to "the delight which the contented mind has in acquiring it [knowledge] for its own sake". Harvey said that "the pains of discovery are amply compensated by the pleasures of discovery". Malpighi was greatly stirred by his observation of the blood streaming through the capillaries. Jenner wrote joyfully to his

friend Mr. Gardner of his first successful vaccination. Pasteur had a sleepless night of anxiety when he had completed his first inoculations for rabies on a human being. Lister, a member of the Society of Friends, could write, "I don't think any case ever excited me so much", in referring to his first use of antiseptic ligatures. Graham Bell and Edison were delighted with the telephone and the phonograph respectively. Lord Kelvin, having devised a delicate electrical instrument, would have it brought to his drawing-room mantelpiece, so that he might exult over it at leisure. So the story continues. The joy of the creative intellect, whether in art, literature or science, is one of the most exalted human emotions.

### Drops and Splashes

Two public lectures under the auspices of the British Association were given at Preston (September 16) and at Rochdale (September 17) by Prof. Allan Ferguson, who took as his subject "Splashes and What They Teach". The lectures dealt with the phenomena attendant on the formation and separation of a drop of water at the end of a vertical tube, the splash of a drop of liquid falling into a liquid, of a solid sphere falling into a liquid and of a drop of mercury falling on to a horizontal sheet of glass. As is well known, experiments were carried out by Worthington some forty years ago in order to elucidate some of these happenings. Photographic technique was then very primitive, and Worthington's experiments were carried out under difficult conditions. Recently a high-speed camera has been developed, in which the film is drawn continuously through the camera at a speed of about thirty miles an hour. A prism rotating rapidly about a horizontal axis is placed between the lens system of the camera and the film, and throws a picture of the object downwards on the film, so that, for a fraction of a second, the image is stationary relative to the film. In this way it becomes possible to take pictures at the rate of 2,000 a second, and therefore, by running them through a projector at the rate of 20 a second, to alter the time-scale in the ratio of a hundred to one. The films so taken corroborate in a remarkable manner the results obtained by Worthington's method of taking separate photographs of drops, each at a different stage of its fall.

### Caucasian Studies

To remedy the neglect of a field in which the Russian literature, with a virtual monopoly created by circumstance, can do less than justice, a society has been founded in England for the promotion of Georgian and Caucasian studies. The promoters include Sir Oliver Wardrop and Mr. W. E. D. Allen, who are among the foremost authorities on Georgia in the West. Sir Denison Ross is the Society's first president. The Society will publish a journal under the title *Georgica*, of which the first part has already appeared. Its contents, for most of which natives of Georgia, recognized as authorities, are responsible, indicate that breadth of interest, combined with sound scholarship, will be the aim of its promoters. *Georgica* will also endeavour to keep its readers abreast of current developments in Caucasian studies not otherwise readily accessible. As preliminary matter, Sir Denison Ross contributes an introductory note explaining the objects and methods of the new society, and Mr. W. E. D. Allen reviews the present state of Caucasian studies. Among the remaining papers are a discussion of Georgian chronology by Prof. Taqaishvili, an examination of the Asianic element in Georgian paganism by Prof. M. Tseretelli (see p. 512 of this issue of NATURE), a census of Georgian manuscripts in England, of which there are three important collections, by the Archimandrite Peradze, and an account of the Holy Lance of Echmiadzin by Mr. F. J. Baddeley, who considers that it is identical with the lance discovered in the siege of Antioch in 1098. Dr. A. Gugushvili adds a valuable, if tentative, system of Georgian phonetics, which, it may be hoped, will lead to further discussion. The honorary secretary of the Georgian Society is Dr. A. Gugushvili, to whom inquiries should be addressed at Commonwood House, Chipperfield, Herts.

### Exhibition of Photography

THE eighty-first Annual Exhibition of International Photography by the Royal Photographic Society was opened on September 11. It will remain open daily (Sundays excepted) from 10 a.m. until 9 p.m. (Tuesdays and Fridays excepted—lecture evenings—when it will be closed at 6 p.m.) until Saturday, October 10. Pictorial photography occupies the principal galleries and, as usual, has attracted exhibitors from all over the world. Among the scientific exhibits are two infra-red photographs taken by A. W. Stevens and O. A. Anderson from about 69,780 feet above the ground over Central South Dakota on November 11, 1935. One of these is a vertical photograph, the other lateral. The latter is said to be the first photograph to show the division between the troposphere and the stratosphere. The horizon, 330 miles away from the camera, is clearly arched. The trade sections, though not extensive, are well worth inspection. The emphasis among apparatus is upon the miniature cameras. Instructional exhibits include explanations of the working of the Pola screens and of the Kodachrome process, the effects of varying the filter in making photomicrographs of stained sections and the troubles that may arise through mishandling photographic materials.

### Smoke Abatement Exhibition at the Science Museum

AN exhibition on the abatement of smoke will be opened at the Science Museum, South Kensington, by the Minister of Health, the Right Hon. Sir Kingsley Wood, M.P., on October 1, and will remain open until October 31. It has been arranged by the National Smoke Abatement Society (by permission of the director of the Museum, Colonel E. E. B. Mackintosh), with the co-operation of interested Government departments and industrial associations. Models and other exhibits demonstrating the efficient combustion of coal in steam-raising and other industrial operations will be shown, and other sections

will be devoted to the uses of other natural fuels, namely, anthracite and anthracitic coals, and oil. Another section will exhibit material relating to the generation, distribution, and uses of electricity. The pre-treatment of coal will be demonstrated by exhibits on high-temperature carbonization (gasworks practice) for the preparation of town's gas and gas coke, and on low-temperature carbonization, in which the product of principal interest is the semi-coke. For the scientific investigation of the smoke problem, methods for the measurement of smoke are required, and an exhibit of the Fuel Research Station will be concerned with current researches on this subject, which are being carried out with the view of developing a domestic fire that will burn coal smokelessly. The Department of Scientific and Industrial Research will show exhibits on the nature and causes of smoke, and on the investigation of atmospheric pollution. A section of the exhibition will be devoted to material demonstrating the effects of smoke. The Annual Conference of the National Smoke Abatement Society will be held at the Museum on October 14–17, and will be opened by Captain Harry Crookshank, M.P., Secretary for Mines. Particulars of this Conference may be obtained from the Secretary of the Society, at 36 King Street, Manchester 2.

### The World Power Conference

THE third World Power Conference, which was opened at Washington on September 7, was one of the largest technical conferences ever held. The British party, which travelled by the *Queen Mary*, numbered about a hundred. According to the *Electrical Times* of September 10, the records of the papers and discussions will run to more than three million words. As there was no hall in Washington large enough for a banquet of 3,000 delegates, the official banquets were held in the waiting hall of the railway station, suitably transformed for the purpose. Each country submitted papers to the Conference setting forth its own particular power problems and questions connected with them. Economic, technical and allied subjects were all discussed. The papers from each country having to be read before a mixed international audience, largely American, were naturally mainly reports of the country from which they originated. The British papers therefore were mainly of interest to all dwelling outside Britain. An exception may perhaps be made for the paper read by S. E. Britton, the city electrical engineer of Chester. His paper was entitled "Rural Electrification in Great Britain". When the use of electricity produces a revenue equal to twenty per cent of the outlay on the electrical distribution system, the inhabitants in rural areas can get a supply of electricity for all purposes at economic rates and use it for the same purposes as those residing in urban areas. Information is given of the annual expenditure on heat, light and power by those living in rural areas who use electricity and those who do not. The paper is clearly written and is very complete. It is particularly applicable to the conditions prevailing in the neighbourhood of Chester.

### German Chemical Engineering

ALTHOUGH a certain amount of publicity was obtained in the scientific journals, trade papers and the daily Press for the German Chemical Engineering Exhibition held at Cologne in 1934, the organizers felt that these reports were necessarily incomplete, and so they have published the Achema Jahrbuch, 1935–36 (Berlin : Verlag Chemie, G.m.b.H.), to give some indication of the recent progress in chemical engineering illustrated by that exhibition, which was visited by 48,600 representatives of industrial firms and professional men from forty-six countries. Opportunity is also taken of directing attention to Achema VIII, which will be held on July 2–11, 1937, at Frankfort-on-Main, where accommodation amounting to 240,000 square feet of floor space will be available for exhibitors. In this exhibition, one building will be reserved for firms wishing to show scientific instruments and equipment such as are used industrially for making technical measurements or controlling and regulating the flow of fluids, heat and electricity. Another building will house industrial apparatus made of non-metallic materials, whilst the third and fourth buildings are reserved for machines used in the artificial silk and associated industries, and large-size equipment for the chemical and allied industries respectively. It is intended to publish at the beginning of 1937 a catalogue giving detailed information of the exhibition. The "Jahrbuch" also gives a list of the exhibitors at the 1934 exhibition in English, French and German as well as notes in two of these languages on some of the more important sections and the equipment which was shown.

### Magnetic Observations in New Zealand and elsewhere

OWING to the world economic crisis and other causes, many magnetic and meteorological observatories, including those of some great nations, have fallen seriously into arrears with their publications. The ideal, approached, if not always attained, by the chief British observatories, is to publish the observations of one calendar year before the end of the next. Now that the great and successful co-operative effort of the Second International Polar Year has been accomplished—so far as the observations go, though the publication and, still more, the discussion of the results is still very incomplete—a desirable goal for new effort on the part of geophysical observatories would be to overtake their arrears of publication within an assigned time, say by the end of 1940. A step in this direction has been taken by New Zealand in publishing three years records of the Christchurch Magnetic Observatory in one volume (Annual Reports for 1931, 1932, 1933. Wellington : Government Printing Office, 1936. Pp. 132. 10*s*. 6*d*.). The volume naturally consists almost entirely of tabular matter, and for economy is reproduced directly from typescript, in a reasonably satisfactory manner. The magnetic data refer (as for 1930) to the Amberley sub-station, about twenty-five miles from Christchurch. Monthly mean daily variations are given for all days (with Fourier analysis) and international quiet days, but (regrettably) not for international

disturbed days. The volume includes a brief seismological report for 1931. An account of the instrumental equipment of the Observatory in the introduction would have added to the convenience of users. Though the director's introduction is written in the first person, his name (Mr. H. F. Skey), by a curious oversight, seems to occur nowhere in the volume.

### The Rockefeller Foundation

ACCORDING to the annual report for 1935, the Rockefeller Foundation expended 12,725,439 dollars. Of this sum 692,524 dollars was for medical education, including 460,850 dollars to the China Medical Board, 2,217,425 dollars on research programmes at universities and similar institutions, and 669,214 dollars on research programmes at research institutions and organizations. The report gives a brief description of the work of the International Health Division, the budget of which is 2,200,000 dollars; this Division covered yellow fever studies in Brazil, research on yellow fever, malaria and other diseases at the Institute's laboratories, field research on malaria in various countries, surveys to determine the status of hookworm disease in North Carolina, studies on tuberculosis, yaws and mental hygiene, as well as research on typhoid fever, smallpox vaccine and the common cold. Work in China has placed emphasis on organized efforts at rural reconstruction by assisting concrete studies and training personnel, particularly graduates, to participate in such reconstruction work.

IN the field of natural science, the Rockefeller Foundation has devoted its appropriations chiefly to research involving the application of the technique of the exact sciences to biological problems, particularly studies which contribute directly to, or form the necessary basis for, an understanding of behaviour. Grants have also been made for research on plant genetics, vitamins and hormones, physiology of reproduction and respiration, nerve physiology, etc. With regard to the social sciences, the Foundation is using its resources to develop specific areas of activity which promise to assist the solution of pressing social problems. The three areas of study thus far undertaken are social security, international relations and public administration, and the 3,807,500 dollars expended on social sciences in 1935 includes grants for research on problems of the business cycle, study of the relief situation in New York State, the Institute of Pacific Relations, agricultural economics, research on international relations and training projects in public administration.

### Science in Poznań

AMONG the contributions to vol. 21 (1936) of *Nauka Polska* is a long account (pp. 70) by Prof. Z. Lizowski of the present position of science at Poznań. This ancient centre of culture in western Poland has become the most intensely Polish of all the university cities in the country, partly because 95 per cent of its inhabitants are Poles and partly because of the impetus given to its development since the liberation of the country in 1918. From the time of the partition of the ancient kingdom of Poland until the end of the Great War, Poznań was nominally a German city, and although the pursuit of scientific investigations was possible it was hampered by cultural restrictions, including the suppression of the Polish language. Since 1919, a definite revival has occurred in all branches of pure and applied natural science and the university has attracted students, lecturers and distinguished visitors from other countries.

THE international character of science has also been promoted by the lectures delivered by Poznań professors in Germany, France, the United States, Czechoslovakia and elsewhere. This issue of *Nauka Polska* also contains particulars of prizes and awards distributed to men of science and to various scientific institutions throughout Poland during the past academic year. No complete figures are given, but it seems that many thousands of pounds have been distributed. Aerodynamics, investigations on the oxides of nitrogen, Grignard's reactions, rubber research and plant physiology are among the many investigations that are being encouraged with financial assistance. In the 'foreign notes' the attention of Polish readers is directed to the Oxford conference on 'academic freedom', whilst several works by British authors are included among the books reviewed.

### Rabbits in Britain

ATTENTION has been directed once again, by articles and correspondence in contemporary journals, to the damage caused by the superabundance of wild rabbits in Britain. An introduced animal, the rabbit, encouraged by conditions of soil, climate and food, has bred and spread, so that for the past century its activities have become increasingly harmful to agriculture and forestry. So long as two opposed views regarding its presence are strongly held, one emphasizing its destructiveness and the other its value as food and as an object of sport, it is unlikely that common action against the rabbit will be taken without legal compulsion. But the necessity for control in other countries and the methods employed for control are of general interest, and knowledge of them may become of great importance in Britain also, so that useful service is performed by Guy Dollman's article on "The Rabbit Menace" in the *Natural History Magazine* (**5**, No. 39, July 1936, p. 297), where a summary of recently developed means of limiting or eradicating the pest is given.

### Research in Plant Breeding

SUPPLEMENT 2 of *Plant Breeding Abstracts*, which has been issued by the Imperial Bureau of Plant Genetics, Cambridge (price 5*s*.), gives a concise account of work carried on during 1932–35 on crop plants in the British Empire. It shows the great variety of plants grown and the large amount of work in progress on such crops as wheat, cotton, rice, sorghum, coco-nut, apples, etc., gleaned from more than four hundred reports in various parts of

the Empire. It is so arranged that one can see at a glance, for example, the investigations of coffee that are being made in Mysore, Ceylon, Uganda, Kenya and Tanganyika, or of strawberries in England, Scotland, Canada, New Zealand and New South Wales. Work on cytology and on the genetics of plant parasites is included, and the whole serves as a very useful summary for plant breeders and geneticists. This outline picture also shows that a surprising variety of economic plants is undergoing genetic improvement.

### National Research Council of Japan

THE report of the National Research Council of Japan covering the period April 1934–March 1935 contains a useful list of papers published in various Japanese scientific journals during the period, together with brief particulars of divisional and committee meetings held during the year. A committee on dyestuffs research has been concerned with the investigation of standards of intermediates and dyestuffs and of the present state of industrial research on dyestuffs and chemical compounds in Japan. A further committee is concerned with radio research, and a committee on industrial research has considered the design of long-range aeroplanes, light-signalling through foggy atmospheres in daytime, the electrolytic oxidation of aluminium and its applications, material-testing by X-ray radiography and chloronaphthalenes as electrical insulators.

### Conference on Bee Diseases

A CONFERENCE to discuss the causes of bee diseases and the practical means of controlling them will be held on Saturday, September 26 at Rothamsted Experimental Station, Harpenden, Herts. Contributions will be presented by Dr. H. L. A. Tarr, of Rothamsted, on "Brood Diseases in England: the Results of a Three Year Investigation"; Dr. Guy D. Morison, advisory entomologist, Marischal College, Aberdeen, on "Bee Paralysis"; Dr. Otto Morgenthaler of the Bee Disease Division, Eidgenössiche milchwirtschaftliche und bakteriologische Anstalt, Liebefeld-Berne, Switzerland, on "Brood and Adult Bee Diseases in Switzerland". A paper on brood diseases in the United States specially prepared for this conference by Dr. J. I. Hambleton, Chief of the Apiculture Division, United States Department of Agriculture, will also be read.

### Announcements

SIR ARTHUR SMITH WOODWARD, Sir Charles Sherrington, M. Ruzicka and M. Bottazzi have been elected to the grade of associate of the Royal Academy of Belgium. Prof. F. Van den Branden, professor of clinical urology in the University of Brussels, and Prof. H. Fredericq, professor of zoology in the University of Liège, have been elected *correspondants* of the Academy.

THE following appointments have recently been made in the Colonial Service: E. J. H. Berwick, to be agricultural officer, Malaya; C. E. Johnson, to be agricultural officer, Northern Rhodesia; D. R. N. Brown, J. W. Purseglove, and J. M. Watson, to be agricultural officers, Uganda; J. E. Garfitt, to be assistant conservator of forests, Malaya; N. S. Alexander, to be professor of physics, Raffles College, Singapore; J. R. Clackson, to be European assistant, East African Meteorological Service; O. T. Faulkner, director of agriculture, Nigeria, to be director of agriculture, Malaya; J. E. A. Carver, assistant conservator of forests, Nyasaland, to be conservator of forests, Mauritius; J. S. Dunn, inspector of schools, to be engineering chemist, Public Works Department, Gold Coast; H. Harrison, field assistant, to be field officer, Tsetse Research Department, Tanganyika; J. Y. Moggridge, field officer, to be entomologist, Tsetse Research Department, Tanganyika; V. Rasaretnam, assistant superintendent of surveys, to be superintendent of surveys, Ceylon; C. L. Southall, assistant analyst, Straits Settlements, to be Government analyst, Nigeria.

PROF. CARL NEUBERG of Berlin, director of the Kaiser Wilhelm Institute of Biochemistry, has been elected a foreign member of the Swedish Academy of Sciences.

PROF. FRIEDRICH KÖRBER of Dusseldorf, director of the Kaiser Wilhelm Institute for Iron Research, has been elected a corresponding member of the Royal Swedish Academy of Engineering Science.

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

A city engineer and surveyor at Lincoln—The Town Clerk, Town Clerk's Office, Corporation Offices, Lincoln (September 19).

Assistants (Grade III) in the Meteorological Office—The Secretary (S.2.E.), Air Ministry, Adastral House, Kingsway, W.C.2 (September 23).

A civilian engineer by the War Department at Christchurch, Hants.—The Under-Secretary of State (C.5), War Office, London, S.W.1 (September 25) (Quote E.B.E.).

Assistants (Grade III) in the Royal Aircraft Establishment, South Farnborough, Hants (aeronautical engineering)—The Chief Superintendent (September 26).

A temporary engineer for work at Ellesmere, Salop, on purification of milk factory effluents—The Secretary, Rothamsted Experimental Station, Harpenden, Herts (September 30).

An assistant (Grade III) in the Air Ministry Scientific Research Pool (physics or engineering)—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (October 2).

An organizer of technical education in the Melton Mowbray district (who in due course will become the principal of the New Technical College)—The Director of Education, County Education Office, Grey Friars, Leicester (October 7).

Assistant quantity surveyors in the Air Ministry—The Secretary (W.B.9), Adastral House, Air Ministry, Kingsway, W.C.2.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 511.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Chemical Composition of the Planetary Nebulæ

THE physical conditions in the planetary nebulæ are such that atoms or ions in metastable states are not disturbed by electron impact or the absorption of radiation during their lifetimes of one minute or more. The intensity of a 'forbidden' emission line (due to transitions from such a metastable state) is then[1] $I=nh\nu$, where $n$ is the number of ions arriving in the metastable state per second, and $h\nu$ is the energy emitted from each transition. It is possible to determine the relative abundance of ions in the nebulæ from the observed[2] intensities of their forbidden lines (listed in cols. 5 and 7 of the Table), if, following Bowen, we assume the excitation to the metastable state to be due solely to inelastic electron collisions, that is, $n$ is proportional to $N(w)p(v,w)\rho(E)$, where $N(w)$ is the number of ions of atomic weight $w$ per c.c., $p(v,w)$ is the probability of electron collision and resultant excitation, and $\rho(E)$ is the number of electrons per c.c. with kinetic energy greater than the excitation potential, $E$, of the ion.

potential is greater than the 2·5 volts of O++, because there are fewer electrons available to excite such ions (that is, $\rho(E)$ is smaller than for O++); otherwise they are upper limits as indicated in cols. 6 and 8.

With a knowledge of the temperature of the ionizing radiation and its dilution, we can use the ionization formula[3] to determine the relative abundances of the elements from the proportions of their ions. The central star temperature is 50,000° K. for the nebula N.G.C. 7027 and the dilution (which is not simply geometrical dilution, but complicated by absorption in the inner layers of the nebula) was calculated from the measured ratio $O^+/O^{++}=5\times10^{-3}$. (This was derived by the above method from the intensities of λ5007 and λ4959 relative to λ3726 and λ3729, the nebular lines of O+, given by L. Berman[4]. Berman's published ratio must be corrected by +1·09 mag.) In this manner we arrive at the abundances listed in col. 9, corrected to relative numbers of atoms of the elements (for N.G.C. 7027). The proportions of oxygen, neon, and argon are approximately

| Element At. Wt., $w$ | Ion Ion. pot. | Forbidden lines | Classification[1] $E$ | N.G.C. 7662 Line Int. $I$ | N.G.C. 7662 Abundance of ions, $N$ | N.G.C. 7027 Line Int. $I$ | N.G.C. 7027 Abundance of ions, $N$ | N.G.C. 7027 Abundance of atoms | Earth[3], abundance of atoms |
|---|---|---|---|---|---|---|---|---|---|
| N 14 | $N^+$ 14·48v. | λ6583 6548 | $^3P-^1D$ 1·9v. | ..... ..... | ..... | 26[2] ..... | <0·21 | $<6\cdot5\times10^2$ | $9\cdot3\times10^{-4}$ |
| O 16 | $O^{++}$ 34·93v. | λ5007 4959 | $^3P-^1D$ 2·5v. | 84[2] 32[2] | 1·00 | 118[2] 42[2] | 1·00 | 1·00 | 1·00 |
| A 40 | $A^{+++}$ 40·78v. | λ4740 4711 | $^4S-^2D$ 2·6v. | ..... 0·98 | $>7\times10^{-3}$ | 0·70 ..... | $>5\times10^{-3}$ | $>3\times10^{-3}$ | $3\cdot2\times10^{-6}$ |
| Ne 20 | $Ne^{++}$ 40·9v. | λ3968 3869 | $^3P-^1D$ 3·2v. | 2·6 7·15 | $>4\cdot9\times10^{-3}$ | 1·35 5·18 | $>3\cdot6\times10^{-2}$ | $>1\cdot6\times10^{-2}$ | $6\cdot0\times10^{-9}$ |
| S 32 | $S^+$ 10·3v. | λ4076 4068 | $^4S-^2P$ 3·0v. | 0·00 0·00 | >0·00 | ..... 0·19 | $>10^{-3}$ | $>3\cdot1\times10^3$ | $9\cdot0\times10^{-4}$ |

In N.G.C. 6572[4] the abundance of $Ne^{++}$ is 0·054 that of $O^{++}$.

[1] I. S. Bowen, *Rev. Mod. Phys.*, **8**, 69 (1936).
[2] H. H. Plaskett, *Harvard Coll. Circ.*, **335** (1928).
[3] Clarke and Washington, *Proc. Nat. Acad. Sci.*, **8**, 114 (1922) and V. M. Goldschmidt, *Fts. der Min. Krist. u. Pet.*, **17**, 114 (1933). The mass of the atmosphere is taken as 0·03 per cent that of the earth.
[4] Derived from line intensities given by L. Berman, *Lick Obs. Bull.*, **15**, 97 (1930).

The 'nebular' lines (that is, lines due to the shortest forbidden transition to the ground state) of five ions are listed in column 3 of the table (the 'transauroral' lines of S+ are included). They are in the range λ6600–λ3800 and therefore have excitation potentials, $E$ (col. 4), between 1·9 and 3·2 electron volts, corresponding to a range of 25 per cent in $v$, the electron velocity. If we assume that $p(v,w)$ is constant in the small ranges of $v$ and $w$ here involved, the relative numbers of quanta in the forbidden lines, $I/h\nu$, derived from the intensities in cols. 5 and 7, are proportional to the numbers of ions in the nebula. With O++ as standard, these values are lower limits to the relative numbers of ions when the excitation

the same as of their ions, O++, Ne++, and A+++, because their ionization potentials (given in col. 2) are so nearly equal. The N+ and S+ ions, however, form only a small fraction of the total amount of nitrogen and sulphur, which are present mainly as N+++ and S++++, and therefore the determination of nitrogen and sulphur content is of low accuracy.

The most surprising of these first quantitative results is the high abundance of neon and argon in the nebula. If the identification of the forbidden lines and also our assumptions are correct, we must explain a ratio of neon to oxygen $10^6$ times as great and a ratio of argon to oxygen $10^3$ times as great as on the earth (last col. of the table). There are two

possibilities: either (1) the nebulæ are normal in composition and the earth has lost neon, nitrogen, and argon, or (2) the earth is normal, and the nebulæ are low in oxygen and argon content relative to neon.

As regards (1), Russell and Menzel[5] have shown that light gases such as neon and nitrogen would completely disappear from the earth, if and when it were hot enough, long before heavier gases like argon even began to escape. Possibility (2) might be caused by the oxygen and argon at the low black body temperature in the nebula (15° to 20° K.) freezing out on dust particles (the presence of which in the nebulæ has already been suggested on other grounds[2]). The freezing points are: oxygen, 55° K.; argon, 85° K.; nitrogen, 62° K.; neon, 20° K. Unless almost all the oxygen were in combination in the dust particles, however, this still leaves unexplained the high content of argon which, freezing at a higher temperature than oxygen, should be more completely solidified.

We conclude that there is as yet no completely satisfactory explanation of these abundances.

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Aug. 25.

[1] I. S. Bowen, *Rev. Mod. Phys.*, **8**, 69 (1936).
[2] T. L. Page, *Mon. Not. Roy. Ast. Soc.*, **96**, 622 (1936).
[3] cf. Eddington, "Internal Constitution of the Stars", p. 383 (Cambridge, 1926).
[4] *Lick. Obs. Bull.*, **15**, 97 (1930).
[5] Russell and Menzel, *Proc. Nat. Acad. Sci.*, **19**, 997 (1933).

## Radioactive Isotopes of Bromine

FERMI and his collaborators[1] detected two unstable isotopes of bromine characterized by half-periods of eighteen minutes and 4·2 hours. The nuclear transformations are probably expressed by the equations:

(1) $^{79}_{35}\mathrm{Br} + {}^{1}_{0}n \rightarrow {}^{80}_{35}\mathrm{Br} \rightarrow {}^{80}_{36}\mathrm{Kr} + e^{-}$;

(2) $^{81}_{35}\mathrm{Br} + {}^{1}_{0}n \rightarrow {}^{82}_{35}\mathrm{Br} \rightarrow {}^{82}_{36}\mathrm{Kr} + e^{-}$.

The isotopes 80, 82, of krypton are normal constituents of the element.

We noticed that when pure liquid bromine was exposed to neutrons for a week and then transferred to a thin-walled cylindrical glass cell encompassing a Geiger-Müller counter, the instrument registered twenty impulses per minute after a lapse of thirty hours. Previously we had observed the phenomenon in silver bromide precipitated from an irradiated aqueous solution of ammonium bromide. The time of half-decay is provisionally estimated to be twenty-four hours.

As a result of many experiments we conclude that the following reactions occur very infrequently, if at all:

(3) $^{79,81}_{35}\mathrm{Br} + {}^{1}_{0}n \rightarrow {}^{79,81}_{34}\mathrm{Se} + {}^{1}_{1}\mathrm{H}$;

(4) $^{79,81}_{35}\mathrm{Br} + {}^{1}_{0}n \rightarrow {}^{76,78}_{33}\mathrm{As} + {}^{4}_{2}\mathrm{He}$.

Selenium, and arsenious sulphide, precipitated from irradiated solutions of ammonium bromide exhibit no long-period activity. This excludes, in particular, $^{76}_{33}\mathrm{As}$ ($t_{1/2} = 26$ hours) as a possible source of the 'twenty-four hours' activity. The likelihood that it is due to another radioactive isotope of bromine or to an excited bromine nucleus is strengthened by the fact that we have not succeeded in separating the 'twenty-four hour' period from the other two; that is, all three activities in nearly the same relative proportions (small variations would be anticipated) have been observed irrespective of the form in which bromine is presented to the counter. Up to the present, *bromine*, *ammonium bromide*, *silver bromide*, *lead bromide*, and *ethylene dibromide* have been examined. To an irradiated solution of ammonium bromide, arsenic and selenium compounds were added, and pure samples of the three salts obtained from the mixture. Ethylene dibromide was prepared from radioactive bromine.

When, as in this case, the number of recognizable half-periods exceeds the number of isotopes in the natural element, several hypotheses can be suggested to explain their origin. Moreover, the half-periods are often difficult to determine precisely, and may sometimes be compounded of two or more. If there are, in fact, only three periods characteristic of bromine, the simplest explanation appears to be that a neutron is either absorbed, equations (1) and (2), or causes the expulsion of another neutron, thus:

(5) $^{79}_{35}\mathrm{Br} + {}^{1}_{0}n \rightarrow {}^{78}_{35}\mathrm{Br} + 2\,{}^{1}_{0}n$;

(6) $^{81}_{35}\mathrm{Br} + {}^{1}_{0}n \rightarrow {}^{80}_{35}\mathrm{Br} + 2\,{}^{1}_{0}n$.

Fermi[1] discussed this type of collision, but did not observe it. Bromine atoms of mass 80 are produced by reactions (1) and (6), and until a fourth half-period can be shown to exist must be presumed identical. The isotope $^{78}_{35}\mathrm{Br}$ may emit a *positron* or an electron, becoming $^{78}_{34}\mathrm{Se}$ or $^{78}_{36}\mathrm{Kr}$. These are stable.

In our experiments the substances were exposed to fast and slow neutrons (and $\gamma$-radiation) produced by a mixture of beryllium dust and radium bromide. Fast neutrons are probably required to bring about reactions (5) and (6). The effect of varying the relative concentrations of slow and fast neutrons will shortly be investigated. The main results are summarized in the accompanying table:

| Half-period | Relative initial activity | Relative total activity |
|---|---|---|
| 18 min. | 8 | 1 |
| 4·2 hours | 3·5 | 6 |
| 24 hours (?) | 1 | 10 |

Figures in the third column are proportional to the total number of impulses given to the Geiger-Müller counter during the whole period of decay. They are of interest in connexion with the hypothesis suggested above, wherein isotope 82 is produced by absorption of a neutron, 78 by disintegration, and 80 by both processes, but an attempt to assign half-periods to particular isotopes would be premature at this stage.

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Aug. 19.

*Proc. Roy. Soc.*, A, **146**, 483 (1934); A, **149**, 522 (1935).

## Neutron Absorption of Boron and Cadmium at Low Temperatures

IN the same arrangement as used for silver absorption[1], we have measured the influence of temperature on the absorption of neutrons in Fermi's group 'C' by boron and cadmium, using the 2·3 min. silver activity as detector.

Absorption curves were taken with detector, source and absorber kept at room temperature in the centre of a large vessel containing liquid hydrogen (20·4° K.) or water (300° K.). The ratio of thickness giving equal absorption at different temperatures, $\sqrt{(300)}/\sqrt{(20{\cdot}4)}$, was found to be fairly independent of the absorption itself, its value being $1{\cdot}65 \pm 0{\cdot}20$ for boron and $1{\cdot}4 \pm 0{\cdot}25$ for cadmium.

The theoretical value to be expected from a $1/v$ law of absorption, assuming a Maxwell distribution, would be 3·84. Preliminary results on cadmium absorption in paraffin cooled by liquid nitrogen (77° K.) gave, for $\sqrt{(300)}/\sqrt{(77)}$, a value less than 1·1 in agreement with the results of Rasetti, Segrè, Fink, Dunning and Pegram[2] with the mechanical selector, and those of Dunning and others[3], obtained at 85° K. We therefore conclude that the absorption curve of cadmium has a selective character, though comparison with 20·4° K. shows that an increase of cross-section certainly exists at the lowest energies, presumably due to overlapping of a selective band with the usual increase obtained with most elements at very low energies.

The results with boron cannot be explained on the assumption of a $1/v$ law for both boron and silver, but it is not possible to decide whether this is not due to the deviation of the silver detector alone from the $1/v$ law, since experiments have not yet been made with a boron chamber as detector.

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[1] *Sow. Phys.*, **10**, 170 (1936); NATURE, [**138**, 326 (1936)].
[2] *Phys. Rev.*, **49**, 104 (1936).
[3] *Phys. Rev.*, **49**, 650 (1936).

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## The State of Ascorbic Acid in Plant Tissues

DURING the last two years, considerable discussion has arisen over the state in which ascorbic acid occurs in natural food materials. It is an experimental fact that some vegetables after being heated in boiling water exhibit an apparent increase in the amount of titratable ascorbic acid, which can then be extracted from the plant tissues.

Three explanations for this anomalous increase have been advanced:

(1) Heating breaks up the cellular tissue and allows a more complete extraction of ascorbic acid[1].

(2) A part of the ascorbic acid exists in a combined or esterified form which is hydrolyzed by heat or acid[2,3].

(3) Heating inactivates the oxidizing enzymes, thus preventing the oxidation of ascorbic acid[4].

The first explanation has been discarded, but the (2) and (3) have provided the basis for the present controversy. As a matter of fact, all the phenomena were noted by Tillmans and his associates[5] several years ago. They state that with certain vegetables the proposed titrametric method agreed with the biological assay method only if the oxidized ascorbic acid were reduced with hydrogen sulphide. The oxidation of ascorbic acid occurred during the extraction and might be prevented by heating before extraction or by extracting with stronger acid.

These facts have been insufficiently realized by later workers. Thus, Ahmad[2] considers that no oxidase was concerned, since raw cabbage extracted with cold 20 per cent trichloracetic acid gave a lower titre than boiled cabbage extracted with the same acid. The assumption that 20 per cent trichloracetic acid completely inhibits the enzyme action in cabbage is erroneous. In a forthcoming communication from this laboratory, it is shown that while the optimum *p*H for the reaction of ascorbic acid oxidase is about 5·5, a considerable activity persists at very much lower *p*H values. Although an oxidizing enzyme has been found in every one of nine vegetables investigated, its activity varies greatly. The oxidase in cabbage is barely inhibited by extraction with 1 *N* sulphuric acid, in which case the *p*H of the extract is 0·8. Furthermore, it should be realized that while the final concentration of an extract may be 20 per cent trichloracetic acid, it is very much less than that in the crushed plant cells during the first few moments of grinding up the vegetable.

Recently, Guha and Pal[6] have reported experiments which are claimed to demonstrate almost conclusively that the increase in ascorbic acid content of certain foodstuffs on boiling cannot be accounted for on the oxidase theory. Alcoholic and ethereal extracts of cabbage are claimed to give an increase in ascorbic acid after heating. It should be pointed out that ascorbic acid oxidase is completely inactivated by both absolute alcohol and ether. Therefore any increase in ascorbic acid on heating these extracts has no bearing whatever on the oxidase theory, but must be explained by other means.

EXPERIMENTAL PROCEDURE

| Treatment | Ascorbic acid (mgm. per gm. of vegetable) Before Reduction with $H_2S$ | After Reduction with $H_2S$ |
|---|---|---|
| 1. 20 gm. cabbage extracted with 100 ml. cold water ... ... | 0·003 | 0·50 |
| 2. 20 gm. cabbage covered with 40 ml. cold water and heated 4 min. at 100° C. under $CO_2$. Extracted with 60 ml. additional water ... ... ... ... | 0·47 | 0·48 |
| 3. 20 gm. cabbage extracted with 100 ml. cold 1*N* $H_2SO_4$ containing 2 per cent $HPO_3$ ... ... | 0·50 | 0·51 |
| 4. 20 gm. cabbage + excess $Na_2SO_4$ extracted with 100 ml. cold anhydrous ethanol ... ... ... | 0·51 | 0·54 |
| 5. 20 gm. cabbage + excess $Na_2SO_4$ extracted with 100 ml. cold anhydrous ethyl ether ... ... | 0·004 | 0·03 |
| 6. Extract (1) heated 4 min. at 100° C. under $CO_2$ ... ... | 0·04 | 0·47 |
| 7. Extract (1) made 0·2 per cent with resp. to HCl, let stand 1 hour ... | 0·006 | 0·43 |
| 8. Extract (1) made 1 per cent with resp. to HCl, let stand 1 hour ... | 0·008 | — |
| 9. Extract (4) heated 4 min. at 100° C. under $CO_2$ ... ... ... ... | 0·50 | — |
| 10. Extract (4) heated 10 min. at 36° C. under $CO_2$ ... ... ... ... | 0·47 | — |
| 11. Extract (5) air dried, then heated in 50 ml. water 4 min. at 100° C. under $CO_2$ ... ... ... ... | 0·004 | — |

I have carefully repeated the experiments of Guha and Pal and failed to observe any increase in ascorbic acid content on heating. Instead, the results show that the samples of cabbage examined in this laboratory did not contain appreciable amounts of ascorbic acid in a combined state. If the enzyme is inactivated by heat or alcohol, or inhibited by

extracting with *sufficiently strong acid*, the total amount of ascorbic acid is obtained. The fact that practically none of the ascorbic acid is recovered by acidifying or heating an aqueous extract indicates that nearly all the apparent increase on cooking is due to the inactivation of the enzyme. The slight increase on heating the aqueous extract may or may not be due to the liberation of bound ascorbic acid. I do not regard it as evidence of the existence of an ascorbic acid ester in natural foodstuffs.

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Aug. 3.

[1] Ahmad, *Biochem. J.*, **29**, 275 (1935).
[2] Ahmad, NATURE, **136**, 797 (1935).
[3] McHenry and Graham, *Biochem. J.*, **29**, 2013 (1935).
[4] Van Eekelen, NATURE, **136**, 144 (1935).
[5] Siebert, Inaug. Dissertation, Frankfort a. Main (1931); Tillmans, *Z. Unter. Lebensm.*, **63**, 267 (1932).
[6] Guha and Pal, NATURE, **137**, 946 (1936).

## Phosphagen in Echinoid Muscle and in Electrical Tissue

IT has been shown[1,2] that the electrical organs of *Torpedo* contain phosphagen, thus adding another to the series of resemblances already known to exist between electrical and muscular tissue. The possibility that both tissues may make use of the same or similar chemical mechanisms led us to study the electrical cells of *Torpedo* from the point of view of the interrelationships of certain of the phosphorylated compounds believed to be concerned in muscle chemistry.

It was found that the partition of phosphorus in the tissue is very like that in the muscles of the rat and the frog, and the following observations all serve to confirm the close resemblance already mentioned. (1) Extracts and breis prepared from the electrical organ will synthesize creatine phosphoric acid from creatine and phosphoglyceric or phosphopyruvic acid in the presence of adenylpyrophosphate or adenylic acid under conditions which lead to a similar synthesis in muscle preparations. (2) In dialyzed extracts this synthesis is catalyzed by the magnesium ion. (3) Phosphoglyceric acid is converted into pyruvic acid (demonstrated by the nitroprusside reaction and by the formation of a crystalline 2–4–dinitrophenylhydrazone). (4) Phosphagen can be synthesized from adenylpyrophosphate in high concentration without the addition of phosphoglyceric or phosphopyruvic acid. (5) Adenylpyrophosphate is rapidly dephosphorylated by such tissue preparations.

Hence this electrical tissue, like muscle, contains enzymes capable of catalyzing the following reactions:

(1) Phosphoglyceric acid → phosphopyruvic acid;

(2) Phosphopyruvic acid + adenylic acid → adenyl pyrophosphate + pyruvic acid;

(3) Adenylpyrophosphate + creatine → adenylic acid + phosphagen;

(4) Adenylpyrophosphate → adenylic acid + phosphoric acid.

It therefore seems very probable indeed that the cells of muscle and of the electrical organ of *Torpedo* alike derive the energy for their activity from the same chemical sources through the same chemical mechanisms, a suggestion which harmonizes with the well-known parallel between the physiological and pharmacological behaviour of the tissues in question, and the fact that they are both derived from embryonic pre-muscular rudiments.

Needham, Needham, Baldwin and Yudkin[3] reported the presence in the jaw muscles of *Paracentrotus* of two phosphagens, believed to be the phosphoric acid compounds of creatine and arginine respectively. In view of the phylogenetic interest[4] of these results we have studied the behaviour of certain phosphorylated compounds in the presence of enzyme extracts, prepared from the jaw muscles of *Sphærechinus granularis*, and have been able to demonstrate the synthesis of two phosphagen-like compounds from creatine and arginine respectively. The first of these behaves exactly in the way expected of creatine phosphoric acid, and in view of the results already reported by Needham, Needham, Baldwin and Yudkin, is almost certainly that compound. The second, synthesized by the enzyme preparations from arginine, behaves, so far as we can determine, like arginine phosphoric acid. Its hydrolysis is considerably retarded by molybdate, and the base liberated by the hydrolysis gives the Sakaguchi reaction and, when submitted to the action of arginase prepared from rabbit liver, gives quantitative yields of urea.

All the evidence we have obtained confirms the existence in echinoid jaw muscle of enzymes analogous to, if not identical with, those found in the muscles of other organisms and, as reported above, in the electrical organ of *Torpedo*, and we have found no reason to suppose that the mechanisms involved in the synthesis of the two phosphagens differ essentially from those demonstrated in vertebrate muscle by the Parnas school[5] and Needham and van Heyningen[6], and in arthropod muscle by Lehmann[7].

This confirmation of our earlier results makes us feel justified in laying considerably more emphasis than hitherto upon the phylogenetic significance of these purely biochemical results.

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August 15.

[1] Kisch, *Biochem. Z.*, **225**, 183 (1930).
[2] Baldwin, *J. Exp. Biol.*, **10**, 222 (1933).
[3] Needham, Needham, Baldwin and Yudkin, *Proc. Roy. Soc.*, B, **110**, 260 (1932).
[4] Needham and Needham, *Sci. Progress*, **104**, 626 (1932).
[5] Parnas, V^e Congrès de Chimie Biologique, Bruxelles (1935).
[6] Needham and van Heyningen, NATURE, **135**, 585 (1935).
[7] Lehmann, *Biochem. Z.*, **281**, 271 (1935).

## Swarming of the Males of Certain European Anophelines in Captivity

THE study of the biology of the European *Anopheles*, particularly the complex of forms known as *Anopheles maculipennis*, has been greatly hampered by the difficulty of inducing mating under laboratory conditions. Missiroli and I[1] have given a summary of the experiments made with these mosquitoes, of which only the 'race' known as *atroparvus* has mated in captivity. In this form, it appears that there is no sexual dance on the part of the males as a preliminary to mating. Curiously

enough, females of all the races will mate with *atroparvus* males, but repeated attempts on the part of many investigators to get them to pair with males of their own kind have failed.

Some years ago, I constructed a large cage of wire netting, 10·5 metres long, 5 metres wide, and 6·2 metres high, in connexion with the malaria laboratory in Albania. The cage was designed for the observation of the behaviour of *maculipennis*, and an attempt was made to make the conditions within the enclosed area as natural as possible. A cement pool, a stable, a small laboratory, and a tree were included within the cage. Fertile *typicus* eggs were found in the pool in 1934, but in small numbers compared with the quantity of mosquitoes released, and no sexual activity was observed in the cage. Between June 19 and July 12, 1936, we released in the cage 4,500 adults of *typicus* bred from the egg, and on July 7 we first observed swarming of the males, although larvæ had been found in the pool some days previously. Since then we have found the males swarming almost every evening, the swarm usually starting between 7.15 and 7.30 p.m., and the principal swarm always forming in the same position : about half a metre beneath the top of the cage, directly under one of the cross beams, and about half a metre from one of the upright poles supporting the side. This orientation, under the cross beam, seems very curious, and we should consider it to be fortuitous were it not repeated so frequently.

The wire cage is, of course, completely open to external stimuli, and we have been carrying on some experiments in the opposite direction : in a room insulated so far as possible from external stimuli, so that all the reactions of the mosquitoes would be to factors within the room. The room used is 2·5 metres long, 2·3 metres wide and 2·6 metres high. It is constructed of mud brick, with an air space between the ceiling and the roof ; the windows are kept closed and have been covered on the outside with canvas curtains, so that the maximum light during the day is only about five foot-candles. The climate within the room remains remarkably constant, the temperature showing a diurnal fluctuation of about 5° around a mean of 20°, the humidity varying between 84 and 94 per cent. We released in this room about a thousand *maculipennis* adults bred from *typicus* eggs, but we did not observe any sexual activity, and we only obtained two batches of fertile $F_2$ eggs. At the same time, about 600 *Anopheles superpictus* were released in the room, and the males of this species were found to swarm under these conditions very readily, and numerous fertile *superpictus* eggs were found in the aquarium in the room. Up to July 27 we had released in the same room about 500 *Anopheles elutus*, raised in the laboratory. The males were first observed swarming on July 28, and afterwards batches of fertile eggs were found in the aquarium.

We are thus able to observe under varying conditions the sexual activities of the three malaria vectors of Europe. A few *bifurcatus* were also released in this room, and one evening four or five males were observed forming a swarm, and fertile eggs of this species were afterwards obtained.

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[1] *Rivista di Malariologia*, **14**, 45 (1935).

## Persistence of the Eel-Grass Disease and Parasite on the American Atlantic Coast

EARLY in the summer, through facilities extended by Mr. John Lynch, of the U.S. Biological Survey, I was able to make a number of investigations of the existing eel-grass beds along the middle Atlantic coast, in the range of Cape Cod, Massachusetts, to Barnegat Bay, New Jersey. Mr. Lynch also supplied me with systematically taken specimens from beds farther north and south, Casco Bay, Maine, to Chesapeake Bay, Maryland, and with repeated observations from a number of points between. These studies were undertaken to discover to what extent the increasing number of optimistic reports concerning new and larger beds might indicate an effective return of the plant. For the greater part such reports describe late spring growths, during the season of rapid vegetative development, and give no clue of the plant's ability to withstand conditions arising in the less favourable warmer months, when the parasitic *Labyrinthula* is most active, or of its value as winter food for migratory birds, a matter of practical concern.

At the time of the first survey, in early June, small scattered beds of eel-grass, varying in vigour, were found all along the coast so far south as the northern end of Barnegat Bay, and extensive beds of small-leafed growths were described in the eastern shore of Chesapeake Bay, where the latter was being used for packing material. Barnegat Bay and the Delaware coast were notably free from the plant, as were the relatively rocky bays of the Connecticut coast.

The shallow bays of Long Island, Rhode Island, and Massachusetts bore patchy beds often several acres in area, and these were underlaid by extensive mats of healthy stem stock. These beds could conceivably be of ecological value, especially those along Rhode Island and Massachusetts, where the leaves averaged a metre in length, and foliation was relatively dense.

In all beds studied some plants were in seed, and, I understand from Mr. Lynch, a large fraction in the beds south of Cape Cod are now seeding. Seeds have been produced early in the summer for the past three years. It is surprising, therefore, to find but few seedlings even among the scattered plants in what appear to be new beds. Most shoots can be traced back to stem stock one or two seasons old, not very vigorous stock as a rule. If the beds continue to propagate mainly from stem stock, progress will be slow, even under favourable conditions of competition with the parasite.

Symptoms of the wasting disease were present everywhere in June, but there seemed to be no correlation between density of growth and infestation. The wasting is now at its height, so that some beds, as in Great Bay, Long Island, have entirely disappeared.

Specimens from all beds visited were examined microscopically for the *Labyrinthula* described in NATURE last year, and with which confirmatory inoculation experiments have since been performed[1,2]. Without exception it was present and active in streaked or mottled leaves, and in many regions it had already caused considerable wasting.

If previous experience may be taken as an indication, the following seasonal sequence may be expected : Very slow winter growth of the *Zostera* with the *Labyrinthula* passive in the leaves (the spindle form of the parasite has been found in winter specimens),

rapid vegetative development in the late spring, with slight increase in activity of the *Labyrinthula*, diminution in the vitality of the plant prior to seed formation in the early summer with sudden activation of the parasite, destruction of leaves, development of new leaf shoots and their subsequent destruction (repeated several times in mid-summer), and final exhaustion of a portion of the stem stock and dying back of part of the bed developed earlier. A number of plants will seed prematurely, or will appear to because more retarded members die off before the normal fruiting period is finished. Barring the development of resistent strains of *Zostera* or general attenuation of the parasite, this seems to be the probable cycle within any progressive return of the plant. This, I realize, is not a cheerful interpretation, but it will be recognized that readjustments no less drastic, but easily overlooked, occur constantly.

I should be grateful to readers of NATURE for particular information on local conditions of the eel-grass in England and on the Continent.

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[1] C. E. Renn, NATURE, **135**, 544 (1935).
[2] C. E. Renn, *Biological Bulletin*, **70**, 148 (1936).

## A Case of Complete Reversion of a Chromosomal Rearrangement in *Drosophila melanogaster*

THE process of gene mutation is known to be reversible, since back-mutations occur both spontaneously and under X-ray treatment. Yet no authenticated case of a complete reversal of a gene rearrangement has hitherto been observed. Muller and Stone[1] induced a partial re-inversion of the *ClB*-inversion of the *X*-chromosome, but neither of the new breaks corresponded to the original *ClB* breaks. A spontaneous re-inversion of the same inversion observed by Gershenson[2] has not been completely analysed; so it remains doubtful whether in this case old and new breaks coincided precisely.

In 1935, I described[3] a very long inversion of the *X*-chromosome induced by X-rays which was inseparably associated with a 'gene' for very rough eye-surface. In a stock homozygous for this inverted chromosome and carrying several recessive markers, animals with normal eye-surface appeared. Contamination was excluded by the fact that all the other factors were still present. A thorough genetical analysis showed that in these animals not only the rough eye-surface 'gene', but also the inversion had disappeared, and that old and new breaks were identical. This has since been checked up cytologically by my colleague, Mr. C. W. Emmens, in the salivary gland chromosomes.

The rough eye-surface associated with the inversion behaves allelomorphically with the factor roughest[2]. Genetical and cytological methods have hitherto failed to reveal any signs of a chromosomal abnormality associated with that mutant. Nevertheless, it remains still possible that roughest[2] is a position effect too minute to be demonstrable with our present methods.

This seems to be the first case in which a complete reversal of a gene rearrangement has been demonstrated by all available criteria. At the same time, the case furnishes crucial evidence for the existence of a position effect, since phenotypic effect and inversion appeared and disappeared simultaneously.

A detailed analysis of the case will be published in the *Journal of Genetics*.

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[1] H. J. Muller and W. S. Stone, *Anat. Record*, **47** (1930).
[2] S. Gershenson, Drosophila Information Service, No. 1 (1934).
[3] Hans Grüneberg, *J. Genetics*, **31**, 163 (1935).

## Different Results in Reciprocal Crosses between Diploid and Triploid *Allium Schœnoprasum* L.

IN the summer of 1934, crosses were made between diploid forms of chive ($2n=16$) and artificial triploids ($2n=24$)[1]. The somatic chromosome numbers in the progeny of these crosses have now been determined for 100 plants and are shown in the accompanying table.

The results exhibit a decided difference, according to whether the diploid or the triploid was used as the mother plant. In the former case, the majority of the progeny obtained were diploids, only 18 out of 71 plants having different chromosome numbers, namely, $2n=22$–$24$. In this cross the numbers 17–21 were not found at all. If, on the other hand, the triploid was used as the mother plant, all chromosome numbers between 16 and 24, except the number 20, were obtained. The trisome class, $2n=17$, which was not formed in the former case, was now the one most numerously represented. In addition, there also occurred one plant with 28 chromosomes, the result of the functioning of a giant gamete.

| Direction of cross | Chromosome number of the progeny | | | | | | | | | | Total of plants |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | Med. | |
| $2x$ ♀ × $3x$ ♂ | 53 | 0 | 0 | 0 | 0 | 0 | 4 | 11 | 3 | 17·8 | 71 |
| $3x$ ♀ × $2x$ ♂ | 8 | 9 | 1 | 2 | 0 | 4 | 1 | 2 | 2 | 18·5 | 29 |

It is obvious that the effect of the elimination or non-formation of aneuploid zygotes is greater when the embryo develops on a diploid than on a triploid plant.

These results are in agreement with earlier work on reciprocal crosses between diploids and triploids, for example, in *Oenothera*[2] and *Zea*[3].

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[1] Levan, *Hereditas*, **22**, 1 (1936).
[2] van Overeem, *Beih. Bot. Zbl.*, **38**, 73 (1921).
[3] McClintock, *Genetics*, **14**, 180 (1929).

## The Feulgen Reaction of the Bacteriophage Substance

THREE years ago, a method was described which yielded pure preparations of a *Coli* bacteriophage of large particle size (*WLL*) in weighable quantities[1]. The high phosphorus content (3·7 per cent) of these preparations and their high affinity for basic dyes

suggested—in connexion with other analytical results—that the chief constituent of the particles was of nucleoproteid nature[2].

It has now been found that they are intensively stained by Feulgen's reagent, generally regarded as a histo-chemical reagent for thymonucleic acid. Bacteria and bacterial debris (even a concentrated preparation of debris of phage-size obtained by lysing the organism with the very small phage *S*13 which afterwards could be removed by washing) treated in the same way remain unstained. So the phage-substance seems to be chemically different from any constituent of the bacterial cell normally present in significant amount.

The concentrated and purified preparations of a *Staphylococcus* phage obtained recently by Dr. Elford show exactly the same staining reactions as the *WLL-Coli*-phage.

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M. Schlesinger, *Biochem. Z.*, **264**, 6 (1933).
[2] M. Schlesinger, *Biochem. Z.*, **273**, 306 (1934).

## Lightning and Atmospherics

IN NATURE of August 15, on p. 278, I notice a paragraph dealing with atmospherics produced by lightning discharges. From my own observations, I would express the opinion that the statements made in that paragraph only represent a part of the complete picture. There are so many different kinds of atmospherics observed both aurally in radio receivers and visually when they are recorded as by means of cathode ray oscillographs, that a complete generalization in such simple terms as are there expressed is scarcely possible.

With certain classes of atmospherics, in some cases quite a prolonged crackling can be observed lasting as much as a second before the lightning flash is observed visually. In such instances the crackling, one can only presume, arises from initial priming discharges somewhat in the nature of long brushing streamers, such as may be observed with high-tension electrical test apparatus, which brushing ultimately culminates in a complete sparkover. In all cases of observed atmospherics of this nature, the crackling sound of more or less prolonged duration finishes with a loud crack coincident with the final sparkover, which is observed as the visible lightning flash.

This type of atmospheric is only observed with certain forms of thunderstorms and is by no means of general occurrence. In many cases the sounds heard are of a simple click nature, which corresponds to straight sparkover without the preliminary brushing discharges giving the prolonged crackling sounds.

So far as my own observations go, the type of atmospheric particularly referred to, which gives the long crackling noise followed by the final crack of the sparkover, is a much rarer form than the simpler types in which it is obvious that the sound accompanies the visual flash. It is possibly for this reason that little notice has been taken of this form of discharge.

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## Colloid Substrate in Photosynthesis

IN an earlier note on this subject[1] it was recorded that in the interaction of two salts in an aqueous medium, leading to the formation of periodic structures (mineral arboreal growth), a colloidal condition is created in the medium, this state remaining stable under the original experimental conditions.

Since then, it has been observed that whilst periodic structures find their existence above the transition point of the colloid to the physico-chemical associations approaching double salts, the range of the colloid state is much wider, extending both above and below this transition point. Thus in the interaction of calcium chloride with sodium carbonate, arboreal growth appears above the hydrocalcite to calcite transition point, that is, at 10°–12°[2] with a range of formation of 10°–12°. But the systematic formation of the colloidal phase itself commences with the appearance of the gelatinous membrane at the interface of the two electrolytes at about 4°, and is produced regularly so long as this membrane exists.

Close observation showed that the colloid was not always confined to the aqueous medium. Very often it was also dispersed in the air above it. During the eruptions from the membrane-protuberances, effervescence on the surface of the liquid could be frequently observed, and by means of a narrow parallel beam of light from a Miller projecting lamp, the Brownian movement of finely divided colloidal matter could be seen in the space above the liquid. The evolution of this effect depended on such experimental conditions as osmotic pressure, height of column of liquid above membrane and character of membrane itself.

In the light of researches by Baly, Dhar and others on photosynthesis, these observations when applied to marine and atmospheric surroundings appear to have an important bearing upon natural phenomena. Details of this work are to be published elsewhere.

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[1] NATURE, **132**, 67 (1933).
[2] Copisarow, *J. Chem. Soc.*, **123**, 785 (1923).

## Indication of a Decrease in the Polarizability of a Non-Polar Molecule by Pressure

SOME years ago, results were published of measurements on the dielectric constant of carbon dioxide under pressures up to 1000 atm.[1]. Using Amagat's isotherm data, where available, the Clausius Mosotti function $P = \frac{\varepsilon - 1}{\varepsilon - 2} \times \frac{1}{d}$ was calculated; $P$ is proportional to the polarizability of the molecule. It was stated that $P$ showed a tendency to decrease, the decrease at 1000 atm. being about 1 per cent. It was considered not impossible at that time that this decrease was due to an uncertainty in the density $d$.

Lately more accurate isotherms of carbon dioxide have been published[2]. Using these data, the value of $P$ has been recalculated. As an example of the results, values of $P$ have been plotted in Fig. 1 against density, and in Fig. 2 against pressure. It can be seen that $P$ decreases with pressure and this

decrease is obviously more simply related with the change in pressure than with the change in density.

There are two possibilities to account for this effect. The first is, that the Clausius Mosotti expression is not the exact relation between the polarizability of the molecules and the dielectric constant; the second one is, that the polarizability of a molecule is really decreased by pressure. With regard to the first possibility, it must be remembered that a rigorous proof of the Clausius Mosotti expression has not yet been given, and it is possible that the assumptions necessary to arrive at the formula do not hold under the present conditions. From the way in which the formula is deduced, and from a recent discussion by Darwin[3], it can be expected that, if corrections to the simple Clausius Mosotti expression are necessary at higher densities, these will be functions of density, which will not strongly depend on temperature. This view is, however, in contradiction with the experimental data.

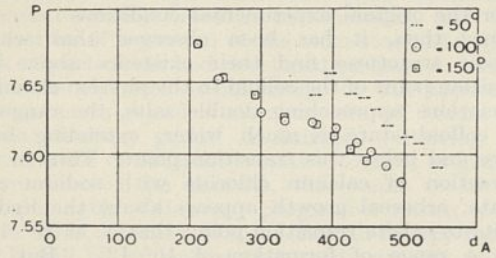


FIG. 1.

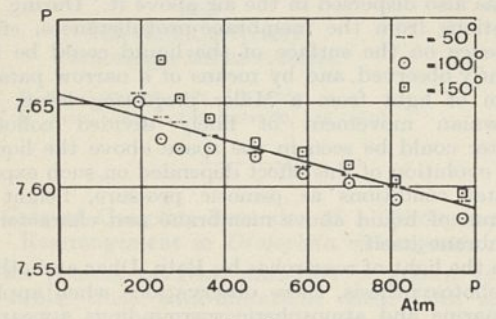


FIG. 2.

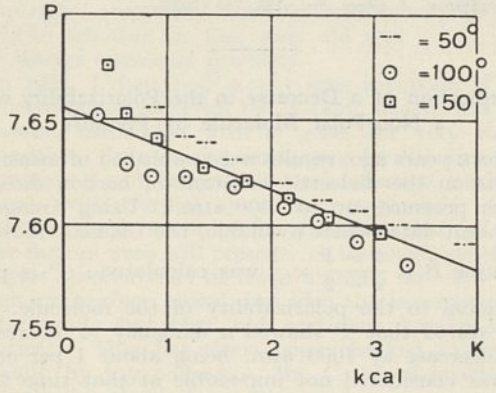


FIG. 3.

In favour of the second possibility, an argument can be given making use of the virial theorem. If the constituent parts of the molecule, that is, nuclei and electrons, are treated as separate particles, all the forces acting between those particles are Coulomb forces. The virial theorem applied to such a system leads to

$$3\triangle pv = \triangle K + \triangle U^{4}.$$

where $pv$ is the product of pressure and volume, $U$ is the total energy of the system, and $K$ is the sum of the kinetic energies of all particles. For an isothermal compression the kinetic energy of the molecules (for example, translational and rotational) is constant by the equipartition law. Therefore $\triangle K$ measures the increase of the kinetic energy of the internal motion of the molecules (for example, kinetic energy of nuclear vibrations and electronic motion) and can be considered as a useful measure of any alteration inside the molecule, caused by compression. It is, therefore, apparent that a relation between $\triangle K$ and $P$ must be sought.

In the case of carbon dioxide, $\triangle K$—which can be calculated from isotherm data—amounts to 3·5 kgm. cal./mol. at 1000 atm., or 0·15 e.v. per molecule. It changes almost linearly with $p$, and is affected only slightly by temperature. The simple relation found between $P$ and pressure therefore points to a similar relation between $P$ and $\triangle K$. In Fig. 3, $P$ is plotted as a function of $\triangle K$, for three sets of measurements at different temperatures, and it can be seen that, within the experimental accuracy, $P$ is a linear function of $\triangle K$. (The uncertainty in $P$ is estimated as $\pm$ 0·03 at density 200 A.; $\pm$ 0·015 at 400 A.; $\pm$ 0·01 at 600 A.)

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[1] Michels and Michels, *Phil. Trans.*, A, **231**, 587 (1933).
[2] Michels and Michels, *Proc. Roy. Soc.*, A, **153**, 201 (1935).
[3] C. G. Darwin, *Proc. Roy. Soc.*, A, **146**, 17 (1934).
[4] W. Schottky, *Phys. Z.*, **21**, 232 (1920); J. C. Slater, *J. Chem. Phys.*, **1**, 691 (1933).

## Excitation of Raman Spectra of Substances with the aid of 'Optical Catalysers'

IN a recent paper[1], we have shown that the infra-red frequencies of glass can be calculated by taking the wave-lengths of the maxima of absorption bands of didymium glass as the incident exciting radiations, and those of the maxima of the fluorescent bands of the same glass excited by sunlight, as the Raman lines. The values thus obtained are in excellent agreement with those obtained for glass by the usual method of experimentation using a mercury lamp and many hours of exposure.

Following the same method of experimentation, we have now extended our observations to water, methyl alcohol, ethyl alcohol, acetone, pyridine and nitric acid solution in water. In order to produce absorption bands in these media, a trace of potassium permanganate was added to each of the above substances. The corresponding fluorescent bands obtained with sunlight were photographed. The duration of exposure varied, from two to three hours giving sufficiently strong bands on development of the plate. From the wave-lengths corresponding to the maxima of absorption and fluorescent bands as located by microphotometric records for each material, Raman shifts have been calculated which

represent both fundamental and combination frequencies. It is interesting to point out in this connexion that combination frequencies calculated in this way, when not in agreement with the values of previous workers, can still be built up either entirely with their values or jointly with our own.

The importance of this new technique for the study of Raman spectra lies in two directions. First, with the use of sunlight the time of exposure is considerably cut down, so that very faint lines can also be brought out; secondly, small shifts of faint Raman lines, which generally are masked by the strong incident spectrum, can be calculated.

Since the minute traces of potassium permanganate used to produce the absorption bands in the various substances do not seem to affect their modes of vibration concerned in the Raman effect, their action and that of didymium salts in glass may very appropriately be referred to as 'optically catalytic'. Workers on the Raman spectra of glass have also noted previously that small quantities of metallic oxides present in different varieties of glass do not alter their Raman lines.

There are other points connected with the method which throw an interesting light on the nature of the relations observed. For example, the work of Merton[2] and Taylor[3] on the absorption bands of solutions of potassium permanganate in different solvents shows that the differences of wave numbers between successive bands, for any solution, are not really constant, although their mean value is usually taken to represent the frequency of the $MnO_4$ ion as affected by the particular medium of the solvent. On the view taken in this paper, these discrepancies between the differences of wave numbers of the successive absorption bands are real, and are due to the fact that the actual positions of the absorption bands are conditioned by the appearance of Raman lines representing either fundamental or certain combination frequencies of the solvent medium, at certain definite wave-lengths constituting the fluorescent spectra of the substance under examination.

No results are given here as they would occupy too much space. They will be published with full experimental details elsewhere shortly.

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[1] *Z. Phys.*, **98**, 324 (1935).
[2] *Trans. Chem. Soc.*, **99**, 637 (1911).
[3] "Molecular Spectra and Molecular Structure", Faraday Soc. Disc. No. 790, pp. 860–63 (1929).

## Points from Foregoing Letters

THE first quantitative measurements of the abundances of the elements in the planetary nebulæ are derived by Mr. T. L. Page from the intensities of 'forbidden' lines in the spectra of these objects. An explanation is sought for the surprisingly high abundance of neon and argon relative to oxygen, as compared with their proportions in the composition of the earth.

A variety of radioactive bromine has been detected, by Dr. C. H. Johnson and F. T. Hamblin, which possesses a half-period of some twenty-four hours. The authors consider that it is either an activated bromine nucleus or a new isotope.

The absorption of neutrons (belonging to Fermi's group C) by boron and by cadmium at ordinary and at low temperatures has been determined by a group of investigators from the Ukrainian Physico-Technical Institute. They conclude that the absorption curve of cadmium has a selective character. The results for boron do not agree with the 'inverse velocity law', but that may be due to a deviation of the silver detector from the $1/v$ relation.

G. L. Mack writes that he has failed to confirm the increase of ascorbic acid (vitamin C) when cabbage is boiled, as reported by Guha and Pal. The amount, he says, is no greater than that obtained by alcohol extraction or after treatment with hydrogen sulphide. The author concludes that practically all the apparent increase is due to the inactivation of an oxidizing enzyme, and not to the hydrolysis of an ascorbic acid ester.

E. Baldwin and Dr. D. M. Needham find that the electrical tissue of the ray, *Torpedo*, contains enzymes analogous to those found in the muscular tissue of that fish, and also in the jaw-muscle of the sea-urchin, *Sphærechinus granularis*. They deduce that both muscle and electrical organ derive their energy from the same chemical sources and through the same chemical mechanism.

In a stock of fruit-flies with very rough eye surface, accompanied by an inversion in the *X*-chromosome (originally induced by X-rays), Dr. H. Grüneberg has observed the appearance of animals with normal eye surface and without chromosome inversion. This is claimed to be the first clearly demonstrated case of complete reversal of a gene rearrangement.

A. Levan reports that crosses between two strains of chive (*Allium Schœnoprasum*) containing 16 and 24 chromosomes respectively gave offspring containing mostly 16 chromosomes when the mother plant contained 16, while when the mother plant contained 24, the chromosome number in the offspring varied between 16 and 24 (except 20), the most frequent being 17.

Dr. M. Schlesinger finds that his pure bacteriophage preparations are intensively stained by Feulgen's reagent, whilst bacteria and bacterial debris treated in the same way remain unstained.

Graphs showing the relation between the Clausius Mosotti function, $P$ (proportional to the polarizability of the molecule) and the density, the pressure and the change in kinetic energy of the internal motion of the molecules, $\triangle K$, are given by Prof. A. Michels, C. Michels-Veraart and A. Bijl, from calculations based upon recent data for carbon dioxide. They find a nearly linear relation between the polarizability and the pressure, also between polarizability and $\triangle K$.

Previous work of Prof. K. Prosad and D. K. Bhattacharya on didymium glass, of which the wave-lengths of absorption bands were taken as the incident exciting lines for the study of the Raman spectra of glass with very satisfactory results, has now been extended to a number of organic liquids and to nitric acid solution. Absorption bands in these liquids were produced by adding traces of potassium permanganate.

# Research Items

### Asianic Deities in the Paganism of Ancient Georgia

A RE-EXAMINATION of the evidence relating to Paganism in early Georgia by Prof. M. Tseretelli (*Georgica*, 1, 1) indicates the need for revision of hitherto accepted views, and the recognition of a considerable Asianic element in the ancient cults of the Caucasian area. The deities enumerated in the sources are Armaz Zaden, Ga or Gaím and the Chaldean goddess It'rujan, or It'rushana. The resemblance of Armaz to Ahura-Mazda, together with the fact that Mazdaism was introduced into Georgia long before Christianity, suggests an obvious identification. There is no doubt that Armaz is a Georgian national deity. The account of the copper idol and the religious festival of Armaz given by St. Nina point to identification with Teshub, the god of the Mitanni and Urartaeans, the pre-Indo-European people of Armenia, who is represented with thunderbolt and axe, and may be related to Zeus Labraunda and Jupiter Maximus Dolichenus, *natus ubi ferrum exoritur*, whose worship was said to have been brought to Kommagene by Khalybean smiths. The god Zaden with Armaz gives rain and fertility to the Georgian soil. He is, in fact, the Asianic god of fertility, Sandar or Marduk, the Babylonian Tamūs. The custom of offering first fruits and the first born of man and beast to Zadin is probably Semitic. Human sacrifice was also offered to Ga and Gatsi. It is argued that Gatsi and Ga are the 'father' and 'mother' of the widespread fertility cult. A deity not mentioned in the texts, the goddess Ašhara, is still worshipped among the Abkhasians. She may be the goddess Išhara, mentioned in the Boghazhoï texts, who was also worshipped in Babylon, Assyria and Elam. She is the tutelary goddess of the homestead, and the mountaineers still worship "the angel of the house". Finally, there is the Chaldean goddess It'rujan who is opposed to Armaz. It'ru is rightly identified with Ishtar ; 'jan' is probably Samain, the goddess of heaven, who as a Chaldean deity destroyed the idol of Armaz and was resisted by the natives. There is also evidence of a tree and pillar cult.

### Antiquities in Shetland

A TOUR of archæological investigation in Shetland made by Mr. Ludovic Man in July last, following up a similar investigation in Orkney last year, has produced some interesting results. An examination of the glacial clays and derived gravels produced a number of rolled stone implements of types similar to those of the palæolithic cultures of England and France. At Bressay an old land surface about three feet below the existing surface yielded more than a hundred tools, mostly of quartz and quartzite and of small dimensions, unrolled with sharp edges, which Mr. Man classifies as mesolithic. On Ward Hill at Sumburgh, a settlement of considerable size has been exposed by wind erosion. Stone foundations of a large number of buildings have been bared. The walls appear to have been three feet thick at the base, and the oval internal chamber some fifteen feet by ten feet in dimensions. No traces of superstructure survive ; but stone implements, the half of a large saddle quern, and a massive hammer-stone, weighing thirty pounds, point to a considerable antiquity. Possible evidence of cultivation is found in small cleared plots, thirty feet in diameter, with the stones from the clearing lying without system on the periphery—it may be a prehistoric anticipation of the present method of cultivation in walled enclosures. The most interesting find, however, was at Braewick, where storm water had breached an 'ayr', or storm beach, and drained a small lock, exposing ancient timbers, in which the distinctive character of the nails, and the wooden pegs with hexagonal shafts, point to a Viking origin. If further examination of the material, which is now in Glasgow, confirms Mr. Man's conclusion that this is part of a Norse boat, it is the first find of that kind to be recorded in Scotland.

### Fossil Horse Remains from Idaho

NORTH AMERICA has supplied in its remains of fossil horses one of the most complete of evolutionary series. The collection of bones described by C. Lewis Gazin, from the Hagerman lake beds of Idaho, belonging to the Upper Pliocene, contains an abundant assortment of remains of *Plesippus shoshonensis*, an advanced member of its genus bordering on the horse types of the Pleistocene age (*Proc. U.S. Nat. Mus.*, 83, No. 2985, 281, Washington 1936). The material included 130 skulls of the species named above, and a large quantity of other skeletal material, some of which was found still in a position of articulation. The appearances are that the remains accumulated naturally round a water-hole, for amongst the many other vertebrates which are represented in the Hagerman beds there is a noticeably large number of aquatic forms. The paper contains descriptions, measurements, and comparative comments upon the horse remains.

### Urethral Sinus in Rodents and Insectivores

THE male of certain rodents and insectivores possesses a sac-like diverticulum of the urethra, the urethral sinus. The development of this structure in the white mouse and its occurrence in other forms have been dealt with by Hall (*J. Anat.*, 70, Pt. 3, 1936). The sinus makes its appearance about the sixteenth or seventeenth day. At this time, the fusion of the genital folds gives rise to the penile or secondary urethra, and the sinus arises as a dorso-lateral bulge at their point of junction, but is derived from the primary urethra. A pair of solid club-shaped structures then arise as buds from the urethral epithelium just at a point where the sinus bulge occurs ; these are the rudiments of Cowper's glands, which in the adult open into the base of the urinary sinus. The walls of the sinus are similar in nature to those of the urethra, and contain glands, whereas the epithelium of the penile urethra is non-glandular. The presence of this urino-genital sinus is reported in *Evotomys glareolus*, *Microtus hirtus*, *Apodemus sylvaticus*, *Mus rattus*, *Cricetus auratus* and *Fiber* (that is, *Ondatra*) *zibethicus*. It is apparently not present in *Cavia cobaya*.

### Loose Smut of Oats

THE fungus *Ustilago Avenæ*, causing loose smut of oats, is capable of infecting its host through the stigma of the flower, and the disease may also appear from later infection. A paper by Mr. Robert McKay ("Methods of Infection of Oat Grain with Ustilago Avenæ and the Influence of External Factors on the Incidence of the Disease", *Sci. Proc. Roy. Dub. Soc.*, 21, No. 33, July 1936) shows that under the conditions of the crop in Ireland, the fungus produces a resting mycelium within the glumes, and further spores may also lodge there. These remain ungerminated until the following spring. Experiments on washing flower-infected grain in water, and on removing the glumes (de-hulling), both gave a substantial reduction of infection in the subsequent crop. A combination of these two methods of treatment resulted in almost complete control of the disease, and suggests that most of the infection is brought about by the ungerminated spores lodging within the glumes.

### Immunity of Apples to Woolly Aphis

IN certain countries the use of immune stocks and stems on which desirable varieties are grafted has met with considerable success as a means of combating attacks of woolly aphis (*Eriosoma Lanigerum*). An attempt to elucidate the underlying causes of resistance and immunity to this pest is described by M. B. Crane *et al.* (*J. Pom. and Hort. Sci.*, 14, 2, 137; 1936). Its life-cycle is outlined, and preliminary experiments on the physiological aspect of immunity described. These suggest that the mechanical structure of the stem and the presence of certain insoluble substances may possibly be related to resistance, though they do not explain complete immunity. A genetical analysis was made by crossing a large number of common apple varieties with a number of well-known susceptible and immune rootstock varieties and testing the resultant seedlings for resistance or immunity. The results of this analysis indicate that "the hereditary behaviour of immunity is determined by and dependent upon a certain balance of genetic factors and is governed by a number of genes, the action of which is in part complementary and in part cumulative". Several immune seedlings raised in this way are being tested for their suitability for general use in respect to vigour, ease of propagation and productivity.

### Diorites of the Cascade Range, Oregon

A SERIES of dioritic intrusions penetrate Tertiary volcanic rocks in a narrow belt which extends longitudinally through the Cascade Range of Oregon. An interesting regional study of these rocks and the associated metasomatism and metamorphism has been made by A. F. Buddington and E. Callaghan (*Amer. J. Sci.*, 421–449; 1936). The intrusions are mostly dyke-like, but there are numerous plugs and a few small stocks. The rock-types represented range from augite-diorite to granodiorite and porphyritic dacite. Replacement of plagioclase by orthoclase is a common feature throughout. Similar orthoclasization, described by Gillson, transformed a gabbro into quartz-monzonite (Pioche, Nevada) and was ascribed by him to the action of potash-bearing emanations from below during the magmatic stage and also, locally, after solidification. The Cascade rocks are shown to be closely related chemically to those of the Mesozoic intrusives of the Sierra Nevada. Volcanic rocks surrounding the intrusions have been modified through zones varying in width from a few inches to nearly half a mile. In places the original rocks (basalt-andesite-rhyolite series) have been wholly reconstituted and changed to tourmaline-hornfels.

### The Patwar Meteorite, 1935

IT has been estimated that the number of meteorites recovered, after their fall to the earth's surface has been actually seen, averages about four per year since the year 1850. A large proportion of these meteorites are stones or masses of crystalline rock, a much smaller proportion being composed of metallic iron alloyed with nickel and cobalt. An account of the "Patwar Meteoric Shower of 29th July, 1935", by Dr. A. L. Coulson (*Rec. Geol. Surv. India*, 69, 439), illustrates the considerable amount of careful work required to ascertain the circumstances of the fall of a meteorite, the recovery of its various parts, and the subsequent mineralogical and chemical analyses. Reports collected from the Tippera district of Bengal indicate that the Patwar meteorite fell on July 29, 1935, at $14^h\ 20^m$ Indian Standard Time. Its fall was accompanied by the usual phenomena of light and sound. Five portions of the meteorite were recovered over an area of about $4\frac{1}{2}$ square miles. The largest portion, weighing 23 kgm., which came from Patwar, had penetrated the ground, presumably soft owing to monsoon conditions, to a depth of 34 inches. This portion, which is completely illustrated in the report by a number of photographs, has a greatest circumference of 2 ft. $9\frac{1}{2}$ in.; its greatest length is 1 ft.; its breadth 10 in. and its thickness $8\frac{1}{2}$ in. The specific gravity of the meteorite is 4·21. Analysis shows that the meteorite, which is intermediate in composition between a stone and an iron, is composed chiefly of nickel-iron, with olivine, enstatite and bytownite, together with smaller amounts of other compounds including hydrocarbons.

### Absorption of Short X-rays

T. R. Cuykendall and M. T. Jones have recently described (*Phys. Rev.*, 50, 105) absorption experiments on X-rays from a 600 k.v. tube. A double crystal spectrometer was used to isolate X-ray beams of wave-length down to 40 X.U. The absorption of very short X-rays by carbon was in excellent agreement with the Klein-Nishina scattering formula. The absorption coefficients for a number of elements, heavy and light, were determined, and the photo-electric part of the absorption fitted to an empirical formula. The photo-electric absorption observed in lead in this frequency region is about 10 per cent higher than that calculated theoretically by Hulme and others.

### Mass-spectrographs

IN an article on "Second Order Focusing for Mass Spectrographs" (*Proc. Camb. Phil. Soc.*, 32, pt. 3) Mr. W. W. Sawyer considers the conditions under which focusing may be improved when, instead of the electrostatic deviation being produced by the field between parallel plates, the field between co-axial cylindrical plates with the axis perpendicular to the plane traversed by the charged particles is substituted. The mean path of the particles in this field is nearly a concentric circle, and on emergence they enter a magnetic field the lines of which are parallel to the axis of the cylinders and the section

of which is a circle. The advantages of this arrangement were mentioned by Dr. F. W. Aston in a recent note in NATURE (137, 357; 1936). Mr. Sawyer gives the dimensions of the spectrograph constructed on these lines as follows: mean radius of cylinders 40 cm.; angle subtended at the axis $\frac{1}{4}$ radian; distance from farther edge of electrostatic to near edge of magnetic field 15 cm.; diameter of magnetic field 15 cm.; the near edge of the photographic plate is 11·3 cm. beyond the farther edge of the magnetic field and 16·2 cm. from the axis of the beam between the two fields; and the plate itself is inclined at 24° to this axis.

### Resolution of an Allene Compound

THE prediction that optical activity could be exhibited by allenes of the general type

$$\begin{matrix} a \\ b \end{matrix}\!\!>\!C = C = C\!<\!\!\begin{matrix} c \\ d \end{matrix}$$

was made by van't Hoff in 1875 ("La Chimie dans l'Espace", p. 29) and many unsuccessful attempts were made to verify it. The linking of the central carbon atom in the triad differs considerably from those types for which the tetrahedral theory has been shown to hold. The groups $a$ and $c$ and $b$ and $d$ may be identical. P. M. Raitland and W. H. Mills (*J. Chem. Soc.*, 987; 1936) have now shown that the compound in which $a = d = C_6H_5 = \varphi$ (phenyl) and $b = c = C_{10}H_7$ (naphthyl), when produced by the catalytic dehydration of the alcohol:

$$\begin{matrix} \varphi \\ C_{10}H_7 \end{matrix}\!\!>\!C(OH).CH:C\!<\!\!\begin{matrix} C_{10}H_7 \\ \varphi \end{matrix} = H_2O +$$

$$\begin{matrix} \varphi \\ C_{10}H_7 \end{matrix}\!\!>\!C:C:C\!<\!\!\begin{matrix} C_{10}H_7 \\ \varphi \end{matrix}$$

by means of optically active catalysts, can be obtained in two entiomorphous forms. As catalysts, *d*- and *l*-camphor sulphonic acids were used in benzene solution. The specific rotation $[\alpha]_{5461}$ of the active allene has the large value of 437°–438°. The two forms (m.p. 158°–159°) combined in solution in ether to a racemic compound (m.p. 242°–244°). Van't Hoff's prediction of the enantiomorphism of unsymmetrically substituted allenes is thus verified. It depends on the assumptions of the linear arrangement of the three carbon atoms and the disposition of the external valencies of the terminal carbon atoms in planes at right angles to one another.

### The Marconi-E.M.I. Television System

ON the occasion of the recent demonstrations of television provided in connexion with the Radio Exhibition at Olympia, the programmes were transmitted on alternate days by the Baird system and by the Marconi-E.M.I. system. Some details of the latter system are given in an illustrated pamphlet just issued by the Marconi-E.M.I. Television Co., Ltd. The system employs one or more 'Emitron' scanning cameras, having no moving parts, by means of which the scenes to be transmitted are directly and continuously transformed into electrical impulses without the intermediary of a film device. These cameras can be used under normal conditions of daylight on exterior locations or in studios. Film scanning cameras are also included in the normal equipment. In either case, the resulting electrical impulses are fed to a specially developed modulator unit, whence the oscillations of the main transmitter are controlled. A suitable synchronizing signal is included in the transmissions by means of which complete steadiness of the received picture is ensured. The pictures are transmitted at a frequency of 25 per second with a scanning detail of 405, 240 or 120 lines, and provision is made in the equipment for either straight or interlaced scanning. The latter system is recommended since flicker of the received picture is entirely eliminated. The radio transmitter consists essentially of a master oscillator, frequency doubler and amplifying and modulating equipment. With the carrier frequency in the region of 40 megacycles per second, it is claimed that the frequency can be maintained constant to an accuracy of $\pm 1$ part in 20,000. The modulating stages are designed to have linear response from zero frequency up to 3 megacycles per second. The aerial system comprises a number of aerial and reflector units suspended round the periphery of an octagon; the whole system is designed to give maximum radiation in the horizontal plane, uniform in all directions. In the arrangement of the aerial system at the B.B.C. station at Alexandra Palace, the aerials for the sound and vision transmissions are erected one above the other on the same tower.

### Accuracy of Meteor Observations

WITHIN recent months, three independent articles have appeared in different journals dealing with this subject. Mr. B. S. Whitney has published (*Mon. Not. R.A.S.*, 96, 5, March 1936) an interesting paper, "New Methods for Computing Meteor Heights", in which it is admitted that meteor heights deduced from ordinary visual observations are subject to large errors because of the difficulty in observing and plotting the paths accurately. He proceeds to develop a method for adjusting the beginning and ending as seen at different stations, the adjustments being the smallest possible which will refer the recorded directions to a common point. In the case of multiply observed meteors or fireballs a least square solution is developed, and three cases have been already computed by the method by the staff of Flower Observatory of the University of Pennsylvania, where the author is engaged in research. Unfortunately, the numerical results are not given, so it is impossible to judge the extent of the observational errors. In *Popular Astronomy* of May 1936 there is an article by Messrs. F. Watson, jun., and E. M. Cook, entitled "The Accuracy of Observations by Inexperienced Meteor Observers", in which some rather startling conclusions are drawn from the results of observational tests. It appears that in the case of inexperienced observers, the probable error in the direction of a meteor lies between $\pm 10{\cdot}8°$ and $\pm 18{\cdot}8°$. Experienced observers, however, concentrating on bright meteors, have reported observational errors as low as $\pm 4°$. The Rev. Dr. M. Davidson (*J. Brit. Ast. Assoc.*, 46, 8, June 1936) has given a very comprehensive analysis of the method which he proposes for computing real paths, assuming the *direction* of flight to be accurately recorded, but allowing for the beginning or ending of the apparent path to be missed. In this article, "The Computation of the Real Paths of Meteors", two numerical examples are fully worked out, and it is shown that in both cases a considerable portion of the flight was missed by one or other observer. These papers suggest that the whole subject of meteor observation may require reconsideration in order that more accurate results may be obtained.

# Science and Electric Lighting

A POPULAR discourse at the Blackpool meeting of the British Association was given on Friday, September 11, by Mr. C. C. Paterson. He chose as his subject "Science and Electric Lighting", and illustrated his discourse by many striking and spectacular experiments. Through the medium of these experiments, he enabled the audience to picture the present outlook of the scientific worker in the field of electric lighting and how rapidly it is changing. During the last four years, the amount of light that can be obtained from a given quantity of electricity has been increased three times. During this time, it has also been demonstrated that it is possible to make lamps of which the luminous component is at least a hundred times brighter than the brightest filament previously available. These great achievements are rapidly being exploited by industry in Great Britain.

Mr. Paterson began by showing the fundamentally different methods of producing electric light by filament lamps and discharge lamps. In one we obtain light from solids and in the other from vapours. In the latter kind of lamp, the light comes from vapour made brilliantly luminous by passing electricity through it. He showed a lamp with a container for a small quantity of vapour having a volume of about a twentieth of a cubic inch. Success followed research when it was found how to pass a current through this little enclosure. The difficulty was to make the free molecules of the vapour carry electricity, but once the current started it was difficult to control it. The intensity of the light in this lamp is a measure of the vigour with which the molecules of vapour respond to the stimulation. The molecules of different vapours respond in different ways, and they show their peculiarities by the nature of the light they emit. By the spectrograph, this light can be separated into its various components, and from the point of view of the lamp maker these specify the lamp.

In the incandescent filament lamp, the filament of which is now made of tungsten, and is heated to a very high temperature, the molecules of the solid tungsten do not radiate light in the same way as vapour molecules. This is shown by the fact that the spectrum of this lamp contains all the colours shaded into one another. The spectrum of any incandescent solid or liquid is always of this type. This follows because the molecules cannot move as if they were in free space ; they are constrained by the neighbouring molecules. Their light is very similar to that of the sun, which comes from incandescent gases and vapours under extreme conditions of pressure. The light given by an incandescent filament being a rough imitation of sunlight satisfies our demands for illumination. Why therefore should we want to use something else ? The reason is that the new lamps are able to give us much more light in comparison with the waste heat that is always produced.

With filament lamps the higher their temperature the more light they give, but the tungsten evaporates more rapidly the higher the temperature and thus its life is short. Research has discovered that if we coil the filament so that it occupies less space, the total convection currents will be less and the evaporation will be reduced. From this was developed the tightly coiled gas filament lamp which has been the most popular type of electric lamp for the last twenty years. In addition, by coiling the coil the efficiency can be still further increased. More than half the number of lamps now used in Great Britain for domestic purposes have coiled coil filaments and they give up to twenty per cent more light for the same consumption of electricity.

The metal tungsten out of which the filament is made is one of the toughest and most refractory of metals. It is so hard that it has to be drawn through diamond dies which have to be pierced with round holes no more than the size of a fine human hair. The wire diameter has to be correct to within 0·5 per cent, that is, five millionths of an inch. The craftsmanship of the girls who do this wire drawing is deserving of the highest praise. Mr. Paterson said that one of them described the process to him as like threading a wire you can't see through a hole that isn't there. This minute thread has then to be coiled with the greatest uniformity and equal precision, and finally the coil has to be again coiled. Out of the 3,775 turns in this spiral, not a single one must touch its neighbour, although the space between them is less than the thickness of a cigarette paper.

The enhanced efficiency of a vapour lamp is due to the absence of unwanted kinds of radiant rays. For mercury vapour lamps the effective light radiated is about three times as great for the same consumption of energy. If we had two electric lamps both using a pennyworth of electricity a day, but one giving only blue light and the other only green light, the latter appears to give more light than the former. The reason is that the green light is more useful to see with—in other words, it appears brighter. For this statement to be strictly correct, it has been presupposed that the blue light and the green light demand the same proportion of the electric power to produce them.

Tubular lamps were shown containing vapours of many kinds, and the difficulties of producing light of a satisfactory colour at a cheap rate were considered. The sodium lamp, which is the most economical, gives light of an unpleasing colour, and unfortunately no good way of correcting this colour defect has yet been invented. The neon lamp has been found very useful for floodlighting red brick buildings and for other colour effects. It is almost completely deficient in green and blue rays.

Mr. Paterson mentioned that some new investigations have opened out a new and very promising field of research. It has been discovered that if we coat the inside of a neon tube with a certain luminescent powder, the activity of the gas in the tube excites the characteristic fluorescence of this powder. It therefore gives out light of the colour we want, which, as it mixes with the red light from the neon gas, gives a series of pleasant colours very suitable for interior lighting. Hitherto it has only been found possible to excite fluorescence to an appreciable extent by direct excitation of the powder by the electrons of which the current consists, or else by means of the mercury discharge, which is very rich in ultra-violet lines. The great advance lies in the

discovery that neon, which is comparatively poor in ultra-violet light, can by using suitable powders be made to excite luminescence. These luminescent materials will probably be largely used in electric discharge lamp lighting. They will add the missing colours to light given out by vapours and gases, thus making objects illuminated by them appear as they do in daylight.

It was found four years ago that very great yields of light could be obtained from the passage of electricity through mercury vapour, if the pressure of the vapour was increased to about one atmosphere instead of using only one hundredth of an atmosphere as in the older types of lamp. This has led to the improved lighting of hundreds of miles of streets in Britain. There are now about 15,000 street lighting posts fitted with these lamps.

Light is becoming so cheap that it is foolish not to make full use of it. Its liberal use contributes greatly to safety. It enhances the beauty of our homes and increases the efficiency of our workshops. Gardens and highways at night can be made beautiful by its use. Blackpool, perhaps more than any other town, has improved its amenities by using artificial light. Incidentally, this gives a royal welcome to its visitors.

## Plant Hunting and Exploration in Tibet

THE second evening discourse at the Blackpool meeting of the British Association was delivered on September 15 by Capt. F. Kingdon-Ward. He said that however much we may regret some of the results of the industrialization of Britain—the destruction of forest, the urbanization of pasture land, slums, and so on—our country is in some respects a vast improvement on the England of four centuries ago. It was then a colourless land, especially during the winter. Thanks to the great interest taken in horticulture and sylviculture to-day, it is that no longer. About twelve thousand species of introduced trees, shrubs and herbs are cultivated in the open—nearly ten times the total number of flowering plants which occur wild. Thus the British climate must be singularly elastic, and the plants themselves highly adaptable. Probably in no other country in the world of equal area can so many alien plants be grown. Some are difficult, but more are easy, and not a few naturalize themselves.

Tibet, the highest plateau in the world, is not as is generally supposed a complete desert. There is a gradual increase in the flora from west to east, and from north to south, corresponding with the change in the physiographical nature of the country; the vegetation slowly changes from tundra to scrub and grassland, and from scrub to forest. Naturally, the most prolific and varied flora is found in the forested south-eastern region. This flora is a mixed one. The climate varies greatly from warm temperate at the bottom of the gorges where Tibet reaches its lowest altitude at 5,000 feet, to subarctic on the high snow-clad ranges the peaks of which attain 25,000 feet. All adjacent regions—China, Indo-Malaya, the Himalaya—have contributed to the flora of Tibet. Not every plant found there is hardy in Britain, but a surprising number are. Nor is it possible to forecast whether a given plant will be hardy or not; experience enables one to make a shrewd guess, but no more. On the whole, the plants which have proved most adaptable to our gardens are those which are not found growing under extreme conditions; that is to say, the plants, not of the tundra, nor of the deep forested river gorges, nor of the highest alpine ranges, but those of the intermediate scrub-clad plateau country, at 10,000–12,000 feet altitude.

Throughout the summer, one is busy collecting plants in flower. In late autumn, one starts harvesting seeds. It is not necessary to mark the plants when in flower, of which seed is required. Most plants are found over extensive areas where the climatic conditions are similar, and constant practise enables one to recognize a given plant by its fruits as readily as by its flowers. Particular plants occur in prodigious numbers; most species are at least common; the difficulty is to discover a rare plant! Capt. Kingdon-Ward said that he could recall very few of which he discovered but *one* specimen—*Leycesteria crocothyrros* is one of them.

Tibet has become famous as the land of the blue poppy (*Meconopsis betonicifolia*) and the scarlet creeping rhododendron (*R. repens*). But it is equally the home of many other beautiful flowers, as gentians, lilies, barberries, primulas and many more.

## Science at the International Peace Congress

SCIENTIFIC concern for the preservation of world peace found abundant expression at the International Peace Congress held at Brussels on September 3–6. Special commissions considered the bearing of art, science and letters, medicine, agriculture and education on the problems of peace and war, the report of the Science Sub-Commission, formed by a small but internationally representative body of scientific workers under the chairmanship of Dr. J. D. Bernal of Cambridge, being typical of the constructive attitude of the professional delegates.

This committee clearly recognized the effects of war in disintegrating the humane purpose and international character of science, and declared that scientific workers should do their utmost to strengthen international amity not only by a general determination to oppose war but also by definite practical activity. "We have to consider," it decided, "how we can best assist in preventing an immediate

outbreak of war, and in permanently removing its fundamental causes. The International Peace Campaign offers us the great opportunity of working effectively for both these ends." Stressing the importance of the radical approach, it added that scientific workers should co-operate "in the task of removing the causes of war by subjecting them to scientific and historical analyses and by exposing the theories of those who strive to excuse and justify war."

It was unanimously agreed, therefore, that a permanent Science Commission of the International Peace Campaign should be set up "with the general object of uniting all scientists in the struggle for peace". Its proposed activities include (1) the co-ordination of the work of the existing peace organizations of scientific workers and their extension to countries in which they do not exist; (2) the formation of joint commissions on (*a*) science and war and (*b*) the removal of the basic causes of war; (3) propaganda for a peace oath by all scientific workers and the incorporation of such a declaration in the oaths of those taking university degrees and diplomas; (4) concrete support for those scientific workers who are made to suffer for refusing to take part in research or other activities concerned with war.

The joint commission on science and war is to include chemists, physicists, engineers, aeroplane technicians, doctors, bacteriologists, geologists and military experts, who will endeavour (1) to study the technique of modern warfare and its probable effects on the military and civil populations; (2) to co-operate effectively in the international suppression of chemical and biological warfare; (3) to publish the results of its investigations promptly and clearly, without minimizing or exaggerating the dangers of modern war or seeking to claim an unobtainable accuracy; (4) to issue critical bibliographies on the technique of warfare and other special studies on this subject; (5) to impress on scientific workers themselves the part they are playing, directly or indirectly, in preparations for war, and to direct attention to the utilization for military purposes of funds intended for civil research and development; (6) to serve as an information bureau on technical military questions to all peace organizations.

The committee concerned with the fundamental causes of war is to include biologists, psychologists, anthropologists, medical men, sociologists, historians and economists, whose immediate task it will be to produce a concise statement on the causes of war and the ways in which men of science can help to eliminate them. It will also neglect no opportunity to expose pseudo-scientific and pseudo-historical theories used for war propaganda, such as those which postulate the biological necessity of war, the need for colonial expansion because of population pressure, the innate inequality of races, the degenerating effects of miscegenation, and so on. The regular work of this committee will therefore include (1) continuous propaganda in the scientific and popular press; (2) the exposure of subtle and direct war propaganda in schools and colleges; (3) appeals to learned societies and other organizations to defend scientific truth against distortion and unjustified rationalization; (4) the provision of study facilities by the publication of critical bibliographies and such other assistance as a central bureau can provide.

The translation of these objectives into effective practice will require considerable funds, organizational ability and individual support, but the success of the Peace Congress as a whole, combined with other evidence of a widespread appreciation of the duty and purpose of scientific endeavour, suggests that these essentials will not be lacking. They must not be if the lust for war is to be overcome by an organized will for peace. CEDRIC DOVER.

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# Molluscs of Northern Asia

MR. ALAN MOZLEY, after several studies of the Mollusca of Canada, has recently made expeditions into Siberia and northern Kazakstan during the open seasons of the years 1932 and 1933, when typical areas in several of the great natural regions were examined in some detail, and extensive collections made with the object of obtaining fresh and accurate information regarding the constitution and distribution of the molluscan fauna ("The Freshwater and Terrestrial Mollusca of Northern Asia". *Trans. Roy. Soc. Edin.*, 58, Part 3 (No. 24), 1935–36). The area covered includes the greater part of continental Asia to the north of latitude 50°, not including Outer Mongolia and Manchuria.

The aquatic species inhabit three types of water—ponds, lakes and streams. Of these the ponds and pond-like lakes only have an abundant molluscan fauna, and these are mostly hardy northern European species. Both the large lakes, which are uncommon, and the streams, usually present special conditions unfavourable to the molluscs. There is found to be a small group of circumboreal, a large number of Eurasian species, a few which are common to North America and north-eastern Asia, and several endemic forms. On the basis of these groups, Northern Asia may be divided into four faunal regions, the Great Siberian Region, the Baikal Region, the Far Eastern Region and the Chuckchee-Kamchatka Region.

In the northern part of Kazakstan and Southern Siberia there are numerous drainage basins in which the reservoirs are saline to a varying degree, the main salts being chlorides and sulphates which are detrimental to the molluscs. The presence of old shore lines round many of these indicates their greater extent during previous pluvial periods, fossil molluscs being found in some of these old shore-line deposits, in some cases the number of species decreasing in the descending series of beaches, giving evidence of a progressive decrease in molluscs. The species most tolerant of these conditions are *Planorbis planorbis* L., *Limnæa palustris saiidalensis* Mozley, and *Limnæa palustris Kazakensis* Mozley.

Temporary ponds formed by melting snow in spring are characteristic habitats in the steppe and forest steppe region both in Canada and Siberia, conditions of life being severe; but numbers of invertebrates manage to exist in them, including five species of molluscs in Northern Asia.

## Educational Topics and Events

CAMBRIDGE.—The Vice-Chancellor gives notice that the professorship of animal pathology will be vacated on September 30 by the resignation of Prof. J. B. Buxton.

The Board of Managers of the Frank Edward Elmore Fund have awarded studentships to A. C. E. Cole of Trinity College, G. D. Hadley of Clare College, L. C. Martin of Gonville and Caius College and B. McArdale. Dr. H. G. Booker of Christ's College has been appointed assistant lecturer in mathematics, and Mrs. J. V. Robinson of Girton College assistant lecturer in economics and politics.

Dr. T. S. Hele has resigned his University lectureship in biochemistry, H. W. Hall of St. John's College, W. A. Fell of Sidney Sussex and R. S. Handley of Gonville and Caius College their demonstratorships in anatomy, Dr. M. Born his lectureship in mathematics and T. C. Nicholas of Trinity College his lectureship in geology.

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COURSES in administration have hitherto been specialized or restricted to different fields of administration, such as industrial, business, public, military, colonial and agricultural administration and often with more emphasis on the adjective than the noun. In a recently issued prospectus, Mr. W. R. Dunlop gives a syllabus of a course in administration with no particular applicational bias, though permitting of such bias by the appropriate selection of illustrative cases and problems. The course embodies the principles and technique, the underlying subjects and the mental activity and art common to all administration. Special attention is given to the history of administration from early times and with special reference to policy and leadership. Administration in its wider sense of human purpose and method is held to be one of the primary objectives of general education, and Mr. Dunlop would like to see specific education for administration, or at least management, made part of our educational system. The prospectus is supplemented by appendixes describing the research work, connexions and experience on which these views and the course itself are based. Copies may be obtained on application in writing to Mr. W. R. Dunlop, 57 Gordon Square, London, W.C.1.

DR. ROSCOE POUND, dean of the Faculty of Law of Harvard University, spoke recently at a Graduate School Convocation in Brown University on "The Place of Higher Learning in American Life". The general tenor of Dr. Pound's thoughtful and stimulating address (*School and Society*, August 8) may be inferred from his remark that his topic might well have had for its title "Higher Learning as Insurance of American Institutions" coupled with his opinion that what is significant in those institutions is that they tend to safeguard opportunity for all, freedom, and the corollary of freedom, responsibility. One of the points he makes is in connexion with the enormous development in recent times of means of manipulating public opinion. "The methods of advertising, carried to the limits of psychological effectiveness in business, have been taken over into public affairs. . . . Even newspapers are being left behind by broadcasting. A proper functioning of democratic institutions calls for corresponding development of the means of resistance to this pressure, and the best guarantee of intelligent resistance is to be found in a general high level of learning".

SALESMANSHIP has long been recognized as a suitable subject of instruction in institutions of higher education in the United States. Recently the complementary science and art of shopping have received a good deal of attention, partly because the industrial depression has focused attention more urgently on the problem of how to get the most one can for one's dollar. At four regional conferences on home-economics education called by the United States Office of Education in 1934, this matter was a principal topic of discussion, and on the basis of material resulting from these and later conferences a pamphlet was prepared by specialists of that Office and published under the title "Consumer-buying in the Educational Program for Home-making: Suggestions for Teachers of Home-making in Secondary School and Adult Classes". Among the reasons given for education for buying are the enormous increase in the variety of commodities and services offered and the fact that price has become even less a guide to quality than it was formerly. The United States Government has been zealous in publishing masses of statistics bearing on the subject in the interest of consumers. Among them are numerous publications of the Department of Agriculture, including its food and drug administration. Such is the profusion of data that in July 1934 a special index to them was published under the title "Government Publications of Use to Consumers".

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## Science News a Century Ago

### Lyell and Mantell

IN a letter to Mantell written on September 19, 1836, Lyell referred to John Fleming (1785–1857), the Presbyterian minister and naturalist, who "after several applications in vain for chairs more consistent with his zoological and botanical acquirements", had accepted the chair of natural philosophy at Aberdeen. This appointment, Lyell said, had given him no doubt "much fag to get up arrears of mathematical knowledge. But unfortunately, something worse than the lectures fell to his hard fate. Several University bills and a Royal Visitation caused tremendous secretarian or clerk's labour to fall on the Junior Professor who is obliged to serve as secretary to the University."

"You will see by this that you, my good friend," Lyell continued, "are not singular in finding it difficult to gratify your liberal thirst for science, without interfering with professional profits. Really, as Milman says, it would be well for the country if, instead of abolishing prebendal stalls, they were given to clerical and lay cultivators of literature and science, who had shown that they would devote energy and superior talents to those departments. When Babbage was taunted one day by a Conservative with 'What do you mean to be when the revolution comes?' he said, 'Lay Archbishop of Winchester'."

### Association of German Naturalists

THE annual gathering of the Association of German Naturalists—a society which was a forerunner of the British Association—was held at Jena on September 20–26, 1836. The meeting was attended by many civil and military officials, representatives from Great Britain, Russia, Belgium, Holland, Switzerland,

Greece and Mexico, and many of the greatest German men of science, including von Humboldt, von Buch, Ehrenberg, Weber, Hansen, Reichenbach, Fuchs and Döbereiner.

At the first general meeting, Dr. Kieser, after alluding to the philosophers and naturalists Jena had produced, gave a sketch of the history of the Association. Fifteen years previously, he said, it consisted of only thirteen persons, in 1835 it numbered 500 members and attracted friends from all parts of Europe and even from the other side of the Atlantic. In imitation of the Association, others had been established in England, France, the Netherlands and America. At the same meeting Mädler described the structure of the moon and exhibited his map of its surface.

There were three other general meetings, while papers were read to the seven sections : (1) Physico-Chemical Science ; (2) Geology, Geography and Mineralogy ; (3) Pharmacy ; (4) Botany ; (5) Anatomy, Physiology and Zoology ; (6) Medical, Surgical and Obstetric Science ; and (7) Technology and Agriculture. On September 24, the visitors and members were presented to the Grand Duke of Saxe Weimar, and after dining with him and other princes in the Orangery, repaired to the theatre, where Goethe's "Tasso" and Schiller's "Bell" were performed.

### Andrew Crosse and his Electrical Experiments

At the British Association meeting in Bristol in 1836, no communication raised more enthusiasm than the account given by Andrew Crosse (1784–1855) of his experiments on electric currents and their effects on minerals. Crosse was a man of means who lived at Broomfield on the Quantock Hills, Somerset, and at Bristol he gave a general invitation for any present at the meeting to visit him. The first to do so was Sir Richard Phillips (1767–1840), who described his visit in a letter to Mantell which was read at a conversazione of the Mantellian Museum at Brighton on September 20. The account was afterwards published in Sturgeon's *Annals*. Sir Richard spoke of the fine house and park and also of the music room in which were seven or eight tables filled with batteries. "They resembled battalions of soldiers in exact rank and file and seemed innumerable. Altogether there were 1,500 voltaic pairs at work in this great room, and in other rooms about 500 more. There were besides, other 500 ready for new experiments". But Crosse's "greatest electrical curiosity was his apparatus for measuring, collecting and operating with atmospheric electricity. He collects it by wires, the 16th of an inch diameter extended from poles to poles, or from trees to trees in his grounds and park".

### Walter Hancock's Steam Carriages

In the *Mechanics' Magazine* of September 24, 1836, is an account by Hancock of the work done by his steam carriages *Infant*, *Erin*, *Enterprise* and *Automaton* in London. He said that altogether these carriages had run about 4,200 miles, carried 12,761 passengers, made 525 journeys between the City and Islington, 143 between the City and Paddington and 44 between the City and Stratford. They had used some 55 chaldrons of coke. The same issue of the *Mechanics' Magazine* contained a description of the *Automaton*, the last of the four carriages to be built.

## Societies and Academies

### Paris

Academy of Sciences, July 27 (*C.R.*, 203, 289–352).

Aymar de La Baume Pluvinel : Obituary of Paul Stroobant.

J. Geronimus : Some orthogonal polynomials.

Georges Giraud : Complement to a result on equations with principal integrals.

Kyrille Popoff : The pendular movement of projectiles.

Emile Merlin : A particular case of trajectories of certain heterogeneous perfect fluids.

Assène Datzeff : A transformation which keeps the form of canonical equations.

Raymond Chevallier and Marcel Laporte : The permanent magnetization of steel in the neighbourhood of a circuit traversed by a rapid aperiodic discharge.

Louis Néel : The theory of constant paramagnetism. The application to manganese.

G. Foex and Ch. Fehrenbach : Variations of the magnetic moment of the cobalt ion in the anhydrous chloride and in the systems of mixed crystals $CoCl_2$–$CdCl_2$ and $CoCl_2$–$MnCl_2$.

Mme. Marie Freymann, René Freymann and Paul Rumpf : The absorption spectra in the near infra-red of aniline derivatives.

Roger Servant : A spectro-polarimeter for the Schumann region.

Léon Capdecomme : The influences of elliptic light and of the orientation of the polarizer in comparisons of reflecting powers with the microscope.

Pierre Brun : The formation of metallic alcoholates.

Henri Muraour and Albert Michel Lévy : The spectrum of ionized calcium obtained by collisions with detonation waves.

André Kling and Maurice Claraz : The rapid determination of oxygen in gaseous atmospheres.

Jean Byé : Study of molybdic chlorhydrin and of the normal molybdate of glycol.

Charles Bedel : The minimum temperature of oxidation of silicon. The lowest temperature at which the oxidation of silicon commences is relatively high : it is lowered by the presence of moisture.

Mlle. Denise Montagnon : Contribution to the study of the double iodides of copper and ammonium.

Charles Dufraisse, Léon Velluz and Mme. Léon Velluz : Dissociable organic oxides. Special study of 9-phenylanthracene and of some of its derivatives.

Roger Perrot : Some nitrosochlorides of the benzene series.

Mlles. Marthe Montagne and Yvonne Isambert : The action of ethylmagnesium bromide on butyric ethylanilide.

Martin Battegay and Pierre Bœhler : α- and β-mononitroanthracene.

André Meyer and Paul Heimann : The nitroso derivative of 4-hydroxycarbostyril.

Georges Lévy : The nitration of β-ethylnaphthalene. The synthesis of 2-ethyl-8-naphthol.

Gonzague Dubar and Mlle. Dorothée Le Maitre : New deposits of Spongiomorphides and of Algæ in the Lias and the Bajocian of Morocco.

Charles Bois : Deep focus earthquakes.

Achille Urbain and R. Cahen : The proportion

of derivatives of degradation of nitrogen in the serum of some ungulates.

RENÉ LEGROUX: The treatment of glanders in the Equideæ.

GEORGES BOURGUIGNON and MARCEL MONNIER: The variations of chronaxy under the influence of coloured light in spasmodic stiff neck.

BARUCH SAMUEL LEVIN and IVO LOMINSKI: Vaccination against bird plague with virus treated with X-rays.

## Melbourne

Royal Society of Victoria, July 9.

L. W. STACH: An Upper Oligocene bryozoan faunule. A small faunule at 66–67 feet in the Torquay bore is indicative of shallow water deposition. The range of *Cellaria depressa* is extended to Upper Oligocene, and a study of *Otionella cupola spiralis* Chapman suggests that *Cupuladria* Canu and Bassler is a synonym of *Heliodoma* Calvet. *Cucullipora tetrasticha* belongs to sub-family Hippoporininæ of Schizoporellidæ.

F. CHAPMAN and W. J. PARR: A suggested classification of the Foraminifera. The classification differs from Cushman's in the grouping of the arenaceous after the hyaline types. The whole order (Foraminifera) is arranged in the super-families, the Allogromoidea (chitinous), the Spirillinoidea (hyaline or perforate types), and the Ammodiscoidea (arenaceous, porcellanous and subarenaceous forms). The family groups of Cushman are re-sorted and reduced from 47 to 33. About 570 genera are admitted up to the year 1934, as against 144 genera in Chapman's "Foraminifera" of 1902.

G. W. LEEPER, ANN NICHOLLS and S. M. WADHAM: Soil and pasture studies in the Mount Gellibrand area, Western District of Victoria. A soil survey of 12,000 acres of pastoral country surrounding the volcanic cone of Mount Gellibrand. Nine soil formations are defined with laboratory analyses of each type, and mineralogical studies of the fine sand fractions. The present flora is described, and future development of the area discussed.

B. J. GRIEVE: The application of a staining and maceration method in tracing the distribution of bacteria in wood vessels of herbaceous plants.

## Moscow

Academy of Sciences (*C.R.*, 2, No. 4, 1936).

G. SIRVINT: Asymptotic series of Dirichlet.

L. VINOKUROV and E. LEVSHIN: Study of the extinction of luminescence of phosphorescent substances activated by organic activators.

G. G. LAEMMLEIN: Model of polymerized molecule of silicic acid in molten flow.

M. N. MICHAILOVA and M. B. NEUMANN: The cetene scale and the induction period preceding the spontaneous ignition of Diesel fuels in bombs.

S. J. KRAJEVOJ: The influence of ultra-short rays on the chromosomes of plants.

O. ISTOMINA and E. OSTROVSKIJ: The effect of ultra-sonic vibrations on plant development.

A. N. KLECHETOV: New species of *Colletotrichum* on the rubber-producing plant *Taraxacum kok-saghyz* Rodin.

A. SERGEJEV: The influence of human structures on the distribution of birds in steppes.

# Forthcoming Events

Tuesday, September 22

ENGINEERS' STUDY GROUP ON ECONOMICS, at 6.30.—Annual General Meeting to be held at 23 Grosvenor Place, London, S.W.1.

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FARADAY SOCIETY, September 24–26.—General Discussion on "Structure and Molecular Forces in (*a*) Pure Liquids and (*b*) Solutions" to be held in the University of Edinburgh.

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# Official Publications Received

## Great Britain and Ireland

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 37: The Glaciation of the Bantry Bay District. By A. Farrington. Pp. 345–361. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 2*s*. [228

Department of Scientific and Industrial Research. Final Report of the Steel Structures Research Committee. Pp. xxvii+572+16 plates. (London: H.M. Stationery Office.) 12*s*. 6*d*. net. [228

Home Office. Report on Conferences between Employers, Operatives and Inspectors, concerning Fencing of Machinery and other Safety Precautions, First Aid and Temperature in Woollen and Worsted Factories. Pp. 19. (London: H.M. Stationery Office.) 4*d*. net. [258

Board of Trade. Survey of Industrial Development, 1935: Particulars of Factories opened, extended and closed in 1935, with some Figures for 1934. Pp. iv+36. (London: H.M. Stationery Office.) 9*d*. net. [258

London County Council. Lectures and Classes for Teachers: Handbook for the Session 1936–37. Pp. 86. (London: London County Council.) [258

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1682 (2030): Effect of Weight on Take-off and Landing. By E. Finn and S. P. Osborne. Pp. 13+5 plates. (London: H.M. Stationery Office.) 1*s*. net. [268

University of Manchester: Faculty of Technology. Prospectus of University Courses in the Municipal College of Technology, Manchester, Session 1936–37. Pp. 408. (Manchester: College of Technology.) [268

Forestry Commission. Afforestation in the Lake District: Report by the Joint Informal Committee of the Forestry Commission and the Council for the Preservation of Rural England. Pp. 6+2 plates. (London: H.M. Stationery Office.) 3*d*. net. [278

Scottish Society for Research in Plant-Breeding. Report by the Director of Research to the Annual General Meeting, July 30, 1936. Pp. 30. (Edinburgh: Scottish Society for Research in Plant-Breeding.) [278

Forest Bibliography to December 31, 1933. Part 1. Pp. xviii+78. (Oxford: Department of Forestry, University.) [288

Papers from the Geological Department, Glasgow University. Vol. 18 (Quarto Papers of 1934–1936.) (Glasgow University Publications, 39.) Pp. iv+11 papers. (Glasgow: Jackson, Son and Co., Ltd.) [288

## Other Countries

Proceedings of the United States National Museum. Vol. 83, No. 2991: Pycnogonids from Puget Sound. By Harriet I. Exline. Pp. 413–422. Vol. 83, No. 2994: New Species of Polychaetous Annelids of the Family Nereidae from California. By Olga Hartman. Pp. 467–480. (Washington, D.C.: Government Printing Office.) [278

Smithsonian Institution: Bureau of American Ethnology. Bulletin 112: An Introduction to Pawnee Archaeology. By Waldo Rudolph Wedel. Pp. xi+122+22 plates. (Washington, D.C.: Government Printing Office.) 30 cents. [278

Smithsonian Miscellaneous Collections. Vol. 95, No. 13: A Comparative Study of the Labium of Coleopterous Larvae. By W. H. Anderson. (Publication 3393.) Pp. 29+8 plates. (Washington, D.C.: Smithsonian Institution.) [278

Cornell University: Agricultural Experiment Station. Bulletin 642: An Economic Study of Land Utilization in Broome County, New York. By T. E. LaMont. Pp. 51. Bulletin 644: Economic Studies of Dairy Farming in New York. 12: 150 Farms in the Tully-Homer Area, Crop Year 1931. By John R. Raeburn. Pp. 53. Bulletin 645: The Residual Effects of some Leguminous Crops. By T. L. Lyon. Pp. 17. Bulletin 649: Rural Youth: Activities, Interests and Problems. 1: Married Young Men and Women, 15 to 29 Years of Age. By W. A. Anderson. Pp. 53. Bulletin 650: Fertilizing Onions on Muck Soils. By J. E. Knott. Pp. 20. Bulletin 651: Quality of Lettuce as it affects the New York Lettuce Industry. By J. E. Knott, Pp. 17. Memoir 187: Effects of Light on Carotenoid Formation in Tomato Fruits. By Ora Smith. Pp. 26. Memoir 188: Genesis and Composition of Peat Deposits. By B. D. Wilson, A. J. Eames and E. V. Staker. Pp. 13. (Ithaca, N.Y.: Cornell University.) [278

U.S. Department of the Interior: Office of Education. Bulletin, 1935, No. 10: Public Education in Hawaii. By Katherine M. Cook. Pp. 56. 10 cents. Bulletin, 1936, No. 18—IV: Youth . . . Vocational Guidance for those out of School. By Prof. Harry D. Kitson. Pp. vii+81. 10 cents. Pamphlet No. 69: Per Capita Costs in City Schools, 1934–35. By Lula Mae Comstock. Pp. 22. 5 cents. (Washington, D.C.: Government Printing Office.) [278