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A Psychiatrist on Religion

SOME years ago a distinguished anthropologist observed, with regard to the conflict between religion and science, that the battle had scarcely begun; the anthropologists were just getting their guns into position. He might have added that their allies—the psychologists—were also just preparing to take off with a heavy load of bombs to support the artillery.

Dr. David Forsyth's recent presidential address delivered before the Psychiatry Section of the Royal Society of Medicine must certainly be regarded as an able and disturbing contribution to this offensive. The explosives utilised were of the recognised Freudian type. For example, inasmuch as remarkable likenesses exist between certain religious ritual practices and the behaviour of sufferers from obsessional neurosis, we may conclude that "the private obsessional neurosis is a private religious system, and religion a universal obsessional neurosis". Conscience, too, consists of latent memory of parental injunctions and prohibitions. The adult idea of God "has originated in the earlier idea of the father, of which it is an abstracted and elaborated repetition". With regard to guilt, "The original guilty feelings seem to arise from conflict between the child's inclinations and its parents' wishes . . . and from the child's contending emotions towards its parents—its love of the one and jealousy and hate of the other". In prayer and contemplation "the worshipper withdraws into himself, shuts out his sensory perceptions and gives himself over to rumination in an auto-suggestive state". The belief in a soul "has no other origin than the experience of dream".

With regard to religious conversion, which is essentially a phenomenon of adolescence, "psychologically the phenomenon is none other than the new strong tide of sexual feeling that accompanies puberty being checked in its usual course and deflected into religion. The check comes from an undue sense of guilt about sexual matters". Sexual deprivation and religious adoration too are closely connected; "it is inevitable that the unsatisfied erotic feelings should find expression in some 'non-carnal' direction". Even the theological doctrine of the Holy Trinity may be traced to the fact that "a child throughout its earliest and most impressionable years is influenced almost exclusively by two individuals only—its parents. . . . Its earliest conception of human-kind must surely

be as consisting of its father, its mother and itself. Here is the first experience of a trinity".

Such contentions, and many others of the same sort, cannot but be extremely damaging to religion, if they are valid. Far more damaging, however, is the Freudian contention that religion is seriously inimical to mental health and well-being. That a distinguished British psychiatrist should have been led by his practical experience to support this contention ought to lead the exponents of religion to reflect seriously over their policy in certain respects. To quote Dr. Forsyth :

"In the last 25 years we have learned more about the working of the human mind than in the previous 2000, and our psychological methods of treatment have no more in common with the spiritual methods of religion, than modern medical science with the cure of bodily disease by exorcism and prayer.

"If there is one consideration more than any other which confirms this it is in the attitude of the Churches to sex. I believe I am voicing the opinion of the large majority of medical psychologists in saying that of all the causes of mental illness easily the commonest lies in the sexual life. Go about in this country and you will find homes innumerable containing middle-aged nervous invalids, men as well as women, who owe their plight to having been brought up according to the prudish ideas current in their childhood. These ideas survive in the Churches to-day."

Although economic and social as well as religious causes contribute to sex starvation or perversion (it is middle-class families which suffer most—Mr. Barrett of Wimpole Street is still functioning), yet there is no denying that the Church has a bad record in this respect. The trouble is that the Church starts from the principle that there is something 'unclean' about sex, besides being dogmatically committed to certain applications of that principle in the sphere of ethics. Indubitably, owing to the fact that Nature has wished to run no risks about the reproduction of the race, sex is a powerful force, only to be controlled with difficulty. But that is a pressing reason for trying to understand it and deal with it rationally, and not for dogmatising about it and meeting all proposals with a flat *non possumus*.

There can be no doubt that the new psychology is distressing to many people. But the fact has to be faced that we can now no more go behind Freud than we can go behind Newton or Darwin. Theories of gravitation or of evolution doubtless have to be modified, but the principles stand ; and so with the theory of the subconscious. What Freudians do sometimes overlook is that their dialectic is an ambiguous weapon and can be used against other activities besides religion. For example, Dr. Forsyth notes how Freud discovers a close parallel (as was indicated above) between religious practices and the behaviour of patients with some obsessional neurosis. But could not many of the practices of the laboratory be attributed in like manner to some morbid curiosity-complex of the 'peeping-Tom' type, especially if the laboratory were a physiological one ? Again, there is plenty of evidence adduced by the Freudians for the existence of sadistic and masochistic practices in religion. But could not the practice of vivisection be attributed to a repressed sadistic instinct ? Also, might not the neurologists, bacteriologists and physiologists who have not hesitated to experiment upon themselves in the course of their researches, be branded as morbid masochists ? To the man of science this interpretation of his behaviour would seem unreasonable, but the closely parallel interpretations of the Freudians seem equally absurd to the sincere religionist.

The truth seems to be that inasmuch as all human activities, scientific and artistic as well as religious, are in the short or long run expressions of the *libido*, all of them are subject to Freudian interpretations. This does not mean that the Freudian dialectic is invalid, but only that it fails to give a complete account of the activities which it sets out to explain, and may thus evacuate them of much of their real value Religion, connected as it is so closely with sexuality (primitive religions being fertility cults), is liable to suffer more from Freudian analysis than either art or science—though art comes off worse than science owing to its connexion with religion and magic.

In another respect, too, religion is less fortunate than either science or art. In discussing it, metaphysical issues can scarcely be avoided. The man of science is more fortunate. He can assume that the entities with which he deals, whether forces, or objects, or organic and mental processes, are real without having to define in what sense they are real, for the simple reason that they seem real to the uncritical perceptions of the general public. What is more, he can brand as unreal whatever eludes his measuring instrument for the time being, and be sure of public support in so doing. Along these lines it is not difficult to represent religion as concerned with fantasy,

and science with reality. The scientific point of view (regarding the world we know by sensory perception as reality) can be represented as the awakening of the mature mind from that confused state of infant mentality when the subjective and the objective are in a state of total confusion. For example, Dr. Forsyth quotes from an article contributed by him to the *British Journal of Psychology* for 1921 :

"Where the pleasure principle dominates and psychic truth is accepted as the standard, interest passes to elemental psychical processes, and thence to the supernatural and spiritual ; this is exemplified in the evolution of religion and of personal religious faith. Alternatively, with objective reality as the aim, chief importance is given to the facts of the physical and material world, and thence to natural laws ; along this line come science and an interest in science."

The only evidence, however, given to show that the 'pleasure principle' and not the 'reality principle' is dominant in religion is that in the case of very young children and neurotics this is the case. But not all religion is immature infantilism or neurotic fantasy. It has been taken for granted, but not proved, that 'objective reality' cannot be the aim of religion, but can only be the aim of science. As a matter of fact, the critical study of scientific method (apart from all questions of metaphysics and the criticism of the 'objective reality' of sensory experience), suggests that the 'truth' of science is largely abstract in its nature, and that the concrete richness of reality escapes the scientific net. This does not discredit science, of course, but suggests that there are areas of objective reality which elude it.

The public, however, general as well as scientific, is placed under a considerable obligation by the writer of such a paper as we have tried to examine. Too rarely does the medical profession lift that veil of reticence where certain important matters are concerned. But with regard to the psychotherapist's general attitude, is it inevitable that he should regard all religion, good as well as bad, as pathological ? This appears to be an extreme point of view. Experience teaches that a good religion has a sanitary and stimulating effect, banishing worries and achieving that inner harmony which is the foundation of mental and moral health. What most of the neurotics need is not less religion, but more, provided always that it is of the right kind. J. C. HARDWICK.

Crystal Chemistry

Kristallchemie der anorganischen Verbindungen. Dargestellt von M. C. Neuburger. (Sammlung chemischer und chemisch-technischer Vorträge, begründet von F. B. Ahrens, herausgegeben von Prof. Dr. H. Grossmann, Neue Folge, Heft 17.) Pp. 115. (Stuttgart : Ferdinand Enke, 1933.) 9.70 gold marks.

THIS monograph has been written in order to bring to the notice of a wider circle of readers the work of G. N. Goldschmidt, as set out mainly in publications by the Norwegian Academy. His work on ionic radii, which occupies about sixty pages of the present monograph, is already familiar to English readers, since it formed the subject of a lecture to the Faraday Society in 1929. The ingenious application whereby the crystal properties of zinc silicate, Zn_2SiO_4, as willemite were imitated in the soluble salt Li_2BeF_4 are also familiar to English readers.

One example of the principles involved may, however, be cited as an illustration. According to Goldschmidt, the type of lattice developed by an ionic aggregate AB depends on the ratio of the ionic radii $r_A : r_B$ of the ions A and B. Thus, if this ratio is 0·15 or less, the ion A can be stowed away on the interstices of an equilateral triangle formed by the larger ions B ; if the ratio is 0·22, it can be accommodated in a tetrahedron ; if 0·41, in a square or in an octahedron, as in rock salt ; if 0·73, in a cube as in cæsium chloride. The formation of layer lattices in crystals of the type AB_2 is also determined by the ratio of the ionic radii. Thus, when this ratio is less than 0·73, the metallic ions A can be sandwiched between twin layers of the ion B, giving rise to crystals which have very little cohesion between successive sandwiches. If, however, the ratio is greater than 0·73, an ordinary ionic lattice of the fluorspar type may be developed. Thus $NiCl_2$ forms layer lattices, just like $CdCl_2$, since the ratio of the ionic radii is only 0·43 ; but $[Ni.6NH_3]Cl_2$, where the ratio has been increased to 1·41, gives a structure of the fluorspar type. If, however, iodides are considered instead of chlorides, the negative ion has such a large diameter (2·19 A.) that it is impossible to find a simple cation of sufficient diameter to produce this effect. *All* metallic iodides of the type RI_2 therefore form layer lattices ; but by making use of the complex cation, $[Ni.6NH_3]^{++}$, which has a much larger ionic radius (2·56 A.) than any simple cation, the ratio can be raised to 1·17 and the fluorspar lattice is again developed.

The influence of atomic radii on crystal structure is only precise when the ions can be treated as undeformable spheres, and is subject to profound

disturbances when the ions are 'deformable', as postulated by K. Fajans in 1923. This phenomenon depends on polarisation, and forms the subject of twenty of the most important pages of the monograph. Thus, in compounds of the type AB_2, the small undeformable fluoride ions generally give the ordinary 'co-ordination' type of ionic lattice as in fluorspar: but when a small and therefore strongly polarising cation is associated with a large and therefore easily polarised anion as in CdI_2, the tendency to form layer lattices is enormously increased; and this is in many respects a half-way stage in the direction of the formation of molecular lattices such as are found in crystals of calomel, ClHgHgCl. Attention is also directed to the fact that many hydroxides, for example, $Mg(OH)_2$, $Cd(OH)_2$, $Fe(OH)_2$, $Ni(OH)_2$, $Co(OH)_2$, have the same structure as CdI_2, and this is attributed to the fact that the hydroxyl ion is a strong permanent dipole.

An interesting development of these considerations is found in the phenomenon of 'counter-polarisation', when a complex ion is pulled to pieces by the influence of a rival centre of polarisation. Thus the distance between nitrogen and oxygen in $NaNO_3$ is 1·22, but is increased to 1·25 in $LiNO_3$, where the oxygens are subject to the strong polarising influence of the compact lithium ion and are thus drawn away from the central atom of nitrogen. In $CaTiO_3$ this process is carried a stage further, since the distances of the oxygen from titanium and calcium correspond so closely with the normal ionic radii that the formation of a complex anion can scarcely be detected; and in $MgTiO_3$ the break-up of the complex anion appears to be complete, since the crystal behaves as an aggregate of oxygen ions, interspersed with ions of magnesium and of titanium, with a similar structure to corundum, Al_2O_3. Thus a crystal of the type ABX_3 has been conformed to the type A_2X_3 by breaking up the radical BX_3 by a process of 'counter-polarisation'. As a still more extreme case, it is suggested that in spinel, $MgAl_2O_4$, the aluminate radical has been broken up by counter-polarisation, with formation of a new radical MgO_4, and that when Mg is replaced by Be, the structure of Al_2BeO_4 is of the type A_2BX_4, in which the complex ion BX_4 is fully developed as in K_2SO_4.

In all these discussions the inorganic salt is considered as an aggregate of simple ions, consisting of a single more or less polarisable atom with an appropriate positive or negative charge, and, following Kossel's theory of valency, the formation of chemical bonds is in the first instance entirely ignored. Thus the NO_3 and CO_3 ions are treated as aggregates of O^{--} ions surrounding a highly charged cation, C^{+4} or N^{+5}. To chemists, Kossel's method of formulation is intolerable, even in compounds such as CCl_4 and CH_4, and becomes absurd in compounds such as CH_2Cl_2, where the central atom of carbon would be neutral and therefore entirely unable to hold the 'ions' of H and Cl. It is therefore of interest to record the conclusion (p. 101) that "The conception that there are different kinds of chemical binding is completely confirmed by the results of the investigation of crystalline substances". As a criterion, it is noted that the sum of the atomic radii remains constant in series such as

		CuBr	AgI
BeO		ZnSe	CdTe
BN	AlP	GaAs	InSb
CC	SiSi	GeGe	α SnSn

when the total number of valency electrons is kept constant but the nuclear charges are distributed differently. On the other hand, a contraction of about 11 per cent occurs when the same process is effected in compounds of the series

NaF	KF	RbF	NaCl	KCl	RbCl
MgO	CaO	SrO	MgS	CaS	SrS
NaBr	KBr	RbBr	—	KI	RbI
MgSe	CaSe	SrSe	—	CaTe	SrTe

The members of the wurtzite, zinc blende and diamond group are therefore essentially different from the rock salt group, in accordance with the chemist's conception of diamond as a network of atoms held together by bonds, but of rock salt as an aggregate of ions. It therefore appears that in the former series the length of the bonds is not affected by juggling with the nuclear charges, whereas in the latter series the closeness of the packing is influenced very greatly by the magnitude of the ionic charges. As interesting exceptions, it is noted that TiC and ZrC, although they have structures of the rock salt type, resemble the diamond as regards the effects of substitution, whilst MgTe and AmF, which have a lattice of the wurtzite type, resemble rock salt in this respect.

An important part of the monograph deals with the phenomena of isomorphism, polymorphism and morphotropy. 'General isomorphism' is defined as depending on similarity of crystal structure, whilst 'special isomorphism', which carries with it the characteristic of 'isomorphous miscibility', requires that the ionic radii shall not differ by more than about 15 per cent on the smallest radius. 'Antisomorphism' is a variant on general isomorphism, in which the signs of the ionic charges are reversed, but it never gives rise to isomorphous miscibility. Thus ThO_2 and Li_2O are described as having an '*iso*fluorite' and an '*anti*fluorite' structure. So also '*iso* layer lattices', such as $NiCl_2$ and

CdI_2, in which polarisable anions are packed on either side of a layer of polarising cations, have their counterpart in '*anti* layer lattices', in which polarisable cations are packed on either side of a layer of polarising anions as in PbO or in one form of La_2O_3. 'Polymeric isomorphism' serves to describe the similarity of structure of polymers such as Ti_2O and $FeNb_2O_6$; it is not incompatible with isomorphous miscibility, but does not warrant the deduction that rutile contains molecules of the type Ti_3O_6.

Polymorphism depends on the fact that the relative stability of different types of ionic lattice may be influenced by changes of temperature and pressure, just as it can be influenced by substitution, for example, of Cs for Na in rock salt, or of I for Cl in $[Ni.6NH_3]Cl_2$. This effect is, however, attributed mainly to variations of polarisability, since the relative changes of ionic radii are too small to produce changes of structure. When the changes of structure produced by substitution are too great to be compatible with isomorphism, they are described as morphotropy. Thus changes of structure resulting from altered thermodynamic conditions give rise to polymorphism, whilst those resulting from substitution give rise to morphotropy. Polymorphism therefore occurs when the effects produced by alterations of temperature and pressure exceed the limits of 'self-isomorphism', and is specially characteristic of those substances in which chemical substitution gives rise most readily to morphotropy.

Although the author has given an interesting account of researches on crystal chemistry made during the past ten years, he does not even mention the important pioneer work done by Barlow and Pope between 1906 and 1910. He has, however, paid them the compliment of reproducing (without acknowledgement) photographs of two of their models of close-packed aggregates of spheres, which he ascribes to a German paper published in 1928. The actual models were prepared for a Friday evening discourse at the Royal Institution on April 15, 1910, and photographs (which can be recognised with certainty as the originals of Figs. 1 and 2 of the present monograph) were reproduced in the *Proceedings of the Royal Institution* (vol. 19, pp. 826–827, 1910) and at a later date in the *Proceedings of the Royal Philosophical Society of Glasgow* (1914). The reviewer has a personal interest in that the models, which were photographed again for use as illustrations in his "Inorganic Chemistry" (1922 and 1931), are now in his keeping and are used regularly in lecture demonstrations for Part II of the Tripos.

The price in English currency is about fifteen shillings for a pamphlet of 115 pages.

T. M. LOWRY.

Historical Geology

(1) *Historical Geology.* By Prof. Raymond C. Moore. Pp. xiii+673. (New York and London: McGraw-Hill Book Co., Inc., 1933.) 24*s.* net.

(2) *A Textbook of Geology.* Part 2: *Historical Geology.* By Prof. Charles Schuchert and Prof. Carl O. Dunbar. Third edition, largely rewritten. Pp. vii+551. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 25*s.* net.

(3) *The Principles of Historical Geology from the Regional Point of View.* By Prof. Richard M. Field. Pp. xii+283+10 plates. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1933.) 20*s.* net.

THE branch of geology with which these volumes are concerned deals with two thousand million years of the earth's history. It traces from the beginning the succession of geographies, the rise and decline of great mountain chains and the orderly evolution of life that have produced our modern world. The grandeur and interest of such a theme need no emphasis. Unfortunately, the subject is all too easily made unattractive and indeed unintelligible by the presentation of a host of seemingly unrelated facts. The general conceptions of the evolution of the earth and of its inhabitants are hidden. Properly pursued, historical geology should be one of the great disciplines, as it requires accuracy of reasoning, a rigorous sifting of evidence and completeness of observation. General works on the subject should be concerned more with methods of thought than with results.

(1 and 2) The books by Prof. Moore and by Profs. Schuchert and Dunbar have many points of resemblance. Both are excellent introductions to the study of earth-history. In each, an endeavour is made to show the methods by which a summary of the geological history of North America is obtained. After introductory material, the geological systems are examined in order, and the succession of events, the life and the palæogeography of the times discussed. Both works are attractively written, and are illustrated by a large number of maps and sections, and photographs of rock-exposures and characteristic fossils. The non-American student of geology is here provided with a couple of interesting guides to North American stratigraphy, whilst the more general reader can find plenty of entertainment, especially perhaps in connexion with zoological evolution.

(3) The third book, that by Prof. Field, is different. It is based on the brave new idea of teaching historical geology as certain law schools teach law—by selecting cases for elucidation and

discussion. Classic geological areas—the Grand Canyon, the Niagara Falls region, the Appalachians, the North-west Highlands and the Alps—are considered in detail, so that a series of lessons in tectonics of increasing complexity is presented to the student. The most important illustrations of the book are ten folding plates, mostly block diagrams, contained in a pocket at the end. The intention of the book is excellent but, unfortunately, the intention is not everywhere fulfilled.

At the outset, a feeling of irritation—if not distrust—is produced by the presence of a loose sheet bearing a long list of errata, such as "*for* Murchison *read* Sedgwick, *for* James *read* George", and this feeling is intensified by the discovery, soon made, that all errors are not on this loose sheet and that the loose sheet itself requires correction. The work is curiously uneven. Certain aspects of historical geology are well demonstrated and there are many passages in which the philosophy of field geology is charmingly and clearly put. But there are other pages that are clumsy and obscure, whilst the inclusion of a semi-popular guide to the Yellowstone Park seems scarcely necessary. It is greatly to be regretted that the excellent purpose of the book is not more nearly attained. H. H. R.

The Science of Farming

Agriculture: the Science and Practice of British Farming. By Prof. James A. S. Watson and James A. More. Third edition, revised and enlarged. Pp. x+777+35 plates. (Edinburgh and London: Oliver and Boyd, 1933.) 15*s.* net.

THE fact that this book has now reached its third edition shows that it serves a useful purpose; it is indeed a greater tribute than it would be for a purely scientific work, in view of the well-known reluctance of agricultural students to purchase books.

Much of the book has been revised, and fresh sections have been added dealing with the new fertilisers and cultivation implements, new varieties of barley and modern methods of treating grassland, while since the first edition new chapters have been added on sugar beet and on farm costs. In accordance with modern tendencies on the farm, more space is devoted to pigs, while poultry have been given an entire chapter and a new chapter is added setting out the details of breeding, of rearing and of the various methods of keeping a commercial laying flock, including the vitally important question of costs. The account of the systems of farming in Great Britain has been expanded and greatly improved by the addition of details concerning the amounts of capital required and the probable costs and returns under present-day conditions. There is also a useful account of the comparative costs of working by horse and by tractor, and the chapter on costing contains much information about the difficulties of arriving at any result and the significance of the figures when they are obtained: actual examples are given of costs of grazing, sugar beet production and milk production. A useful addition to the tables is one showing the amounts of work normally expected per day when a man is doing various operations.

The book is clearly written, the information is sound and well set out so that the reader easily finds what he wants. It includes much material not easily otherwise obtainable and can be strongly recommended to agriculturists who do not already use it.

Since the first edition appeared, the volume has increased by some 120 pages and is now not far short of 800 pages. If, as seems likely, a fourth edition is called for, the authors might consider cutting out much of the general parts on soils, fertilisers and animal nutrition which the student should get from his agricultural chemistry course, and of the section on Mendelism which should come into the biology course; the day is gone when one and the same man is expected to expound both sex linkage and hydrogen ion concentrations, to say nothing of colloids and metabolisable energy. These sections are quite well written and could make a separate and useful guide to farmers on the principles of science that underlie farming operations; and their removal would liberate space for further additions on the practical side, and especially for fuller descriptions of actual farm practices, husbandry systems and other matters here treated more fully than elsewhere. So the book could continue its useful career without becoming too unwieldy.

Nutrition and Disease

Nutrition and Disease: the Interaction of Clinical and Experimental Work. By Dr. Edward Mellanby. Pp. xix+171+52 plates. (Edinburgh and London: Oliver and Boyd, 1934.) 8*s.* 6*d.* net.

DR. E. MELLANBY delivered the Croonian lectures before the Royal College of Physicians, and the Linacre lecture at Cambridge, in 1933 and gave an account of his researches on various problems of nutrition and disease. Their publication is most welcome since such important matter should be considered at leisure. The book opens with a summary of the well-known and valuable work of Dr. and Mrs. Mellanby on rickets and dental caries and the

discovery of vitamin D, a milestone in the progress of medical science. Their new work deals with the inhibitory action on vitamin D of oatmeal and wheat germ which appears to be due to the phytic acid in these cereals interfering with the calcium and phosphorus supply in the diet.

Dr. Mellanby insists that liability to infections can be reduced by proper diet. Septic lesions occur in human beings and animals whose food is almost devoid of vitamin A or its precursor, carotene. Vitamin A therapy lessens mortality in puerperal sepsis, in septicæmias and in infections following measles. Pyorrhœa in dogs is caused by a deficiency of vitamin A, and is prevented by this vitamin.

The nerve degeneration, a demyelination of the fibres of the posterior roots, which is responsible for the inco-ordinated movements in rickets, is due to a deficiency of vitamin A in the diet. The similarity of the nerve lesions in beriberi to those produced by lack of vitamin A points to the neuritis in beriberi being caused by deficiency of vitamin A. Deficiency of vitamin B produces prostration which is rapidly cured by administration of vitamin B, whilst the paralysis, slower to yield to treatment, is relieved by vitamin A.

The dietetic errors responsible for the nervous disorders in ergotism, lathyrism and pellagra are probably due to deficiency of vitamin A. Again, cereals interfere with the action. An unknown neurotoxic substance is counteracted by increased vitamin A.

Combined experimental and clinical studies of simple and toxic goitres show that their etiology differs fundamentally. Simple goitre is caused by a deficiency of iodine in the food and is reduced by iodine therapy. In toxic goitre there is local absence of iodine in the thyroid and excess in the blood, due to withdrawal as fast as it is formed of the colloid together with its active principle. In exophthalmic goitre, iodine therapy is only palliative and has its dangers. The iodine withdrawal from the thyroid is initiated by a chemical substance in the anterior part of the pituitary gland.

The value of the book is not only as a record of fruitful research but it is significant also as an emphatic justification of the alliance of research worker and clinician. The practice of medicine tends to remain a religion of traditional beliefs and empirical knowledge passed on from senior to junior physician. A chair of dietetics may be founded in connexion with a large hospital, but if the chair may not be placed by the bedside as well as in the laboratory, of what is its use? It is salutary to remember Pasteur and the indebtedness of medicine to a mere chemist. The book is one to buy and read, and not to borrow.

Short Notices

Handbuch der Experimentalphysik. Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 12 : *Elektrochemie.* Teil 2. Herausgegeben von K. Fajans und E. Schwartz. *Elektromotorische Kräfte*, von Prof. Dr. C. Drucker und Prof. Dr. C. Tubandt ; *Polarisationserscheinungen*, von Prof. Dr. R. Kremann ; *Elektrochemie der Phasengrenzen*, von Prof. Dr. E. Lange und Dr. F. O. Koenig. Pp. xix+483. (Leipzig : Akademische Verlagsgesellschaft m.b.H., 1933.) 40 gold marks.

THIS volume, the second part of the section on electrochemistry in the Wien-Harms "Handbook", well maintains the standard of thoroughness of earlier volumes. Drucker writes competently on electromotive force in cells with liquid electrolytes, without, however, making much attempt to describe the atomic or electrical mechanisms involved, except in the liquid portion of the system, or the relationship between the affinity of the metals for electrons and their electromotive powers. The classical electrochemistry of all the usual types of cells is well and clearly treated. Tubandt contributes a short section on cells with solid electrolytes.

Kremann gives a valuable and very well documented account of polarisation phenomena, including, of course, passivity and overpotential ; in this section, theory, as is perhaps inevitable when dealing with such a quantity of unruly experimental data which will not enter the harmonious thermodynamic edifice devised to house the more docile phenomena of reversible cells, is weaker than the description of experimental results.

The last two hundred pages are devoted more specifically to phase boundary potentials. Lange deals thoroughly with the methods of measuring Volta potentials, between liquids and air as well as between two metals, but is not up-to-date in the description of the influence of surface films on these potentials. The Peltier effect and dropping mercury electrodes are well treated, the former especially thoroughly. There is one real gem in this volume : Koenig's treatment of the electrocapillary curve on pp. 376–416. This is based on a partly new and original thermodynamic treatment which avoids the improbabilities of earlier treatments, and is very ably worked out and applied to all the more important experimental observations ; the chapter closes with a good account of the molecular theory of the double layer. A somewhat brief but very clear account of electrokinetic phenomena is also contributed by the same author, whose critical handling of these two difficult subjects is in many respects original and is probably unsurpassed anywhere in scientific literature.

N. K. A.

Law and Order in Polynesia : a Study of Primitive Legal Institutions. By Dr. H. Ian Hogbin. Pp. 296+8 plates. (London : Christophers, 1934.) 12*s.* 6*d.* net.

DR. HOGBIN'S study of social regulation in Polynesia adds another to the series of monographs on the ethnography of 'primitive' peoples, which has been inspired by the methods and theories of Prof. B. Malinowski as the founder of the school of 'functional anthropology'. The investigations in Ontong Java, perhaps better known as Lord Howe's Island, in the western Pacific, which are the major source of his book, were carried out by Dr. Hogbin under the auspices of the Australian National Research Council and the University of Sydney ; but the book itself was written in London as a thesis for the Ph.D. These details are by no means unimportant. They point to the formative influences which have determined the character of Dr. Hogbin's work ; he has been a pupil of Prof. A. R. Radcliffe-Brown and Prof. Malinowski ; and his approach to his problem, therefore, has been entirely that of the 'functional' school. Given this point of view, his work is of a high standard in its careful observation, valid argument and lucid exposition.

In detail, Dr. Hogbin's work shows how, functionally considered, individual relations, as elements in situations conditioned by the various group organisations of Polynesian society, are essentially a reciprocity, a co-operative activity, which involves an observance of social and religious obligation. Law and order, thus regarded, cease to be a matter of sanctions or of imposition by a higher authority, but are inherent in function and, in the normal course, sufficiently powerful to overcome any individual inclination to transgression.

It will be seen that this interpretation of law and order differs *toto cœlo* from the outlook of jurisprudence. If the method is sound—there is no desire to raise the question in this connexion—it is necessary, in the interests of comparative study, to find some mode of reconciliation. Otherwise the study of the growth of law and legal institutions is left hanging in the air.

Prof. Malinowski resolves the difficulty in an introduction to Dr. Hogbin's work, in which it is shown that the gap which appears to lie between 'primitive' and civilised, from the point of view of the orthodox jurist, vanishes in the light of an analysis of custom, law, and social and legal institutions, as functionally co-operative to secure the satisfaction of human needs—biological, physiological and psychological.

Le poison des Amanites mortelles. Par R. Dujarric de la Rivière. Pp. 182+24 plates. (Paris : Masson et Cie, 1933.) 60 francs.

FROM the earliest times, toadstools have had the reputation of being poisonous, and most people know some way or other of distinguishing which of them by chance is edible. The fact is, however, that *Amanita phalloides* and its near allies, are the only deadly species, and very few others cause serious inconvenience : it may be added that *A. phalloides* 'peels' and does not turn silver black !

In the monograph under notice this common species is considered from every point of view ; the somewhat rare *A. verna* and *A. virosa* are treated, but with much less detail. Four excellent coloured plates show the three species in a way which should ensure their ready recognition.

The main interest in the volume is the medical consideration of the fungus-poison both from the physiological viewpoint and that of pathological anatomy. Here is contained a good deal of original investigation. Two of the plates give forty-five photographs taken from a film of the different attitudes of a mouse after a dose of the toxin of *Amanita phalloides*.

It seems a little alien to our insular ideas to find a chapter on the medico-legal aspect of fungal poisoning, but it is reported that in Great Britain during 1837–38 statistics gave 4 out of 541 cases of criminal poisoning as caused by fungi. It appears that in France the vendor of fungi is legally responsible for their edibility. There is a chapter on prophylactics, a very full list of references, and a list of papers on poisonous fungi published in the *Bulletin de la Société Mycologique de France.* J. R.

Counter Attack from the East : the Philosophy of Radhakrishnan. By C. E. M. Joad. Pp. 269. (London : George Allen and Unwin, Ltd., 1933.) 7*s.* 6*d.* net.

THE apparent chaos of Western civilisation suggests to Prof. Joad the idea of seeking our salvation through Eastern channels, and this he enthusiastically proposes through an analysis of Radhakrishnan's philosophy. The contribution of Indian thinkers to philosophical discussion is no doubt exceedingly valuable and suggestive ; but it is with some reluctance that one would blindly turn to it for exclusive inspiration unless one has fairly well exhausted the possibilities of the West. Occasional remarks about the religious and mystical thought of the West make one rather suspect of Mr. Joad's knowledge of them. But apart from this initial difficulty, the reading of this work will prove to many of singular interest, both in its expository statements and in the contrast it marks out between East and West.

La science française depuis la xvii^e siècle. Par Prof. Maurice Caullery. (Collection Armand Colin : Section de Philosophie, No. 165.) Pp. 215. (Paris : Armand Colin, 1933.) 10.50 francs.

PROF. CAULLERY gives a bird's-eye view of French scientific thought from the seventeenth century to the present day, He could scarcely do more than that in the small compass of his book, which thus suffers from unsupported generalisations, especially about the Middle Ages and about the philosophical bearings of the theories discussed. As an introductory book, it will be found very useful and inspiring, though his bibliography is not quite up-to-date. T. G.

The Problem of Ether Drift*

By DR. C. V. DRYSDALE, C.B., O.B.E.

ANALYSIS OF THE MICHELSON-MORLEY OBSERVATIONS

IT should be noted that as the displacement of the fringes is proportional to the square of the velocity of drift, a velocity of 10 km./sec. only corresponds to a displacement of about 0·1 of a fringe, and, as the width of the fringes could not be kept quite constant, visual estimation to the nearest 0·1 fringe was all that was possible for the enormous number of observations which have been made. Hence the existence of a drift could only be determined by averaging a large number of sets of observations at sixteen equally-spaced azimuths, and by employing a Henrici harmonic analyser to determine the component of double period in a revolution. The results of this analysis reveal a small full-period component which was accounted for satisfactorily by Hicks in 1902 as due to the small inclination of the mirrors required to produce the fringes, and a relatively large double-period component, the amplitude of which represents the component of the drift in the plane of the interferometer. The sum of the higher harmonics is usually relatively small, which indicates that the drift effect is real. This procedure seems first to have been adopted for the Mount Wilson observations of 1921, which explains why various interpretations could be put upon the earlier Michelson-Morley results. Miller has, however, since applied it to these earlier observations, and has therefore come to the conclusions above stated.

But the harmonic analyser gives the phase as well as the amplitude of the double period component, and therefore the azimuth of the horizontal component of the drift. By taking observations at several intervals during the day and correlating the magnitudes and azimuths of the drift with the geographical position of the interferometer and the movements of the earth, it became clear that the drift observed was not chiefly caused by the orbital motion but by a motion of the whole solar system in a direction nearly perpendicular to the plane of the orbit. Further observations were therefore made at Mount Wilson in April, August and September 1925, and in February 1926, in order if possible to determine the sense as well as the direction of the absolute motion, as the interferometer is of course 'bi-directional'. The four apices of the motion, which can be determined independently from the amplitudes and the phases of the observed drifts, were found to lie almost exactly on a circle which is the 'aberration orbit' of the earth; and this led to the conclusion that the solar system must be moving towards the constellation Dorando in a direction 7° from the south pole of the ecliptic, and with a velocity of about 208 km./sec.

* *Continued from p.* 798.

The above velocity was derived by calculation from the orbital velocity of the earth and the directions of the drift at the various epochs; and as it is about twenty times the velocity of the drift given by the interferometer, it would appear either that the earth imparts a material fraction of its velocity to the ether near its surface, which is highly improbable, or that the Fitzgerald-Lorentz contraction differs by five per cent from the truth.

It is impossible to read Prof. Miller's account of these laborious researches, with the meticulous care they reveal, and the remarkable consistency of the results, without feeling that a drift has actually been observed; but, on the other hand, Michelson himself, Piccard and Stahel, Kennedy, and Zoos have recently made careful trials with various modifications of the interferometer, and have all failed to detect any definite evidence of drift. Miller, however, is definitely of the opinion that the drift can be screened by thick walls or metallic enclosures, and points out that nearly all these instruments were so enclosed. At a conference held at Mount Wilson Observatory in 1927, at which Michelson, Miller, Lorentz and Kennedy were present, Miller was the only champion of a positive result, and Lorentz confessed that at a previous conference at Düsseldorf in 1898 the conviction against the detection of at least a first order effect became so strong that attention was only paid to those papers which announced negative results. Nevertheless, the impression created by Miller was considerable, and Michelson proposed to carry out a further trial with an invar-framed interferometer and further optical refinements.

So the matter rests at the present time, but it is clear that it is in a very unsatisfactory state, and that it cannot be settled by any improvements in the Michelson-Morley apparatus, or by any other method based on a second order effect, on account of the doubt concerning the exact amount of the contraction or rather distortion which theory indicates must exist, apart from the extreme delicacy of the method.

IS A FIRST-ORDER EFFECT UNOBTAINABLE?

It is evident, therefore, that a first-order effect is imperatively needed to clear up the problem, but the complete failure of all attempts to detect

a change of deviation or of the time of transit through dense transparent media, combined with the theoretical impossibility of doing so if the Fresnel drag formula is accurately true, has led to a universal disbelief in the possibility of observing a first-order effect; just as the supposed null results of all experiments by the Michelson-Morley method, combined with the Fitzgerald-Lorentz contraction formula, have evoked disbelief in the possibility of detecting a second-order effect. Indeed, the denial of any possibility of detecting motion through the ether has become a cardinal assumption of the general theory of relativity. This denial has been emphatically stated by Prof. R. W. Wood in the last edition of his "Physical Optics", where he says that the first postulate of the theory of relativity "amounts to saying that motion through the ether (if the ether exists at all) will be wholly without influence upon all optical experiments made with terrestrial sources of light".

But the Maxwellian theory, as developed by Drude and by Lorentz, definitely indicates the possibility of observing a first-order effect, and as a matter of fact such an effect was actually observed, as early as 1859, by Fizeau, who conceived it from the then existing theory. As is well known, Drude was the first to introduce the modern conception of mutually attracting ions into optical theory, and thereby to develop a remarkably successful theory of dispersion as well as of most other optical phenomena. Following on the same lines, Lorentz in 1895 published an important paper on electrical and optical phenomena in moving bodies, in which he established the Fresnel drag formula on a sound theoretical basis and gave an outline of the theory of the "contraction" effect. These important developments have helped greatly to clarify our conceptions.

One fundamentally important conclusion which emerges from the above theories and from the moving water experiments of Fizeau, Michelson and Morley, and Zeeman, is that motion through the ether has a definite meaning and measurable effect. The failure of all interferometer and deviation experiments with dense media to reveal any effect of the earth's motion through the ether is simply due to the fact that the effects which are undoubtedly produced when the light enters the dense medium are exactly cancelled by its subsequent passage through the medium. In the case of a block of dense medium interposed in an interferometer and moving in the direction of propagation, the increase in the velocity of propagation due to the motion is exactly balanced by the increase of the effective length of the block. A transverse motion, on the other hand, produces a change in the angle of incidence of the wave front equal to the aberration, and therefore a corresponding deviation of the refracted wave front, but this deviation is exactly neutralised by the transverse drag of the medium as the light proceeds. The fact that no resultant deviation can be observed is therefore an experimental proof of a deviation of the refracted wave front, unless we assume that the ether near the surface of the earth is carried along with it, which would be contrary both to the Maxwell-Lorentz theory and to the observations of astronomical aberration.

Both theory and experiment therefore agree in indicating that a transverse drift alters the refraction at the surface of a dense medium, so that it is clear that any effect of that change at the surface which is unmodified by subsequent passage of the light through the medium should be capable of observation.

Such an effect is available in the polarisation which occurs at oblique incidence on an isotropic dense medium. According to the Maxwellian theory, this polarisation depends simply upon the inclinations of the incident and refracted wave fronts to the surface; and the angle of complete or maximum polarisation of the reflected light is given by $\tan \theta = n$. Jamin has shown that this polarisation is practically complete at the polarising angle for substances having a refractive index of about 1·46, so that it would appear that a simple blackened-glass polariscope should show a change of about 37 seconds in its polarising angle when it is rotated in the plane of the earth's orbit.

Of course, such a small effect would probably be difficult to measure, but it may be amplified considerably by making use of the rotatory effect of an oblique plate on an already polarised beam; and this was the method employed by Fizeau, who used a pile of forty thin glass plates of slightly prismatic form so as to deviate the reflected beams away from the transmitted beam, the rotation of which was observed. His observations, which were conducted with three different dispositions of the apparatus, gave rotations in some cases of as much as $2\frac{1}{2}$ degrees; and they varied with the orientation of the apparatus and time of day as anticipated. They also agreed fairly closely with his predictions from the then existing theory, but these are perhaps open to criticism.

There can be little doubt, however, in the light of our present knowledge, that the basis of Fizeau's method is sound; and it is a remarkable testimony to his prescience and ingenuity that he should apparently have realised the necessity for what may be called a "surface method" and have devised such an ingenious method of carrying it into effect at such an early date. Unfortunately, he does not seem to have realised its importance in relation to the ether drift problem, and devised it primarily for the purpose of extending his verification of the

Fresnel drag formula to solid substances; neither did he give any cogent reasons for having adopted this particular method; so that his remarkable research has scarcely attracted any attention.

After a comprehensive survey of the problem, however, the present writer is convinced that the surface polarisation method does provide a means of measuring a first-order effect of ether drift, and that Fizeau's experiments have actually demonstrated such an effect. There seem to be various possibilities for simplifying the method, with which it is hoped to experiment before long; but in the meantime, this account of Miller's and of Fizeau's experiments may do something to revive interest in this important problem and to dispel the prevalent belief that it is insoluble.

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The Study of Behaviour*

By DR. E. S. RUSSELL, O.B.E.

IT was Descartes who imposed upon European thought for at least two centuries, and upon biology for much longer, that 'bifurcation' of Nature into matter and mind which has raised so many insoluble problems for philosophy, and diverted biology from its true method. As to its effect on philosophy, Prof. A. N. Whitehead writes:

"The seventeenth century had finally produced a scheme of scientific thought framed by mathematicians, for the use of mathematicians. . . . The enormous success of the scientific abstractions, yielding on the one hand *matter* with its *simple location* in space and time, on the other hand *mind*, perceiving, suffering, reasoning, but not interfering, has foisted on to philosophy the task of accepting them as the most concrete rendering of fact. Thereby, modern philosophy has been ruined. There are the dualists, who accept matter and mind as on equal basis, and the two varieties of monists, those who put mind inside matter, and those who put matter inside mind. But this juggling with abstractions can never overcome the inherent confusion introduced by the ascription of *misplaced concreteness* to the scientific scheme of the seventeenth century."

Actually, instead of being the most concrete of realities, both matter and mind are highly abstract concepts, the product of the reflective intelligence working upon the data of immediate experience.

There is given in individual experience only the perceiving subject and his objective world. This dualism does not correspond, is not synonymous with, the dualism of matter and mind. Subjective experience as we know it directly is a function of organism, not of pure mind; objective experience is a relation between organism and other processes or events. The concept of matter is arrived at by abstracting from the data of sense, by leaving out the 'secondary qualities' such as colour, smell and sound, and retaining the so-called 'primary qualities' of resistance and extension, with location in time and space.

By accepting this abstract definition or concept of matter, we substitute for the objective world of perception a symbolic or conceptual world of discrete material particles, which we may call the 'world of matter'. This world of matter the materialist takes to be in some sense more real than the perceptual and colourful world from which he has derived it. Actually it is less real, less concrete. It is important to remember that the world which we perceive through the senses, with its shapes, colours, smells, tastes and so on, is not identical with the conceptual 'world of matter'; we do not perceive 'matter' at all, any more than we perceive mind; we perceive things or relations or events.

Complementary to this abstract material universe is the concept of mind as an inextended, immaterial, thinking entity, and this also is

* From the presidential address before Section D (Zoology) of the British Association, delivered at Aberdeen on September 6.

derived by abstraction from the data of immediate experience, and principally from the subjective aspect of experience.

As applied to biology, this abstract dualism has saddled us with the theory that the organism is a machine, with the pale ghost of a mind hovering over its working, but not interfering. What chance is there for a real science of animal behaviour if this metaphysical view is accepted ?

Obviously from the Descartian point of view, behaviour becomes a subject for the physiologist to study from his analytical point of view ; he must regard behaviour as the causally determined outcome of the working of the animal machine, under the influence of external and internal stimuli, and he must seek to determine the elementary physico-chemical processes out of which behaviour is built up. The physiologist as such can have nothing to do with mind, and hands over its study to the psychologist, who finds that he can know nothing directly about the minds of animals. Hence we get the study of animal behaviour split up between physiology and psychology, with no possibility of a connecting bridge. The scientific study of behaviour thus becomes divorced from natural history, and ceases to take its rightful place as an integral part of zoology.

Aristotle knew better than this ; he regarded life and mind as continuous one with another, and the basis of his zoological system was the form and activity of the animal as a whole. But then Aristotle was a first-rate field naturalist and observer.

Let us try to rid our minds of the abstract notions of matter and mind, and regard the activities of living things without metaphysical preconceptions. As zoologists, our job is to study animals in action. Let us try to approach our task with the same directness and *naïveté* that Aristotle showed when he laid the foundations of our science. Instead of assuming *a priori* that the physico-chemical or analytical method of approach is the only possible and the only fruitful one, let us try the alternative of considering first the most general characteristics of the organism as a whole, and working down from the whole to the parts, rather than up from the parts to the whole, as is the more usual method.

Taking this simple and direct view of living things, abandoning theory and accepting the obvious facts at their face value, we see first of all that the complete phenomena of life are shown only by individuals, or organised unities. Sometimes these units are combined loosely or closely in unities of higher order, as in social insects and in colonial animals, such as corals, but these cases scarcely affect the main thesis that life is a function of individuals. There is accordingly no such thing as 'living matter', save as part of an organised unity.

The second thing we note is that all living things pass through a cycle of activity, which normally comprises development, reproduction and senescent processes leading to death. This life-cycle is in each species a definite one, passing through a clearly defined trajectory, admitting of little deviation from normality ; it takes place generally in an external environment which must be normal for the species, and as a rule the internal environment also is kept constant round a particular norm. The activities whereby the needs of the organism are satisfied and a normal relation to the external and the internal environment is maintained, may be called the maintenance activities of the organism, and they underlie and support the other master-functions of development and reproduction.

Our general definition or concept of organism is then an organised unity showing the activities of maintenance, development and reproduction, bound up in one continuous life-cycle. A static concept is inadequate ; time must enter into the definition ; the organism is essentially a spatio-temporal process, a 'dynamic pattern in time', as Coghill aptly calls it.

Now all these activities are, objectively considered, directed towards an end, which is the completion of the normal life-cycle. One is tempted to use the word 'purposive' in description of these activities, but this term is used in many senses and has a strong psychological flavour about it, so I shall use instead the neutral word *directive*, which I borrow from C. S. Myers. It is quite immaterial from our simple objective point of view whether these directive activities, or any of them, are consciously purposive. The directiveness of vital processes is shown equally well in the development of the embryo as in our own conscious behaviour.

It is this directive activity shown by individual organisms that distinguishes living things from inanimate objects. The peculiar character of this directiveness, its orientation towards a cyclical progression of organisation and activity, clearly distinguishes it from the static directedness of a machine, constructed for a definite purpose. It should be noted too that the living thing shows a certain measure of adaptability in completing its life-cycle, so that the end is more constant than the way of attaining it.

Now from this point of view, which is, I maintain, strictly objective, behaviour is simply one form of the general directive activity of the organism ; it is that part of it which is concerned with the relations of the organism to its external world. Plants show behaviour in this general

sense just as much as animals do, but they, being for the most part sessile and stationary creatures, respond to the exigencies of environment, and satisfy their basic needs, mainly by processes of growth and differentiation, and only exceptionally by active movements. Thus the dune plant seeking water grows an enormously long root which burrows down through the sand until moisture is reached. Animals on the other hand respond to environment and satisfy their needs by means of movements, either of the body as a whole or of certain organs. But sessile animals, like plants, may also respond or show behaviour by means of morphogenetic activity. The hydroid, *Antennularia*, for example, if suspended in the water may send out 'roots' or holdfasts to regain contact with the bottom.

Behaviour, whether of plants or animals, is thus to be regarded simply as one form of the general directive activity which is characteristic of the living organism. It holds no privileged position; it does not require 'mind' as an immaterial entity to explain it.

If we accept this view of organism, which is to my mind a simple generalisation of fact, we escape or elude the difficulties of dualism; we need no longer regard behaviour as either the mechanically determined outcome of the material organisation of the body, or the result of the activities of an immaterial mind or entelechy influencing in some utterly mysterious way the mechanical workings of the body. By taking as given and as fundamental the plain objective characteristics of the living and intact organism, by refusing to split it up into matter and mind, we avoid both materialism and its counterpart vitalism.

This is, as I conceive it, the central position of the modern organismal theory—the substitution of the concept of organism for the concepts of matter and mind. The concept of organism, or more generally of organised system, may of course be applied right down through the inorganic realm, wherever organised unities are found. Thus a molecule is an organised system, and so also is an atom. I do not, however, agree with those who think that all real unities, both organic and inorganic, are adequately characterised as 'systems'. In certain most general characteristics an atom and a living organism agree, for both are systems or wholes. But the living organism has characteristics which are lacking in inorganic systems, and it can be adequately defined or characterised only by reference to those peculiarities which we have just considered—the weaving together in one cyclical process of the master functions of maintenance, development and reproduction. These distinguish it from any inorganic object or construction, from any inorganic system. Underlying these characteristics is the general directiveness of its activities, their constant drive towards a normal and specific end or completion.

It will be noted that this organismal view makes no real distinction between life and mind, between vital activities and those which in immediate experience appear as mental or psychical activities. In this respect we hark back to a pre-Descartian mode of thought, and call Aristotle our master.

Simple observation shows us that living animals exhibit activities which are obviously not, on the face of them, those of a mechanism. Many of their behaviour actions are strictly analogous to those which in immediate experience we should describe as psychological. Thus we see animals trying hard to achieve some aim or end—a salmon struggling to surmount a fall, for example, or a cat using all its skill to catch a bird. We do not know whether these actions are consciously purposive or not, but we cannot dismiss the objective facts of striving merely by assuming that they are mechanically determined. There are the facts; animal behaviour is predominantly directive, or in an objective sense purposive, and there is no use closing our eyes to it.

It is well known too that many animals can learn and profit by experience. Thus if you train a puppy to play with a ball, this becomes of functional significance to it; it will go and look for its ball, which it remembers; and other objects of a similar size or shape acquire for it the functional value of a ball, and are used in play. There is here definite evidence of memory, or retentiveness.

In the same way, there is abundant evidence that animals perceive their surroundings, singling out those objects and those events that are of importance in relation to their needs. Of course we cannot know what the quality of these perceptions is, but we *can* determine by suitably planned experiments just what it is to which the animal responds, and we often find that the response is to patterns or images or relations, and not to a simple summation of physico-chemical stimuli. From the organismal point of view there is no difficulty in assuming that animals perceive and react to an external world of their own; here, as in our own case, perception may be regarded as a function of organism, not of 'mind'.

This is essentially the attitude of ordinary common sense. In practice we treat our fellow men and at least the higher animals as being real individuals with perceptions, feelings, desires, similar to our own; and common sense is in principle justified, though of course it runs a great risk of reading human motives, human ways of thought, into the behaviour of animals, and of

assuming without sufficient warrant that their perceptual worlds are the same as ours. But because there is a danger of faulty interpretation, due mainly to inaccurate or inadequate observation, we are not thereby compelled to throw over the general conception that the animal organism is capable of perception, conative behaviour, and memory, if the facts of observation lead us to this conclusion. I do not mean that we should explain behaviour as being due to psychological functions labelled conation, perception and memory—that would be an empty and barren explanation. We are concerned only with behaviour, not with the subjective experience of the animal, which cannot be the subject of scientific study. But we must describe the behaviour fully and adequately, using if necessary terms of psychological implication, refusing to be bound or hampered by the metaphysical notion that the animal is merely a machine or can be treated as such.

In affirming as we do that the animal organism in its behaviour shows a kind of activity which cannot be adequately described in terms of material configuration we are taking no great risk. Our own immediate experience is there to assure us that in one case at least the organism certainly does perceive, strive, feel and remember.

From the organismal point of view, the study of behaviour is neither comparative physiology nor comparative psychology; it is the study of the directive activity of the organism as a whole, in so far as that activity has reference to the organism's own perceptual world. It must start with what Lloyd Morgan calls the 'plain tale' of behaviour, the full and accurate description of what animals do, and of what they are capable.

The plain tale description of animal behaviour must begin with a study of the natural history and ecology of the animal. Most animals are restricted to one definite and rather specialised kind of environment; they are adapted both in structure and activity to inhabit some particular ecological norm or ecological niche. We must discover by field observation how the animal finds this ecological niche to begin with, and how it maintains itself therein. We must investigate how it counters changes in its environment, how it defends itself against enemies, how it finds or captures its food. All this is straight natural history in the old sense, the study of the 'habits' of animals, and it is linked up closely with the modern study of ecology. It is the necessary basis for the more detailed study of behaviour. It is also the clue to much of the behaviour shown in the artificial conditions of a laboratory experiment.

Clearly then we must start with direct observation of the animal's behaviour in the field, or in experimental conditions that approximate as nearly as possible to the normal. We must then ask what is the animal trying to do, what is the objective end or aim of its action? Sometimes the animal is doing nothing in particular; it is resting or merely waiting for something to turn up. Usually, however, the animal is active, is showing behaviour; its actions are directed to some end, are aimed at satisfying some need, and we can determine by observation and experiment what that end is; the sign that the end is attained is the cessation of the train of action.

We find very often that a simple directive activity is part of a general directive process of long range, which may take months to reach its goal; and to understand the simple action we must relate it to, or integrate it in, the general process of which it is a part. Take for example the building of a nest by a bird. This taken by itself is a directive activity, aimed at the construction and completion of an adequate brooding place for the eggs and young. It is a fairly stereotyped and specific activity, but unusual materials may be pressed into service if the normal materials are hard to come by. But nest-building is simply one link in the long reproductive cycle, which may commence with migration, and its relation to that cycle, which includes both behavioural and physiological activities, must be studied if we are to understand it fully.

This illustrates the general rule of biological method which we have just discussed—that the whole life-cycle of activity must be regarded as the primary thing, and that the parts of it which may be isolated for study must be re-integrated in the whole-activity. The human mind is prone to analysis, and we must be on our guard against its inveterate tendency to separate and distinguish parts or elements in what are, fundamentally, continuous processes.

In thus relating partial events to life-cycle, we must of course consider above all their time-relations, not only their relations to what has gone before, but also and more particularly to what follows after. I should like to refer in this connexion to a recent address by Coghill, in which the organismal view of development, including the development of behaviour, is set out with great clearness and authority. He tells us that:

"the neuro-embryologic study of behavior shows that events within a behavioral system can be understood scientifically only as their relation is known to subsequent as well as to antecedent phases of the cycle. The antecedent tells a part of the story about the present, but not all of it; for within the present are events that have behavioral significance only in that which follows. . . . The purely scientific method, dealing

exclusively as it does with space-time relations, can not reject the future from its explanation of the present in behavior, because any event in an organismic cyclic system is an integral part of both the future and the past."

To conclude—it is time biology shook itself free from the limitations imposed upon it by a blind trust in the classical doctrine of materialism. This doctrine is not in harmony with the modern development of philosophical thought, nor with the modern development of physical science, and it is not well adapted to the study of living things.

We must adopt a more concrete and more adequate concept of the living organism, one that will take account of its essential characteristics. We must think of the organism as a four-dimensional whole, or directive cyclical process, and no longer attempt to contain it within the static scheme of the classical materialism. This does not lead to any form of dualistic vitalism. The relation of behavioural or 'psychological' activities to physiological is not the relation of mental to physical activities, but is, quite simply, the relation of a whole spatio-temporal directive process to its parts.

Finer Structure of Chromosomes

RECENT studies of the chromosomes in various somatic tissues of *Drosophila* and other insects is throwing further light on the processes of heredity. It has been known since 1881, when Balbiani studied the chromosomes in the salivary gland cells of the *Chironomus* larva, that they are relatively very large and are marked with transverse bands or discs. Last year, Prof. T. S. Painter expressed the view that these bands, which show equally in the giant chromosomes of the salivary glands of *Drosophila* larvæ, correspond with the locations of the genes. An exciting line of investigation is now being pursued, in which the positions of the discs or bands are compared in different genotypes of *Drosophila* having deficiencies, translocations and other alterations in their chromosomes.

In two recent papers in *Genetics* (May and September, 1934), Painter has made further studies of the bands of varying widths which occur at fixed positions on the chromosome, making a pattern which may be compared with a spectrogram. It is well known that in Diptera the somatic chromosomes are often closely paired, but he finds that in the salivary gland cells of old larvæ the homologous chromosomes fuse completely, "line for line and band for band", but it is not at present clear how this can take place. This somatic synapsis is accompanied by separation of the long chromosomes into two parts at the spindle fibre attachment, while about three-eighths of the *X*-chromosome—the portion found genetically to be free from genes—as well as the greater part or the whole of the *Y*, disappear completely.

By studying deletions and translocations in which a series of genes are present the position of which on the *X*-chromosome has been mapped, particular bands can be closely identified with particular genes. When certain genes are deleted, corresponding bands will be absent, and if a section of the chromosome is transposed, its bands and their affinities are correspondingly altered. By such methods the chromosomes can be more accurately mapped, and much breeding work can be eliminated by the direct observation of the position of known bands in the chromosomes.

In an investigation of the ganglion cells of *Drosophila*, Dr. Kaufmann (*J. Morph.*, **56**, No. 1) has shown that some of them have satellites, and that, as in plant cells, certain chromosomes (in this case loci of the *X* and *Y*) are concerned in producing the nucleolus. He also finds the anaphase chromosomes double, consisting of two coiled chromonemata as in plant nuclei.

Following these advances in knowledge of the morphology and inner structure of *Drosophila* chromosomes, come fresh observations and speculations regarding the relation between the visible discs and the hypothetical genes. Prof. N. Koltzoff announces (*Science*, Oct. 5, 312) that the diploid somatic non-dividing cells in the salivary glands of insect larvæ contain giant chromosomes because the chromonema in each has divided successively to form probably 16 strands, which he calls genonemes. In addition to the discs at intervals on the chromosome, chromomeres are seen on the individual strands, and these structures can be photographed in the living cell. Koltzoff is inclined to regard the gene as corresponding, not to the chromomere but to the intervening portion of thread between two chromomeres, the discs being regarded as joints between the genes.

Dr. C. B. Bridges has independently come to conclusions in many respects similar, as announced by Science Service in the same number of *Science*. The chromosomes in the salivary glands of fruit-fly larvæ are in some cases seventy times the size of the ordinary chromosomes. By using a method for removing the outer chromatin, Bridges finds the solid discs composed of a bundle of parallel rods like a handful of cigarettes, threads connecting corresponding rods from one disc to another to

form a twisted cable. He concludes that each gene locus corresponds with a particular size or shape of chromomere, always in the same relative position. The sub-units of the discs are apparently regarded as the real genes, and many of them are believed to be no larger than one or a few molecules of the more complex proteins.

While Koltzoff and Bridges thus differ in certain of their interpretations, it is evident that they have both examined the same structures, and it has been shown that these giant chromosomes can be used in a further analysis of the ultimate structure of animal chromosomes and the relation of their finer structure to the processes of inheritance. This new line of investigation is one of much promise as rendering possible a more specific identification of genic structures in the chromosome.

R. RUGGLES GATES.

Obituary

PROF. JAMES MARK BALDWIN

WE regret to announce the death of the distinguished psychologist and philosopher, James Mark Baldwin, which occurred in Paris on November 8. Born at Columbia, South Carolina, in 1861, Baldwin, who originally intended to devote himself to the ministry, studied first at Princeton. Here he came under the philosophical influence of Principal McCosh, which left a lasting imprint upon his mind. Here, also under McCosh's sympathetic tuition, he became acquainted with the general theory of biological evolution and with the leading ideas of Wundt's recently published "Physiological Psychology". In the light of this early orientation, the subsequent development of his psychological interests becomes clear.

So impressed was Baldwin by the possibility of the then novel project of experimentation in psychology that, on gaining a graduation fellowship, he spent two semesters in Germany, studying at Leipzig, Tübingen and Berlin; and, as he himself says, the chief result of these studies was "a sort of apostolic call to the 'new psychology' ", which he accepted with enthusiasm. Returning as a teacher to Princeton, though still occupied with apologetics and theology, his 'call' soon led him to Mount Forest, where he was appointed to a chair in philosophy. This was the first of a number of university posts, including chairs at Toronto and Johns Hopkins, which he filled with great distinction; and here, dissatisfied with the barren associationism and structuralism of the textbooks of the day, he began his "Handbook of Psychology", in which he stressed his own developmental and functional theories.

At Princeton, Toronto and Johns Hopkins successively, Baldwin founded psychological laboratories on the model of Wundt's, where courses were given in experimental psychology, and numerous important researches were carried out; but in the end he became somewhat critical of the experimental method of approach because of the paucity of results in respect of the genetic problems with which he was mostly concerned; and he turned definitely to the study of mental origins, development and evolution that formed the abiding interest of his later work. This took the form, in the first place, of an attempt to correlate psychological with general biological data covering the widest field; and it issued in the principle of 'circular reaction' ('trial and error'; 'give and take') which he formulated as the groundwork upon which all the variations of the original life-act rest. In this way he accounted for the evolution of living organisms, individual development and social progress. Evolution, as a process, he thus viewed from a psychological angle as well as a biological one; and the problem as to whether or not there is any directive factor in its course was raised.

Baldwin's solution of this problem in its wider aspect—similar to that of Lloyd Morgan, which appeared at about the same time—relied neither upon a presumed inheritance of acquired characters nor upon any vitalistic determining agency. According to him, the spontaneous variations that occur in individual organisms are not handed on; but in each generation they act as factors which favour the developing function of the species, and thus allow the principle of natural selection full scope. Applied especially to the evolution of mind, in which Baldwin was more keenly interested, this theory becomes one of 'emergence'. The then prevailing view, that mental process should be explained by the quantitative method of analysis, by reduction of the whole to its constituent parts, destroyed the possibility of reaching any real genetic solution of the problem. Higher forms of mentality cannot be accounted for by mere reference to, or analysis into, lower ones. The properties of water—he takes the example from chemistry—cannot be explained by saying "water *is* (=) H_2O"; but only by saying "H_2 + O *becomes* (<) water" (a view strongly reminiscent of the old theory of the 'mixt', and closely akin to, if not a foreshadowing of, that of configurationism). Accordingly, the proper position to adopt is that every true genetic development is irreversible; and that every phase in such a development indicates a new, higher, and heretofore unrealised, manifestation of what we call 'reality'.

These manifestations, so far as mind is concerned, may be studied in various ways: phylogenetically, anthropologically and ontogenetically; and all these methods of approach supplement one another. Accordingly, animal behaviour will form an objective subject of research, in which biogenetic results will be discovered; the stages of mental growth, as exhibited in all its phases from that of primitive peoples to the highest cultures, will be investigated, again objectively, by an examination not only of the mentality of existing peoples, but also of the languages, mores, laws, institutions and the like, to

which historically they have given rise; while from the psychogenetic point of view, the development of the individual mind from infancy to maturity will be the (largely subjective) complement by which the former results are interpreted and understood.

All this Baldwin dealt with in his several works on what he calls genetic logic, extending the use of the term 'logic' to signify the evolving processes of mental organisation as phases in one continuous movement. He recognised three distinguishable, though overlapping, stages in mental development, in which the same motives operate continuously. These are characterised as the pre-logical, the logical, and the super-logical; the principal signs of which are respectively sensory perception and memory, reasoning, and those hyper-rational functions which have been distinguished from reasoning, in the usual sense of the term, as 'reason'.

Baldwin made much of 'play' in this mental development; and found in it a motive ranging from the explorative and experimental play of children, through the tentative trials of hypotheses in logical reasoning, up to the idealisations of artistic production and mysticism on the highest plane. He also gave a high place to the genetic factor of social intercourse as a continuous motive of development which, on the principle of circular reaction, is to be found working at all levels, and issues, among other things, in the discursive processes of thought and language and the common heritage of an organic system of socially shared knowledge. In this connexion he emphasised the nature of the individual as a differentiation of a common social protoplasm; he is a social outcome rather than a social unit—a view again akin to, if not foreshadowing, configurationism.

Baldwin worked out the implications of these lines of thought in the direction of the life of feeling also, tracing the primitive 'interest' that lies at the basis of the whole, through its successive manifestations in organic, emotional and theoretical reactions, to its final response in the moral, æsthetic and religious sentiments, and dealing with many problems, such as those of value and æsthetic sympathy and immediacy, which present themselves in this field. From the foregoing it will readily be appreciated how thoroughly, in his many books and papers, he covered the ground he had mapped out for conquest at the beginning.

Despite the large output of his work and his closely reasoned geneticism, which have played no small part in the shaping of contemporary psychological thought, Baldwin is perhaps best known because of his "Dictionary of Psychology and Philosophy", which he produced, with the collaboration of more than sixty eminent thinkers, as an attempt to determine and stabilise a precise psychological terminology. More, perhaps, than any other science, psychology has suffered, and indeed still suffers, from ambiguities due to the fact that its technical terms are borrowed for the most part from ordinary language. It had been proposed to coin a terminology on the pattern of those of mathematics and chemistry, by the use of which it might be possible to avoid the theological and metaphysical connotations of such words as soul, cause, reason and the like, then in common use. Baldwin did not go so far as this; but he did produce a work of uncommon value for psychology, in which an exact usage is provided, together with its equivalent in other languages, for every term with which it deals. There are few teachers or students of psychology and philosophy who have not found this work indispensable. He has bequeathed also to psychology another invaluable legacy in the *Psychological Review*, which he founded with the veteran psychologist, James McKeen Cattell. This, together with the *Psychological Bulletin*, *Monograph Supplements*, and *Psychological Index*, which grew out of it, are likewise of the greatest value to the student.

It is difficult, at close range, to estimate the effect that the life-work of a man has upon the science that he represents; but it is safe to say that the future historians of psychology will see in James Mark Baldwin one of the outstanding representatives of the vital movements that are shaping the destinies of the science of psychology at the present day.

We regret to announce the following deaths:

Sir E. A. Wallis Budge, formerly keeper of the Egyptian and Assyrian Department of the British Museum, on November 23, aged seventy-seven years.

Prof. Willem de Sitter, professor of astronomy in the University of Leyden, on November 20, aged sixty-two years.

News and Views

Anniversary Meeting of the Royal Society

In connexion with the anniversary meeting of the Royal Society, on November 30, when the medals for the year were presented (NATURE, Nov. 10, p. 727) it may be recalled that this gathering one hundred years ago took place on December 1, in consequence of St. Andrew's Day falling upon a Sunday. The treasurer, Sir John William Lubbock, occupied the chair, the reason for this arising from a letter that he had received that day from H.R.H. the Duke of Sussex, president of the Society, stating that the condition of his eyesight forbade attendance. "I regret," the Duke wrote, "being deprived of the pleasure of conferring the medals this day, and particularly the one which has been so properly adjudged to you, for whom I profess the highest consideration." The customary anniversary address was not delivered. The Copley medal was allotted to Giovanni Antonio Plana, professor of astronomy and director of the observatory of the University of Turin, for his work entitled, "Théorie du Mouvement de la Lune" (3 vols. 4to., 1832). Elected a foreign member of the Society in 1827, Prof. Plana died at Turin in 1864. The recipients of the Royal medals were (1) John W.

Lubbock for his investigations on the tides, and (2) Charles Lyell for his work, "Principles of Geology". The grounds for the latter award were announced as: (*a*) the comprehensive view taken of the subject, and its philosophical spirit and dignity; (*b*) the important service rendered to science by specially directing the attention of geologists to effects produced by existing causes; (*c*) the author's admirable descriptions of many tertiary deposits; (*d*) the new mode of investigating tertiary deposits, which his labours have greatly contributed to introduce, namely, that of determining the relative proportions of extinct and still existing species, with the view of discovering the relative ages of distant and unconnected deposits. The Rumford medal was awarded to Prof. Macedonio Melloni, of Parma, for his researches and experiments on the diffusion of heat by radiation, and its relationship in lunar light. Melloni was director of the Meteorological Observatory, Mount Vesuvius, 1839–49, and became a foreign member of the Royal Society in 1839; he died in 1853.

British Association: Norwich Meeting

THE annual meeting of the British Association will be held next year in Norwich on September 4–11 under the presidency of Prof. W. W. Watts. The following sectional presidents have been appointed: Section A (Mathematical and Physical Sciences), Dr. F. W. Aston; B (Chemistry), Prof. W. N. Haworth; C (Geology), Prof. G. Hickling; D (Zoology), Prof. F. Balfour Browne; E (Geography), Prof. F. Debenham; F (Economic Science and Statistics), Prof. J. G. Smith; G (Engineering), Mr. J. S. Wilson; H (Anthropology), Dr. Cyril Fox; I (Physiology), Prof. P. T. Herring; J (Psychology), Dr. Ll. Wynn Jones; K (Botany), Mr. F. T. Brooks; L (Educational Science), Dr. A. W. Pickard-Cambridge; M (Agriculture), Dr. J. A. Venn. The president of the Conference of Delegates of Corresponding Societies will be Prof. P. G. H. Boswell.

Dud Dudley and the Coal-Iron Industry

THROUGH the publication of his little work "Mettallum Martis", 1665, Dud Dudley, 1599–1684, a son of Edward Sutton, Lord Dudley, has long enjoyed a reputation as being a pioneer in the use of coal, instead of charcoal, as a fuel for smelting iron. Most early writers on industrial history accepted Dudley's writings at their face value without inquiring into their correctness. A proposal made some years ago to erect a monument to him at Dudley, however, led to a closer scrutiny of what he had written and the state of the iron industry at the time, with the result that many of his assertions have been found impossible of belief, and many of his claims to our admiration as an outstanding pioneer have to be rejected. A review of the whole question was given by Mr. R. A. Mott on November 21 in a paper read to the Newcomen Society at the Iron and Steel Institute, and in the subsequent discussion Mr. Mott's views found general acceptance. Dudley lived in stirring times and had many adventures, but his work as an iron master was done when he was a young man. That he did make iron there seems no need to question, but that he produced good quality iron with the use of coal has to be rejected. Mr. Mott's view is that, as a historian, Dudley's veracity has to be questioned, while as a man he was an opportunist, vain and boastful. A consideration of the technical basis of his claims shows that they were impossible of achievement. The *Transactions of the Newcomen Society* contain several valuable papers on the history of the iron industry and these, with that of Mr. Mott, should be studied by all interested in this phase of industrial history.

Cardiff Engineering Exhibition

THE thirteenth annual exhibition at Cardiff, held under the auspices of the South Wales Institute of Engineers, opened on November 21 and closes on December 1. The main object of these exhibitions is educational and also to encourage industry by bringing the manufacturers of machinery and plant into touch with the users. Whilst mining appliances were well represented, almost every branch of engineering activity has received attention. An outstanding feature of this year's display was an exhibition coal mine, equipped by the Coal Face Machinery Exhibitors' Association—an association which comprises nearly all the manufacturers of coal face machinery in Great Britain. It was installed not as an advertisement of any particular plant, but to show the possibilities of mechanisation at the coal face, and to keep mining engineers and others interested and informed of the most recent developments in this respect. The mine consists of a main roadway, a machine-mined heading and a longwall face, in which are placed examples of coal face machinery—longwall coal cutters and shearing machines, jigger and belt conveyors, dust filters and pneumatic drills. In the roadways and face, modern methods of supporting roof and sides are shown. The Department of Scientific and Industrial Research had a valuable exhibit illustrating some of the research activities of the National Physical Laboratory, the Fuel Research Station, the Chemical Research Laboratory and other scientific bodies. Thus, fatigue of metals, lubrication research, electric welding, alignment of machine tools, steel casting, microstructure of metals, corrosion of metals, hydrogenation of coal, smokeless fuel and industrial applications of X-ray analysis, were among the topics illustrated. An interesting exhibit consisted of turned objects made of some of the latest plastic materials derived from coal, and intended to display the artistic possibilities of such materials.

Competitive Trials of British Military Aircraft

THE periodical trials for the selection of new types of aircraft for R.A.F. equipment, now in progress, include some machines that have considerable technical interest. Two of the day and night fighters now being tested are monoplanes, designed and built by Messrs. Bristol and Vickers respectively. The British Service requirements for a fighter have hitherto put extreme manœuvrability in action first

in importance. In this respect the biplane is best, and at present all of the R.A.F. fighter machines are of this type. Some Continental nations consider superiority in speed of greater importance, allowing the pilot to engage or break off action at will. The clean lines and somewhat smaller head resistance of the monoplane give it the advantage in this case. The biplane has another point in its favour which must be considered when making comparisons. The wing structure can be built more sturdily for a given weight, and it is consequently safer for resisting the stresses developed in high velocity diving bombing, or in very small turns at high speeds when fighting. The new Bristol monoplane is fitted with a retractable undercarriage to eliminate the resistance of that part when in the air. The motion is carried out electrically, the pilot merely having to move a switch, an indicator on the dashboard telling him the position of the wheels. This type of undercarriage has not been used on R.A.F. standard equipment up to the present.

Heavy Water in Chemistry

AT the Friday evening discourse at the Royal Institution on November 23, Prof. M. Polanyi dealt with heavy water in chemistry. Heavy water has a density ten per cent greater than ordinary water. Its chemical composition is the same as that of ordinary water, two hydrogen atoms to one oxygen atom. Nor is there anything unusual about the oxygen atom. All the heaviness is due to the new kind of hydrogen discovered by Prof. H. C. Urey, which is contained in the heavy water. Its atomic weight is two instead of one. Heavy hydrogen atoms have the same structure as ordinary hydrogen atoms, only with a heavier nucleus. Such a pair of atoms would have the same chemical properties if the atoms were merely material particles. Atoms, however, are not only particles, but they are also waves: as waves, the two hydrogen atoms are different. The heavy one has a shorter wave-length. The chemical dissimilarity between the two hydrogens shows to what extent atoms behave as waves and not as particles.

THE chemical differences of ordinary and heavy water make it possible to extract heavy water from its natural dilution of one part in four thousand and prepare it in pure form. The preparation is still a very expensive operation, but methods can be outlined by which it might be considerably cheapened. Heavy hydrogen might then be used in the manufacturing of drugs and dyestuffs, if its properties should turn out to be useful, for example, if it shows greater stability than the products made of ordinary hydrogen. With heavy hydrogen, reactions can be discovered in which chemically nothing is changed, because all that happens is an interchange of hydrogen atoms. When part of the hydrogen atoms are 'labelled' by being of heavier sort, this interchange becomes apparent. Some well-known chemical reactions of hydrogen appear now as subordinate effects of this hitherto undiscovered interchange process. When, for example, hydrogen is added to benzene forming hydrobenzene, for every molecule adding on hydrogen there are a hundred molecules which react with hydrogen in the way of an interchange. It seems that hydrogenation may be just an occasional by-reaction of this main interchange process. Following this line, the atomic mechanism of hydrogenation can be worked out completely.

Preservation of Scenic Amenities

THE necessity for preserving the scenic amenities of the countryside is fortunately gaining more attention, and there is hope that some of the worst vandalism may be checked before it is too late. But the dangers of urban growth are still insistent, and to this topic Dr. Vaughan Cornish refers in an article in *Geography* of September on the scenic amenity of Great Britain. It is not only the growth of radial suburbs with their monotonous plans, but also the reconstruction of existing urban centres that needs to be controlled. The nineteenth century saw the spoliation of many picturesque market towns and beautiful cathedral cities and the growth of urban 'deserts' on the coalfields. Among the few examples of urban scenery from which Nature has not been expelled are the west end of London, the collegiate parts of Oxford and Cambridge and the precincts of most cathedrals. It is to be hoped that in schemes of reconstruction the dignified architecture of the eighteenth century, where it exists, will be preserved, while in the replacement of the closely packed streets of the Victorian era due regard should be paid to the possibility, with modern constructional materials, of accommodating the people on half the area by doubling the height of the houses and so leaving space for town gardening and afforestation. The conversion of every city into a garden city is the most important consideration in the replanning of towns, and this must entail the abandonment of formal lines which are so tiring to the eye.

Recent Acquisitions at the Natural History Museum

AMONG the recent acquisitions at the British Museum (Natural History), the Department of Zoology has received as a donation from the Rowland Ward Trustees an exceptionally fine mounted head of the Tian-Shan wapiti, and from Sir Arnold Hodson, Governor of the Gold Coast, a further skull of the so-called dwarf elephant, or 'Sumbi', from the Gola Forest, Sierra Leone. This specimen is a young individual of the forest elephant. The horns of a white rhinoceros from the Belgian Congo have been presented by Mr. Stanley C. Tomkins. This gift is of special interest in that the Museum already possesses the skull to which these horns belong. One hundred and fifty birds of 76 different kinds collected in the dry thorn bush region of the West Usambara Mountains, Tanganyika Territory, have been purchased, and also an interesting collection of more than 200 birds from Serbia and Macedonia. Extensive collections of insects made during the summer months of 1931, 1932 and 1933 by members of the staff of the Department of Entomology in the Scottish Highlands are beginning at last to yield interesting results. More than 7,000 specimens were obtained and added to the collections, and among them so

far more than 50 species have been recognised that have not previously been recorded from Great Britain, including at least 13 new to science. The particular aim of the collecting undertaken was the study of the fauna occurring in association with the relict arctic-alpine flora peculiar to elevations above 2,500 ft. In one group alone, consisting of the sawflies, four species new to science, and 13 new to Great Britain were obtained, with a total of 18 species peculiar to the region specially investigated.

Botany at the Natural History Museum

MR. J. D. SNOWDEN has presented to the Department of Botany his herbarium of 2,300 plants. During his period of service as agricultural officer in Uganda, Mr. Snowden was an enthusiastic botanical collector with great opportunities of which he made full use. His collections rank, both in number and quality, among the best from the Protectorate, and include many plants discovered by himself. The specimens presented to the Museum formed his own personal set. Some of the plants were collected in the little-known Acholi Hills in the south of the Sudan, but the great majority came from Uganda, particularly from Mount Elgon, the flora of which—like that of the other great African mountains—is of exceptional interest. As an agricultural officer, Mr. Snowden knew just what was required, and his material is accompanied by adequate notes. He paid special attention to grasses, a group in which his name is commemorated by the genus *Snowdenia*.

SIR J. L. HANHAM, who accompanied Mr. J. M. Wordie's recent arctic expedition, made a collection of plants from West Greenland (500 numbers) and Baffin Land (200 numbers), together with a few lichens and mosses. Plants in the arctic are well known to be shy flowerers, and this collection contains exceptionally good specimens; they are unusually well dried, whereas so many arctic collections have suffered much from mould and mildew owing to the great humidity of the atmosphere in high latitudes. As a result, this collection is a valuable one apart from the fact that it has been made in little-known regions. Mrs. E. M. Day has presented the paintings of larger fungi made by her late husband. They number 1,400. Most of them have been examined by eminent mycologists or have been drawn from specimens named by them. An interesting fern herbarium of about 500 specimens from Trinidad has been presented by Archdeacon A. Hombersly. The herbarium is in very good condition and is of particular value as the donor used his collection as the basis of an account of the ferns of Trinidad which is now being prepared for Press. Mr. E. Heron-Allen has presented a copy of the valuable first edition of the "Thesaurus Evonymi Philiatri de remediis secretis", by Conrad Gesner, 1557. This is a rare book, particularly in the first edition. It makes an interesting addition to the collection of herbals in the Department of Botany.

Die Physik

THE quarterly journal *Die Physik in Regelmässigen Berichten*, which is sponsored by the German Society for Technical Physics, has completed its second year. As the full title implies, its contents are mainly surveys of larger or smaller fields of physics, the average length of an article being about 15 pages. The thirteen subjects dealt with range widely, and include hygrometry, acoustics, medical physics, corpuscular radiations and general quantum theory, the balance between the old and the new physics being carefully maintained. It is presumably the intention to give further surveys with the same titles, as the subjects develop, since the title of each article is followed by the numeral I. The reviews appear very thorough, considering the space available, and are all by acknowledged experts in their subjects. Thus F. Henning writes on thermal apparatus, M. Pirani on illuminants and illumination, W. O. Schumann on dielectrics and G. Wentzel on quantum theory and wave mechanics.

A FEATURE of the publication is the method of citing references to investigations mentioned in the surveys. Whenever possible, the volume and page number of the abstract in the *Physikalischen Berichte* is given, without more detailed reference, a note at the end of every article explaining that this has been done. Additional references are collected together at the end of the survey. An innovation which seems to have little to recommend it is that of numbering the pages of each survey independently, and printing this page number on the top corner of the leaf. A second set of page numbers running serially through the volume is also provided, but is in a less conspicuous position, at the bottom corner of the leaf. The periodical is published by J. A. Barth of Leipzig, and the annual subscription (post free) is 24.60 gold marks.

A New Modified Bunsen Burner

THE Bunsen burner is one of those simple and ingenious contrivances that could only have emanated from the brain of a practical genius. Unlike some of his successors to-day, Bunsen was never a *Schreibtisch-Chemiker*; flouting speculative hypotheses, he excelled in practical work of many kinds, and in devising his celebrated burner he created for himself a memorial that may well outlast his fame as an analytical investigator. Generations of chemists and physicists come, use his burner, and go; yet the principle of it stands fast. From time to time a useful modification, for example, the Meker and the Teclu, arises, and the latest, which has recently been marketed by Messrs. Amal Ltd., of Birmingham, appears to belong to this category. In this burner, a very sensitive control of the gas flow is obtained by means of a needle-valve, inserted in the orifice of the jet, which is capable of very fine adjustment by an external screw. Air-regulation is unnecessary, and the flame can be reduced almost to invisibility, by means of the needle-valve, without flashing back. As in the Meker burner, the combustion-head is perforated with many small holes, so that the flame consists of a cluster of perfectly aerated small cones. Attached to the base is an insulated hooked strip of metal for use as a holder should the burner become

hot. The Amal burner is supplied in several sizes, that for ordinary use measuring 5½ in. high and one inch across the head, and costing 12*s*. 6*d*.

Value of Anti-Diphtheritic Serum Treatment

THE autumn issue of the *Fight against Disease* (22, No. 4), the quarterly journal of the Research Defence Society, contains an article by Sir Leonard Rogers showing the reduction in the suffering and the deaths of children from diphtheria during the last forty years consequent upon the use of anti-diphtheritic serum treatment. He points out that the *case mortality*, the most scientific test of the value of treatment, from diphtheria in the hospitals of the Metropolitan Asylums Board, has steadily fallen every year from a percentage of 30·4 in 1890–93 before serum was used, to 9·0 in 1905, 7·4 in 1910, and less than 4·0 in 1933, following the treatment of the disease with the serum. More striking still is the fall in mortality for laryngeal cases, from 62 per cent in 1894 to 11·7 in 1910. The value of the serum treatment is even more conclusively shown by its remarkable efficacy in the early stages of the disease, as compared with its comparative failure when given after the fourth day of the disease, when the toxæmia of the disease is fully developed, in accordance with what animal experiments had indicated would be the case. The case mortality per cent when treatment is commenced on the first day of the disease is only 1·6, on the second day it is 7·9, and on the third 17·2. As Sir Charles Martin has pointed out, "If the antitoxin (serum) were a remedy of no value, whether it was administered on the first or on the fifth day of the disease would be immaterial". Clinical evidence is no less conclusive: many doctors still living can testify to the horrors of diphtheria in young children in the pre-serum days. This is now all changed, and the young diphtheria patient if treated early with serum will rarely succumb. Sir Leonard Rogers estimates that had the pre-serum mortality from diphtheria continued since 1911, there would have been 250,000 more deaths from diphtheria than were actually recorded.

Television in the United States

THE October issue of *Electronics* contains an illustrated article surveying the principal systems of television which are undergoing development in the United States of America. Of the six systems reviewed, four employ a cathode ray oscillograph type of tube for both transmission and reception; while the other two employ mechanical-optical systems comprising a vibrating mirror or a rotating mirrored disc, in conjunction with a photoelectric cell for transmission and a Kerr cell for reception. All the methods are capable of transmitting scenes photographed on the standard size of cinematograph film; most of them are also suitable for the transmission of studio scenes, while some can be successfully operated on outdoor scenic material. The number of scanning lines into which the picture is dissected for transmission varies from 60 to 400, while an average value of 240 lines is very popular. The transmission of such a picture at the standard cinematograph rate of 24 per second requires a communication channel of the order of 1,000 kc./sec., as compared with the space of 9 or 10 kc./sec. permitted in modern sound broadcasting. Such a large band-width is considered to be essential for satisfactory picture reproduction, and this technical limitation presents one of the most serious problems to the television worker. It requires transmitting and receiving circuits of great complexity and high cost, and it would appear to limit the available waveband for broadcast television to the ultra-short region below 10 metres. The article referred to discusses briefly the prospects of the commercial application of television in America, and expresses the opinion that in addition to the technical problems, there are other difficulties of a financial nature involved in the provision of a television programme service throughout the country.

General Štefánik

GENERAL MILAN R. ŠTEFÁNIK had the distinction of being almost the only Slovak man of science to attain any eminence since the time of Komenský (1592–1670). He studied in Paris, and before the War became secretary of the Observatory at Meudon and went on several French scientific missions. During the War, he was an air force officer in France, Serbia and Italy before becoming Czechoslovak Minister of National Defence in 1918. He was unfortunately killed when his aeroplane crashed near Bratislava as he was returning home in May 1919. Some account of his work has now been placed on record in a book recently published by Eos, Bratislava. The author, Mr. Ferdinand Písecky, was closely associated with General Štefánik during his missions in Russia and the United States, and the book is a valuable addition to Czechoslovak literature; although it deals primarily with Štefánik's War career and his political activities, occasional reference is made to his scientific work.

Eskimo Studies

A PRIZE of a gold medal and a thousand crowns has been offered by the Royal Academy of Sciences and Letters of Denmark for a study of Eskimo origins. In the statement of the conditions upon which this prize is offered for competition, it is pointed out that there are two main opposing views on the origins and ethnological affinities of the Eskimo. The older of the two theories to which reference is made derives from the views put forward by the Danish authority, J. H. Rink, in 1871, that the Eskimo were of close affinity to the Indians of North America and had originated in a comparatively restricted centre in the interior of the American continent, from which they had migrated to Alaska and afterwards spread across the northern area as far as Greenland. Later, the place of origin was defined more precisely as in the neighbourhood of Hudson Bay. The alternative theory, which it may be said is that now more generally held, is that the Eskimo, while showing affinities with the Indians,

are derivative from certain peoples of Eastern Asia, but there is considerable difference of opinion on many points. Dissertations have, therefore, been invited in which an attempt is to be made to resolve the problem of the origin of the ancient Eskimo civilisation in the light of every available class of evidence, physical character, culture, linguistic, folk-lore and the like. The result of the competition will be announced in February next.

Annual Radiological Congress

THE Annual Congress of the British Institute of Radiology (incorporated with the Röntgen Society) will be held in the Central Hall, Westminster, London, S.W.1, on December 5–7. The Congress will be officially opened on December 5 by Sir Humphry Rolleston. The seventeenth Silvanus Thompson Memorial Lecture will be delivered by Dr. H. H. Berg on "The Digestive Mucosa" on December 6, and the fifteenth Mackenzie Davidson Memorial Lecture by Sir William Bragg on "X-Rays and the Coarse Structure of Materials" on December 7. In connexion with the Congress, an exhibition of X-ray apparatus will be held at the Central Hall. Further information can be obtained from the Organising Secretary, 47 Red Lion Street, High Holborn, London, W.C.1.

Ramsay Memorial Fellowships

THE following Ramsay Memorial fellowships for the year 1934–35 have been awarded: Mr. G. C. Hampson, a British fellowship of £300, tenable for two years, at the University of Oxford; Mr. George Bryce, a Glasgow fellowship of £300, tenable for two years, at the University of Cambridge; M. Berton, a French fellowship, at the Imperial College of Science and Technology, London; Dr. Charles Haenny, a Swiss fellowship of £300, at Birkbeck College, London; Prof. G. Semerano, an Italian fellowship of £300, at the Imperial College of Science and Technology, London; Dr. M. G. van ter Horst, a Netherland fellowship of £300, at the University of Cambridge. The following fellowships have been renewed for the same year: Dr. C. Kawassiades (Greek fellow), Ramsay Memorial Laboratory of Chemical Engineering, University College, London; Dr. Ikutaro Sawai (Japanese fellow), University College, London; Dr. A. G. Winn (British fellow), University College, London.

Announcements

THE Buchan Prize of the Royal Meteorological Society for 1935 has been awarded to Dr. F. J. W. Whipple, for papers contributed by him to the *Quarterly Journal* of the Society during the years 1929–33.

PROF. ERNST HERZFELD, director of antiquities, Persia, will deliver the Schweich lectures on biblical archæology at the British Academy on December 3, 5 and 7. The subject of Prof. Herzfeld's lectures will be "The Archæological History of Iran".

PROF. W. L. BRAGG, Langworthy professor of physics in the University of Manchester, will deliver the Christmas Lectures adapted to a juvenile audience at the Royal Institution on December 27, 29 and January 1, 3, 5 and 8, at 3 p.m. The subject of Prof. Bragg's lectures will be "Electricity". Further information can be obtained from the Secretary, Royal Institution, 21 Albemarle Street, London, W.1.

THE Meldola Medal, the gift of the Society of Maccabæans, is awarded annually by the Council of the Institute of Chemistry to the British chemist under thirty years of age whose published chemical work shows the most promise. The next award will be made in January 1935, and the Council would be glad to have attention directed, by December 31, to work of the character indicated. Communications should be addressed to the Registrar, Institute of Chemistry of Great Britain and Ireland, 30 Russell Square, London, W.C.1.

ARRANGEMENTS have now been completed in connexion with the symposium organised by the British Section of the International Society of Leather Trades' Chemists on "Technical Aspects of Emulsions" to be held at University College, Gower Street, W.C.1, on December 7 (not, as originally announced, at the Royal Society of Arts), at 10 a.m.–6 p.m., under the chairmanship of Prof. F. G. Donnan. The symposium has attracted considerable attention in chemical, industrial and medical circles, and a large attendance is assured. Members and others desiring to attend should notify Dr. C. H. Spiers at the offices of the Society, 17 Market Street, London, S.E.1. The papers read at the meeting are to be published in bound form, which will be available shortly after the symposium.

MR. ARCHIBALD THORBURN, the well-known bird artist, has again presented the Royal Society for the Protection of Birds with one of his beautiful pictures for its special Christmas greeting card. The painting is of a pair of longtailed tits poised on a spray of golden gorse. Copies may be obtained from the Royal Society for the Protection of Birds, 82 Victoria Street, London, S.W.1, for 4*s*. 7*d*. a dozen, inclusive of envelopes and postage.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A temporary assistant lecturer in zoology and geology at University College, Southampton—The Registrar (Dec. 8). A museum assistant at the Woolwich Borough Museum—The Town Clerk, Town Hall, Woolwich (Dec. 10). Two junior assistants at the Museum and Art Gallery, Birmingham—The Keeper (Dec. 11). A lecturer in physics and mathematics at the Northampton Polytechnic Institute, St. John Street, London, E.C.1—The Principal (Dec. 12). A lecturer in mechanical engineering at the University of Capetown—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, London (Dec. 19). A guide lecturer in the British Museum (Natural History)—The Secretary, British Museum (Natural History), London, S.W.7 (Dec. 31).

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. 854.]

Direct Introduction of Deuterium into Benzene

THE interchange of hydrogen between benzene and 90 per cent sulphuric acid reported by Ingold, Raisin and Wilson[1] appears to us to be a special case of the following general principle, by which interchange with the hydrogen of unsaturated compounds may be effected.

The equilibrium between an ethylene derivative and the alcohol resulting by addition of water to the double bond has been studied recently by Stanley, Youell and Dymock[2]. The dehydration is endothermic (by approximately 9,000 cal.), and hence, whenever the ethenoid compound and water are both present in appreciable concentrations, an equilibrium will be established with the formation of a finite quantity of alcohol.

Remembering that catalysts of dehydration must also accelerate the reverse process, we conclude that when a system consisting of an ethenoid compound and D_2O is brought into contact with a dehydrating catalyst, a trace of alcohol will be formed, which will, in its turn, immediately decompose with the reformation of the unsaturated compound. Owing to the approximate chemical equivalence of H and D, the water molecule eliminated during the course of this decomposition would appear to have an equal chance of being either HDO or D_2O. In the former case, an interchange of one of the original H atoms attached to an unsaturated carbon atom has occurred. The mechanism of the process can be depicted as follows:

$$-CH=CH-+D_2O=-\underset{\underset{OD}{|}}{CH}-\underset{\underset{D}{|}}{CH}- = \begin{matrix}-CH=CH-+D_2O\\ \text{or}\\ -CH=CD-+HOD.\end{matrix}$$

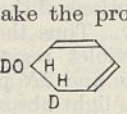
After such a process of transitory addition of water, the ethenoid bond would necessarily be left in the more stable (*cis* or *trans*) steric form. If it had originally been in an unstable form, it would be converted into the stable one.

Furthermore, the process might result in a migration of the double bond as in the following scheme:

$$-CH=CH-CH_2-+H_2O=-CH-\underset{\underset{OH}{|}}{CH}-CH_2-=$$

$$-CH_2-CH=CH-+H_2O.$$

The same considerations would apply to the transitory addition of hydrogen halides to an ethylene linkage. Again, the occurrence of such transitory additions can be predicted, if catalysts by which the *splitting off* of the hydrogen halide with concomitant formation of a double bond is effected are present. Hence, in the presence of such catalysts, a hydrogen halide will act on an ethenoid double bond in three different ways: (*a*) hydrogen replacement; (*b*) *cis-trans-* inversion; (*c*) wandering of the double bond.

The interchange reported by Ingold and his co-workers comes under the principle enunciated here, if we make the probable assumption that the compound  is readily dehydrated by 90 per cent sulphuric acid to form benzene.

The strictness of the above conclusions depends on the condition that the splitting off of water or hydrogen halide from the alcohol or alkyl halide should not be affected by the presence of the reaction products in those concentrations in which they are to be applied in the interchange reaction. In this case—and assuming again equivalence of H and D—we can calculate the velocity constant k of exchange reaction from the equilibrium constant K, and the first order velocity constant k' of decomposition in the usual way: $k=k'/K$.

We consider the following two observations of an interchange of hydrogen atoms between ethylene and 96 per cent H_2SO_4 as a confirmation of our principle:

96 per cent H_2SO_4		Quantity of C_2H_4 absorbed	Ethylene recovered	
Quantity	per cent D		Quantity	per cent D
5·1 gm.	9·1	69 c.c.	28 c.c.	5·2
4·9 gm.	9·4	69 c.c.	27 c.c.	5·0

In the first case, the ethylene absorbed was left overnight in solution; in the second case it was removed, by heating the solution *in vacuo*, immediately after absorption had been completed.

J. HORIUTI.
M. POLANYI.

Department of Chemistry,
University,
Manchester.

[1] NATURE, **134**, 734, Nov. 10, 1934.
[2] *J. Soc. Chem. Ind.*, **53**, 625; 1934.

PROF. POLANYI and Dr. Horiuti have kindly shown us the manuscript of their letter referring to our observation of hydrogen exchange between aqueous sulphuric acid and benzene. We should like to indicate our point of view in the matter.

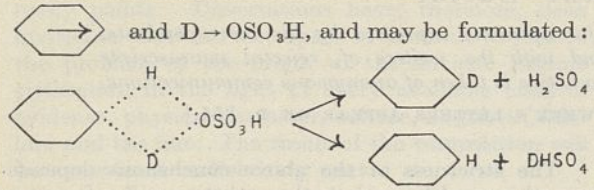
Whilst we concur in the suggestion that hydrogen exchange in unsaturated compounds through the action of reagents such as aqueous sulphuric acid would often be caused by the addition and elimination of some simple molecule such as water,

$$.CH:CH. + D_2O \rightarrow .CH(OD).CHD. \rightarrow .CH:CH. \text{ or } .CH:CD.,$$

we would not apply this type of theory to exchange in benzene or in aromatic compounds generally. In its application to the aromatic case, this theory seems to us to be a special case of the two-point addition theories of aromatic substitution; these have now been abandoned as they give but a poor account of orientation and are inconsistent with the non-parallel relation between orientation and velocity[1].

We regard hydrogen exchange in benzene derivatives as a special application of our views on aromatic substitution by electrophilic reagents[2], and we expect to prove that the exchange obeys the ordinary orientation laws. Our theory involves one-point addition: aromatic substitution differs from substitution in saturated compounds mainly in the circumstance that the polarisability of the aromatic system is available to assist the formation of the

additional partial bond in the critical complex. The exchange we described[3] involves the polarisations



This mechanism is analogous to that originally illustrated by Ingold and Ingold for nitration[4].

C. K. INGOLD.
University College, C. G. RAISIN.
London. C. L. WILSON.

[1] Ingold and Shaw, *J. Chem. Soc.*, 2918; 1929.
[2] Ingold and Ingold, *J. Chem. Soc.*, 1310; 1926. Ingold, *Rec. Trav. Chim.*, **48**, 797; 1929. *J. Chem. Soc.*, 1120; 1933. *Chem. Rev.* (in press).
[3] NATURE, **134**, 734, Nov. 10, 1934.
[4] *loc. cit.*

Spectra and Latent Energy in Flame Gases

PROF. W. T. DAVID in the first paragraph of his letter under this title[1] makes two points about the afterglow in the gases from flames or explosive reactions; the first that the temperatures determined by the sodium flame reversal method are too high, compared presumably with the platinum resistance method, the second that 'long-lived' luminous products account for a considerable proportion of the heat of combustion, while further on he mentions 15 per cent.

The sodium reversal method demands that the atoms of sodium are in thermodynamic equilibrium with the gas, and this is not necessarily the case if a small percentage of metastable excited molecules are present which are capable of communicating energy more easily to the sodium atoms[2]. As regards the second point, the energy associated with the change of metastable CO_2 to the normal state seems to be of the order of at least 80 cal. per mol., as indicated by the photographs of the diffuse banded spectra[3] and probably higher[4]. Since the heat of combustion of CO is only 67·6 cal. per mol., Prof. David's value for the proportion of the heat of combustion latent in the metastable molecules would indicate that 13 per cent of the molecules were in such a state, and if these all returned to the normal state by emitting light, the efficiency of illumination by the CO flame would be far greater than experience indicates. As one of us wrote in the discussion of one of Prof. David's papers, he is possibly correct in ascribing the luminosity or afterglow to metastable molecules, but the amount of energy which he connects with them seems altogether unreasonable.

A. EGERTON.
Thermodynamics Dept., A. R. UBBELOHDE.
Clarendon Laboratory,
Oxford.

[1] NATURE, **134**, 663, Oct. 27, 1934.
[2] cf. Ubbelohde, *J. Chem. Soc.*, 977; 1933.
[3] Fowler and Gaydon, *Proc. Roy. Soc.*, A, **142**, 362; 1933.
[4] cf. Goodeve, *Trans. Faraday Soc.*, **30**, 63; 1933.

MESSRS. EGERTON and Ubbelohde appear to agree that flame temperatures determined by the sodium line reversal method may be too high. The evidence that they are, in general, too high, seems to me to be overwhelming and has been recently reviewed[1]. They are not only in general too high (by some hundreds of degrees centigrade) when compared with temperatures determined by the platinum resistance method, but sometimes also when compared with the ideal calculated temperatures.

In one instance only, so far as our experiments have gone, are the platinum and sodium temperatures in approximate agreement, namely, for flames resulting from the combustion of a 'correct' CO-air mixture. For this mixture burning at atmospheric pressure the sodium flame temperatures determined by Loomis and Perrot[2] and by Ellis and Morgan[3] are 1900° C. and 1930° C. The maximum value determined by Griffiths and Awbery[4] by the same method is considerably lower, about 1780° C. Our platinum-rhodium wire resistance measurements yields for the same mixture burning at the same pressure a temperature of approximately 1870° C. (slightly extrapolated from a series of experiments on 'weak' and 'over-rich' mixtures[5]).

Confining attention to this mixture, in regard to which the approximate flame temperature can scarcely be in doubt, calculation shows that less than 80 per cent of the heat of combustion has been released in the flame gases, and, as the platinum wire experiments show that a state of equilibrium has been reached[6], there would seem to be a clear case for postulating a long-lived latent energy within the flame gases amounting to more than 20 per cent of the heat of combustion.

Messrs. Egerton and Ubbelohde think it likely that the afterglow of the flame gases is to be attributed to metastable molecules, but consider it unreasonable to suggest that the whole of this large amount of latent energy is associated with them. They make a strong case for this view, arguing upon the assumptions that carbon dioxide can possess only one metastable state and that the normal state can only be reached by the emission of light. But our knowledge of the metastable states of triatomic molecules is at present at a very elementary stage, and exclusive quantitative criticism would seem to be a little premature. It may, therefore, be worth while keeping metastability in mind as a possible seat of the long-lived latent energy, though, as stated in my previous letter, another explanation would appear to be possible.

Whatever may be the explanation, it seems certain that there exists in flame gases a long-lived latent energy, which is large in amount in flames and relatively small in amount in large vessel explosions. The object of my letter was to point out a probable connexion with Prof. Bone's spectrograms for flames and explosions.

W. T. DAVID.
Engineering Department,
University,
Leeds.
Nov. 9.

[1] "The Sodium Line Reversal Method of Determining Flame Temperatures", *Engineering*, Nov. 2, 1934.
[2] *Ind. and Eng. Chem.*, Oct. 1928, 1007.
[3] *Trans. Faraday Soc.*, 28, 826; 1932.
[4] *Proc. Roy. Soc.*, A, **123**, 401; 1929.
[5] *Phil. Mag.*, **17**, 176; 1934.
[6] *Phil. Mag.*, **17**, 174; 1934. **18**, 230; 1934.

Chemical Reactivity and Absorption of Light

IN recent publications[1], it has been shown that the absorption of light by a mixture of two reacting substances is greater than the absorptions of the reacting substances considered separately. Thus the absorption in the visible and ultra-violet regions by a mixture of $N/400$ aqueous iodine and $2N$ potassium oxalate is much greater than the light absorption by $N/800$ aqueous iodine and N potassium oxalate taken

separately. This relation has been observed with numerous chemical reactions taking place in aqueous solutions.

Recently, we have measured the absorption of light in the visible region of hydrogen, methyl and ethyl alcohol vapours, chlorine and bromine in the gaseous state separately and in mixtures of one reducing agent and one oxidising agent, by a Hilger quartz spectrograph E_1, having an arc of copper and iron electrodes as the light source. The absorption chamber consisted of a glass tube 80 cm. long and 2·5 cm. in diameter with quartz windows. The time of exposure was one minute.

The accompanying results were obtained :—

	Partial pressures (cm. Hg)	Absorption limit
Hydrogen	40 cm.	No absorption
Ethyl alcohol (vapour)	40 cm.	No absorption
Methyl alcohol (vapour)	40 cm.	No absorption
Chlorine	20 cm.	3705–2824 A.
Bromine	20 cm.	4164–5105 A.
Hydrogen + Chlorine	40 cm. H_2 + 20 cm. Cl_2	3770–2824 A.
Hydrogen + Bromine	40 cm. H_2 + 20 cm. Br_2	4140–5105 A.
Ethyl alcohol + Bromine	40 cm. C_2H_5OH + 20 cm. Br_2	4100–5105 A.
Methyl alcohol + Bromine	40 cm. CH_3OH + 20 cm. Br_2	4125–5105 A.

From the results, it is observed that the absorption by mixtures of reacting substances in the gaseous state is greater than the absorption by the ingredients considered separately. It is interesting to note that we have found no increased absorption when chlorine, bromine and hydrogen are dried by passing through concentrated sulphuric acid or phosphorus pentoxide. It is well-known from the researches of H. B. Baker[2] and others that desiccation decreases chemical reactivity. It seems, therefore, that increased absorption of light is a measure of the reactivity of a system. We are of opinion that the increased absorption of light by mixtures is due to the weakening of the binding forces of the molecules. Thus, the presence of hydrogen or any other reducing agent weakens the binding forces of the halogen molecules, with the result that the molecules become reactive and show increased absorption.

The observations of Weigert and Kellermann[3] on fog formation when hydrogen is added to chlorine, and the increased absorption of light observed by Henri and Landau[4], J. C. Ghosh and collaborators[5] with mixtures of organic acids and ferric and mercuric chlorides and uranyl nitrate solutions, and the observations of Fajans and Karagunis[6] that the absorption by silver halides containing adsorbed silver is greater than that of silver halide alone or of silver halide containing adsorbed halogen, have been explained from the point of view that chemical reactivity is associated with increased absorption of light. It is well known that silver halides containing adsorbed silver are more readily decomposed in light than silver halides containing adsorbed halogen.

N. R. DHAR.
P. N. BHARGAVA.

Chemical Laboratory,
University of Allahabad.
Oct. 4.

[1] Dhar and Bhattacharya, *J. Indian Chem. Soc.*, **11**, 33, 311 ; 1934. Dhar and Kar, *ibid.*, **11**, 629 ; 1934.
[2] H. B. Baker, *J. Chem. Soc.*, **65**, 611 ; 1894 ; **81**, 400 ; 1902.
[3] Weigert and Kellermann, *Z. phys. Chem.*, **107**, 1 ; 1923.
[4] Henri and Landau, *C.R.*, **158**, 181 ; 1913.
[5] J. C. Ghosh and collaborators, *J. Indian Chem. Soc.*, **4**, 353 ; 1927 ; **5**, 191, 569 ; 1928.
[6] Fajans and Karagunis, *Z. phys. Chem.*, (B), **5**, 385 ; 1929.

The Crystal Structure of $Hg(NH_3)_2Cl_2$

THE X-ray photograph of this cubic crystal powder shows an unexpected small number of interference lines (Fig. 1). The unit cell of dimensions $(4{\cdot}06\ A.)^3$ contains but *half* a molecule. A similar fact, $n = \frac{1}{3}$, was found in the case of $CdBr_2$[1] ; here the small pseudoperiod as indicated by the X-rays was explained by a mode of compilation of the atomic layers, in which the CdI_2 and the $CdCl_2$ type follow in haphazard succession.

Putting

NH_3 on 000
Cl on $\frac{1}{2}\frac{1}{2}\frac{1}{2}$
$\frac{1}{2}$ Hg distributed without order over the edge centres :
$\frac{1}{6}$ Hg on $\frac{1}{2}00$, $0\frac{1}{2}0$ and $00\frac{1}{2}$,

the puzzling diagram can be explained as follows :

hkl	Intensity	S calculated
ppp	strong	$\frac{1}{2}F_{Hg} + F_{Cl} + F_{NH_3}$
iii	strong	$\frac{1}{2}F_{Hg} + F_{Cl} - F_{NH_3}$
ppi	absent	$\frac{1}{6}F_{Hg} - F_{Cl} + F_{NH_3}$
pii	absent	$\frac{1}{6}F_{Hg} - F_{Cl} - F_{NH_3}$

(p = even, i = odd).

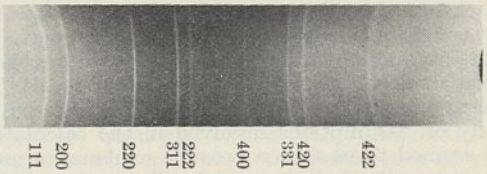


FIG. 1. X-ray photograph (copper K-rays) of $Hg(NH_3)_2Cl_2$.

The structure was proved by substituting Cl by Br. The diagram of $Hg(NH_3)_2Br_2$ shows close resemblance to that of the chloride, except that the reflections of mixed indices appear with weak intensity ($a = 4{\cdot}21$ A.). The intensity ratios in and between both reflection groups (mixed and unmixed indices respectively) are calculated in the right order on the basis of the structure model given.

A haphazard distribution of n atoms over a more than n-fold position has been deduced for $\alpha - Ag_2HgI_4$[2] and for $\alpha - AgI$[3] from the analysis of their diffraction intensities. In the present case, such a complication is most obvious as it reduces the Röntgen period to a value incompatible with the extension of a molecule.

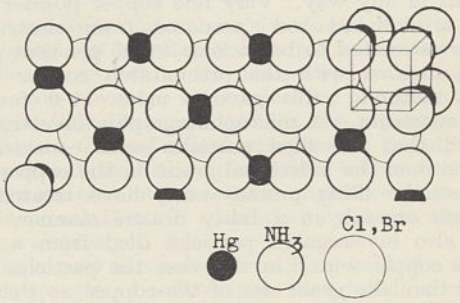


FIG. 2.

If we are prepared to limit the distribution of the Hg ions by the condition that each NH_3 group should be in contact with *one* Hg only, then the

structure shows linear complexes $NH_3 - Hg - NH_3$ orientated along the three axes in irregular succession (Fig. 2).

A detailed account will appear in the *Zeitschrift für Kristallographie*.

J. M. BIJVOET.
C. H. MACGILLAVRY.

Laboratorium voor kristallografie
der Universiteit, Amsterdam.
Oct. 18.

[1] J. M. Bijvoet and W. Nieuwenkamp, *Z. Krist.*, **86**, 466; 1933.
[2] J. A. A. Ketelaar, *Z. Krist.*, **87**, 436; 1934.
[3] L. W. Strock, *Z. phys. Chem.*, B, **25**, 441; 1934.

Effect of Dispersion and of Lattice Distortion on the Atomic Scattering Factor of Copper for X-Rays

NUMEROUS investigations of the effect of dispersion on atomic scattering factors for X-rays have shown that, when the wave-length of the X-radiation is comparable with the wave-length corresponding to an absorption edge of the scattering atom, the value of the scattering factor f is lowered by an amount Δf depending on the proximity of the incident wave-length to the absorption edge; the effect is in many respects similar to 'anomalous' dispersion in the optical region. The agreement between experiment and theory regarding the magnitude of Δf has been very rough and, as Williams[1] has pointed out, "the results obtained by different observers do not show a consistent departure from the calculated results". It is clear therefore that the blame cannot be laid wholly on assumptions involved in the calculations.

It seemed to us that a possible explanation might be based on the fact that nearly all experiments have been carried out with powdered crystals of iron and copper, and it is well known that metallic crystals are very easily deformed; different degrees of deformation in the specimens used by different investigators might be the cause of the variations in the final results. We have, therefore, tested this possibility very carefully for the case of copper $K\alpha$ radiation reflected from powdered copper crystals; the wave-length of the radiation is 1·539 A. and the wave-length for the K absorption edge of copper is 1·379 A.

For the (220) spectrum at room temperature we obtain a value 11·7 for the atomic scattering factor. Very finely divided powder was used, which was prepared by precipitation from copper sulphate solution by the addition of zinc; great care was taken in the preparation to avoid deforming the crystals in any way. Very fine copper powder filed from a chill-cast rod (prepared from electrolytic copper estimated to be at least 99·95 per cent pure) was compared with the precipitated copper by a direct method; this gave a value 11·0 for the same spectrum. A microphotographic investigation showed that the filed particles were considerably smaller than the individual grains in the copper rod, so that the filing process must have treated the separate crystals in a fairly drastic manner. We have also investigated particles filed from a hard drawn copper wire; in this case the particles were larger than the grain size of the copper, so that the filing process would tend to rip apart groups of small crystals. This led to a value of 11·4 for the (220) spectrum.

These differences between the atomic scattering factors for different specimens of copper are much larger than the experimental errors; they have been determined by a direct method and are confirmed by the fact that for higher order spectra the differences are considerably greater. We give the results for the (220) spectrum because this has always been taken as the 'standard' spectrum in other investigations of this type.

The value 11·7 for precipitated copper, which presumably is strain-free, when corrected for heat motion in the lattice, becomes 12·7, while the corresponding figure for wave-lengths outside the dispersion region on the small wave-length side is 16·0, so that the lowering of the scattering factor due to dispersion is 3·3. This is to be compared with 2·3 calculated by Williams and 2·5 calculated from data given by Hönl[2].

The results of these experiments, which we hope will soon be published in detail, show that distortions in a metal reduce the value of the atomic scattering factor, and this may be one cause contributing to the present differences between the results of different observers.

G. W. BRINDLEY.
F. W. SPIERS.

Physics Laboratories,
University of Leeds.
Oct. 15.

[1] E. J. Williams, *Proc. Roy. Soc.*, A., **143**, 358; 1934.
[2] H. Hönl, *Ann. Phys.*, **18**, 625; 1933.

Rotational Raman Scattering in Benzene Vapour

A THEORY of the rotational Raman scattering by polyatomic molecules has been put forward by Placzek and Teller[1]. According to this theory, in the case of the benzene molecule at room temperature, the rotational wing accompanying the Rayleigh line should start with zero intensity at the centre of the Rayleigh line and have a maximum intensity at about 18 wave numbers from the Rayleigh line, and afterwards its intensity, diminishing fairly rapidly, should become zero at about 70 wave numbers from the Rayleigh line. Experimental measurements of the distribution of intensity in the rotational wing accompanying the Rayleigh line scattered by liquid benzene at room temperature have been made by Weiler[2] and more recently by Bhagavantam and Rao[3]. The experimental results do not agree with those predicted by the theory. In order to test whether the results obtained in the case of vapours can be explained by the theory, the distribution of intensity in the rotational wing due to benzene vapour at high temperature and pressure has been measured quantitatively.

A small quantity of distilled benzene was sealed in a thick-walled Jena glass tube of diameter 18 mm., and was heated to 210° C. in a cylindrical electric heater provided with two windows, one along its length and the other at one of its ends. Stray light could not be eliminated completely, but the pure rotational wing on the Stokes side of the Rayleigh line was recorded successfully, because the pressure of the vapour being about 16·6 atmospheres, the intensity of the scattered light was greater than that of the stray light, so that the spreading of the undisplaced line due to stray light was negligible. Also, the particular Fuess glass spectrograph used in the present experiment produced lines which were absolutely free from coma on the Stokes side, though there was an intense coma on the anti-Stokes side.

The microphotometric records of the lines 4046 A. and 4077 A. in the scattered spectrum and of the line 4046 A. in the incident spectrum are reproduced in Fig. 1. The dotted part of the record in Fig. 1 (*a*) would be obtained in absence of the wing. On measuring the relative intensities in different parts of

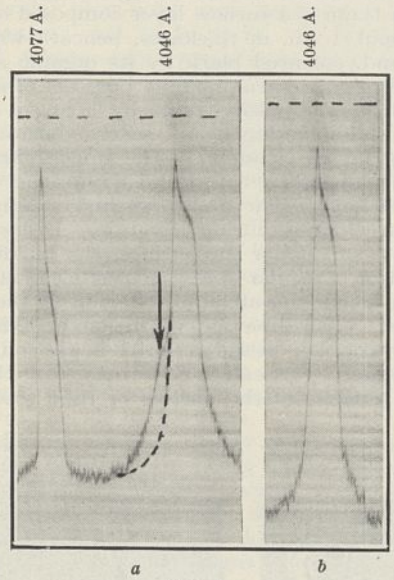


FIG. 1.

the wing, the curve reproduced in Fig. 2 is obtained. The approximate theoretical curve for the benzene molecule at 210° C. is shown by the broken line in Fig. 2. In view of the defects in the experimental arrangements, it can be concluded from the above results that there is fair agreement of the observed facts

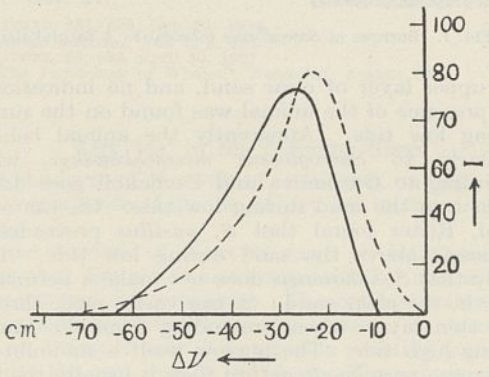


FIG. 2.

with the theory. Probably with a spectrograph having greater dispersion and with a denser picture, the agreement would be much better.

My thanks are due to Prof. D. M. Bose for his kind interest in the work.

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92, Upper Circular Road, Calcutta.
Sept. 21.

[1] *Z. Phys.*, **81**, 209; 1933.
[2] *Z. Phys.*, **68**, 782; 1931.
[3] *Ind. J. Phys.*, 8, 437; 1934.

Bands at 4450 and 4180 A. in the Spectra of the Night Sky and of the Aurora

IN the observation of the spectrum of the night sky or of the aurora by Vegard, Lord Rayleigh, Slipher, Sommer, Dufay, Ramanathan and others, it has already been reported that bands or lines appear in the regions near 4450 A. and 4180 A. These lines, which have been referred to by Lord Rayleigh as X_1 and X_2, were identified by Kaplan with the OII lines 4416·97 and 4169·23.

In the course of investigations of the band spectrum of nitrogen excited by very weak current under low pressure, I have observed three bands, which have heads at 4728·5, 4432·3 and 4165·9 A., respectively, in addition to other well-known bands. Of the three, the band at 4728·5 A. is the weakest. Under low dispersion, each of these three bands has apparently four intensity maxima (4744, 4740, 4736, 4730; 4448, 4443, 4439, 4434; 4179, 4175, 4172, 4167), and is little degraded towards the longer wave-length side. At ordinary temperature they are emitted only when the nitrogen gas is very pure; and the enhancement of their intensity relative to the second positive bands is observed with increased pressure of nitrogen, and with decreased density of the exciting current. Helium or neon gas exerts no appreciable effect when it was mixed with nitrogen, while the bands are almost quenched by the introduction of argon gas. At low temperature, especially at the temperature of liquid air, their intensity is markedly enhanced.

From the fact that the three bands are almost completely quenched when the temperature of nitrogen is high and when the persistence of vibration is brought out by the introduction of argon, and, therefore, the average vibrational and rotational energies of the normal nitrogen molecules are abnormally high, it is concluded that the upper state of emission is very unstable.

Taking into consideration the wave-length regions where they appear, together with the exciting conditions, it seems that there is a possibility of the identification of the Rayleigh bands X_1 and X_2 in the spectra of the night sky, and perhaps also of the aurora, as the Goldstein bands which I have described above.

H. HAMADA.

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Sendai, Japan.
Oct. 9.

Nuclear Spin of Iodine

IN an earlier report[1] on the fine structures in the arc spectra of bromine and iodine, a tentative value of $\frac{9}{2}$ was proposed for the nuclear spin of iodine. The iodine arc spectrum was excited by a high-frequency electrodeless discharge, and as the structures were small and the individual components broad, it was pointed out that the spin value, which was based largely on one line, was not reliable because of imperfect resolution. It was definitely shown then that I was certainly $\geqslant \frac{5}{2}$.

I have now succeeded in exciting both the arc and spark spectra of iodine in a cooled hollow cathode discharge, and the resulting lines are considerably sharper than in the previous source. The fine structures in the spark spectrum, being on a much larger scale, are sufficiently resolved in some lines to enable an unambiguous spin value to be determined. Some fine

structures in the spark spectrum have been previously reported by Wood and Kimura[2], but resolution was incomplete such that, for example, only five components were found in a line shown by the present observations to have ten. For this reason the conclusions about the spin drawn from these early data by Murakawa[3] require further examination.

A partial classification of the gross multiplet terms of the iodine spark spectrum has been given by Murakawa (loc. cit.) but even without this the nuclear spin can be deduced. Thus the lines in the accompanying table exhibit regular degraded quintet patterns, arising obviously from terms with $J=2$. (This agrees with the allocations which are taken from Murakawa.) The calculated interval factors for spins of $\frac{5}{2}$, $\frac{7}{2}$, $\frac{9}{2}$ are given. In a line free from perturbations, these should be constant, and it is quite evident that the nuclear spin of iodine is $\frac{5}{2}$. The slight irregularities in the interval factors calculated for the $\frac{5}{2}$ value are due to the small unresolved upper term fine structures.

Intervals in cm.$^{-1}$ × 10^{-3}

Line	Spin 5/2	Spin 7/2	Spin 9/2
λ 5496·8	9×47·5	11×39	13×33
	7×47	9×36	11×30
$6\,^5S_2-6\,^5P_1$	5×47·5	7×33	9×26·5
	3×50	5×30	7×21·5
λ 5774·7	9×82	11×67	13×57
	7×78·5	9×61	11×50
$X_2-6\,^5P_1$	5×79	7×58	9×44
	3×76	5×45	7×32
λ 5161·2	9×44	11×36	13×30·5
	7×42·5	9×33	11×27
$6\,^5S_2-6\,^5P_3$	5×42	7×30	9×23
	3×40	5×24	7×17

Structures have been measured in a large number of arc and spark lines and in some of these perturbations have been found. Full details will be published elsewhere.

S. TOLANSKY.

Physical Laboratory,
University of Manchester.
Oct. 23.

[1] *Proc. Roy. Soc.*, A, **136**, 585; 1932.
[2] *Astrophys. J.*, **46**, 181; 1917.
[3] *Sci. Pap. Inst. Phys. Chem. Res. Tokyo*, **20**, 285; 1933.

The Burrow of an Enteropneust

STIASNY described how *Balanoglossus clavigerus* lives in a U-shaped burrow, which is characterised by a regular funnel on the surface at the anterior end of the animal, with the coils of fæces at the posterior end. His illustration has been reproduced in several books. Morgan has also found similar funnels and masses of fæces in the case of another species of *Balanoglossus* and it is probable that all species of this genus inhabit similar burrows. Other species of Enteropneusta, for example, those belonging to the genera *Glossobalanus* and *Ptychodera*, live among the roots of seaweeds, under stones or in the sand in irregularly-shaped tubes of sand-grains, etc., cemented together by slime. It is known that most species of *Saccoglossus* (*Dolichoglossus*) prefer to live in a black muddy soil, but Davis is the only author who has described a special burrow for *Saccoglossus pusillus*, and according to his figure this burrow is irregularly formed.

In 1929, Dr. Mortensen collected near Lourenço Marques a new species of enteropneust, the description of which, under the name *Saccoglossus inhacensis*, will shortly be published by one of my students. When I visited the island Inhaca with a number of students in July 1934, we observed numerous specimens of this animal. It lives on the flats at the eastern side of the island, facing Delagoa Bay. In this area there is a surface layer composed of yellow sand, about 1 cm. in thickness, beneath which is a sandy mud, coloured black by its organic contents. *Saccoglossus inhacensis* inhabits burrows of a typical form, which were easily found by lifting a spadeful of mud and breaking it up, several burrows often occurring in one spadeful. The upper part of the burrow is irregularly coiled and within this part the long proboscis, collar and branchial region of the animal are lodged during low tide. Deeper down, about 4–5 cm. under the surface, the burrow takes the form of a regular spiral, consisting of up to six turns, in which the abdominal region of the animal is located. The direction of the main axis of the spiral is variable; in the majority it was found to be approximately vertical, but it may even be horizontal. Nothing of the burrow or tube was seen in

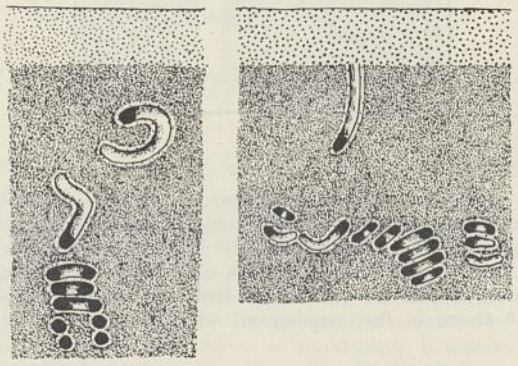

FIG. 1. Burrows of *Saccoglossus inhacensis*. ¾ natural size.

the upper layer of clear sand, and no indication of the presence of the animal was found on the surface during low tide. Apparently the animal behaves similarly to *Saccoglossus mereschkowskyi*, which according to Gurjanova and Uschakoff goes deeper down into the mud during low tide. On the other hand, Ritter found that *S. pusillus* protrudes its proboscis above the sand during low tide. It is likely that *S. inhacensis* does not make a permanent tube in the clear sand; it can easily push through this thin layer, when protruding from the burrow during high tide. The burrow itself is undoubtedly of a more permanent nature than is usually the case in Enteropneusta. The spiral part especially is so consistent that it can easily be detached from the surrounding mud.

In the dark mud the burrow is very conspicuous because it is lined by a thin layer of clear sand. This in turn is covered by a layer of slime, giving the inner surface a smooth, shiny appearance. A piece of the mud containing the burrow, such as is illustrated in Fig. 1, was preserved by allowing it to dry up partially, after which small quantities of gum arabic were carefully poured over it.

C. J. VAN DER HORST.

University of the Witwatersrand,
Johannesburg.
Oct. 8.

Whales and Caisson Disease

I DOUBT if whales avoid caisson disease—the usual consequence of deep diving—by filling their lungs with sea-water as Dr. J. Argyll Campbell suggests[1]. Where whales abound, the temperature of the water is sometimes as low as 28° or 29° F. Moreover, their valvular blow-holes seem designed to keep out the sea-water: not to let it in. So far as I have observed, whales expel water from their blow-holes only in the form of vapour.

If Dr. Campbell had said mucous instead of sea-water he might have been, perhaps, on somewhat firmer ground. Scoresby[2] says, "a moist vapour mixed with mucous" is discharged from the blow-holes of the Greenland whale, and as stated in my letter on the "Sleep of Whales"[3], quantities of what looked like mucous discharged from their blow-holes were sometimes seen floating on the surface of the sea.

There is still another way in which the whale might avoid diver's paralysis or caisson disease. I mean by the 'short circuiting' of its pulmonary circulation. This theory also assumes the deeply submerged whale to be independent, as regards oxygen, of the air in its lungs.

The idea of a whale deeply submerged with its lungs short-circuited and living on oxygen stored in its *retia mirabilia*—peculiar vascular organs possessed by whales—is, I understand, not one that appeals to the physiologist; nevertheless, as I have stated elsewhere[4], it is one that seems to explain first, why the *ductus arteriosus* is in a patent condition in whales; secondly, why each time a whale comes up from the depths it remains at or near the surface some minutes during which it takes a number of breaths, and lastly, why the newly-born animal escapes death from drowning.

8 Hartley Road, Exmouth.
Oct. 27.

ROBERT W. GRAY.

[1] NATURE, **134**, 629, Oct. 20, 1934.
[2] "Arctic Regions," vol. 1, p. 456.
[3] NATURE, **99**, 636, April 30, 1927.
[4] "The Physiology of Whales", *Naturalist*, August 1934.

'Dry Ice' in the Machine Shop

IN the issue of NATURE of October 6, on page 529, mention is made of the use of 'dry ice' in the machine shop.

Some readers of NATURE may be interested to know that dry ice is used regularly by one of our large automobile companies. The exhaust valves on the cars manufactured by the concern in question seat on a ring of heat and corrosion resisting material set into the cast iron of the block. The ring is made over-size by the required amount and is shrunk by means of dry ice. As the motor blocks pass by on a conveyor, the rings are removed from the dry ice refrigerator and are slipped into place in the block. As they come up to room temperature, they of course expand and are held firmly in place.

There would seem to be many advantages in making this type of a fit. Certainly in the case mentioned, the other way of inserting the rings, namely by heating the cylinder blocks, would be expensive and inconvenient.

THEODORE H. BEARD,
Supervising Engineer.

Dictaphone Corporation,
Bridgeport, Connecticut.
Oct. 15.

Freshwater Research in New Zealand

THE New Zealand Freshwater Research Committee commenced in 1932 to investigate the mortality occurring up to the fry stage in the life-histories of wild Brown Trout (*Salmo trutta*), Rainbow Trout (*S. irideus*) and Quinnat Salmon (*Oncorhynchus tschawytscha*).

Observations have been made on thirteen streams, and 180 samples have been taken from spawning redds. More than 80,000 eggs and alevins have been examined.

The average fertility of ova has proved to be 98·9 per cent. In Slovens Creek, 62 Brown Trout fry emerge per 100 eggs lodged in the redds. In Winding Creek there has been a fluctuation in the annual emergence of Quinnat Salmon fry of from 86 to 95 per 100 ova lodged. Losses have been associated with causative factors.

Work is proceeding on further material in hand and will probably be extended to cover most of the important spawning regions in the Dominion.

D. F. HOBBS.

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Christchurch.
Sept. 28.

Sunspot Number and the Refractivity of the Air

IN connexion with the note by L. W. Tilton on the relation between the sunspot number and refractivity of dry air[1], it is of interest to examine whether such a relation may be deduced from the astronomical observations. For this purpose we have selected twenty independent determinations of the refraction constant (μ) and reduced them to 0° C.,

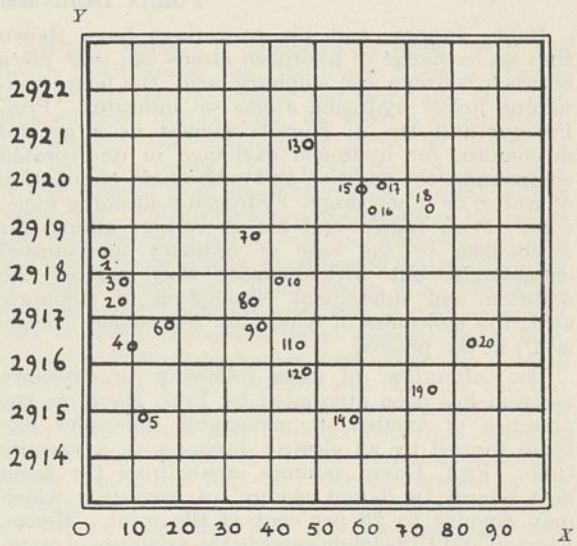

FIG. 1.

760 mm. pressure, 6 mm. vapour pressure (π), $\varphi = 45°$ and sea-level. The corresponding values of the index of air (n) as well as the relative sunspot numbers for the approximate mean epochs of the determinations of μ are shown in the Y and X axes of Fig. 1. The diagram does not show any marked dependence of index of air on sunspot number. Assuming $y = ax + b$, we have: $a = +0{\cdot}10$, $b = 1{\cdot}00029171$, the correlation coefficient being

$r = +0{\cdot}15$. All the above values of μ are within the limits of $60{\cdot}10''$ and $60{\cdot}22''$. The corresponding values of n are 1·0002915 and 1·0002921, the range of variation being only 6×10^{-7}. The mean of n for $\pi = 0$ mm. is 1·00029208, that given by Tilton being 1·00029237. These values agree well considering that this latter is referred to the D line while in the astronomical observations the bisections of a stellar spectrum are usually made between C and D lines.

Comparing the values of n, as given in Tilton's note and in Landolt-Börnstein's Tables (from 1877 to the present time), with the corresponding sunspot numbers (s) we obtain on the average :

s	n
12	1·0002925
26	26
44	24
64	25
78	24

which, contrary to Tilton's results, does not show any observational evidence of the dependence between n and s.

N. Dneprovsky.

Poulkovo Observatory.

[1] Nature, **132**, 855, Dec. 2, 1933.

The Scientific Approach to Peace

We welcome the leading article in Nature of November 17, on "The Scientific Approach to Peace", indicating as it does the growing realisation of the special importance of the attitude of scientific workers to war, but we cannot agree with the assertion that the 'realistic' attitude of Prof. Huxley represents the point of view of the majority of scientific workers. In Cambridge alone there are some eighty scientist members of the anti-war movement who adopt a fundamentally different attitude. That we are not alone is shown by Prof. K. T. Compton's article[1] and the talk on the causes of war which was to have been broadcast by Prof. J. B. S. Haldane[2] and which, unfortunately, was not permitted.

At the present time it is clearly out of the question to expect individual scientific workers to cease doing war research, but this could be brought about, as Nature points out, if they were organised in a powerful professional body. An organisation of scientific workers and other intellectuals in France has already developed in the Comité de Vigilance, which is exerting itself in every direction to prevent another war. Similar activity, which is severely repressed by authority, is being carried on in the United States of America, Germany and Italy. An International Congress of these and similar bodies is being held in Geneva on December 29–31, and it is of the greatest importance that British men of science should co-operate by sending delegates, and by helping financially the delegates from Germany and Italy.

C. B. O. Mohr.
Nora Wooster.

(Joint Secretaries of the Cambridge Scientists' Anti-war Group.)

Cavendish Laboratory and
Dept. of Mineralogy and Petrology,
Cambridge. Nov. 17.

[1] *Technology Review*, **36**, 295.
[2] *Daily Herald*, Nov. 3, 1934.

Points from the Foregoing Letters

Prof. Ingold and his co-workers have shown that an exchange of hydrogen atoms can take place between benzene and sulphuric acid, the latter containing heavy hydrogen atoms as indicator. Prof. Polanyi and Dr. J. Horiuti suggest as a general mechanism for hydrogen exchange in unsaturated compounds, the addition and subsequent elimination of water, or other simple hydrogen-containing molecule. Prof. Ingold and his co-workers admit this mechanism in the case of ordinary unsaturated compounds, but with benzene they assume the addition and subsequent elimination of sulphuric acid, the molecules of which are rearranged ('polarised') in the process.

The 'afterglow' of gases following an explosive reaction has been attributed by Prof. David to the presence of excited or metastable molecules like those formed by an electric discharge in a vacuum tube. Prof. David assumes, apart from the usual heat energy, a 'latent energy' of excitation which may amount to 20 per cent of the total. Messrs. Egerton and Ubbelohde agree to the existence of metastable molecules, but believe the energy associated with these to be considerably less.

Prof. Dhar and Mr. Bhargava bring new evidence that light passing through reacting gases is absorbed to a greater extent than by those gases separately. They suggest, further, that the increased absorption of light is a measure of chemical reactivity.

Messrs. Brindley and Spiers show that powdered copper obtained by chemical precipitation scatters X-rays (of wave-length comparable with its absorption edge) more nearly in accordance with theoretical expectations, than do copper filings, the crystalline structure of which is presumably distorted.

Dr. Sirkar describes the Raman spectrum (scattering of light accompanied by change in wave-length) of benzene vapour and points out that it accords with the theory of Placzek and Teller, while the Raman spectrum for liquid benzene does not. The Raman spectrum has already yielded valuable information concerning the structure of organic compounds.

On passing a weak electric current through nitrogen at low pressure, Mr. Hamada has observed three new bands in the violet (4165·9 A.), blue (4432·3 A.) and bluish-green (4728·5 A.) regions. He suggests that the first two might be identified with similar light in the spectra of the night sky, and perhaps also of the aurora.

By means of an electric discharge in a cooled hollow cathode, Dr. Tolansky has obtained more details in the arc and spark spectra of iodine, which enable him to calculate more accurately the nuclear spin of iodine, a constant which plays an important part in determining the probability of atomic transmutation when the nucleus is hit by another particle.

Mr. L. W. Tilton claimed to have found a correlation between the number of sunspots and the index of refraction of air, from analyses of data since 1912. Mr. Dneprovsky, director of the Pulkovo Observatory, taking into consideration values available since 1877, and also data calculated from the astronomical measurements of the 'refraction constant', maintains that no such correlation can be inferred.

Research Items

Cultural Analysis in Western Europe. When Prof. H. J. Fleure touches upon a familiar topic in his occasional lectures, he may be trusted to approach it at a new, or at least unfamiliar, angle. The lectures which he has delivered at the John Rylands Library, Manchester, in the last three years afford apposite examples. The latest, recently published in the Bulletin of the Library, deals with the megalithic problem, and is, in his own words, an attempt to show "that the megaliths are not a matter of a vanished people and a forgotten civilisation; they belong to the core of our heritage as Western Europeans" ("Prehistoric Elements in our Heritage." By Prof. H. J. Fleure. Pp. 36. Manchester: Manchester University Press, and John Rylands Library, 1934. 1*s*. 6*d*. net). He argues with an almost bewildering wealth of detail that the civic civilisation, which developed in early prehistoric times in the Near East, expanded by land and sea to form a series of archæological provinces in distant lands, to which adventurers took something of the religious associations of a common life. In attacking the problem of the megalith, Prof. Fleure has taken the position that buildings, no longer the civic type of orderly shaped stone, but of rough stone, including the megaliths, appear in different regions and at different dates. In other words, it was the concept and not the form which was carried from province to province. These provinces, in which development took place along different lines and with varying stimuli, were none of them isolated; each linked up with others in more than one direction. Among the examples of the persistence of the influence of the megalith and the culture of which it was a manifestation down to Christian times and later, Prof. Fleure cites, *inter alia*, the occurrence of cults from early prehistoric times at places of entry such as that of St. Iago in Galicia and Portugal and that of the saint of St. David's in South Wales.

Brahmins of Behar. A comparative study of the physical characters of two classes of the Brahmins of Behar has been made by Bajra Kumar Chatterjee (Anthropological Bulletins from the Zoological Survey of India, No. 2). Of the six most important groups of Brahmins of Behar, the present study deals with two, the Kanaujia and the Maithil. The Kanaujia hold a very high position among the Brahmins of northern India. Both this group and the Maithil belong to the five divisions known as the *Panch Gaur*. Among the Kanaujia are many exogamous sub-sections having different status for matrimonial purposes, while among the Maithil there are numerous exogamous groups which constitute a complete hypergamous system. A hundred individuals from each of the two groups were measured. Seventeen characters are recorded and thirteen indices calculated, in addition to observations of skin, eyes and hair. A comparison of the two series of measurements shows that the two groups are physically alike in most of the characters, and can with good reason be assigned to the same racial stock. Differences noted in a few characters are probably due to the presence of another strain. A high percentage of certain characters, such as is shown by the breadth-height index and the nasal index, points to miscegenation with some such aboriginal stock as the Bhils or Chenchus. This appears to have proceeded further among the Maithil than in the Kanaujia Brahmins. A further comparison with measurements taken by other observers elsewhere points to the fact that these two groups of Brahmins are related to some of the groups of Bengal, Orissa and southern India. Racial kinship is also discernible with the Namburdiri of Malabar; but there does not appear to be any with the Brahmins of the United Provinces of Agra and Oudh and Central India, this last conclusion being contrary to tradition, which, however, supports the connexion with the Brahmins of Orissa.

Vanadium in Marine Animals and in Mineral Oils. Vanadium has been known to occur in small quantities (of the order of about 10^{-5} per cent) in various terrestrial and marine animals and plants. In two groups of marine animals, namely, Ascidians and Holothurians, it has been found, however, in very high concentrations (up to 1·5 per cent of the ash in some Ascidians). This lends support to the theory according to which Tunicata and Echinodermata are considered of close phylogenetic affinity. Since sea-water contains very small quantities of vanadium, it appears probable that the source of the vanadium found in Ascidians is marine bottom muds, which are often rich in that element. Moreover, Ascidians form highly specialised biocœnoses on the sea-floor, and after their death they should enrich the bottom sediments with vanadium. It is suggested, therefore, by A. Vinogradov (*C.R., Acad. Sci. Leningrad*, 3, No. 6) that oils containing vanadium are connected in their origin with marine sediments formed under conditions favourable to organisms concentrating vanadium.

Burmese Fishes. A collection of fishes from the South Shan States and the Pegu Yomas, Burma, is described by Dr. Sunder Lal Hora and Dev Dev Mukerji (*Rec. Indian Mus.*, **36**, Part 1, March 1934). The material was obtained by Mr. V. P. Sondhi of the Geological Survey (both of the districts consisting of hilly tracts) from small torrential streams with a rocky bed. The streams are characterised by rapids and slow currents with pools and back-waters here and there. Some of them are diverted for the irrigating of 'paddy' fields, and in the South Shan States the water is usually charged with lime to such an extent that it forms travertine dams causing small falls. The fishes from Pegu Yomas were caught by putting a dam across a small stream and allowing the bed below the dam to run dry, and picking up the fish from underneath stones and boulders and from crevices. An abnormal specimen of *Ophiocephalus gachua*, a widely distributed and very variable species of the Oriental region with a marked amphibious life, had no ventral fins, but had the basipterygials only slightly deformed. This raises the question of the validity of the generic names *Channa* and *Ophiocephalus*, in *Channa* the ventral fins being totally absent. The authors are of the opinion, after examination of a number of specimens, that *Ophiocephalus harcourt-butleri*, Annandale, is synonymous with *O. gachua*.

Trematodes from Deep-Water Fishes. Mr. H. W. Manter has described the digenetic trematodes collected from many species of fishes from 40 to 582

fathoms, trawled at Tortugas, Florida (Papers from the Tortugas Laboratory of the Carnegie Institution of Washington, **28**, 1934). The worms are in general markedly distinct from those in the nearby shallow water, and approximate more closely to the cooler water forms of more northerly regions. Seven species are identical with the northern forms, including the common *Derogenes varicus*, which is found in a large number of British fishes, and is very widely distributed. It has been recorded from more than 50 species, 5 more being added in the present work, occurring in depths ranging from 190 to 315 fathoms. Out of 49 trematodes recorded, 15 species belong to the Hemiuridæ, 13 to the Fellodistomidæ and 11 to the Bucephalidæ. Interesting results arising from this research show restrictions in distribution in depth. Thus, some trematodes are able to live in several different fishes, but appear to be limited to certain depths. *Cymbephallus vulgaris* is the commonest species collected, and was found in 15 species of deep-water fishes but never in those from shallow water. It was not found above 40 fathoms, and is most prevalent from 75 to 175 fathoms, not occurring at lower depths. Of the few species occurring both in shallow and deep water, *Sterrhurus floridensis* is very common. This is the only sexually mature form found generally in both shallow water and deep water regions.

Root Rots of the Strawberry. Dr. G. H. Berkeley and Miss Isabel Lauder-Thomson contribute an article on "Root Rots of Strawberry in Britain" to the *Journal of Pomology and Horticultural Science*, **12**, No. 3, Oct. 1934. Dr. Berkeley is senior pathologist-in-charge at the Dominion Laboratory of Plant Pathology, St. Catharine's, Ontario, Canada, and lately stayed for a year at the East Malling Research Station, Kent. The 'black lesion' type of strawberry root rot causes severe damage to the crop in Canada, and the present paper shows that it is a serious factor in strawberry degeneration in Great Britain. Five species of soil fungi have been proved capable of attacking the roots of strawberries, often causing death. They are *Coniothyrium Fuckelii*, *Hainesia lythri*, *Cylindrocarpon radicicola*, *Fusarium orthoceras*, and *Pachybasium candidum*. Symptoms do not seem to vary greatly with different fungi, and infected plants are always dwarfed and brown, whilst the roots have black lesions and little fibre. Many dead roots appear, and severely infected plants often wilt and die. Crop rotation and the selection of healthy runners are the main control methods (see also NATURE, **132**, 570, Oct. 7, 1933).

Irish Fungi New to the British Isles. Messrs. A. E. Muskett, H. Cairns and E. N. Carrothers are making a study of the fungus flora of Ulster, and publish fresh annotated records from time to time. Their latest contribution reports the addition of 275 species and 9 varieties ("Further Contributions to the Fungus Flora of Ulster", *Proc. Roy. Irish Acad.*, **42**, Section B, No. 4, Sept. 1934). No less than 133 species and 8 varieties are new Irish records, whilst two species and one variety are new British records. *Hygrophorus agathosmus*, Fr., var. *aureofloccosus*, Bres. was found by Mr. Carleton Rea at Glenariff in 1931. *Corticium anceps* was found at Hallsborough and was parasitic on bracken, but did not appear to do much damage to its host. *Phytophthora megasperma* was isolated by Cairns from potato tubers affected with pink rot. It has hitherto been described only from the United States, where it causes a disease of hollyhocks. The new fungus can cause a pink rot of potato tubers indistinguishable from that produced by the usual parasite, *P. erythroseptica*. The records include considerable numbers of Phycomycetes and Fungi Imperfecti, in addition to the larger forms.

Turbulence near the Ground. A lecture on this subject was delivered before the Royal Aeronautical Society on November 22, by Prof. W. Schmidt, director of the Austrian Meteorological Service. The lecture was mainly devoted to the discussion of some 350,000 observations of wind in the lowest 10 metres of the atmosphere. The instrument used consisted of a light wire ring of 20 cm. diameter, covered with muslin, and mounted on a horizontal axis 50 cm. from the centre of the ring. In practice, a number of the rings were fixed on a frame set vertically at right angles to the wind direction, the dimensions of the frame being usually 6 m. × 12 m., so that the distribution of wind could be investigated instantaneously over a front of 12 m. across wind and up to a height of 6 m. above the ground, by photographing the frame. Diagrams were shown representing the variation of wind over the area covered by the frame, and the variation of wind with time at different heights above the ground. Over a field of turnips the wind was more turbulent than over a stubble field in the lowest metre above the ground, but was less turbulent at heights greater than 1 metre. Some of the diagrams indicated that the occurrence of high velocities near the ground is to be explained by the intrusion of fast moving air from higher levels. This confirms the results described by Scrase in M.O. Geophysical Memoir No. 52. Tables of coefficients of correlation between the simultaneous observations of wind at points separated by vertical distances up to 5 m. and horizontal distances up to 10 m., showed that the distance at which the coefficient falls off to any particular value increases with height, as might be expected if the dimensions of the eddies increase with height above the ground. The correlations were all smaller with strong than with light winds. This was attributed by Schmidt to the large number of frictional eddies produced in strong winds. The values of the *Austausch* coefficient (eddy diffusivity × density) were shown in a table, the values varying from 0·8 to 5,800 cm.$^{-1}$ gm. sec.$^{-1}$, corresponding to a variation of the eddy diffusivity, K, from about 600 to about $4{\cdot}6 \times 10^6$ cm.^{2} sec.$^{-2}$ The very high value was associated with a wind from a lake with 500 metres of dry strand in front of the point of observation.

Crystal-Structure of Bismuth Oxyhalides. At the meeting of the Mineralogical Society of Great Britain on November 1, Mr. F. A. Bannister read a paper giving the results of X-ray study of crystals of BiOCl, BiOBr, and BiOI which he had succeeded in preparing by a diffusion method. They are formed as square plates rarely larger than $0{\cdot}3 \times 0{\cdot}3 \times 0{\cdot}05$ mm. showing flat pyramidal faces vicinal to the basal plane; all yielding a negative uniaxial figure under the microscope. Laue and rotation photographs show that the space-group of these compounds is $P4/nmm = D^7_{4h}$ and that their crystal-structures closely resemble that of matlockite (PbFCl), the main difference lying in the closer packing of the bismuth and oxygen ions than the packing of the lead and

fluorine ions. The unit-cell sides and parameters of the atoms of the bismuth oxyhalides are :

	a	c	u	v
BiOCl	3·89	7·37 A.	0·171	0·650
BiOBr	3·92	8·11	0·153	0·650
BiOI	4·01	9·14	0·132	0·667
PbFCl	4·09	7·21	0·208	0·650

The co-ordinates of the atoms in these structures are :—Metal, $00u$, $\frac{1}{2}\frac{1}{2}\bar{u}$; halogen, $00v$, $\frac{1}{2}\frac{1}{2}\bar{v}$; oxygen, $\frac{1}{2}00$, $0\frac{1}{2}0$. The calculated radius of the bismuth ion for all three oxyhalides is 1·0 A. The interatomic distances within the halogen layers are less than the values usually accepted, especially for the oxyiodide.

Biological Effects of High-Energy Radiation. W. V. Mayneord (*Proc. Roy. Soc.*, A, Oct. 15) considers the possible biological effects of high-frequency radiation of different energies. The radiation gives rise to fast-moving electrons by photoelectric absorption and by recoil (Compton scattering), and with 'hard' radiation the latter is the predominant process. The fast secondary electrons have a range in the tissue corresponding to many cells, but they lose little energy in passing through a single cell, while the slow electrons lose energy much more rapidly. If the biological changes in a cell are effected by the absorption of a small quantity of energy, 'hard' radiation, say, γ-rays, should be very effective relative to X-rays which produce short trails of intense ionisation, while if a large transfer of energy to a single cell is required to affect the latter, the soft rays will be relatively more efficient for equal amounts of absorbed energy. This provides a possible basis for the selective action observed by some workers in which the destruction of rapidly growing cells relative to ordinary cells was more marked with short wave radiation. The paper contains calculations of 'survival curves' of cells exposed to radiation, made on various assumptions about the electronic treatment necessary to kill a cell.

Experiments with Heavy Hydrogen. A. Farkas and L. Farkas have continued their interesting work with heavy hydrogen (*Proc. Roy. Soc.*, A, Oct. 1) and they now suggest that the separation of the hydrogen isotopes by the electrolysis of water is due largely to the simple fact that the equilibrium

$$HD + H_2O \rightleftarrows HOD + H_2$$

corresponds to a gas phase which is about four times as rich in D as the liquid phase. The composition of the gas obtained by electrolysing various heavy-light water mixtures is similar to that obtained by bringing hydrogen into contact with the mixtures in the presence of a catalyst (palladium black). This reaction explains the fact that the separation factor is not very dependent on the conditions of electrolysis, but it is not the only factor operating since the factor may be higher than six in efficient fractionation experiments. In a second paper, the authors have described the use of the heavy isotope atoms as 'labelled' hydrogen atoms in experiments on the ethylene-hydrogen reaction, performed in presence of a nickel catalyst. The experiments show that an exchange reaction :

$$HD + C_2H_4 \rightleftarrows C_2H_3D + H_2,$$

takes place as well as the addition reaction :

$$C_2H_4 + HD \rightleftarrows C_2H_5D.$$

An experiment in which the state of the wire catalyst was followed by testing its efficiency in catalysing the conversion of para-hydrogen was also carried out and showed that at 20° C. and 10 mm. ethylene pressure the wire was nearly completely covered with ethylene.

Effect of Oxygen on Photoelectric Emissivity of Silver. At low temperatures, silver adsorbs oxygen rapidly, and the oxygen is readily removed by evacuation. At high temperatures the adsorption is slower and the oxygen is not removed except by prolonged heating or by treatment with hydrogen. These two types of adsorption have been called 'physical' and 'activated', respectively, and it has been suggested that two types of forces are involved, in physical adsorption forces related to van der Waals' forces, and in activated adsorption those commonly termed electrostatic or valency forces. The theory of electrons in metals recently proposed by Sommerfeld provides a satisfactory picture of electrical forces present at surfaces, and since the photoelectric effect provides a sensitive means of study of the electrical properties of surfaces, A. K. Brewer (*J. Amer. Chem. Soc.*, **56**, 1909 ; 1934) has made an investigation on the adsorption of oxygen on silver on these lines. The photoelectric effect gives a measure of the work function associated with the removal of an electron from the metal surface. Very clean silver was used and the threshold values at 20° and 600° were found to correspond with the wave-lengths 2675 A. and 2725 A., respectively. The following results were found : (1) At room temperature the presence of oxygen slightly enhances the emissivity, the effect disappearing with the removal of the oxygen. (2) After treating in oxygen, the silver was heated in a vacuum and then possessed an abnormally large emissive property, the effect disappearing only after long heating. (3) Heating in oxygen or exposure to ozone destroyed the emissivity. The effects observed under (1) and (2) were associated with 'physical' and 'activated' adsorption, respectively, whilst (3) is associated with the presence of 'surface' silver oxide. The lowering of the work function by 'physical' and 'activated' adsorption is brought about, apparently, by positive oxygen ions, whilst the increase in work function brought about by 'surface' silver oxide is apparently due to negative oxygen ions, since previous workers have shown that negative adsorbed ions raise the electron work function whilst positive ions shift it to lower values.

Enzymic Scission of the Nucleic Acid of Yeast. Following his work on the enzymic degradation of lecithin and lysocithin, Contardi, in conjunction with Ravazzoni, has published (*Rendi. R. Ist. Lombardo*, **67**, Parts 11–15) an account of investigations on the enzymic scission of the nucleic acid of yeast. The results recorded show that the diminution occurring in the rotatory power of aqueous solutions of sodium nucleinate may be due, in some cases, to mutarotation phenomena. The rotation alone is, therefore, insufficient as a means of observing the hydrolysis of the nucleinate. The enzymic action of extracts of rice husk consists first in the almost complete demolition of the sodium nucleinate to simpler organic phosphorus compounds, this action being brought about by the phosphodiesterase at an optimum *p*H of 4. Afterwards, the whole of the phosphorus is liberated in the form of inorganic compounds as a result of the action of the phosphomono-esterase, this proceeding best when the *p*H is 5·5.

The Historic Sequence of the Celts

DR. A. B. SCOTT, in his paper on "The Historic Sequence of Peoples, Culture and Characteristics in Scotland, 400 B.C.–A.D. 950", read before Section H (Anthropology) of the British Association meeting at Aberdeen, began by a reference to the two lines of approach into western Europe: (1) up the Danube Valley, (2) along the course of the Save, and thence into the valley of the Po. Between 1200 and 1000 B.C. a division of the Celts, moving westward, was on the Wallachian and Pannonian plains. The Celts moved as colonists, with families, slaves, workers and cattle, escorted by the military caste. The Celts from the Danube stream produced the descendants who first entered Britain as a *P*-preserving folk. The other stream made contact with Greek peoples, Illyrians, Ligyes (Ligurians), Italic peoples. They met non-Celtic neighbours who pronounced Indo-European *Qu* in the throat as well as others who articulated it from the lips as *P*.

Reservoirs of Celtic humanity were formed *en route*, in the Hercynian area, the Isar region, and about the Lakes of Constance and Neuchâtel. These, in turn, spilled out their surplus populations. Long after Gaul had been occupied, groups returned east over the routes of their ancestors such as the Tectosagians, the Tolistoboians (279 B.C.), and certain others who settled in Western Germany. In 600 B.C., the Celts were on the Atlantic sea-board of France. Before 500 B.C. they were on the Atlantic shore of Spain. The descendants of the Danubian stream of Celts were crossing into the British Isles about 800 B.C., and spreading over the land. The tribal names on both sides of the English Channel show that, for a time, the chief Celtic ferry was at the Straits of Dover.

The first, main inflow into Britain, by the Straits about 800 B.C., were Belgæ, Devonians, and Brigantes. The latter included *Manapioi*, the ferrymen of the venture. The Belgæ concentrated round *Venta Belgarum* (Winchester). The *Damnonioi* (Devonians) were pastoral folk. They and the Belgæ penetrated to Ireland and became known there as *Fir Domnann* and *Fir Bolg*. Smaller groups of both, from the English section, spread into Scotland. The *Brigantes* were cultivators, pastoralists and fort-builders. The *Briga* of York was their centre, and they were the most powerful tribe in Britain. All these Celts possessed their own military castes. *Ganganioi*, Brigantes and Manapians were penetrating Ireland between 600 B.C. and 400 B.C.—nearer the former date than the latter.

About 400 B.C., Gaels, according to themselves, arrived in Ireland from the Iberian Peninsula. They secured a footing in parts not occupied by the Iro-British Celts—part of Cork, Kerry and Donegal. They pronounced *Qu* in their throats as *C*. They aimed at control and tribute. Not until their thirteenth generation did they acquire a measure of power. They were a well-armed minority, organised on a military basis; and they exerted themselves to secure control of the high-kingship.

About 350 B.C. a small section of Iro-British Celts issued from Ireland to secure a footing in Scotland. The Gaels called these people *Cruithne*, their designation for all people of Brito-Celtic stock in Ireland. The section that emigrated from the Boyne were warrior-groups, 300 in all; and they were fort-builders. They occupied parts of Man, Rathlin, Islay, Tiree and certain islands in Orkney and Shetland. They were energetic seafarers.

Dr. Scott reviewed the evidence in Pytheas, Julius Cæsar, the "Historia Brittonum", and Ptolemy's "Geographike", pointing to the all-Brittonic outspread "from Totness (Devon) to Burra Head (Shetland)". He then dealt with the transportations of Britons into Scotland by the Romans in A.D. 138 and 182; the consequent alterations in tribal names; and the effect of the counter-migration, more than two hundred years later, under Cunedag, and the creation of the *Cymry*.

According to Dr. Scott, Eumenius evolved the nickname 'Picts', and applied it to the 'unsubmitted' Britons of Stirling and Perth shires who gave Constantius trouble, and endangered his prospects. He observed that 'Picts' became a literary convention among Latin-writing chroniclers for all 'unsubmitted' Britons, and was used by scribes through medieval times into the modern period.

Dr. Scott showed that the military effect of Cunedag's march from the Forth to North Wales was to turn the left flank of the Romans and to accelerate their retreat. The political effect was that *Gwynedd* (North Wales) was recreated. The linguistic effect was that the dialect of Celtic ceased to be *Brythoneg* and became *Cymraeg*. The domestic effect was that the North Britons came among the imperialised Britons as 'co-workers', hence their designation 'Cymry'.

The third contingent of Celtic incomers to Northern Britain was a body of Dalriads from Antrim who called themselves the 'Clan Erc'. They were not Gaels, but were politically allied to them, and tributary to them. They entered Argyll about 500 A.D. They were a small body, well-armed and organised. Their aim was to impose themselves as a ruling caste on the British *Epidioi* of Argyll. At their best, the total strength of the Dalriads was 1,410 houses, and an armed muster of 1,500 men. These are the possessions and military strength on which the Gaelic fabulists base the 'Kings of Alba'; the 'Conquest' of Northern Britain; and other inventions of the medieval Gaelic clergy.

The 'Scots' (Irish) who assisted the Northern Britons against the Romans were the Iro-British allies of the latter from Ulster. Dr. Scott reviewed the political expansion of the Gaels and their ruling caste, and showed how impossible it was, in the then political position, for the Gaels to operate in mid-Britain. He reminded the audience that the Gaels scarcely influenced Scotland until the early Middle Ages through their clergy or the Dalriads: and that after A.D. 736–741 Dalriad power was broken by Angus MacFergus I. For 160 years the MacAlpin ruling caste subjected the central area of Scotland to an administration of destruction. In A.D. 1005, Malcolm II, son of an Iro-British woman of Leinster, broke away from Gaelic methods; and, with the aid of his friend Crinan, began a constructive and unifying policy.

Dr. Scott concluded by pointing out that the first great monastic schools and churches were all founded by men of British or Iro-British blood.

Building Research

THE staff of the Building Research Station now numbers 150, and the results of their work for the past year are embodied in the report* of the Building Research Board for 1933. The work carried out has been very comprehensive, including the investigation of the weathering of building stones, building material of all kinds, the structure and strength of these materials, and the efficiency of buildings from the point of view of the user. The ever-growing volume of special investigations and inquiry work—more than 1,500 inquiries were dealt with during the year—indicates that the activities of the Building Research Station are becoming increasingly known, and that the facilities offered are coming into regular demand.

A considerable amount of work has been carried out on Portland and Clipsham stones, and work on sandstone is in progress. It is found that measurements of 'microporosity' (a measure of the porosity of the oolitic grains—see 1931 report) and 'saturation coefficient' (a measure of the degree of saturation reached under standardised conditions of soaking) form a reasonably certain basis for the expression of an opinion on the quality of any particular sample of Portland stone of the normal type. Tests on the Clipsham stone have led to the conclusion that the more shelly type is of superior weathering quality. The crushing strength of stones is found to be a quality quite independent of their resistance to weathering.

* Department of Scientific and Industrial Research: Report of the Building Research Board, with the Report of the Director of Building Research for the year 1933. Pp. x+139. (London: H.M. Stationery Office, 1934.) 2*s*. 6*d*. net.

Work on stone preservatives shows that the effective life of certain of the materials commonly employed is limited to about 12–18 months.

Many investigations on bricks are described. Research was carried out to discover the amount of soluble salts a brick may safely be allowed to contain. It is stated that a brick containing 0·1 per cent of water-soluble magnesium sulphate would almost certainly cause failure in plaster applied to it; but an equal amount of calcium sulphate would be quite innocuous.

The behaviour of bricks depends greatly on their texture. Examinations of bricks from different regions of a kiln showed serious underfiring in some of these regions. A systematic firing of different clays under different conditions of temperature and kiln atmosphere is now progressing. The behaviour of the various bricks was examined by exposing them in a 'cemetery', the bricks being partly buried in soil. The results effectively dispose of the idea that high crushing strength denotes great resistance to exposure.

Many other investigations are described dealing with the thermal expansion of glass, paints, cement and concrete, the effect of sea-water on concrete, the effect of moisture content on the thermal resistance of fibre board, asphalt roofing, the supposed effects of different types of heat radiation on health, etc., all of which are of great scientific interest and practical importance. The volume is one of the most striking examples of the applications of the methods of scientific investigation to problems of everyday life which has recently appeared, and it appeals to a wide range of interests.

Angle of Incidence of Short Waves in Radio Reception

IN radio reception, a knowledge of the angle of incidence at the ground of short waves returned from the ionosphere is important. The accurate design of antenna arrays for radio communication by the beam system requires information as to the angle of elevation at which the beam is to be projected and of the corresponding angle of arrival.

A paper by Mr. A. F. Wilkins (*J. Inst. Elec. Eng.*, June) describes some experimental measurements, carried out at the Radio Research Station, Slough, of the angle of incidence at the ground of short waves from some American radio-telephone transmitting stations. The angles of incidence were determined from the phase differences of the E.M.F.'s which the arriving waves induced in two similar horizontal aerials at the same height above the ground. To achieve this, the aerials were connected by transmission lines to two similar receivers the outputs from which gave a trace on the fluorescent screen of a cathode ray oscillograph. If the two aerial E.M.F.'s were in phase, a straight line at 45° to the oscillograph axes would be produced on the screen. When the E.M.F.'s are equal in amplitude but are not in phase, the trace on the oscillograph screen will be an ellipse with its major axis lying along the 45° line. The phase difference is then the angle subtended by the minor axis at the end of the major axis of this ellipse.

The aerial system at Slough was set up particularly for observations on the signals from several stations at Lawrenceville, New York, on wave-lengths of about 20 metres. The results obtained show that, over the period January–April 1933, one main ray accompanied by other rays of smaller amplitude was received during the normal working period of these stations. The average angle of incidence of this main ray was 72° measured from the normal to the ground. During the above period this angle remained fairly constant and the oscillograph traces were similar from day to day. Towards the end of April, however, a marked change in the diurnal variation both of angle of incidence and of signal intensity became apparent. At the commencement of transmission, about noon G.M.T., the angle of incidence was about the value given above; but this angle was found to increase gradually until values of 80°–90° were obtained towards sunset. A decrease in the average signal intensity was also noticed during the same period.

These changes are explained as being due to the increased absorption during the summer months, consequent on the greater density of ionisation in the *E* region of the ionosphere, through which the waves have to travel before and after their reflection at the *F* region. The rise in angle of incidence exhibited during the evening at Slough is a result of the diminution of the absorption in the *E* region as the ions start to recombine. This investigation is being continued on a systematic basis with the aid of special pulse transmission from the American stations.

Training Chemists for Administration

IN a series of articles published in recent issues of the *Industrial Chemist*, there will be found many pertinent observations and useful suggestions regarding the problems connected with the training of chemists for administrative posts in industry. In an editorial, it is pointed out that chemists have all too often been regarded as unfitted for high administrative positions, a disability which they have been alleged to share with other scientific workers. Few technical men are to be found on boards of directors and in managerial positions. Incidentally, this peculiarity is one of the many distinctions between British and German technical industry.

In the August number, Mr. R. Brightman, in an article on "Some Problems of Industrial Recruitment and Leadership", remarks that industry does not appear to have considered seriously as yet whether training for management might not well be given at an intermediate stage in an industrial career, when those undergoing the training have some store of industrial experience on which to draw. If such training were limited to those who have afforded indications both of the capacity and the ambition for high administrative posts, such as is required from naval and military officers before undergoing advanced theoretical training in naval war schools or staff colleges, industry may possibly find in it one solution of the problem of securing a supply of administrators of the requisite quality.

Mr. Brightman argues that much closer co-operation is required between industry and education as well as more intimate knowledge of each other's requirements. Our existing educational facilities when fully utilised should be adequate for industrial requirements subject to (1) the reorganisation of elementary education on the lines recommended by the Hadow Committee, and (2) the gradual transfer of technical education from evening classes to part-time day instruction.

In the September issue of the *Industrial Chemist*, Mr. H. Lewis writes on training for administration in the chemical industry. Previously, he points out, it was possible to obtain most of the knowledge required by working through the departments of a firm, and this is the method adopted by small firms at the present, and often by the large firms through a trainee system. There are, however, many serious obstacles in the way of obtaining an adequate understanding of the varied problems of management of a large organisation by this method, and at best, it often becomes merely an instructional course in the methods of production. It is rarely that breadth of outlook can be obtained from experience in an individual firm, and resort must therefore be made to some other method of obtaining this necessary adjunct for effective management. Facilities for the study of administrative subjects are now becoming increasingly available in various centres, but so far it would appear that the only systematically organised institutional course in England dealing specifically with administration in chemical works is that provided by the Manchester College of Technology in the Department of Industrial Administration ; the subjects comprised in this course being economics, organisation of industry and commerce, industrial history, chemical economics and markets and chemical works organisation.

In the October number, Mr. H. Housley suggests that the chemical industry can usefully employ several groups of chemists ; there will be a large group who have decided to make chemical work their vocation, but others might combine the training and experience of the chemist with that of accountancy or engineering or administration. He argues that industry requires a number of schools situated in the more important industrial centres, each offering an organised course in administration covering a period of two or possibly three sessions.

Studies in Perseveration

AT an inter-sectional discussion on perseveration in Section J (Psychology) of the British Association meeting at Aberdeen, Dr. Wynn Jones, who opened the discussion, indicated that manifestations of perseveration may be classified in various ways, for example, as affective, conative, ideational, sensory or motor aspects of mentality. The study of the interrelation between these forms of perseveration has not received adequate attention. He further pointed out that investigators agree in finding evidence for a common factor in the motor tests. It was also suggested on the basis of a preliminary investigation with siblings as subjects that it may be possible to determine whether any of the alleged manifestations of perseveration are subject to hereditary influences.

Dr. W. Stephenson discussed the terms clearness variation, secondary function, perseverative tendency, general inertia, perseverations and stereotypies. In a series of propositions it was suggested that (1) there is a *p*-factor, but its explanation might lie in clearness variation and its laws ; (2) the *p*-factor makes contact with estimates of character, but the explanation of the contact is open to doubt—it cannot be accepted, for example, that general inertia is a fundamental principle subserving the formation of character and conduct generally ; (3) suggestions for the required fundamental principle would seem to come from (*a*) the observed facts of compulsion-repetitions, (*b*) the underlying principle being either that described by Freud as "beyond the pleasure-pain principle" (the "death instinct"), (*c*) or a psychical process impelling activities towards reinstatement of an earlier condition, now, however, a purely unconscious process.

Dr. P. E. Vernon criticised perseveration tests on the grounds that they have in the past been chiefly of a sensory or motor type. Temperament and character may be regarded as organised hierarchically, and in order to measure the 'higher levels' (that is, the more fundamental and significant traits), it is essential to use higher level approaches, that is, test situations which seem meaningful and important to the subject who is tested. Most sensori-motor tests tend to appear trivial or artificial to the subject, and in spite of their objectivity and statistical

reliability, they have usually failed to correlate to any considerable degree either with intellectual capacities or with orectic traits.

Experimental evidence was brought forward by the Rev. J. Leycester King to show that strong perseverators have a narrow mental complex-span, that is, they are unable to group more than a few single mental elements and grasp them as a new complex whole. In the course of the discussion, Dr. King expressed the opinion that the resonance theory of Lindworsky points the way to a simple formulation under which all the various phenomena ascribed to perseveration can be accounted for satisfactorily.

University and Educational Intelligence

CAMBRIDGE.—Miss S. M. Manton, of Girton College, has been approved for the title of the degree of Sc.D.

It is proposed that Mr. J. T. Saunders, of Christ's College, should be appointed secretary general of the faculties in succession to Mr. R. E. Priestley, of Clare College.

Dr. A. N. Drury, of Gonville and Caius College, Huddersfield lecturer in pathology, has been elected to a supernumerary fellowship at Trinity Hall.

EDINBURGH.—The jubilee of the Students' Representative Council, which was founded in 1884, was celebrated on November 20 at a luncheon held in the debating hall of the University Union. The Lord Provost, who proposed the toast of the University, congratulated the Council and wished it continued success and prosperity. Sir Thomas Holland spoke of compensating the senior president of the Students' Representative Council by giving him the opportunity of attending the University free of fees after his year of office for one year in addition to the normal number for his degree, so that he might obtain the class in his degree which indicated his high quality, and stated that a similar offer was to be made to the presidents of the University Union and of the University Womens' Union. Prof. G. L. Gulland, who was one of the executive of the first Students' Representative Council, afterwards addressed a large number of students on student-life fifty years ago.

LONDON.—The title of reader in industrial physiology in the University has been conferred on Mr. G. P. Crowden, in respect of the post held by him at the London School of Hygiene and Tropical Medicine.

The Petrie Medal for distinguished work in archæology has been awarded to the Abbé Henri Breuil, professor of prehistoric ethnography at the Institute of Human Palæontology and of prehistory at the Collège de France.

OXFORD.—The preamble of a statute establishing a permanent readership in soil science has passed Congregation. If the statute itself is approved, a decree will be proposed constituting Mr. C. G. T. Morison, student of Christ Church, the first holder of the office of reader under the statute. It is mainly to Mr. Morison that the present important position of the study in Oxford is due.

Congregation has also approved the preamble of a statute instituting Honour Moderations in Natural Science. This new examination is not intended to interfere with the Final Honour School in Science; its object is rather to provide an opportunity for those who may wish to acquire a wide but sound education in physical and biological sciences as part of a general education.

THE next election to Beit fellowships for scientific research will take place on or about July 12, 1935. The annual value of a fellowship is £240, and it is tenable for two years at the Imperial College of Science and Technology. Applications must be received on or before April 11. Further information can be obtained from the Rector, Imperial College, South Kensington, London, S.W.7.

THE following scholarships, tenable for three or four years, are offered by the Institution of Naval Architects for competition in 1935: Martell (£130 per annum) and Trewent (£125 per annum) scholarships in naval architecture; Yarrow (£100 per annum) scholarship in marine engineering. For these scholarships, candidates must be less than twenty-three years of age. The Denny scholarship (£75 per annum) is offered for competition by boys entering the University of Glasgow for a course in marine engineering. Further information can be obtained from the Secretary, Institution of Naval Architects, 2 Adam Street, Adelphi, London, W.C.2.

THE annual conference of the Geographical Association will be held at the London School of Economics on January 2–5, 1935, under the presidency of Lord Meston. On January 2, Lord Meston will deliver his presidential address entitled "The Geography of an Indian Village". Among the lectures to be delivered are: Brig. H. St. J. L. Winterbotham, "Ordnance Survey History"; Dr. L. Dudley Stamp, "Planning the Land for the Future: a Comparison of Land Utilisation Studies in the United States and Britain"; Dr. Allen Mawer, "The Geographical Value of a Study of Place Names"; Dr. G. P. Gooch, "Geography and International Problems"; Dr. Bernard Smith, "Water Supply". On January 2, a symposium on Russia will be held in conjunction with the Le Play Society; and on January 4, some new geographical films will be exhibited. Further information can be obtained from the Clerk, Geographical Association, Municipal High School of Commerce, Princess Street, Manchester, 1.

FROM the Universities Bureau of the British Empire we have received a copy of its report for the year ending July 31, 1934, the last of the five years during which the post of honorary director was held by Sir H. Frank Heath, who has now retired. The Executive Council has passed a resolution of regret at the death of Sir Donald MacAlister, whose association with the Bureau dated back to its inception in 1912, and contributed powerfully towards keeping alive the spirit of inter-university co-operation evoked at the congress held in that year. That the capacity for spontaneous co-operation is widespread among the university governing bodies is demonstrated by the fact that the list of members of the Bureau includes all those of Great Britain and Ireland, and nearly all the larger universities of other parts of the Empire, the most conspicuous exceptions being the Universities of Bombay, Manitoba and British Columbia. The Bureau's admirable "Yearbook", published annually, is well

known throughout the learned world. During the year, there was a marked increase in the number of inquiries received from foreign countries, mainly owing to the fact that the Foreign Office has intimated to its representatives that the Bureau is prepared to supply information regarding general university matters.

Science News a Century Ago

Meteorological Tables

In a report rendered by the Secretary of the Royal Society on December 1, 1834, it was stated that "by an arrangement made with the editor of the weekly journal, *The Athenæum*, the expense of printing the Meteorological Tables, formerly appended to the *Philosophical Transactions*, will be saved; the editor, in consideration of their being given to that journal exclusively, having agreed to deliver 1000 copies of those tables, printed in manner and form to correspond with the *Transactions* every six months, to be bound up with the latter, free of all cost to the Society". (*Roy. Soc. Abstracts*, vol. 3.)

Entomological Society of London

At a meeting held on December 1, 1834, J. O. Westwood read a memoir entitled "Observations upon the Organization of the Mouth of the *Anthophora retusa*, and upon the nature of the parasitic connexion existing between the working and parasite Bees". Westwood exhibited numerous figures, illustrative of parts of the mouth in different degrees of protrusion. A discussion ensued between Mr. Shuckard and Westwood, the former alleging that the statements therein contained were "destitute of novelty"; whilst the latter affirmed that neither in the works of Latreille, Kirby, Réaumur, nor in any other writer that he had consulted had the curious apparatus described by him for throwing out the labium to its fullest extent from within the extremity of the tubular mentum been noticed. The Rev. F. W. Hope exhibited an extensive series of silk-moths from his own and the collection of Mr. J. G. Children; also, a branch of a tree covered with the cocoons of an exotic silk-moth from the collection of the Naval and Military Museum. (*J. Entom. Soc.*, 1834.)

J. D. Forbes and Quetelet

On December 5, 1834, J. D. Forbes, writing from Edinburgh to Quetelet, said: "I have recently been experimenting with Melloni's Thermo-multiplier, and have been much delighted with it. Very lately I have been enabled to establish beyond a doubt the polarization of non-luminous heat; and have verified Melloni's experiment of the refraction of the heat of boiling water."

"To-day I commenced a register with a particular view to you. I have got an apparatus for weighing and measuring men, and shall collect annually as many results from the students of my class as possible, and also their strength by Regnier's Dynamometer. I distinguish their age and native country. . . . Amongst my many other pursuits, as I mean to begin on optics this winter, I have been studying the undulatory theory with great admiration. We are, I am sure, much indebted to you for putting Herschel's Treatise on Light into a more convenient form than we can find it in England."

Societies and Academies

EDINBURGH

Royal Society, November 5. L. M. DAVIES: The geology of Inchkeith. This island was last surveyed geologically by Sir Archibald Geikie in 1860. Col. Davies replaces Geikie's map by more modern ones; distinguishes between intrusive and extrusive igneous rocks, giving particulars as to their natures; and describes the sedimentary sequence throughout. The drift geology of the island is also systematically described for the first time; and a list is given of the fossils found on Inchkeith. Appendixes are added, on the drift deposits by Dr. R. Campbell, and on the entomostraca by Miss M. H. Latham. C. F. DAVIDSON: The Tertiary geology of the Island of Raasay, Inner Hebrides. The Tertiary igneous rocks of Raasay and South Rona include olivine-basalt lavas, an intrusive suite of acid and basic sills, and a large number of dykes. The major sills are riebeckite-bearing granophyres, and highly differentiated olivine-dolerite (crinanite) types with abundant segregations, including picrite, teschenite, syenite and numerous pegmatites. The petrogenesis of these is discussed. Comparable rocks are found in the dyke-suites, where differentiates also include analcite-basanite and analcite-tephrite. One olivine-dolerite dyke fuses granophyre xenoliths into pitchstone. Other analysed intrusions include a leidleite pitchstone dyke, a peridotite dyke and an elongated boss of gabbroidal teschenite, while a series of vents are believed to represent hot springs of Tertiary age. The paper concludes with notes on the recent earth-movements of these islands. B. P. WIESNER and N. M. SHEARD: The duration of life in an albino rat population. H. W. TURNBULL: The invariant theory of the correlation. This is an extension of methods already utilised in dealing with bilinear and quadratic forms to a class of transformations which occur in algebraic geometry, called correlations. The main results prove to be simpler than might be expected.

PARIS

Academy of Sciences, October 29 (*C.R.*, 199, 813–896). LOUIS DE BROGLIE and JACQUES WINTER: The spin of the photon. HENRI EYRAUD: The most precise value of a distribution. GEORGES BOULIGAND: The general properties concerning the distribution of the limits at a singular point of a compact field. HERMANN MÜNTZ: Mixed problems in heterogeneous space. The equation of heat in n dimensions. ALBERT TOUSSAINT: Contribution to the study of the interactions when 'taxi-ing' for sustaining wings in tandem. Application to the case of a principal wing associated with a very small front auxiliary wing. HÉGLY: The propagation of a solitary wave in a reduced canal with trapezoidal section. EDMOND BRUN: The friction couple to which a disc turning in air is submitted. Results of an experimental study. MAX SERRUYS: Detonation and pseudo-detonation in internal combustion motors. MARCUS BRUTZKUS: A method for the study of the process of combustion in motors. J. ELLSWORTH: The photometric study and new elements of the double system with eclipses of U Cephei. J. E. VERSCHAFFELT: The application of the principles of thermodynamics to conductors. ALFRED LIÉNARD: The Peltier and Thomson phenomena and entropy. ARKADIUS PIEKARA and MAURICE SCHÉRER: The influence of the magnetic field on the dielectric constant of liquids. Measurable increases of the dielectric constants of

eight liquids have been found with a magnetic field of 51,000 gauss. The effect falls off rapidly as the field strength decreases, and becomes insensible when the field is less than 25,000 gauss. CHARLES HAENNY and GASTON DUPOUY: The paramagnetic properties of cerous salts in solution. The mean value found experimentally for the magnetic moment of cerous ions in solution in the case of strong electrolytes is 2·49 Bohr magnetons, very near the value of the theoretical moment calculated by Van Vleck, 2·56. NICOLAS STOYKO: The influences of magnetic disturbances on the velocity of propagation of long electromagnetic waves. Study of the results of 14,000 observations of long wave reception. For each year, the time of propagation diminishes with increase of the magnetic disturbance, or in other words, the apparent velocity increases. This effect is attributed to variations in the height of the ionised layer of the upper atmosphere produced by the magnetic perturbations. W. ARKADIEW: The diffraction of electric waves chemically recorded. The method is based on the application of a detector of the Branly type furnished with electrodes of various metals: the paper is impregnated with a solution giving a change of colour on passage of the current. Two diagrams showing the results obtained are given. VICTOR HENRI: The carbonyl group of aldehydes and ketones compared with carbon monoxide. Conclusions drawn from the study of ultra-violet spectra. There is no correspondence between the vibration frequency of carbon monoxide and that of the carbonyl group in molecules: the Raman, infra-red and ultra-violet spectra all agree in showing this difference. This is interpreted in terms of differences in electronic states. GEORGES BRUHAT and PIERRE GRIVET: The photo-electric analysis of elliptical vibrations. GUY EMSCHWILLER: The chemical action of light on the diiodo derivatives of hydrocarbons: diiodoethanes, diiodomethane. HORIA HULUBEI and MLLE. YVETTE CAUCHOIS: A new technique in the crystalline spectrography of the γ-rays. G. MONOD-HERZEN: A periodic property of the atomic nuclei. PIERRE CHEVENARD: The relation between the heterogeneity of a solid solution and its mechanical and chemical properties. RENÉ PÂRIS: The thermometric study of the precipitation of insoluble ferrocyanides. In the case of simple precipitations with potassium ferrocyanide, the thermometric method leads to the same results as other methods of indirect chemical or physico-chemical analysis, but more rapidly. ARAKEL TCHAKIRIAN: The action of potash or soda on germanoformic acid. LOUIS MARMIER: A catalyst for the production of nitric acid by the oxidation of ammonia. The catalyst used was pozzolana covered with a thin layer of a metal or metallic oxide. Of the metals studied, platinum and chromium proved the most efficient. With chromium, 33–45 per cent of the theoretical quantity of nitric acid was obtained, and it is concluded that chromium might with advantage replace platinum in certain cases. MME. YVONNE KHOUVINE: The alkaline isomerisation of β-glucoheptose. ERNEST FOURNEAU and J. DRUEY: The preparation of 4-iodopyrocatechol. A. SAKAÉ MIHARA: The succession of Permian eruptions in the Vosges (Niedeck). JACQUES FROMAGET: The geological structure of the crystalline and metamorphic base of the River Noire and of Haut Song Ma to the north of the parallel of Dien Bien Phu (Western Tonkin). FRANÇOIS QUIÉVREUX: A fossil-bearing level of the Oligocene potash basin. PIERRE LEJAY: The determination of the quantity of ozone contained in the atmosphere in the neighbourhood of Shanghai. JEAN BEAUVERIE: The causes of the individual resistance of cells of micro-organisms of the same species submitted to the action of the ultra-violet rays. There is a direct relation between the resistance of beer yeast to the action of ultra-violet light and the amount of glycogen in the cells. The glycogen has a protective action against the rays. JOSEPH SIVADJIAN: The pharmacological study of a conditioned reflex. J. ANDRÉ THOMAS: The physiological aspect of the spontaneous transformation *in vitro* of fibrocytes into macrophages. ETIENNE RABAUD and MLLE. MARIE-LOUISE VERRIER: The swim-bladder and the volume variations of fishes. MAURICIO GOMEZ and ANDRÉ LANGEVIN: The utilisation of piezoelectric quartz for the study of certain biological phenomena and especially for the study of the variations of blood pressure in the vessels. Study of the causes of error in earlier applications of the piezoelectric quartz, and description of measures taken to avoid such errors. Two piezograms are reproduced. LOUIS LUTZ: The soluble ferments secreted by the Hymenomycete fungi. The cytolysis of cellulose. RAOUL LECOQ: The food value of mannite and sorbite in relation with the equilibrium of the ration.

LENINGRAD

Academy of Sciences (*C.R.*, 3, No. 4). R. KUZMIN: Theory of the deformation of surfaces. D. PANOV: Some cases of exact solution of problems relating to the bending of a prismatic beam of symmetrical section. G. KRUTKOV: Linear problems of the theory of Brownian movement (2). N. KURCHATOV, L. MYSOVSKIJ, G. SHCHEPKIN and A. WIEBE: The Fermi effect in phosphorus. B. KURCHATOV, I. KURCHATOV, G. SHCHEPKIN and A. WIEBE: The Fermi effect in alluminium. L. MYSOVSKIJ, I. KURCHATOV, N. DOBROTIN and I. GUREVITCH: Possibility of disintegrating nuclei by neutrons with the emission of three heavy particles. V. KRAVCOV: Heights of the potential barriers in the atomic nucleus. N. KREMENEVSKIJ: The molecular absorption of mercury vapour in the Schumann region. N. DOBROTIN: The method of determining the statistical angular distribution of particles inside a Wilson chamber. S. FRISCH and V. TCHERNIAJEV: Methods of enriching hydrogen in its heavy isotope. M. ELJASHEVITCH: An analysis of the pure rotation spectrum of the water molecule. N. PRILEZHAJEVA: Decomposition of $Pb(C_2H_5)_4$ in the glow discharge. N. ZELINSKIJ and N. SHUIKIN: An unexpected and peculiar transformation of cyclohexane under the influence of a nickel catalyst. V. SADIKOV and A. SHOSHIN: Alteration of protein properties during meat storage in antiseptic conditions. M. KRAUSE, M. NEMTSOV and E. SOSKINA: An investigation of the polymerisation of olefines. Kinetics of the thermal polymerisation of propylene, isobutylene and amylene. I. KITAIGORODSKIJ and L. LANDE: The preparation of iron-free glass. E. SOTNIKOV: Production of citric acid by *Aspergillus niger*. (1) Production of citric acid in unchanged solutions. (2) Production of citric acid in changed solutions. S. KRAEVOJ: The tri-, tetra- and hexaploid chromosome complements in somatic cells of *Scorzonera tau-saghiz*. J. KERKIS: Mechanism of the development of triploid intersexuality in *Drosophila melanogaster*. P. and A. LEBEDEV: The geochemistry of titanium and vanadium in western Siberia. S. NEMOVA: Results of a petrographic investigation of the sedimentary strata in Sakhalin Island.

Forthcoming Events

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

Sunday, December 2

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Dr. K. G. Blair: "Sexual Dimorphism in Insects".*

Monday, December 3

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Dr. Malcolm Smith: "Poisonous Snakes and their Venom".*

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5.—Dr. L. W. Hackett: "Malaria in Europe" (Heath Clark Lectures. Succeeding lectures on December 4, 5, 6 and 7).*

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Mr. Hugh Ruttledge's film of the Mount Everest Expedition, 1933, and other Mount Everest films.

Tuesday, December 4

ROYAL SOCIETY OF ARTS, at 4.30.—E. W. Bovill: "Empire Production of Essential Oils for Perfumery".

Wednesday, December 5

UNIVERSITY COLLEGE, LONDON, at 5.—Miss Violet Mason: "Folklore of the Cotswolds".*

Friday, December 7

INTERNATIONAL SOCIETY OF LEATHER TRADES' CHEMISTS, at 10 a.m.—(at University College, Gower Street, W.C.1).—A symposium on "Technical Aspects of Emulsions".*

SOCIETY OF CHEMICAL INDUSTRY (LIVERPOOL SECTION), at 6—(at the University).—Dr. J. T. Conroy: "The Alkali and Associated Industries—a Retrospect" (Hurter Memorial Lecture).*

BEDSON CLUB (ARMSTRONG COLLEGE, NEWCASTLE UPON TYNE), at 6.30.—Dr. W. H. Mills: "Some Stereochemical Questions" (Bedson Lecture).

INSTITUTE OF CHEMISTRY (LONDON AND SOUTH EASTERN COUNTIES SECTION).—Streatfield Memorial Lecture.

ROYAL INSTITUTION, at 9.—Dr. C. H. Desch: "The Crystallisation of Alloys".

BRITISH INSTITUTE OF RADIOLOGY, December 5–7. Annual Congress and exhibition of X-ray apparatus to be held at the Central Hall, Westminster, S.W.1. To be opened by Sir Humphry Rolleston.

December 6.—Dr. H. H. Berg: "The Digestive Mucosa" (Silvanus Thompson Memorial Lecture).

December 7.—Sir William Bragg: "X-Rays and the Coarse Structure of Materials" (Mackenzie Davidson Memorial Lecture).

Official Publications Received

GREAT BRITAIN AND IRELAND

University of Reading: The National Institute for Research in Dairying. Annual Report for the Year ending 31st July 1933. Pp. 93. (Shinfield: National Institute for Research in Dairying.)

Survey of Thunderstorms in the British Islands. Summer Thunderstorms: Third Annual Report, 1933. By S. Morris Bower and others. Pp. 36+vi+6 plates. (Huddersfield: Thunderstorm Census Organisation.) 2*s.* 6*d.*

University of Birmingham: Executive Board of Mining Research. Report on the Work of the Mining Research Laboratory during the Year 1933. Pp. 20. (Birmingham.)

Ministry of Labour. Reports of Investigations into the Industrial Conditions in certain Depressed Areas of 1, West Cumberland and Haltwhistle; 2, Durham and Tyneside; 3, South Wales and Monmouthshire; 4, Scotland. (Cmd. 4728.) Pp. 240. (London: H.M. Stationery Office.) 3*s.* 6*d.* net.

"This Surprising Lancashire!" Some Views and Notes published at the direction of the Municipal Finance Committee on behalf of the Lancashire Industrial Development Council. Pp. 48. (Manchester: Lancashire Industrial Development Council; London: W. H. Smith and Son, Ltd.) 6*d.*

Rubber and Agriculture. Pp. 64. (London: Rubber Growers' Association.) Free.

OTHER COUNTRIES

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 111: A Simple Method of Calculating the Induced Velocity of a Monoplane Wing. By Itirô Tani. Pp. 65–76. 15 sen. No. 112: Motion of Stretched String in a Turbulent Flow of Air. By Daizo Nukiyama. Pp. 77–100. 20 sen. (Tôkyô: Koseikai Publishing Office.)

Science Reports of the Tokyo Bunrika Daigaku, Section B. No. 25: Brachyura from the Coast of Kyusyu, Japan. By Tune Sakai. Pp. 281–330+plates 17–18. 80 sen. No. 26: Bryozoa Fauna in the Vicinity of the Shimoda Marine Biological Station. By Yaichirô Okada. Pp. 20+2 plates. 30 sen. No. 27: The Aquatic Insects at Nikkô. By Yaichirô Okada and Isamu Horasawa. Pp. 21–27. 15 sen. (Tokyo: Maruzen Co., Ltd.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 33, Part 5: Spiders from Hokkaido. By Saiburo Saito. Pp. 267–362+plates 12–15. (Tokyo: Maruzen Co., Ltd.)

Travaux du Laboratoire de Microbiologie de la Faculté de Pharmacie de Nancy. 1934, Fascicule 7. Pp. 234. (Nancy: Faculté de Pharmacie.)

Forest Bulletin No. 85: A Record of the Results obtained with Experimental Treated Sleepers laid in the Indian Railways between 1911 and 1916. By S. Kamesam. Pp. iii+35. (Delhi: Manager of Publications.) 8 annas; 10*d.*

Report of the Botanical Survey of India for 1932-33. Pp. 12. (Calcutta: Royal Botanic Gardens.)

Bulletin of the Madras Government Museum. New Series, General Section, Vol. 3, Part 1: The Three Main Styles of Temple Architecture recognised by the Śilpa-Śāstras. By Dr. F. H. Gravely and T. N. Ramachandran. Pp. 26+2 plates. (Madras: Government Press.) 1 rupee.

Memoirs of the Geological Survey of India. Vol. 63, Part 2: The Iron-Ore Deposits of Bihar and Orissa. By H. Cecil Jones. Pp. iv+167–302+xxv+plates 13–32. (Calcutta: Geological Survey of India.) 7.10 rupees; 13*s.*

Journal of the Indian Institute of Science. Vol. 17A, Part 7: Preparation of Sugar Syrup from Cashew Apple (*Anacardium occidentale*, Linn.). By M. Srinivasan. Pp. 85–94. 14 annas. Vol. 17B, Part 2: Studies in Dielectrics, Part 1: The Effect of Superimposed Magnetic Fields on the Breakdown Voltage of Dielectrics; Part 2: The Effect of Superimposed Magnetic Fields on the Permittivity and Power Factor of Dielectrics. By N. V. Narayanaswami and F. N. Mowdawalla. Pp. 19–46. 2.4 rupees. Vol. 17B, Part 3: Radio Field Intensity Measurements at Bangalore during the Polar Year. By P. L. Narayanan. Pp. 47–67. 1.8 rupees. Vol. 17B, Part 4: Studies in Dielectrics, Part 3: The Effect of Successive Discharges on the Dielectric Strength of Liquids; Part 4: The Effect of Impurities on the Breakdown Voltage of Transformer Oil. By B. S. Ramaswamy, N. V. Narayanaswami and F. N. Mowdawalla. Pp. 69–90. 1.12 rupees. Vol. 17B, Part 5: Brush Contact Drop in D.C. Machines. By M. V. Kesavo Rao. Pp. 91–100. 1 rupee. (Bangalore: Indian Institute of Science.)

Hints to Prospectors and Owners of Treatment Plants. Sixth edition. Pp. 64. (Perth: Government Printer.) 9*d.*

National Research Council. Transactions of the American Geophysical Union, Fifteenth Annual Meeting, April 26, 27, 28, 1934, Washington, D.C., and Berkeley, California, June 20, 21, 1934. Part 1. Pp. 258. Part 2. Pp. 259–634. (Washington, D.C.: National Academy of Sciences.)

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 21, No. 15: The Templeton Crocker Expedition to Western Polynesian and Melanesian Islands, 1933—Notes on the Reptiles and Amphibians, with the Description of a New Species of Sea-Snake. By Joseph R. Slevin. Pp. 183–188. Vol. 21, No. 16: The Templeton Crocker Expedition to Western Polynesian and Melanesian Islands, 1933—Notes on the Birds. By M. E. McLellan Davidson. Pp. 189–198. (San Francisco.)

Obras completas y Correspondencia científica de Florentino Ameghino. Vol. 13: Formaciones sedimentarias de Patagonia. Edición Oficial ordenada por el Gobierno de la Provincia de Buenos Aires. Dirigida por Alfredo J. Torcelli. Pp. 999+7 plates. (La Plata.)

Province of Alberta: Geological Survey Division. Research Council of Alberta, Report No. 30: Geology of Central Alberta. By John A. Allan and Ralph L. Rutherford. Pp. iii+41+v+3 plates. (Edmonton: University of Alberta.) 1 dollar.

Sudan Government. Annual Report of the Gezira Agricultural Research Service for the Year ended 31st December 1933, relating to Experimental Results obtained in the Season 1932–33. Pp. xiii+183. (Wad Medani: Gezira Agricultural Research Service.)

Reports of the Newfoundland Fishery Research Commission. Vol. 2, No. 2: Annual Report, Year 1933. Pp. 117+12 plates. (St. John's: Newfoundland Fishery Research Commission.) 1 dollar.

Meddelelser om Grønland udgivne af Kommissionen for Videnskabelige. Undersøgelser i Grønland, Bd. 79, Nr. 10: The Godthaab Expedition 1928—Copepoda. By P. Jespersen. Pp. 166. (København: C. A. Reitzels Forlag.) 8.00 kr.

Publication of the Netherlands Geodetic Commission (Uitgegeven door de Rijkscommissie voor Graadmeting en Waterpassing.) Gravity Expeditions at Sea, 1923–1932. Vol. 2: Report of the Gravity Expedition in the Atlantic of 1932 and the Interpretation of the Results. By F. A. Vening Meinesz, with the collaboration of Prof. J. H. F. Umbgrove and Ph. H. Kuenen. Pp. iii+208+5 plates. Tables belonging to Gravity Expeditions at Sea, 1923–1932. By F. A. Vening Meinesz. Isostatic Reductions, Elevations and Corrections of Separate Zones. Pp. 61. (Delft: J. Waltman, Jr.)

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