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Systematics in Relation to General Biology

THE classification of living things is of prime importance, and fundamental to any biological research. Taxonomy, the law of order, is not only one of the oldest branches of biology, but also remains one that is basic to such more recently developed branches as cytology, ecology, and genetics. This fact cannot be too much stressed. It is somewhat unfortunate that a really satisfactory history of plant and animal taxonomy remains unwritten. The philosophical and logical principles underlying classification have also not received the consideration they deserve, and taxonomists themselves are often ignorant of the real implications of the working hypotheses they adopt. They are often also none too clear as to exactly what is implied by certain words and phrases, such as 'phylogeny' and 'a natural system', which have perhaps assumed a 'blessedness' they scarcely deserve.

Text-books of systematic biology, with very few exceptions, still define the aim of a natural classification as the reconstruction of the course of evolution, and seem to envisage the possibility of eventually producing a schematic tree on which each group hangs on its appropriate branchlet. That this conception rests on a confusion of thought has been suggested by many biologists, and its continued unqualified statement in taxonomic text-books is to be regretted. Perhaps the fullest discussion of the difficulties of equating a natural with a phylogenetic classification is contained in the late Dr. F. A. Bather's presidential address to the Geological Society in 1927, and the same point was stressed recently by Mr. J. S. L. Gilmour in his article "A Taxonomic Problem" in NATURE of June 19, p. 1040. Clear thinking on this fundamental issue is one of the most urgent needs for the future progress of taxonomic work. The older, 'orthodox', taxonomy is based mainly on morphology (including, especially for some groups, anatomy) and with the supplementary use of geographical data, notably in higher animals. This use of morphological criteria as the basis of classification has yielded remarkably valuable results, of which taxonomists may well be proud. There is also no doubt that much yet remains to be done along the well-recognized lines of morphological description and classification, especially in many groups of invertebrates and lower cryptogams and among the faunas and floras of relatively little-explored parts of the world. It will further be generally allowed by taxonomists that there is still room for improvement in their methods of comparative description, terminology, and details of classification without involving far-reaching changes.

Within the last two decades, however, there has not only been an almost startling advance in cytology, ecology, genetics, and other sub-sciences of biology, but it has also become increasingly recognized that many discoveries classified under these heads have a bearing on orthodox taxonomy. This impact of newer methods on the still essentially morphological systems of naming and arranging animals and plants can no longer be ignored. It concerns all biologists, whatever may be their particular fields of research. There is no general agreement as to whether new subsidiary systems, with their own terminology and symbolism, should be developed as independently as possible of existing taxonomy, or whether the latter can be so expanded as to include those data of cytology, ecology, genetics, etc., that can be used as 'characters' for arranging organisms into groups.

Orthodox taxonomy has developed International Rules of Nomenclature. The use of these within their proper field is not disputed, but they may, in their present form, prove a hindrance if rigidly applied to an expanded taxonomy. The possibility and desirability of developing an all-inclusive taxonomy towards an ideal state of perfection needs full investigation.

Existing taxonomy is based on grouping animals and plants into taxonomic units termed varieties, subspecies, species, genera, families, etc. There is, however, considerable disagreement, even among specialists within one group, as to the limits of the units. A general survey of the systematic categories in different groups, a classification of the criteria used, and a careful consideration of recently discovered cytological and genetical facts might well lead to obtaining greater precision, more logical arrangement, and greater uniformity in taxonomy.

Taxonomic literature is very large, scattered in many periodicals, and very diverse in presentation and contents. Museums, herbaria and other institutions contain quantities of material and data, available to the biologist, but often not in a readily accessible form for any particular piece of research. There is, indeed, an almost unrealizable mass of material and of known facts which would yield results of the greatest biological importance if only they were collated and correlated with the rest of biology. It is to be anticipated that new generalizations of considerable importance will emerge in the process. Some of the preliminary analysis has been done, but the results are scattered and uncorrelated ; the synthesis would seem to await another Darwin. The task, however, is now beyond the physical powers of any one individual.

While taxonomy is at present based mainly on morphology, its history shows that attempts have been made from time to time to incorporate new ideas. Thus, though taxonomy long antedates the general acceptance of the evolutionary principle, this had in time considerable effects on taxonomic theory and practice. Similarly, especially at the species level, peculiarities of distribution have been utilized in drawing limits between groups.

Of recent years, it has become increasingly evident that speciation is neither invariably a simple, clear-cut phenomenon nor due to any one cause or series of causes : rather, a number of factors, internal and external, operate in producing speciation and other evolutionary processes. Their relative importance in different groups needs intensive and extensive investigation. Again, many relevant facts have been published, but until the scattered data have been extracted, correlated and classified, it is impossible to tell along what lines and with what material new research is most likely to throw light on those questions of equal importance to the taxonomist, cytologist, ecologist, and geneticist. It is certain, however, that a great deal of new research is necessary before the problems even of speciation can be solved. The development of biology along synthetic lines does not mean the abandonment of analytical methods in special research. It means rather their intensification, but with a co-ordination at present largely lacking. The collection of material for the eventual publication of a British Fauna and a British Flora on uniform and broad biological lines should serve as a stimulus to research and as a focus for co-ordination.

Many kinds of biological research involve the recording and interpretation of large masses of facts. With proper help and advice, valuable work can be done by local societies, amateurs, schools and colleges. Such research, properly conducted, can have a twofold value : observations or experiments can be made over a wide area or for a long period of time ; and they are of very considerable educational value to the persons making them.

Taxonomists, and indeed other biologists, frequently complain that their subject is not well taught in universities and schools. There is much truth in this complaint, and the modification of teaching methods and syllabuses is an urgent need. Students not infrequently know much about the anatomy of a plant or animal without knowing anything about it as a living organism or its relationships to other organisms. The revivification of taxonomy by expanding its scope to include data from other branches of biology and the realization of what they can gain from taxonomy would in itself tend to encourage greater attention to its careful teaching.

That the time is ripe for increased co-operation between workers in different branches of biology will, it is hoped, be acknowledged. In this connexion the recent formation of an "Association for the Study of Systematics in Relation to General Biology", an account of which was published in NATURE of July 24, p. 163, is of special interest. The work of the Association should do much to stimulate interest and co-operation in the various aspects of the impact of modern biological thought on the problems of taxonomy.

Indian Ethnography

The Khāriās

By Sarat Chandra Roy and Ramesh Chandra Roy. Vol. 1. Pp. xv+306+27 plates. Vol. 2. Pp. ii+307–530+lviii+13 plates. (Ranchi: "Man in India" Office, 1937.) 11 rupees.

STUDENTS of tribe and caste in India are well acquainted with Sarat Chandra Roy's excellent studies of the wild tribes of Orissa and the Central Provinces, of which the results are contained in his works on the Mundas, Orāons, Birhors and Bhuiyas. We are now given two interesting volumes on the Khāriās, who are to be found in Orissa and the eastern portion of the Central Provinces. Following the established order of such works, particulars are given of the origin, migration, physical traits, culture, social organization, birth, marriage and death rites, festivals and superstitions. Dr. Marett gives the work a short introduction, and there are numerous illustrations.

There are three branches of these primitive people, the Erenga or Hill Khāriās, the more civilized Dudh Khāriās, and the Delki or Dhelki Khāriās. The Hill section of this tribe still live by a system of cultivation known as *Jhum* in the eastern and *Kumri* in the western provinces of India. This consists in burning down large tracts of forest and sowing scanty crops in the ashes. As the forest is destroyed by this process, the population moves to fresh areas for a source of livelihood. The other divisions of the tribe have adopted more settled forms of agriculture.

The two large volumes containing the fruits of Sarat Chandra Roy's research offer, as was to be expected, much resemblance to the accounts of similar tribal units in other parts of India. We find traces of totemism, a system of ancestor worship, the belief in and propitiation of evil spirits, a form of medicinal treatment based partly on the use of vegetable products and partly on spirit scaring, and a firm belief in omens and witchcraft. The totem section among the Khāriās is known as *Kili* or *Khili*, corresponding to the *devak*, *bedagu* or *bali* of western India. The author gives the name of many totem divisions which apparently bear close resemblance to those of similar tribes in other parts of the country; but here, it may be noted, identification is rendered difficult by lack of adequate description of the tree or animal referred to. The vernacular names are an inadequate guide, particularly in the case of trees which bear many vernacular names in different areas.

In this connexion, special interest is attached to the list contained on pp. 458–460 in vol. 2. The author is here giving his reader the names of a number of trees of which the products are used for medicinal purposes. It will be at once discovered that the botanical names are those of well-known totems of other parts of India, as for example, *Lawsonia alba*, *Phyllanthus emblica*, *Achyranthes aspira*, *Artocarpus Lakoocha*, *Bombax malabaricum*, *Eugenia Jambolana* and the well-known *Calotropis gigantea*.

The importance of this list lies in the fact that it has been often assumed that there is a close connexion between the medicinal value of certain trees and their adoption as the totem of an exogamous unit. Significance, therefore, is attached to the fact that among the Khāriās, a very primitive tribe, such value is found in the very same trees that the Marāthas and allied castes hold in totemistic relationship on the other side of India.

Russell, in his "Tribes and Castes of the Central Provinces", pp. 445 *et seq.*, describes the Khāriās as a primitive Kolarian tribe which appear to be allied to the Mundas and Savars. He considers them to be an elder branch of the Mundas. He describes them as very dirty in their persons, with features of a low character, not unlike the Bhumij, but with an absence of any strongly marked type.

In the "Linguistic Survey of India", the Khāriā language has been declared to be closely allied to Savara, and to resemble Korku and Juang. It has ceased to be a typical Munda language, according to Sir George Grierson. Sarat Chandra Roy, as was to be expected from the results of similar investigation in other areas, finds evidence that the first spirits to be personified and deified were those of ancestors. He writes:

"This is why we find among all sections of the Munda tribes, the worship of ancestor spirits. One's parents and other near relatives whom the Khāriā loved and honoured when they were living cannot fail to be regarded with love and reverence after they were dead. Spirits of ancestors who were revered and looked up to as *Siāns* or village elders during their life-time are especially remembered and honoured after death" (p. 315).

The late Sir James Campbell, in his notes on the spirit basis of "Belief and Custom" published in the *Indian Antiquary*, held a similar theory, and proceeded to show by numerous examples collected in western India how the original practice

of spirit scaring by various well-known rites developed into a system of spirit 'squaring', whereby suitable propitiation was made to the spirit and a lodging found for him where he would be content to dwell without further troubling the helpless victims of his attention. This process of propitiation for the *Dubo* or ill-disposed spirits is described by Sarat Chandra Roy. In addition to ancestral spirits, as might be expected, Khāriās worship a host of minor deities, of which details will be found in Chapter xi. Above them all is the supreme spirit known as Poromosor, an obvious corruption of the Hindu title of Parameshwar.

We must close this short notice of Sarat Chandra Roy's valuable work by an acknowledgment of the assistance such studies are to those interested in the Ethnographic Survey of India, now represented by a constantly increasing flow of works of this description. If a word of criticism may be permitted, it would take the form of a regret that so many misprints are allowed to disfigure these pages. They are quite unusually numerous, and, strangely enough, we have a consistent wrong spelling of the well-known name of the author of "Tribes and Castes of the Central Provinces". The illustrations, mostly reproductions of photographs, are greatly lacking in clearness of outline, and thus lose much of their value.

R. E. ENTHOVEN.

Afforestation in the Lake District

Afforestation in the Lake District: a Reply to the Forestry Commission's White Paper of 26th August, 1936. By H. H. Symonds. Pp. xxi +97 +4 plates. (London: J. M. Dent and Sons, Ltd., 1936.) 2*s*. net.

IT is well known there has been considerable controversy over the afforestation work which has been and is being undertaken by the Forestry Commission. Mr. Symonds has written a small book dealing with the Lake District in this connexion, and Lord Howard of Penrith contributes a foreword. A joint informal committee of the Forest Commission and the Council for the Preservation of Rural England was appointed. The author details the various results of the meetings, the questions asked in Parliament and comments in the Press on the Forestry Commission's proposals.

Opposition to the proposals to afforest parts of the Lake District is based in part on the monotony of scenery introduced by commercial afforestation. "The sitka spruce and Norway spruce—the staple diet of waterlogged ground—Douglas fir, Corsican pine—how they repeat themselves; ages ago they learnt their lesson, and the 'damnable iteration' of them is an offence: they have the air of mass production, the efficiency of the machine." The author states that his book is not an argument against afforestation or conifers. But he points out that while conifer stands, after first youth, may look magnificent on the Alps, Jura or the Rockies, they are out of place in the fells of Cumberland which are on so small a scale that they "depend for their grandeur on a system of natural proportions which you can spoil, but not alter". As Lord Ullswater has said, the problem is one "of taste, discretion and degree".

If one of the reasons for planting in the Lake District was to give work to the unemployed, it would seem a pity that the Forestry Commission did not avoid controversy, for the work of the forester is exposed to many dangers on an antagonistic countryside, by agreeing to plant broad-leaved trees only, and mixed woodland, as suggested by the author. Some valuable experience would have been obtained on the subject as to the elevation to which some of these species can be taken, and amenity would have been safeguarded; since the forester who knows his job should have been able to adapt his plantings to harmonize with, and not spoil, a piece of countryside the beauty of which has for long been a household word in Great Britain, even amongst many who have never seen it. It would be an interesting piece of work demanding skill and considerable knowledge; a different type of work, it may be admitted, from the monotonous planting of young conifers on a more or less uniform pattern. The question of the longer period the nation would have to wait for a return in money does not appear to be of so great importance in the Lake District, where other advantages are already being reaped.

The author puts up a strong plea for the preservation of the sheep farming and the Herdwick strain, both of which must disappear with any considerable afforestation in the Lake District owing to the fact that of necessity all the lower ground would be planted up, and thus the sheep disturbance would be complete. The Forestry Commission

planting proposals will involve the displacement of more than 5,000 of this local breed of sheep.

Mr. Symonds also deals categorically with the question of the extra unemployed that the scheme would provide for and the question of small holdings. On both these subjects he displays ample local knowledge, and his remarks on the subject of the prospects before the small holder, especially of one unacquainted with the locality, merit consideration.

Mr. Symonds' little book appears to sum up the present position. To many, the Lake District is a thing apart; and when the total area involved and the comparative small size of the conifer woodlands to be established is taken into account, it would appear that the Forestry Commissioners here have the chance of justifying the useful position they have taken in the country by leaving the beauty spots alone, and planting, where planting must be, with hardwoods.

Insect and Allied Pests of Fruits

The Pests of Fruits and Hops

By Dr. A. M. Massee. (Agricultural and Horticultural Handbooks.) Pp. 294 + 27 plates. (London: Crosby Lockwood and Son, Ltd., 1937.) 15*s*. net.

THE production of profitable fruit crops is dependent upon a variety of factors, some beyond the control of the grower, others being within his control. The factor of pest incidence in an orchard or plantation is one of extreme importance, for while the occurrence of some species—resident pests—are within the plantsman's control, others—migratory pests—are to an extent beyond control, and the presence of the latter group are frequently undetected until irreparable damage is committed.

Great advances in fruit culture have been made during the past twenty years, and an increasing number of scientific investigators are engaged upon the elucidation of problems connected with this important industry. Entomologically speaking, the changes have been great both as regards new and troublesome pests, namely, capsid bugs, fruit tree red spider mite, and tarsonemid mites; the appreciation of virus infection and the part played by insects in their transmission; the measures for controlling pests by the introduction of tar-distillate egg-killing washes, petroleum oils, and *Derris* and *Pyrethrum* preparations; and the evolution of high-powered machinery for the application of insecticidal and fungicidal washes and dusts.

It may appear strange that this much-needed volume is only the third standard work dealing with the pests of fruit which has appeared in forty years. To those, however, who are familiar with Miss Ormerod's "Handbook of Insects Injurious to Orchard and Bush Fruits", published in 1898, and with the monumental work of Prof. Theobald, published in 1909, it is less curious, for these authors produced works which were classics in their particular line.

The present author, while purposely omitting technical descriptions of insects, has attempted to place before fruit-growers and students a simple and brief account of some of the more important insect and allied pests that occur on top and soft fruits and on hops. Simplicity of expression is a matter of degree, and while the specialist may consider the account of the several pests to be simple, the layman may think otherwise.

Technicalities are wisely omitted, but the inclusion of some information relative to the more important orders of insects and allied animals would have allowed the lay reader to appreciate the varied life-cycles, feeding habits, and metamorphoses of the several groups of arthropods mentioned in the text. Again, the inclusion of a simple key, with figures, to the larval stages of insects, would enable the practical man to differentiate between the larvæ of the Endopterygota without seeking for such information in the body of the work.

The volume is well illustrated with more than a hundred photographs taken by Mr. R. M. Greenslade, who is Dr. Massee's colleague at the East Malling Research Station. An author would prefer to have the illustrations placed near the description of the pest, and it is unfortunate that publishers frequently fail to attain this desirable end. One example will suffice, namely Plate iv (facing p. 36) illustrates bark beetles and shot hole borers and the damage committed by them, but these pests are described on pp. 181–183—an unfortunate misplacement.

To illustrate insect species without descriptive matter is of little value either to the specialist or to the fruit-grower, for while the former is taught not to depend on an illustration for purposes of

identification the latter is tempted to make his specimen fit the figure. For example, Plate viii illustrates eight species of tortricid moths, but one fails to find any description of the several species on pp. 60–66.

Careful proof-reading has reduced the number of errors to a negligible quantity, and the inclusion of three indexes—scientific, popular, and author—is of immense value both to those who read and to those who scan a textbook.

The author is not hopeful of the standardization of scientific names of insects. The laws of priority must of necessity be obeyed, and as such the standardizing of generic and specific names will take time. The applied entomologist is not blameless in this respect, for he, too, has the habit of changing names; for example, the coccid, *Lecanium corni* Bouché, though long known as the 'peach scale' following its appellation the 'brown scale', is now termed the 'European fruit scale'!

Of the fifteen chapters, eleven deal with fruit pests arranged under their respective hosts, which are arranged alphabetically, and one chapter (xii) is devoted to a review of the pests of hops. Chapter xiii discusses beneficial and harmless insects, while the penultimate chapter deals with insecticides. The final chapter, entitled "Spraying Equipment and Methods", has been written by Mr. J. Turnbull, the Ministry of Agriculture's specialist on the subject.

A limited number of references conclude the note on each pest described, but the omission of references in the case of Chapter xiv requires to be rectified in a second edition. It is apparent both in the notes on control measures and more especially in the chapter on spraying equipment and methods that the book is written primarily for the fruit-grower rather than for the owner of smaller establishments. This is unfortunate, for the earlier works of Miss Ormerod and Prof. Theobald are examples worthy of assimilation, in that these authors never failed to appreciate the difficulties *both* of the owner of large plantations and of the amateur gardener.

It is strange to read the author's statement (p. 233) that the 'cauliflower' disease of strawberry is probably due to virus infection, for the work of Dr. Margaret Lacey indicates that a bacterial organism is concerned with this malformation.

Notwithstanding these several criticisms, Dr. Massee, who is recognized as the foremost pomological entomologist in Great Britain, has produced a work of outstanding merit which will long remain a classic. It will be welcomed by the fruit-growing community, the biologist, the student, and by all who are interested in fruit culture. The author has not sought to embellish his story with scientific jargon; the simplicity of phrase, though worthy of emulation, is rare; and Dr. Massee shines despite of it, thereby showing his eminence in the field of biology.

G. FOX-WILSON.

Experimental Optics

Introduction to Optics

By Dr. G. B. Deodhar. Pp. xii + 614 + 21 plates. (Allahabad: The Indian Press, Ltd., 1936.)

THE term 'Introduction' applied to a text-book on a branch of physics gives little idea of the standard and scope of the work. Those who are familiar with the customary method of teaching optics will understand what is implied in this case from the fact that the work is based upon the author's lectures delivered to degree students in the University of Allahabad. It is assumed that the reader is familiar with the elementary principles of physics, such as are taught to pupils during their last school year, or to students during the first year at a university. In Great Britain the work would be regarded as suitable for an ordinary degree course in optics but as falling short of the standard required in an honours course.

The author tells us that he is especially concerned in keeping the experimental side of the subject in the foreground and that the treatment is chiefly non-mathematical in character. The first six chapters are devoted to geometrical optics and the remaining thirteen chapters to physical optics. The book is large, consisting of some six hundred pages, and the syllabus of subjects is complete and adequate.

In the treatment of geometrical optics, the author adopts the Abbé sign convention, which chooses oppositely directed axial directions for the location of object and image. He thus falls in with a custom which is becoming more and more widely adopted. His convention with regard to angles is confusing, and is not necessary. He introduces the reader to the 'principal points' in a simple and interesting manner; but he ought to have elaborated the brief explanation of his points in this connexion. He ought also to have given a fuller account of telescopic systems.

Many practical questions on the investigation of lens systems are treated, and this is certain to be helpful to the student reader. In the treatment of interference, diffraction and polarization, the author keeps very closely to the methods of some well-known writers on the subject of physical optics, and makes use of familiar diagrams. He makes some improvement in the presentation of the formula for the resolving power of the microscope, but again errs by being too sparing in the discussion. The last few chapters are concerned with Bohr's theory of spectra, with colour, photometry and the ether experiments.

A work of this kind must be judged to some extent on the basis of the purpose for which it is written, but some general criticisms arise in connexion with it. There are several well-known standard text-books on this subject, and a new one ought not merely to add to their number. It must either introduce new matter or present the old in a novel and better way. The present volume does not justify itself on these grounds; indeed the author accepts the old subjects and methods.

There is also the question as to what the nature of an introduction should be. Is it to introduce the reader to a very wide range of subjects, with the sacrifice of thorough study in the case of most of them, or should it treat a more limited range in which the principles are well illustrated and in which superficiality can be avoided? In this book, with its brief references to subjects not always well moulded into the general plan, the author creates the impression that he is afraid of leaving something out. It would appear that he favours the introduction to a wide range. But at the present time, when all branches of physics are becoming more and more bewildering in detail and extent, students require guidance to those parts of the subject where principles can be soundly grasped. Depth of study is an urgent need, and it is suggested that this book will be improved as an introduction to optics if the author will consider this point in modifying future editions.

Advanced Dynamics

Dynamics

Part 2. By A. S. Ramsey. Pp. xi+344. (Cambridge: At the University Press, 1937.) 15*s*.

THE publication in 1929 of Mr. Ramsey's excellent dynamics for the use of higher divisions in schools and for first-year students at universities has called forth many requests for similar treatment of the more advanced parts of the subject. The present volume has therefore been written as a continuation of the course so well laid out in the earlier book. It amplifies both the dynamics of the particle and of rigid bodies, and extends the discussion to three dimensions sufficiently far to meet the requirements of an honours degree. It also includes the use of generalized co-ordinates, motion under no forces and the motion of tops and gyrostats. The author has had the advantage of drawing freely from the late Dr. Besant's "Treatise on Dynamics" which was a model of conciseness and lucid exposition, and which, although revised by Mr. Ramsey some twenty years ago, is now out of print.

The plan of the book has been skilfully devised so that the inherent difficulties of the subject may be intelligently surmounted by the average student. There are twelve interesting chapters, abundantly illustrated by seventy fully worked-out examples, most of which are taken from recent examination papers. This is done to represent the kind of knowledge which is expected of present-day students, but it is apt to confine the subject-matter within somewhat artificial boundaries, especially if the syllabus to be covered is traditionally academic. This, however, is not the fault of any author who sets out to deal with a specific syllabus, and, whilst the content of the present volume is undoubtedly academic, the treatment is thoroughly fresh and stimulating. Practical topics, such as longitude, gyrostats, gyrostatic compasses, etc., are touched upon, though mainly from a theoretical point of view.

The book closes with an appendix on vectors and their applications, for the author does not wholly approve of the principle of establishing the fundamental equations of dynamics by vectorial methods, which he rightly regards as a modern fashion not designed to become permanent.

There is an abundant supply of examples for the use of the student, and each set is roughly divided into two groups, one of easier problems and the other of a more difficult character. The book will undoubtedly be of great value to all students who are training to become mathematical specialists.

F. G. W. B.

The Ancient Burial-Mounds of England

By L. V. Grinsell. Pp. xiii + 240 + 24 plates. (London: Methuen and Co., Ltd., 1936.) 12*s*. 6*d*. net.

MR. GRINSELL is an enthusiast about his subject; and although he does not profess to be a scientifically trained archæologist, if he fails to inspire the reader with his own enthusiasm, it will not be the fault of his excellent descriptions of the barrows of England. He includes all that the amateur will desire to know of the history of the study of barrows, of their types and chronology, of burial customs, of their folk-lore and of their local names. He describes the methods of study in field-work and by excavation. Finally, he gives a detailed topographical list of these monuments, of which the only criticism to be made is that it is more complete for the south of England than it is for the north. The illustrations are good, though small. Brief bibliographies are given for the benefit of those who wish to carry their studies further.

Handbuch der biologischen Arbeitsmethoden

Herausgegeben von Prof. Dr. Emil Abderhalden. Lief. 460. Abt. V: Methoden zum Studium der Funktionen der einzelnen Organe des tierischen Organismus, Teil 10, Heft 6. Allgemeine und vergleichende Physiologie. Eine Verstärkeranordnung zur Registrierung gehirnelektrischer Spannungen, von Rudolf Ottenthal; Neue kataphoretische Verfahren, von Hugo Theorell; Lichtelektrische Zellen und ihre Anwendung für wissenschaftliche Messungen, von Marie Wreschner. Pp. 1075–1234. (Berlin und Wien: Urban und Schwarzenberg, 1936.) 9 gold marks.

THE first paper describes an amplifier designed to work an oscillograph for recording electrical changes in the intact brain. The arrangement consists of a three-stage resistance capacity amplifier containing two pentode valves followed by a triode. The values of the various condensers and resistances are chosen to give a long time-constant, and the author claims an undistorted amplification of 70,500, constant over a frequency range of 10–500 cycles per second.

An interesting application is described in which two amplifiers are simultaneously led off from the same cranial electrodes, thereby giving two oscillograms on the same photographic paper. One instrument responds normally over the complete frequency range, while the other, by means of large capacity condensers arranged in parallel with the anode resistances of the first two stages, amplifies efficiently only at frequencies of 1–10 cycles per second. From the two simultaneous oscillograms an approximate curve analysis is obtained.

The second paper describes an improved type of kataphoresis apparatus in which it is possible to maintain the solution at a constant *p*H value. Several examples of its application for the investigation of biochemical material are quoted, such as references to work on flavin, Warburg's respiratory co-enzyme, cytochrome *c*, blood serum, and the anti-pernicious anæmia principle of liver.

In a larger type of apparatus suitable for the purification of various substances, the cell has a greater cross-sectional area, and parchment paper diaphragms are employed to separate the intermediate buffer solutions.

The third paper commences with a fairly comprehensive survey of present-day knowledge of photo-electric phenomena, and includes a number of useful references. This section is followed by detailed descriptions of different types of photo-electric cells and their characteristics. The remainder of the paper is devoted to descriptions of numerous applications including microphotometry, spectrophotometry, colorimetry, nephelometry, pyrometry and polarimetry.

Die mathematischen Hilfsmittel des Physikers:

Von Prof. Dr. Erwin Madelung. Unter Mitarbeit von Dr. Karl Boehle und Dr. Siegfried Flügge. (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen, herausgegeben von R. Courant, Band 4.) Dritte vermehrte und verbesserte Auflage. Pp. xiii + 381. (Berlin: Julius Springer, 1936.) 28.80 gold marks.

THIS book falls into two distinct parts: mathematics and physics. The third edition differs from the second (published about twelve years ago) in respect of a more systematic handling of the subjects, the introduction of much new matter, including a chapter on group theory, and a complete rewriting of the chapter on quantum theory. The author's object is to provide for physicists a précis of those parts of mathematics which shall be of direct use, and which could only be otherwise obtained by consulting a large variety of text-books. In the second part of the book the equations of mathematical physics are formulated.

The result is excellent as a piece of clever condensation, but one cannot help feeling that to make any adequate use of matter in such concise form—practically no proofs or illustrations are given—the reader will have to consult the text-book after all. For the mathematician or physicist, however, the work affords admirable and useful summaries in their respective subjects.

Faithful Rebels:

a Study in Jewish Speculative Thought. By Dr. Israel Levine. Pp. viii + 146. (London: The Soncino Press, 1936.) 6*s*. net.

IN this work Dr. Israel Levine, the head of the Philosophy Department, University College, Exeter, discusses the outstanding contributions to philosophy by Jewish thinkers from biblical times down to the present day. In the oldest writings of Hebrew culture as represented by the Book of Job and Ecclesiastes and the works of Philo and Maimonides, little philosophy is to be found, and it is not until the middle of the seventeenth century that Jewish philosophy begins with Spinoza, while in the nineteenth and present centuries Marx represents economic science and Bergson metaphysics. Dr. Levine comes to the conclusion that science and philosophy are not really native to the Hebrew genius, but require for their development the stimulus of alien culture and the raw material of alien contact.

The Natural Philosophy of Paintings

By F. Ian G. Rawlins

IN his inaugural lecture in 1936 as Tait professor of natural philosophy in the University of Edinburgh, Prof. Max Born referred to an essential difference between science and art. Mathematical and physical theories deserve well if they meet the intellectual needs of their period, whereas the creations of great artists are for all time. It might appear from this that mankind is obliged to reckon with continuous change in his scientific concepts, and can hope to find rest unto his soul only in the static nature of art. However this may be, it is no purpose of the present article to insist upon such a distinction, but on the contrary, rather to inquire into the conditions which exist (or may exist) tending to bring the worker in the exact sciences into contact with the world of art and its problems.

One such opening is obvious enough—the task of applied physics and chemistry in assisting the curator in the conservation of paintings, both by a knowledge of materials as such and by devising methods of improving the environment in which objects of supreme value are housed. Progress along these directions is not difficult to trace. There are laboratories specially equipped for such studies at the Fogg Art Museum in the United States, at the Louvre in Paris, the National Museum in Lisbon, and three in London—at the British Museum, the Courtauld Institute (Norman Wilkinson Foundation) and the National Gallery. Much has been learnt at all these places; but it is clear that basic questions relating to the behaviour of paintings in certain circumstances remain unanswered, and that a fair amount of the data so far collected is little more than empirical.

In Great Britain, co-operation with specialist institutions under the Department of Scientific and Industrial Research has proved both interesting and effective. The experiments needed are so many-sided that no one laboratory could expect to cope with more than a fraction of them.

There is another way in which physics and chemistry may help. This is in the prosecution of systematic studies relating to the technique of the old masters: the search for forgeries and their possible establishment are notoriously difficult tasks, but if and when such results are possible, it is not infrequently as a by-product of the careful investigation of painters' methods in general. There is much to be said for the regular use of X-ray analysis to assist the student of art history in his researches, and as a check upon the conclusions which he may reach on stylistic grounds. It is no part of scientific method to attempt to do what only 'an eye for a picture' can, in the end, accomplish; nevertheless, investigators will not refuse objective evidence when it can be forthcoming. Fortunately, favourable cases do arise.

Yet another possibility can be visualized, difficult as it is. In much the same way as physics and philosophy are to some extent conterminous, so a detailed study of art history leads naturally to the necessity of exploring the mind of the artist, and consequently the outlook of his time. Thus art history and psychology tend to share common ground. Doubtless, a large number of pictures were commissioned and executed according to rigid conditions prevailing in the ideas of the period, yet here and there examples appear which seem to indicate that the work in question was brought into being in the subconscious mind of the artist and is thus a document of the deepest significance. It is a far cry to the day when anything of this nature might conceivably be demonstrable experimentally; what is important at the moment is the infiltration of scientific method into the attempt to effect a closer synthesis between our appreciation of works of art as they are, and the mental and cultural background which produced them. A work of art is an organized whole, possessing shape as well as tone; above all, it is no mere accident, and in its fashioning the artist may be presumed to have given of his best. These conditions approximate to the law of *prägnanz* in the psychology of Gestalt. It may be here that, in the last resort, a natural philosophy of paintings may be found.

The immediate problem is the application of scientific principles to paintings in the matter of conservation, restoration, environment and in the systematic study of technique. A major consideration is that of safety. No risks can be entertained for a moment, and therefore much may have to be learnt upon models, or by the artificial reproduction of conditions. The essential characteristic of a painting—mural or panel—is its stratified structure. In order, there are (*a*) the support or carrier, for example, plaster or wood, (*b*) the ground, (*c*) the paint film, (*d*) the surface or varnish film. According to the varying methods of different schools, modifications of this sequence

may arise; but it represents the normal state of affairs, and the one with which the scientific investigator usually has to deal. Clearly, of the four, the paint film is of the greatest interest to the beholder, for it is in fact 'the picture', as generally understood.

From this arrangement the scope of physical and chemical investigations can be gauged. First comes the need for accurate knowledge of the physico-chemical properties of plaster and wood. Secondly, the ground is perhaps composed of 'gesso', a water paint containing lime as its main constituent, and often the seat of an involved system of cracks, which may influence the layer above. Thirdly, the paint film is a most complicated phase, comprising pigment plus binding medium. Fourthly, the varnish film is not an exact chemical entity, and its properties change considerably with time. All these layers react to some extent upon one another, more especially with regard to relative flexibility. Chemical reactions in the paint film sometimes generate fissures akin to geological phenomena on a minute scale.

In general, the paint film may be constructed in a variety of ways. The pigments may be embedded in a previously prepared surface, or they may be powdered with a suitable medium (as in ordinary oil painting), or again they may be applied to a dry surface and afterwards fixed by some kind of spraying.

As in other branches of science, physical methods may be preferable to chemical ones in that no sampling or removal of minute fragments of material is required. When, however, it is necessary to know for certain the composition of a pigment, then it has long been the custom to detach a microscopic amount from some inconspicuous part of a picture (under the rabbet of the frame for example) and to subject it to chemical or spectroscopic analysis. In very favourable cases, observation with a polarizing microscope will give a clue to the nature of a pigment *in situ*, by reference to crystallographic properties, colour and index of refraction. An extremely illuminating method—when conditions allow—is to use a micro-borer, and so to obtain, in the form of a minute cylinder, samples of all the different strata. Microscopical examination of the core, at a magnification of about one hundred diameters, reveals the constituents clearly.

The possibilities of X-ray work are considerable, and at several institutions systematic use is being made of them. The whole process, so far as pictures are concerned, depends for its success upon the particular pigments and technique in question. It is by no means of universal application. Exceedingly thin films of paint, such as those sometimes used by the Venetians, are frequently too transparent to offer any appreciable resistance, except perhaps to the very softest radiation. However, areas containing much lead or mercury, in the neighbourhood of compounds like the lakes, composed of elements of low atomic weight, make excellent subjects, and a wealth of detail is often revealed. Sometimes the experienced eye can perceive the presence of an outline under the visible paint layer: X-ray photographs supply the objective proof. The uses to which such photographs can be put are several. If it is proposed to remove over-paint, the extent of the original picture left can be determined before any action is taken. Again, a previous version of a composition may be discovered or, as has happened lately, the work of two artists can be distinguished.

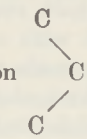
It remains now to discuss some external factors which influence the condition of paintings, and to which it is possible to apply scientific methods. For many years there has been an increasing movement for the abolition of the glasses from pictures in the national collections. From the students' point of view such a course would have everything to recommend it. In practice, however, difficulties are encountered. Experiments have shown that the surface of a canvas, if unglazed, is usually cooler than the air of the gallery, and consequently condensation of moisture sets in, forming a thin wet film over the varnish. Dust and smoke particles settle on this film, and create in time a dull, dirty layer, easily removable in some cases, but by no means in all without risk to the varnish. The cure, theoretically, is a complete air-conditioning and filtering plant. Observations in the National Gallery have demonstrated that for every pound of carbonaceous material per million cubic yards of atmosphere in the immediate neighbourhood of the gallery, 0·7 lb. is present within the building. This is an average figure for the interior as a whole, and seems to represent a fairly constant quantity. In any event, there is a strong argument for air-conditioning in museums and galleries if objects of art are to be seen at their best.

Perhaps the greatest need of all, as indicated already, is a closer understanding between the outlook of the student of art history and that of the scientific investigator. Co-operation for practical ends like conservation and protection there must obviously be. But the ultimate aim is a more intimate fusion of the two ways of thinking, such as would lead to the appreciation of a work of art as an object of the profoundest symbolism. Some of the great masters were intellectuals of a high order, as well as supreme craftsmen. To know them better is to broaden our concept of natural philosophy.

Agricultural Products as Raw Materials for Industry*

TO what extent is agriculture likely in the future to supply the raw materials for industry in addition to food and textiles, her main customers to-day? The answer to this question involves a forecast of both demand and supply: whether the nature of the demands will alter, and whether in meeting them materials or manufacturing methods will change fundamentally. Biochemistry and biotechnology are of great significance for the future of industry, but their value will be judged largely by their power to save expenditure of material and energy. For more than a century, organic chemists have been investigating the atomic structure of the products of organic life, and the new weapons, X-rays and electron diffraction, have been of great service.

Although we still know very little of the mechanism used by Nature in synthesizing these complex substances, it is clear that they are built up on comparatively simple models. Starch, cellulose, hemicellulose, and the pectins appear to be built up from hexose units like glucose, though possibly the primary unit is a triose, like glycerin, containing three carbon atoms, since the units $C_6 - C_3$ and $C_6 - C_3 - C_6$ occur frequently in plant products and the transformation $2C_3 = C_6$ presents no difficulty to Nature. Vegetable oils, fats and waxes are built up of long chains from units of six carbon atoms. Essential oils, resin and rubber are built up from the unit C_5H_8 with a branched carbon skeleton



C — C — C, which may be regarded as their parent substance; and from the same unit the plant can construct the terpenes and diterpenes, which have ring structures. The resins are more complex, containing twenty or more atoms, but of similar type.

Proteins are derived from the union of ammonia with carbon-chain units; amino-acids are formed, and their molecules combine to make long chains, like fibroin, the chief protein constituent of natural silk. Long chains similar to these, but folded into rings, are the structural units of the vegetable proteins found in many seeds and tubers. Many alkaloids also can be regarded as built up in the plant through the medium of amino-acids.

The mode of formation of chlorophyll—the key substance in the living world—is obscure; it presents us with the old problem of the hen and the egg, for chlorophyll is essential for the synthesis of carbohydrates, but carbohydrates are required to make chlorophyll. Many natural flavouring substances, for example, eugenol, are built up upon a $C_6 - C_3$ skeleton, and this group may be doubled to give constituents of many resins, or with the addition of a C_6 group to give the catechins, found in the tannins, and in anthocyanins, the colouring matter of many plants.

Although Nature synthesizes her complex products from simple units with an ease and certainty that tantalizes the chemist, by elucidating their structure, he has succeeded in synthesizing many of them artificially. Nevertheless Nature has proved to be a cheaper producer than the factory, and is likely to remain so. Many so-called synthetic substances, for example, camphor and ionone (the perfume of violets), are made from vegetable products in which the carbon skeleton has already been formed by the plant, and they are thus the result of chemical processing.

Of greater significance from the point of view of displacement of plant products, is the use of cracked oil gas and natural gas in the United States as starting-points for the manufacture of organic chemicals, and also their production from water gas by catalytic processes, and from calcium carbide made in the electric furnace. Here there is direct competition with the products of the fermentation industry and of wood distillation. Synthetic 'rubber' made from cracked oil gas is another example of this competition. On the other hand, the more detailed knowledge of plant products has led to great developments in their extraction and utilization, for example, the process of fat-hardening, the conversion of molasses into alcohol, glycerin, acetone and other solvents, and the production of furfural from cereal wastes for use as a solvent or as a constituent of plastics. Research has also opened up completely new fields, such as the cellulose products and synthetic resins or plastics, in which agricultural materials like casein, glycerin, soya bean are finding fresh outlets. The possibilities of plastics are great; at present they are handicapped by high cost, moulding powder costing £75 to £100 a ton, and the great pressures required for moulding thermoplastics are expensive to apply to large articles.

The present percentage utilization of agricultural produce in the world is, on a value basis, roughly: food 86–88, textiles 9–8, and other industries 5–4, so that the consumption by industry is at most only 12–15 per cent of the total production, and

* Based upon the Mather Lecture given by Sir Harold Hartley to the Textile Institute on June 11.

of this textiles account for about two thirds. On this basis it is estimated that the value of farm, field and forest products used in industry now amounts to about one half that of mineral products, that is, to one third of the whole value of industrial raw materials.

The extent to which agricultural materials may replace minerals and metals will depend on physical properties and cost. Some plastics are suitable for replacing metals; the use of synthetic resins as adhesives, and the improvements in the manufacture of laminated wood already make it a successful rival to metal in many fields, for the new products possess such advantages as absence of fatigue, high ratio of strength to weight, and resistance to corrosion, whilst the defects of wood due to local weakness are eliminated by the laminated structure. Rubber is also supplanting metal in fields where its elasticity, freedom from abrasion, and value in reducing noise are required. Laminated wood is finding many applications in building construction owing to its strength, lightness and low cost; and the substitution of nitrocellulose and synthetic resins for the older natural resins, and that of the new solvents and plasticizers for the older and cruder materials of the forest-produced type, all in the main involve the use of processed agricultural products. The cost of producing fermentation alcohol from molasses, at 2*d*. a gallon, is estimated at 9*d*. a gallon; and from maize at 2*s*. a bushel, at 1*s*. 3*d*. a gallon; but the cost of petrol at the refinery without tax is 3*d*. a gallon; its use to-day as motor fuel is only justifiable on strategic grounds, but when petroleum supplies begin to contract, alcohol will be in a better competitive position. There has been a very great development in the use of new packing materials, made of wood, textiles, cellulose, Cellophane, etc., but mineral oils have been replacing vegetable oils for lubrication, although the total consumption of the latter has not declined.

In the United States, the Farm Chemurgic Council is working strenuously to promote the use of American farm products; and the Department of Agriculture, with its numerous associations, is admirably equipped for research and development work in this connexion; as also in the wider field of finding new crops like soya bean, tung oil and southern pine, to replace products now imported. Success will depend on the co-operation of industry in providing factories for processing the raw materials and the research necessary to find new and cheaper methods of using them. The utilization of farm wastes and by-products is being investigated; already cull citrus fruits in California are being processed for producing citric acid, citrus oils and pectin, but an economic method for using waste farm cellulose for paper, strawboard, insulating material or packing has yet to be found. Within the last decade, the soya bean has become a major crop in the United States. One ton of it yields about 250 lb. of oil and 1,600 lb. of meal. The oil is used in edible products and in making paints, enamels, varnishes, linoleum, soap, glycerin and printing inks. The meal is mainly used in foodstuffs, but a good deal goes to the manufacture of protein glues, paper sizes, washable wall-papers, and protein plastics. Mr. Henry Ford has been one of the pioneers of this new crop. It is estimated that the annual output of a million Ford cars involves the consumption of the following quantities of farm produce: cotton 89 million lb., maize 500,000 bushels, linseed oil 2·4 million lb., molasses 2·5 million gals., wool 3·2 million lb., leather 1·5 million sq. ft., hogs 20,000 (to supply lard for lubricants, oleic acid and bristles for brushes), mohair 350,000 lb., and soya bean oil 2 million lb. (for making enamel).

The discovery of new uses for established crops is well exemplified by research on cotton, which has disclosed the effect of fibre fineness on the strength of cotton yarns. Extensive breeding and selection are showing how to improve this characteristic in American cottons. Strength and durability are needed in cotton used for making bags and bagging, and a fresh outlet here is the development of duplex open and close-mesh fabric bags for packing fruits and vegetables, millions of which have been sold. The use of cotton fabric for reinforcing tarred roads has been investigated, and with seeming success. After the road bed has been levelled and primed with tar, the cotton fabric is laid down and then covered with alternate dressings of asphalt, road metal and chips, which are consolidated with a heavy roller. Strenuous efforts are being made to find new uses for maize. In the Middle West about 7 per cent of the maize crop is processed for industrial purposes, the main products being starch, dextrin, corn syrup, dextrine, corn oil and cake. Finally, sugar or starch derived from second-grade maize or other grain, sugar-beet, and molasses is being converted into industrial solvents.

The energy and skill with which all these investigations are being pursued is beyond praise. The answer to the question posed in the first sentence cannot be definite. The use of carbon compounds is certainly being extended, and perhaps we are approaching a cellulose-plastic age. But the chemist cannot vie with Nature in the cheap production of complex organic molecules: and the future lies in closer association between them. Such a development of the use of agricultural products would be most fortunate in view of the gradual exhaustion of our capital assets, coal and oil.

New Zealand Fish Oils

By F. B. Shorland

ALTHOUGH the fish life of New Zealand waters offers many interesting and unusual features, the study of the fish oils has, until quite recently, been practically neglected. The earlier work included an analysis of sting-ray liver oil by Donovan[1] and more extensive researches on the food values of New Zealand fish initiated by Malcolm in 1920. During the course of these investigations the oil content of the flesh from various fish was examined[2,3] and the fats of red cod (*Physiculus bachus*) in relation to its food were studied. The fat content was less in winter than in summer, indicating a depletion of reserves during the scanty winter feeding[4]. Although tarakihi (*Dactylopagrus macropterus*) flesh was found[5] to contain appreciable amounts of vitamin A, none could be detected either in the ether extract of this flesh or in the ether extracts from the flesh and liver of red cod[6].

Denz and Shorland[7] discovered in 1934 that the larger edible fish of Cook Strait, including ling, English hake and in particular groper and bass, yielded liver oils of much higher vitamin A potency than had generally been recorded in the case of North Sea fish. In contrast with the fish which had hitherto been examined by other investigators, the vitamin A content of ling liver was not found to exhibit any marked seasonal variation[8].

Lately, New Zealand freshwater eels, of which there are two species, *Anguilla aucklandii* and *A. australis*, have received considerable attention. It was found that the body oil (comprising so much as 20 per cent of the total weight of the fish) had a vitamin A potency approaching that of cod liver oil, while the traces of oil in the liver were extremely rich in this vitamin[7,9]. McIntosh and Shorland[9] established a general similarity between the composition of the component fatty acids of *A. aucklandii* and that of typical freshwater fats of the northern hemisphere analysed by Lovern[10], thus confirming the difference between the marine and freshwater types of fat. An examination of the C_{18} unsaturated acids showed the presence of oleic and stearidonic acids. Neither linoleic nor linolenic acid could, however, be detected[9]. Edisbury, Lovern and Morton[11] showed that the ratio of non-liver vitamin A to liver vitamin A of *A. aucklandii* tended to increase with age, while the increased vitamin content of the body oil in the older fish was correlated with the oil content of the tissue.

In many instances, fish oils of high vitamin A potency are also good sources of vitamin D. Cunningham[12] reported vitamin D values of 2,250 and 500 for groper and ling liver oils respectively, as compared with 100 international units per gram for good cod liver oil. Skate (*Raja nasuta*) liver oil and the body oil of freshwater eel gave, respectively, the lower values of 15 and 47.

The deep-sea fishing industry of Cook Strait, which provides the commercial liver oils, is rather

CHARACTERISTICS OF SOME NEW ZEALAND AND OTHER FISH LIVER OILS

	Species	Body weight	Liver weight	% Oil	Iodine value	Saponification value	% Unsap. matter	% Vitamin A ($\frac{E^{1\%}_{1cm}\ 328\ m\mu}{16}$)
New Zealand	Ling (*Genypterus blacodes*)	20 lb.	1 lb. 7 oz.	35	137–153	183–189	2–4	0·6–0·7 (usually)
	English hake (*Merluccius gayi*)	18 lb.	1 lb. 6 oz.	35	132–143	185–187	2–4	0·3–0·8
	Groper (*Polyprion oxygeneios*)	10 lb.	6 oz.	5–10 (usually)	82–122	176–197	3–15	0·5–5·0
	Bass (*Polyprion americanus*)	somewhat heavier than groper	8 oz.	5–10	78–131	175–191	4–16	1·0–4·5
North Sea	Cod* (*Gadus morrhua*)	17 lb.	14 oz.	60–70	140–180	180–190	1	0·01–0·05
	Halibut* (*Hippoglossus vulgaris*)	60 lb.	1 lb.	20	111–171	150–175	8–22	0·2–10 (usually 1–1·5)
	Hake[13] (*Merluccius merluccius*)	—	—	—	149–159	184–186	0·9–1·7	similar to cod liver oil
Chilean	[14] (*Merluccius gayi*)	—	—	—	185	176	2·0	similar to cod liver oil
	Genypterus blacodes and *G. chilensis*[14]	—	—	—	169	188	0·2	somewhat stronger than cod liver oil.

* Typical values from the results of various investigators.

limited on account of the small area of the banks. About 8,000 cwt. of groper and 2,000–4,000 cwt. of ling are caught annually, together with smaller quantities of English hake and bass. In other large centres such as Auckland, smaller fish, including snapper, tarakihi and flounders, predominate, and although some of these yield a small proportion of vitamin-rich oil the livers invariably weigh less than 2 oz.

Cook Strait elasmobranch liver oils are not rich in vitamin A. Skate (*Raja nasuta*) liver oil for example, is less potent than cod liver oil. Oils from individual livers are sometimes exceptionally potent. That from a bass contained 10 per cent vitamin A, while a swordfish from North Auckland yielded a liver oil with some 14 per cent of this vitamin.

An examination of the properties of the liver oils given in the accompanying table for the same or similar species inhabiting different waters suggests that the composition and vitamin A content are sometimes determined more by environment than by biological considerations of species.

Observations on the properties of groper liver oils, which will be published in detail elsewhere, show that the winter oils, especially during July and August, approach the upper limit given in the table as regards vitamin A content, iodine value, and percentage of unsaponifiable matter. During the intensive feeding of October and November, these values approach the lower limit and the livers become softer owing to the infiltration of fat, which in some instances increases the oil content to 20 per cent of the liver weight. The oil from *Sardinia neopilcharda*, a source of food at this time, gave no reaction for vitamin A. Seasonal changes in the properties of groper liver oils thus appear to be associated with alternate intensive feeding and relative starvation. The North Sea halibut affords an interesting contrast with groper in that the potency of the liver oil is lowest in winter but rises to a maximum during the seasonal increase of diatomaceous food in the spring[16]. Winter groper liver oil is exceptional in containing as much as 20 per cent phosphatide. An analysis of the component fatty acids of these oils is being made under the direction of Prof. T. P. Hilditch, of the University of Liverpool. Examination of other fat depots including the roe, head and stomach failed to reveal the presence of vitamin A except in the stomach oil.

Further work on ling liver oil at present in progress substantiates the lack of marked seasonal variation of vitamin A content or in yield of oil as determined by ether extraction. Of the total fat present in the fish, more than 96 per cent is concentrated in the liver, and during spawning less than 0·5 per cent of this fat is transferred to the roe. The ether extract from the ova gave no Carr-Price test, while that from the stomach showed a value of 800. Lack of seasonal variation in the vitamin A content during spawning seems to be explained by the fact that the production of ova requires an insignificant drain on the liver oil. Both cod and halibut appear to derive their vitamin-rich liver oils from food relatively deficient in this vitamin by a process of intensive storage[13,16]. In these circumstances, it is not surprising to find that the livers from the older fish contain a higher concentration of vitamin A[15,17]. In the case of Cook Strait ling, however, the chief food is whiptail[8,18], which is rich in vitamin A (a specimen taken from a ling stomach, for example, yielded an oil giving a Carr-Price value of 75), so that relatively little storage is necessary to produce a vitamin-rich liver. In confirmation of this observation, the larger livers from the older fish have not been found to yield a more potent oil than the smaller livers.

Ling liver oil is distinguished from typical liver oils of the North Sea by the higher content of C_{18} unsaturated acids (35–40 per cent as compared with 27–30 per cent) and the low proportions of palmitoleic acid (7–10 per cent as compared with 15–18 per cent). The ether extract from the roe contains about 56 per cent phosphatide. As in the case of animal fats, the phosphatide fraction is richer in C_{20} and C_{22} highly unsaturated acids than the glyceride fraction. The relative proportions of C_{20} , C_{22} acids in the liver, viscera, roe glyceride and roe phosphatide may be given approximately as 35, 45, 40 and 50 per cent respectively.

I wish to record my sincere appreciation and thanks to the directors of the British Drug Houses, Ltd., London, for generously placing their analytical laboratories at my disposal. Thanks are also due to Mr. T. T. Cocking of that laboratory for valuable advice, to Prof. T. P. Hilditch for his continued interest and to the Department of Scientific and Industrial Research, New Zealand, for a scholarship.

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Obituary Notices

Dr. J. W. Capstick

JOHN WALTON CAPSTICK, who took a prominent part in the work of the Cavendish Laboratory from 1891 to 1898, and in the administration of Trinity College from 1895 until 1910, was born at Lancaster on August 31, 1858, and educated at the 'Friends School' in that town. In 1880 he went to Owens College, Manchester, which was then a part of Victoria University; he won at Owens the senior Dalton mathematical scholarship in 1882 and took first class honours in mathematics at the examination for the B.A. degree at the University of London in 1883. He then took a teaching post in the University of Dundee, saved some money, and entered Trinity College, Cambridge, as a sub-sizar in 1888. He was elected to a sizarship in 1889 and to a scholarship in 1890. He took a first class in Part I of the Natural Sciences Tripos in 1890, and one in Part II, with distinction in both physics and chemistry, in 1891.

In that year, Capstick began original research at the Cavendish Laboratory on the values of the ratio of the specific heats in gaseous compounds of various types. He was a very good experimenter, a skilful manipulator, and very persevering, and was never content until he always got consistent results. These researches, which gave valuable additions to our knowledge, were published in two papers in the *Philosophical Transactions of the Royal Society* for 1894 and 1895. They had much to do with his election to the Coutts Trotter scholarship in 1892 and to a Trinity fellowship in 1893. His next research was on the relation between the 'cathode fall of potential' in compound gases of different types; he was, however, unable to get consistent results; we know now that a mere trace of impurity produces a great effect on the cathode fall, and to remove these traces requires methods of producing high vacua which had not been invented at that time.

In 1895 Capstick was appointed lecturer in natural sciences in Trinity College in succession to Glazebrook, who had been appointed senior bursar; he gave lectures at the laboratory to candidates for the Natural Sciences Tripos, and in 1898 he took over the lectures for medical students which Glazebrook had given for many years. He was appointed to the very arduous post of junior bursar at Trinity College in 1910, and though he still continued to give some lectures at the Laboratory he had no time for research. He was a very successful junior bursar; he liked the work and did it very well.

Capstick had an exceptionally wide range of interests and activities. He took an interest in motoring from its very early stages, and kept in touch with its development. Thus, he was one of the first to drive a motor-tricycle, then he tried a steam car; he must have tried about half a dozen types of cars in his time and was always convinced that the new one was much better than the last. He turned his skill as a driver to good purpose during the Great War; he volunteered for the Red Cross, and for a year drove a motor ambulance for the French Army. He was always anxious to help other people. When at the very beginning of the War the Cloisters in Neviles Court in Trinity College were used for a military hospital, he visited the hospital regularly and often after talking to a patient he would take his photograph and give him copies to send home to his friends. He was an expert photographer, but it required more than photography to think of doing a deed like this.

Capstick had a great love for music, and it was one of the chief interests of his life. For many years he took the leading part in teaching acoustics to the candidates for musical degrees. He was not merely a good lecturer on music but was also a good musician and a good player of that exceedingly difficult instrument the French horn. For years a regular attendant and valued member of the orchestra of the Cambridge University Musical Society.

Capstick's health broke down suddenly about five years ago, and for the rest of his days he had to live the life of an invalid; he died at his house in Cambridge on April 27. His old friends cherish the memory of the help, the kindness and the good companionship they received from him. J. J. T.

Prof. S. Pennington

PROF. SYDNEY PENNINGTON, who died at Newport, Salop, on July 19, was born in 1869 and received his early education at Giggleswick School under the headmastership of the Rev. George Style. After leaving school in 1888 he had four years experience of practical agriculture in Shropshire. The next three years he spent in study at the Royal (Dick) Veterinary College, Edinburgh, and the Royal Veterinary College, London, obtaining the diploma of M.R.C.V.S. in 1895. After this he again returned to farming until 1902, when he decided to enter upon another course of study. Consequently, at an age considerably beyond that at which men now commence their academic career, and with a very thorough knowledge of farming practice, he proceeded to the University of Edinburgh, whence he graduated with the degree of B.Sc. in Agriculture in 1905. His first teaching appointment was as lecturer in veterinary hygiene in the School of Agriculture at Ghizeh in Egypt. In 1908 he returned home, and was in that year appointed lecturer in agriculture at what was then University College, Reading. In recognition of his work he was elected the first professor of agriculture at Reading in 1920. After twenty-five years service to the University of Reading, he retired in 1933, and was accorded the title of emeritus professor.

Pennington will be remembered best as a great teacher by the many agricultural students who passed through his classes. He was himself so full of enthusiasm for his subject that he readily infected others and especially young minds. This was even more marked in his farm classes, where he drew so largely from his personal experiences. He had the secret

of making his students feel they were listening to one who spoke from living contact with a living world. In addition to his teaching duties, Prof. Pennington had charge of the University Farm. When he commenced his work at Reading in 1908 he set himself the task of grading up a herd of dairy shorthorn cattle that would be eligible for registration in Coates' herd book, and at the same time of establishing a herd of cows on the University Farm free from tuberculosis and of good milking type. This he accomplished several years before his retirement, and the herd remains as a record of achievement on the present University Farm. The herd of dairy shorthorns at the National Institute for Research in Dairying was founded largely on cattle of Pennington's breeding.

Though neither an orator nor debater, Prof. Pennington spoke with a sincerity of conviction and a directness of purpose that commanded attention. He loved what was best in literature and art, and gathered together a surprising amount of knowledge and information on many and varied subjects. He was absolutely devoid of pretentiousness or seeking after effect. Pennington carried into everyday life a dignity of thought and conduct that unconsciously raised the tone of those about him.

J. S. L. WALDIE.

Count Robert de Montessus de Ballore

ROBERT FERNAND BERNARD DE MONTESSUS DE BALLORE, whose death occurred towards the end of 1936, was born at Lyons on May 20, 1870. He belonged to one of the oldest families of Burgundy. His mother was a great-granddaughter of Philibert de Commerson, the botanist of the Bougainville expedition, his uncle Ferdinand de Montessus was known as an ornithologist, and his elder brother Fernand was a distinguished seismologist who founded an observatory at Santiago in Chile. For a time Robert de Montessus contemplated a military career, but in his late twenties he made up his mind that such a life was incompatible with a streak of independence in his character, and he began to study mathematics at the Sorbonne. In 1903, while still preparing a dissertation for his doctorate, he was invited to Lille by his friend Robert d'Adhémar, himself a distinguished mathematician, and there he was appointed professor of general mathematics in the Faculty of Science.

Robert de Montessus worked in many fields. Algebra owes to him a fundamental simplification in the use of Sturm's theorem, based on the method of successive approximations; his process is one for evaluating, to an arbitrary degree of accuracy, the real roots of numerical equations, transcendental as well as algebraic. The theory of elliptic functions attracted his attention, and he was stimulated by Halphen's pioneering work to obtain beautiful theorems on the representation, the singularities, and the classification, of algebraic skew curves; he studied carefully the twisted quartic of the first kind, that is, the curve of intersection of two quadrics, showing in detail as Halphen had shown in general terms that the current co-ordinates on this curve are expressible as elliptic functions of a single parameter.

In an important memoir on algebraic continued fractions, which was crowned by the Academy of Sciences, de Montessus presented a body of results constituting great advances in this difficult theory. Starting from a certain fraction which is convergent throughout the whole plane, except possibly on the rectilinear segment joining two points if the function represented by the fraction has two singularities, he deduced that analytic continuation by means of a continued fraction is not impeded by poles, or by algebraic or logarithmic singularities.

In his later years, de Montessus devoted much attention to the theory of probability, which he proposed to found on Bernoulli's theorem, regarded as an experimental fact. He tried also to find a satisfactory theory of correlation which should be applicable when the number of observations is small, and he developed some ingenious ideas on weighted probabilities.

About twenty years ago, de Montessus undertook the publication of the "Index Generalis", an annual reference work now well known throughout the scientific world and of inestimable value to every investigator. It is hard to conjecture the number of practical difficulties which de Montessus had to overcome in organizing this immense mass of data on the universities and learned societies of the world; the scientific qualities of which he had given evidence elsewhere came to his aid here.

In 1931, during a mission to Central Europe on behalf of the French Government, de Montessus gave courses of lectures on various branches of mathematics in Warsaw, Cracow, Lwow, Budapest, Vienna and other universities.

Robert de Montessus, has left the memory of a modest and conscientious scholar, an upright man, and a firm friend.

HENRI VILLAT.

WE are indebted to Mr. E. Mather for the information that the early training of his father, Prof. Mather, was that of an engineer, not that of a carpenter as stated in the obituary notice in NATURE of July 17. Prof. Mather came from a family of engineers. We also learn that, during the Great War, Prof. Mather devoted much time to the invention and development of a device for giving warning of the approach of enemy aircraft.

WE regret to announce the following deaths:

Prof. P. E. Brown, head of the Department of Agronomy in the Iowa State College, known for his work in soil science, on July 8, aged fifty-one years.

Lieut.-Colonel E. G. Ffrench, known for his researches in tropical medicine, especially dermatology, on July 25.

Prof. D. M. Lewis, emeritus professor of physics in the University College of Wales, Aberystwyth, on July 28, aged eighty-five years.

Prof. J. Wilhelm Michaelsen, head of the Department of Natural History in the Hamburg Museum an authority on the Oligochæta, on February 18, aged seventy-six years.

News and Views

Prof. R. A. Sampson, F.R.S.

THE retirement of Prof. R. A. Sampson from the position of Astronomer Royal for Scotland has been recently announced, and will shortly take effect. He has held this office, which is associated with the professorship of astronomy in the University of Edinburgh, since 1910 when he succeeded Sir Frank Dyson on the appointment of the latter as Astronomer Royal at Greenwich. Prof. Sampson's career has been long, varied and distinguished. His earlier years were spent in posts mainly mathematical, and it was only comparatively late in life that he was able to devote all his time, during the twenty-seven years at Edinburgh, to the pursuit of astronomy. But much of his astronomical work had already been done in the earlier period. Happily, this is not the occasion —may it be long distant—when it is necessary to give biographical details or to assess the value of scientific achievements. But it is interesting to recall that Prof. Sampson was the first product of the Isaac Newton studentships (1891–3), then lately founded by Mr. F. McClean, for he gained this prize a year after his election to a fellowship at St. John's College, Cambridge, where his mathematical career had been eminently successful. Between 1893 and 1910 he held a mathematical professorship first at the Durham College of Science, Newcastle-upon-Tyne, and after 1896 at the University of Durham, where (after 1908) he was also professor of astronomy.

PROF. SAMPSON'S first work on a large scale was the editing of the astronomical papers of J. C. Adams, which demanded critical qualities of no common kind. But the work with which Sampson's name will always be associated is that on the four great satellites of Jupiter. This fell into three main phases, all involving immense labour. The first was the reduction of the photometric observations of eclipses of the satellites made at Harvard, the second was the subsequent production of "Tables of Jupiter's Four Great Satellites". These were carried out at Durham. The third phase was a memoir (1921) containing the theory of the four great satellites of Jupiter. The whole of this work constitutes a monument of industry and power. Much else of Prof. Sampson's work in the domain of optics, solar physics, time-keeping and other subjects are of value, but need no more than mention here. The recent history of the Edinburgh Observatory, with the provision of a 36-in. reflector, is too familiar to call for description. Born in 1866, Prof. Sampson has seen the revolutionary change which has influenced the development of the science to which his life's work has been devoted. A sincere hope may be expressed that he will for many years to come have the happiness of seeing the progress of astronomy continue in the manner he has himself so clearly appreciated. (See also p. 229.)

Prof. J. H. Burn

PROF. J. H. BURN has been appointed to the chair of pharmacology in the University of Oxford. At Cambridge, Burn was president of the Union. After serving as a temporary lieutenant in the Royal Engineers he obtained his M.B. degree in 1920, and joined the staff of the National Institute for Medical Research under Sir Henry Dale. In 1925, he was appointed director of the Pharmacological Department of the College of the Pharmaceutical Society of Great Britain. Later he became Dean of the College, and was given the title of professor of pharmacology in the University of London. During the last twelve years he has been responsible for thousands of pharmacological tests carried out on behalf of manufacturing firms. This work has given him an unrivalled experience of the fundamental scientific work upon which a great industry depends. Through his own work, and that of his colleagues, he has devised new tests and improved old ones for a large number of hormones, vitamins, synthetic chemotherapeutic agents, and plant extracts. Besides all this, he has found time to do fundamental pharmacological work, particularly on vasoconstrictor and vasodilator nerves, and to write several books. He has built up a department which is not only famous for its contributions to knowledge, but has also had a direct effect in raising the standard of pharmaceutical products in Great Britain. With the appointment of Prof. Burn, Oxford should look forward to a period of great activity in her Department of Pharmacology.

Dr. H. S. Harrison

IN October next, Dr. H. S. Harrison will retire from the staff of the Horniman Museum, Forest Hill, London, S.E., after thirty-three years service. Dr. Harrison was appointed curator in succession to R. Quick in 1904, not long after the Museum had been transferred to the London County Council by the late Mr. E. J. Horniman. Dr. Harrison re-organized and extended the collections, and the Museum became, and continued to be, under his direction an important centre for lectures on subjects illustrated in the collections, more especially in connexion with the County Council's scheme of lectures for the teachers of the London schools. The value of the collections for the general public was much enhanced by the series of small popular guides written by Dr. Harrison, more especially those on technology, of which "From Stone to Steel" is now in its third edition. Dr. Harrison was formerly honorary secretary of the Royal Anthropological Institute, edited its *Journal* for some years after he relinquished that office, and was president of the Institute in 1935–37. In 1930 he presided over the Anthropological Section at the Bristol meeting of the British Association, when his presidential address, which dealt with the diffusion

of culture, aroused no little interest both in Great Britain and, more especially, in the United States by his well-balanced handling of the subject. Dr. Harrison will be succeeded at the Horniman Museum by Dr. L. W. G. Malcolm, who since 1935 had been a member of the inspectorate of the London County Council, and has been engaged in organizing arrangements for the further utilization of the resources of the museum collections of London by the pupils of London schools as part of the educational curriculum. Dr. Malcolm, on coming to England from Australia, was trained as an anthropologist at Cambridge by Dr. Haddon and in Germany. He was formerly curator of the ethnographical collections in the Bristol Municipal Museum and later conservator of the Wellcome Historical Medical Museum.

British Pharmaceutical Conference at Liverpool

THE seventy-fourth British Pharmaceutical Conference was held on July 26–30 at Liverpool, this being the fourth occasion upon which Liverpool has given hospitality to the Conference. Mr. T. E. Lescher delivered his presidential address entitled "Pharmacy Today—Its Responsibilities" the main theme of which was the contrast between the important contribution made by pharmaceutical research to the national well-being and the lack of official recognition of this service. Many painstaking chemical, pharmaceutical and biological investigations, said Mr. Lescher, have resulted in placing the treatment of disease increasingly on a scientific basis by the discovery of specific remedies which remove the cause of disease rather than alleviate its symptoms and, of almost equal importance, have, where necessary, enabled these remedies to be taken in a form which does not cause the patient to rebel against them. In view of such achievements, it is surprising that the pharmacist has not received the recognition which his work and responsibilities deserve and which his Continental confrère enjoys. The present system of allowing anyone to handle the majority of drugs and medicines on payment of a five-shilling licence annually encourages the exploitation of the public by the distribution of 'cure-alls' without the slightest guarantee of any knowledge of their properties on the part of the vendor. The official attitude in its latest form is seen in the report of the Select Committee on Medicine Stamp Duties, which recommends what is in effect a sales tax on medicines if claimed to be beneficial to health. It is almost unbelievable that a body of public men should suggest that the State is justified in taxing medical substances used in ill-health.

Julaber's Grave, Kent

THE mound or barrow known as Julaber's Grave or Jullieberrie, at Chilham, near Canterbury, has long been an object of interest to archæologists and others, mainly perhaps on account of the lack of precise evidence of its character and age. It is thought to be neolithic, dating from about 2000 B.C. Its excavation has been undertaken by Mr. R. F. Jessup, the author of the volume on Kent in the County Archæology series, on behalf of Sir Edmund Davis of Chilham Castle. The barrow is 144 ft. long, by 45 ft. wide. In the initial operations, which were carried out last year, the course was traced of the ditch running round the mound, from which its material was taken. In the investigations of the present season, a longitudinal section has been cut, following the ditch, which has revealed the construction of the barrow above the original chalk surface. This shows a darker section where the original turves form a core and a loose rubble of chalk from the ditch. A particularly interesting find is recorded (*The Times*, July 31). This is a large circular burial in the side of the mound, probably of Roman date. It shows the cutting through the neolithic layer and the careful replacement of the mixed soil. This is held to support the view that the barrow is the burial place of Laberius Durus, one of Cæsar's generals of the second invasion, of whose name, "Julaber" is thought to be a local corruption. Another interesting find is that of three skeletons at the edge of the ditch at the south end of the mound, three feet below the surface. These have been ascribed to Romans of the third century of our era. They are the remains of a large, well-developed man, a child and a girl. The child's bones were extremely fragile and disintegrated at once, but the small drinking vessel, a platter of rough coarse black ware, and the fibula, which had held the shroud together, were recovered. The girl's remains were fairly well preserved, but those of the man were in an excellent state of preservation.

Angmering Roman Villa

AN appeal is issued for funds for the excavation of the extensive Roman villa site near the old village of Angmering, Sussex. The site is situated in the flat meadows which lie between the downs and the sea, beside a Roman road, still to be traced with probability as a farm track between Lyminster and Poling, and as the footpath from Poling to Angmering across the Black Ditch. The site first attracted the attention of archæologists in 1819, when a Roman bath was discovered, with hypocaust, sudarium and sewers. This bath was rediscovered at the beginning of the present year, and the whole bath building is now being uncovered by Mr. R. C. Sherrif and the Littlehampton Archæological Society, with the co-operation of the Sussex Archæological Society, under the direction of Miss Leslie Scott with Dr. R. E. Mortimer Wheeler acting as advisory director. The bath building comprises a dozen or more rooms, some with hypocausts, grouped around a cold-water tank. The building appears to stand by itself, surrounded by a beaten chalk causeway, flanked on the west side by a ditch. It was built in the latter part of the first century, and is interesting both on account of its early date and for the richness of its internal decoration. Beside the usual painted wall plaster and window glass, common on such sites, there is evidence that some walls were faced with slabs of different coloured stones. The bath building was destroyed in the middle of the second century ;

but whether it was rebuilt can only be decided by excavation. The villa appears to lie to the west. With so rich a bath house, it should be a fine example of an early Romano-British country house. The cost of the complete excavation will be £500, of which £150 is required to finish the present season's work. The appeal is issued by a Committee of which Mr. E. W. Hulme is the chairman and Mr. E. J. F. Hearne the hon. secretary. Donations should be addressed to Mr. D. Crawford, Hon. Treasurer, Angmering Roman Villa Excavation Fund, Barclay's Bank, Littlehampton, Sussex.

Roman Leicester

EXCAVATIONS, which have now been resumed on the Jewry Wall site at Leicester, have brought to light a remarkable example of the Roman bath, where the Roman forum and basilica were discovered by previous excavations (*The Times*, July 31). The bath is situated in the middle of the open space in the centre of the forum. It is probable that this bath was the largest built in Britain by the Romans. It is on an enormous scale, and comparable to the Imperial baths at Rome. It has one suite for men and one for women, with hot, cold and warm rooms. Miss Kathleen Kenyon, who is again in charge of the excavation, is of the opinion that it was built at the beginning of the fourth century B.C. about two hundred years after the erection of the forum.

Mass-Observation

AT a meeting of the Engineers' Study Group on Economics on July 23, Mr. Charles Madge, joint organizer of "Mass-Observation" (6 Grotes Buildings, Blackheath, London, S.E.3), gave a preliminary account of some of the results already obtained. "Mass-Observation" was begun at the end of 1936 to find out more about everybody's everyday normal life and habits. There are now voluntary observers at work all over the world, and special surveys have been made of the life of the community on certain days. It was found that observers' references to people fall mainly into three categories: (*a*) people one knows or one has met already; (*b*) strangers—people one meets in the street, or for the first time; (*c*) celebrities, one hears of, or reads about in the newspapers. Most reports dealt with the unusual happenings of the day, and the observers had, generally, to be reminded not to overlook the routine happenings. Mr. Madge pointed out that the movement uses both trained and untrained observers, and he stressed the great value of having so many observers who have voluntarily offered to supply information of their immediate surroundings. Although many of them are untrained for this special work, nevertheless, much material of value is being gathered. The chairman (Mr. Alexander Farquharson, secretary of the Institute of Sociology) remarked on the useful relationship that the work carried out by "Mass-Observation" had to that of the sociologist, in supplying raw material not always easily obtainable.

Utilization of Leisure

AT a subsequent meeting of the Engineers' Study Group on July 30, Mr. M. M. Bruce, secretary of the London Council of Social Service (7 Bayley Street, W.C.2) outlined the results of a survey undertaken in co-operation with other bodies (L.C.C. Education Department, Y.M.C.A., Young Communist League, trade unions, co-operative societies, Workers Educational Association) to determine how young people between the ages of fourteen and twenty-five years spend their leisure. Some 5,000 answers—an admittedly insufficient sample—were received, which gave an indication of the wide variety of interests. The largest proportion of predilections expressed for any one type of recreation goes, with young men to outdoor sports (11 per cent) and with girls to dancing (30 per cent). The influence of the cinema was very evident in the choice of girls' fashions and hair-dressing styles. A tendency away from organized sports (football, etc.) towards the more individual type (rambles) was also noticeable. The investigation is being continued by a smaller committee, which is looking further into these particular aspects. The survey acquires a particular significance in view of the fact that the Government will, in the autumn, begin a campaign to improve both the physical and the mental abilities of the people of Great Britain.

Annual Report of the Astronomer Royal for Scotland

THE forty-seventh annual report of the Astronomer Royal for Scotland records the work done at the Royal Observatory, Edinburgh, for the year ending March 31, 1937. The daily time service for the city of Edinburgh was maintained without change. The transit circle was used exclusively to determine time. An apparatus installed during the year by H.M. Office of Works enables the mains supply to be used as the electrical power maintaining the winding of the clocks. Provision is made automatically for a temporary breakdown in the mains supply, by means of a secondary battery which is kept fully charged by a trickle from the mains. The 6-inch photo-visual refractor has been fitted with a synchronous drive. The solar spectroscope is being used to obtain spectra of the east and west limbs of the sun's disk to determine the solar rotation from the measured Doppler effect. The seismograph provides daily records which are available to other workers in this field. Observations with the 36-inch reflector were interrupted in order to have the great mirror aluminized by a reputable firm. Unfortunately the aluminium coating was not a success, and the mirror was then resilvered at the Observatory. A number of plates were taken with the 10-inch triplet as part of a programme for a search for variable stars near the Selected Areas centred around declination + 75° and + 60°, the plates being examined with a blink comparator. Among the meteorological observations, it may be noted that the maximum shade temperature was 75° F. on August 28 and the minimum of 24° F. on December 7 and February 11. The deep rock thermometers at a depth of 250 inches on Calton Hill gave a minimum temperature on June 8 of 46·3°

and a maximum of 48·3° on December 14, thus showing, as usual, a greatly reduced annual amplitude and almost a complete reversal of seasons at this depth. (See also p. 227.)

The Treub Foundation of Buitenzorg, Java

DR. K. W. DAMMERMAN, director of the Botanic Gardens, Buitenzorg, has sent us a copy of the first report of the Treub Foundation (Treub-Stichting), which was established at the end of last year for the administration and application of the Treub Fund collected in Netherlands India. When, in 1933, the Government of Netherlands India had, for reasons of economy, to make substantial reductions in the grants to the biological establishments at Buitenzorg, a committee was formed to collect donations for this Fund; and the Government gave permission for any sums received from the sale of surplus plants to be added to the Fund. The Treub Foundation has now been legally constituted to take over and administer this Fund.

THE object of the Foundation is to co-operate in maintaining, and, if possible, in extending the scope of, the scientific institutions united under the name of the 'Government Botanic Gardens', namely, the Botanic Gardens at Buitenzorg and Tjibodas, the Treub Laboratory, the Herbarium, and the Zoological Museum and Laboratory at Buitenzorg, and the Marine Investigation Laboratory at Batavia. The Foundation distinguishes donors, patrons, subscribers and corresponding members. Donors are corporations which contribute one sum of at least Fl. 1,000 and persons who contribute one sum of at least Fl. 500; and patrons those who contribute one sum of at least Fl. 100; subscribers contribute at least Fl. 10 annually. Persons who, because of their interest in the Government Botanic Gardens or in scientific research in the Dutch East Indies, are appointed corresponding members will not be obliged to pay any subscription, but, in their own countries, will look after the interests of the Buitenzorg Institutions in co-operation and in concert with the Foundation. The chairman of the Foundation is Mr. J. H. B. Kuneman, member of the Council of Netherlands India; the secretary is the director of the Government Botanic Gardens, and the treasurer, the president-director of the Java Bank. The capital of the Foundation amounted to about Fl. 20,000 on December 31, 1936. Sir Arthur Hill, director of the Royal Botanic Gardens, Kew, has accepted an invitation to act as a corresponding member of the Foundation in Great Britain, and Dr. David Fairchild, Prof. Elmer D. Merrill and Dr. Thomas Barbour have been appointed corresponding members in the United States.

Phenology of 1936

THE Phenological Report for 1936, recently issued by the Royal Meteorological Society, contains the usual mass of statistics, maps, graphs, etc. of the relations between fauna, flora and the weather. It is the forty-sixth report, compiled mainly by Ivan D. Margary, from 477 reporters. The year was remarkable for its sunlessness generally, for wetness in England and Wales, and a cool winter, so that plants generally flowered late—all in the Midlands, nearly all England, south-east, south-west, and south Ireland, but were earlier in Scotland, especially the west. Insects nearly all appeared late in England, and save for Scotland, spring migrants were generally late because of the cool April; the autumn migrants were mostly early in moving. As in 1934, the lesser celandine was very late, but by early April vegetation had made up the lost ground; late frosts damaged potatoes, beans and most tender growths; fungi were scarce after August, although flowers were especially fine in the dry, sunny late summer and autumn; trees often remained green late, and wind, more often than frost, caused the leaf-fall. A considerable amount of second flowering was noted in autumn on elder, laburnum, dog-rose and apple. Wild fruits did not do so well as cultivated ones, where bumper crops of apples, plums and raspberries were obtained. Garden crops did good, cereals bad, and hay was ruined by rain. After a record early wave of migrants in March, the long April frost caused a marked hold-up until the sunny third week. Bird song was less in the May drought and cold early June; redwings and fieldfares were scarce in the mild winter. An increase in red squirrels was noted in south-west England; but grey squirrels hold their own in the south-east.

An Extra Receiver for the Telephone

BEFORE the introduction of the modern form of hand micro-telephone instrument and before thermionic amplifiers were introduced on trunk telephone lines, the extra receiver was considered a useful means of improving reception. In modern times the popularity of this receiver has greatly declined. At first sight it would look as if when listening with both ears to a long distance call or when in a noisy room it would be a great improvement; but this is rarely the case owing to what is called side-tone, that is, the reproduction by the receiver of room-noise falling on the microphone at the same station. It is far more difficult to sort out the wanted from the unwanted sounds when both are entering both ears, than when one ear alone is used. In the Engineering Supplement to the *Siemens Magazine* of April a new type of the extra receiver is described. It is pointed out that in certain circumstances it is very useful to have an additional receiver. It enables a third person to listen to the conversation and, if necessary, make notes. As this facility is only required occasionally, and if this receiver were always left in circuit it would permanently 'degrade' the hearing, a switch actuated only when the 'watch' receiver is pressed against the ear is introduced in the circuit. Incidentally, this receiver enables the user to know when he is using sufficient pressure. It is not sufficiently recognized that in everyday use, pressing the telephone too lightly against the ear distorts sounds communicated. In the new table pattern 'neophone' telephone, the extra watch receiver is hung up by a hook. When lifted off and pressed against the user's ear, it is immediately available.

Hebrew University of Jerusalem

THE Hebrew University of Jerusalem, now entering on its thirteenth year, is making a special appeal to the Anglo-Jewish community for increased financial support. A pamphlet issued by its "Friends" (199 Piccadilly, London) gives some account of the University's growth and present status. In grounds covering sixty acres on Mount Scopus, its buildings already include institutes of chemistry, physics, mathematics and meteorology, a library containing more than 300,000 books and an open-air theatre. A hospital and graduates' medical school and nurses' home are under construction, and plans have been prepared for a building for Jewish studies and the humanities. A department of radiology and experimental pathology, at present housed in the Straus Health Centre in Jerusalem, is engaged in cancer research, financed by a special endowment of £40,000. In a letter, reproduced in the pamphlet, signed by Lord Rutherford, Prof. Albert Einstein, Sir F. Gowland Hopkins, Sir William Bragg and others, it is pointed out that the University is the only one throughout the Near and Middle East in which scientific and scholarly research is a principal activity, and that some of the widely recognized work of its scientific institutes has been of immediate value to the whole population of Palestine. The director of its department of parasitology, engaged in the study of Mediterranean diseases, was chosen by the Royal Society to carry out investigations. Its department of hygiene and bacteriology maintains a malaria research station and has received subventions for its work from the Health Organization of the League of Nations and the Government of Palestine. Jews in the United States contribute nearly half towards the annual budget of £80,000. Apart from endowments for two chairs and several scholarships, the Jewish community in England has hitherto borne an insignificant part.

Universities of Poland

POLAND'S universities are described in a bulletin recently published by the United States Government Printing Office, Washington (pp. 160. 25 cents). It is one of a series of studies undertaken at the request of the American Association of Collegiate Registrars by the Comparative Education Branch of the United States Office of Education. The institutions of higher education in existence in November 1918 within the boundaries of the new State then constituted reflected the influences, German, Austrian and Russian, of the Governments in whose territory they had been located, but have since been brought, along with a larger number of new institutions, into an organized scheme of training on university levels, all under the strict control of the Ministry of Public Instruction. The total number of regular students is 56,000, being one to 589 of the total population, a high proportion in comparison with those obtaining in other countries. The pressure for admission to many of the institutions such as the polytechnics, academy of mines and the medical schools of the universities, is so great that selection is made by competitive examination from among the qualified candidates. In the small Free Polish University of Warsaw has lately been instituted an ingenious scheme under the name "Universitas Rediviva" for equipping aspirants to a liberal culture with a knowledge of things in general. The name refers to the medieval ideal of a university.

Science in Australia and New Zealand

THE Australian and New Zealand Association for the Advancement of Science is taking steps to give effect to the resolutions passed at the Auckland Meeting last January amending the constitution and by-laws relating to membership. Hitherto, ordinary members have paid a subscription of one guinea for each biennial session of Association ; but it has been decided now to institute annual membership (one guinea per annum) and an elected fellowship (two guineas per annum). The fellows resident in Australia will constitute a committee to be known as the Australian National Research Council, which will have at its disposal for research and other purposes a sum not exceeding one half of the subscriptions of fellows and annual members resident in the Commonwealth. The Council will take over all the assets and responsibilities of the existing body of the same name which was brought into being early in the post-War period as the Australian member of the International Research Council. It is anticipated that one of its activities will be the institution of a periodical for the encouragement and dissemination of scientific knowledge among members of the general public.

The Brisbane Seismological Station

AN important and very welcome addition has recently been made to the chain of Australian seismological stations at Sydney, Melbourne, Adelaide and Perth. As an aid to the study of earthquakes in the south-west Pacific region, a station farther to the north was greatly needed. Interest in the foundation of one in Queensland was aroused by the occurrence of a tremor at Gayndah in April 1935, and a former student in the University of Brisbane offered to provide a Milne-Shaw seismograph. Later, the Council for Scientific and Industrial Research added a second instrument, so that both north-south and east-west components can now be recorded. According to an account given in the *Courier-Mail* (Brisbane) of June 2, the instruments are installed in the basement of the University's new library block. They were placed temporarily on their foundations about midday on May 31, and at 3.30 the next morning recorded an earthquake with its origin about 1,450 miles from Brisbane. The new station has been placed under the direction of Dr. W. H. Bryan, lecturer in geology in the University.

The American Chemical Society

THE ninety-fourth meeting of the American Chemical Society will be held in Rochester, New York, on September 6–10, under the chairmanship of Mr. M. H. Eisenhart, president of the Bausch and Lomb Optical Co. Seventeen professional divisions of the Society and the Microchemical Section will

hold sessions. Dr. E. R. Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh, will deliver the annual presidential address of the Society on September 7. At the twenty-three symposia, the following subjects will be discussed: developments affecting industry, nutrition, public health, pure science, and education; artificial radioactivity and its chemical uses, studies of the chemistry of the earth's crust, low temperature methods and research, chemical microscopy, quantitative spectroscopic analysis, and photography; chemistry and physics of electrical insulation; medicinal patents, vitamins, and the chemistry and metabolism of fats; cellulose derivatives; organic plastics; 'unit processes' and 'automatic control'; characteristic properties and chemical utilization of hydrocarbons; 'gaseous combustion'; investigations dealing with sugar, rubber, water, sewage, and sanitation, microchemistry, organic chemistry, fertilizers, and colloids.

The Selborne By-Pass

THE Selborne Society, which for fifty-two years has cherished the memory of Gilbert White, invites admirers of his life and work to make a copy of the following protest and send it signed to the Secretary of the Selborne Society, The Hermitage, Hanwell, London, W.7, so that it may be forwarded to the proper authority with the Society's own,: "Understanding that powers are to be sought to drive a road, in the future, through the grounds of The Wakes at Selborne between the house and the Hanger which Gilbert White loved so well, I wish to protest against what would be an offence to the memory of a very great Englishman who made his village famous throughout the world and to urge that an alternative scheme, if necessary, be adopted.

Indian Institute of Science, Bangalore.

IT is reported in *The Statesman* (India) of July 21, that, at a meeting of the Governing Council of the Indian Institute of Science, Bangalore, held on the previous day, Sir C. V. Raman accepted the appointment of professor of physics at the Institute at a monthly salary of 2,500 rupees (£187). The Council has appointed an interim director on a monthly salary of 1,000 rupees for one year, in addition to a registrar on 1,250 rupees. Rao Bahadur B. Venkatesachar, a member of the Council, has taken over charge of the directorship from Sir C. V. Raman and the latter has thus been relieved of all administrative duties, including the secretaryship of the Governing Council. The registrar is Mr. C. E. W. Jones, formerly director of public instruction, Central Provinces, who took up his new duties on July 31. (See also NATURE of June 26, p. 1102.)

'Vaseline' Products

THE manager of the Chesebrough Manufacturing Co., Victoria Road, Willesden, London, N.W.10, writes to point out that the word 'vaseline' is wrongly used in a letter by Mr. L. Bellingham in NATURE of July 10, and in the summary of the letter. The word is not a common designation, but "is the trade mark or brand name used to distinguish the particular products marketed by this Company". The manager asks that the word 'vaseline' should not be used "unless in conjunction with and as the brand name applied to one of our products, such as 'Vaseline' Petroleum Jelly".

A History of Chemistry

AN interesting handbook issued by the Science Museum, London, S.W.7, entitled "Chemistry, a Brief Outline of its History and Development", by A. Barclay, gives an account of the history of chemistry, and is well illustrated, in some cases with representations of historical apparatus in the Museum. Apparatus used by Davy, Faraday, Graham, etc., is included. There are a good index and a bibliography. The subject is dealt with from the earliest period to modern times, the last section being on atomic structure. The handbook forms a useful and interesting supplement to text-books on chemistry. The price is 1*s.* 6*d.*, post paid 1*s.* 8*d.*, from the Museum or the sales offices of H.M. Stationery Office.

Announcements

THE Baly Medal for 1937 of the Royal College of Physicians has been awarded to Prof. E. L. Kennaway, professor of experimental pathology in the University of London and director of the Research Institute of the Cancer Hospital (Free), London. The award is made in recognition of Prof. Kennaway's biochemical investigations, which have led to the identification of a group of substances provoking malignant growth of tissues and having significant relations in structure to certain hormones and vitamins.

THE Warren Research Fund Committee of the Royal Society has appointed G. S. Hartley, of University College, London, and J. T. Randall, of the General Electric Co., Ltd., to Warren research fellowships, each to be held for four years in the first instance. Mr. Hartley proposes to carry out research on oil drops, films and solutions, and Mr. Randall will undertake a research on the mechanism of fluorescence in pure and impure solids.

THE Ministry of Health has approved the application of the Birmingham Corporation for sanction to a loan of £8,505 for the provision of a forensic science laboratory for the detection of crime.

THE publishers of NATURE have in stock a certain number of bound volumes for which space can no longer be found. The volumes extend from vol. 1 to vol. 91, with the exception of the following: vols. 3, 8, 15, 17, 19, 22, 23, 24, 25, 51, 53, 74, 76, 77, 79, 80, 83, 84, 85, 86. Librarians and others wishing to complete their sets of NATURE can be supplied with any of the volumes in stock, so long as the stock lasts, at the price of 2*s.* 6*d.* per volume, carriage paid. Application, with remittance, should be addressed to NATURE Office, St. Martin's Street, London, W.C.2. Volumes which are not applied for by the end of this year will be destroyed.

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. 242.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Differences in the Chromogenic Properties of Freshwater and Marine Fish Liver Oils

WHEN vitamin A concentrates from marine fish livers are treated with antimony trichloride the blue solution normally exhibits an absorption maximum near 620 mμ with a subsidiary masked maximum near 583 mμ (displaced to 606 mμ and 572 mμ respectively in oils of low potency). In exceptional cases, however, additional maxima at 635, 645, 656, 680 and 690–695 mμ have been recorded[1]. The '693 chromogen' appears to be the most important of these extra chromogenic substances and follows the vitamin A during concentration into the richest fractions. When this chromogen has been recorded previously, in halibut oils, the intensity has usually been about one tenth of that due to the 620 chromogen[2]. Recently, however, liver oils from certain Russian freshwater fish have been reported that gave antimony trichloride solutions exhibiting clear maxima at 645 or 690 mμ and only a weak band near 620 mμ[3].

We have since examined liver oils and concentrates from various freshwater fish by quantitative spectrophotometric methods and have consistently found them to be abnormal in exhibiting an absorption band in antimony trichloride solution at 690–697 mμ, or less commonly at 645 mμ, having an intensity *greater than* that of the 620 band. Up to twenty catches of each of the species quoted in the table were examined, the fish being obtained from the Volga or Don, or rivers in the Leningrad region.

TABLE 1.

Species	Liver oil or concentrate	Ultra-violet absorption		Antimony chloride blue test		Ratio of intensities 693/620
		Maxima† mμ	$E^{1\%}_{1\,cm.}$	Maxima† mμ	$E^{1\%}_{1\,cm.}$	
Catfish (*Silurus glanis*)	C	343 (281)	203 102	695 (620)	560 292	1·92
Pike (*Esox Lucius*)	C	345 (280)	187 124	695 (620)	445 240	1·85
Pike-perch (*Lucioperca Lucioperca*)	Oil	348 (283)	4·0 3·0	693 (606)	8·1 3·45	2·35
Bream (*Abramis brama*)	C	340 280	53·5 36	697 (620)	97 58	1·67
Sturgeon (*Acipenser Stellata*)	Oil	334	3·5	695 617	5·8 4·4	1·32
Sturgeon (*Acipenser Guldenstadtii*)	Oil	330 (280)	2·3 2·1	695 620	3·6 2·7	1·33
Salmon (*Salmo Salar*)	Oil	349 282	14·2 11·8	695 (617)	33·9 14·2	2·38
Salmon (*Onchorhynchus keta*)	C	327 (280)	73 53	695 620	51·5 125	0·41
Halibut* (*Hippoglossus Hippoglossus*)	Oil	328	71·5	697 620	30 170	0·17

* This is a typical marine fish liver oil.
† Values in brackets indicate only ill-defined bands.

We have also found, in addition, that the ultra-violet absorption spectra of the liver oils of freshwater fish are differentiated from those of marine fish, in that the maximum is displaced from 328 mμ to 345–350 mμ (with, frequently, the appearance of another band at 280–285 mμ). The 340–350 mμ maximum thus appears to be associated with the 693 mμ antimony chloride chromogen, just as the 328 mμ band is associated with the 620 mμ chromogen.

Although most freshwater fish liver oils show only one band near 693 mμ in chloroformic antimony trichloride, the absorption near 620 mμ is always appreciable. Thus the 693 : 620 intensity ratio seems to average 2 : 1, whereas for marine fish it is usually less than 0·2 : 1 (*cf.* Table 1 for the spectroscopic data on a few typical oils and concentrates).

The chromogenic properties of the two classes of liver oils reported here are closely parallel with those recently observed by Wald[4] when examining the retinas of marine and freshwater fish respectively. It appears possible to us that the 693 mμ chromogen may be a second vitamin A with some degree of specificity for freshwater fish, and in this connexion an alcohol with six conjugated ethenoid linkages is obviously suggested as a possibility by the spectrographic data. We are at present engaged in an attempt to isolate the compound, and we also have the biological aspect of the question under test. It should, however, be noted that, until both biological and spectrographic data have been accumulated and examined, the accurate determination of the vitamin A content of liver oils of freshwater fish, by physico-chemical methods, is not possible.

E. LEDERER. A. E. GILLAM.
V. ROSANOVA. I. M. HEILBRON.

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[1] Heilbron, Gillam and Morton, *Biochem. J.*, **25**, 1352 (1931).
[2] Heilbron, Heslop, Morton, Webster, Rea and Drummond, *Biochem. J.*, **26**, 1178 (1932).
[3] Lederer and Rosanova, *Biochimica*, **2**, 293 (1937).
[4] Wald, NATURE, **138**, 1017 (1937).

A Possible Vitamin A_2

THE antimony trichloride colour test for vitamin A is associated with a maximum absorption at 620 mμ. We have, since 1929, repeatedly encountered an additional band near 693 mμ, but further characterization of the chromogen has been hindered by the presence of excessive amounts of vitamin A. Thus, in halibut liver oils the relative intensities 620 mμ/693 mμ are *c.* 6 : 1, and in halibut visceral oils 10 : 1. The 693 mμ chromogen is rarely detectable in cod liver oils and never in our experience in whale liver oils.

It is frequently absent from the vitamin A fraction of eyes, but one of us (J.R.E.) has observed the 693 mμ band in extracts from goldfish eyes, the ratio 620 mμ/693 mμ being *c.* 1 : 1·5. Experiments on brown trout have shown that the 693 mμ chromogen occurs in the non-saponifiable extracts from livers and viscera. The 620 mμ band, as such, could not be detected. Direct absorption spectra showed the presence of three broad bands with maxima at 470, 350 and 287 mμ, respectively, the ultra-violet bands varying in intensity with the 693 mμ band in the colour test. Lederer and Rosanova[1] have also found an intense band at 693 mμ in the colour test applied to freshwater fish liver oils from the neighbourhood of the Murmansk Sea. We understand (private communication) that an apparent connexion between absorption bands at *c.* 345 and 285 mμ and the 693 mμ chromogen has been confirmed by Prof. Heilbron and Dr. Gillam on Lederer's oils. Wald's discovery that a substance apparently identical with the 693 mμ chromogen can replace the vitamin A of rhodopsin *without loss of physiological function* runs parallel with the similar replacement in the viscera and liver of brown trout. It therefore seems desirable provisionally to designate as 'vitamin A_2' the 693 mμ chromogen with its characteristic ultra-violet absorption.

In chemical separations with liver oils, the 693 mμ chromogen follows vitamin A, the ratio 620 mμ/693 mμ for a given species remaining very nearly constant. It is not difficult with some liver oil extracts to reach $E^{1\%}_{1cm.}$ 693 mμ 500–1,000, but judging from the amount of vitamin A present, the pure substance will have $E^{1\%}_{1cm.}$ 693 mμ $\lessapprox$ 5,000. On this basis, each brown trout contains of the order 0·12 mgm. of the new material.

It seems clear that the 693 mμ chromogen is not in any simple sense an artefact derived from vitamin A; but the position remains obscure with regard to bands at 640 mμ and 660 mμ which occasionally appear in the colour test.

J. R. EDISBURY.
R. A. MORTON.
G. W. SIMPKINS.

University of Liverpool.
July 6.

[1] *Biochimica*, **2**, 293 (1937).

Specificity of Indophenol in the Estimation of Ascorbic Acid in Fermented Products

DURING the course of an investigation on the antiscorbutic value of Kaffir beer, it was observed that beers treated with a 2 per cent concentration of metaphosphoric acid gave high values for 'vitamin C' when titrated with indophenol in the usual manner, the values varying between 1·1 and 38·5 mgm./100 ml.

Delf[1], working with guinea pigs and monkeys, concluded that Kaffir beer was of slight antiscorbutic value. Levy and Fox[2], using hydrochloric acid for acidification, examined eleven specimens of mine-brewed beer and found values of 0·2–0·5 mgm./100 ml.

Bernhauer *et al.*[3] showed that when *Aspergillus niger* was allowed to grow in sugar mixtures, substances with the same reducing properties as ascorbic acid were formed. Whether these possessed antiscorbutic activity or not was not clear (Křiženecký and Nevalonnyj[4] and Hermann and Fodor[5]).

As with ascorbic acid, norite charcoal (Fox and Levy[6]) completely removed the reducing power. However, only a small fraction (0·8 mgm. out of 13·0 mgm.) was restored after hydrogen sulphide treatment. Hubbard squash extract (Tauber *et al.*[7]) entirely removed the reducing power. The folin uric acid reagent (Medes[8]) gave identical values with indophenol titration in the presence of 2 per cent metaphosphoric acid.

The effect of *p*H on the indophenol titration of the beer was as follows:

INDOPHENOL REDUCING POWER OF KAFFIR BEER AT DIFFERENT *p*H VALUES.
(in mgm. 'ascorbic acid' per 100 ml. beer).

2·5 *N* HCl	8·0
1·2 *p*H	0·8
1·4	0·8
1·6	0·8
1·8	0·8
2·0	(doubtful end-point) 1·5
2·2	13·0
2·4	13·0
2·6	13·0

Guinea pig experiments showed the reducing substance to be almost devoid of antiscorbutic activity, the animals dying of scurvy in three to four weeks. Controls on orange juice remained healthy, and on autopsy showed no signs of scurvy.

The reducing power of the beer was followed at different stages of its preparation, and it was found that a large increase took place during the boiling of the mash, and a further increase during fermentation.

From these experiments it is concluded that the bulk of the reducing substance is not ascorbic acid. The true ascorbic acid content of the beer probably corresponds to the values of about 0·8 mgm./100 ml. obtained with the norite procedure and by titration at a *p*H between 1·2 and 1·8. The concentration was far too low to have any appreciable effect on the guinea pigs in the doses given. It is also shown that ascorbic acid oxidase (cf. Zilva[9]) and Srinivasan[10]), and the folin uric acid reagent (cf. Fujita *et al.*[11]) are not specific for ascorbic acid.

F. WILLIAM FOX.
WILLIAM STONE.

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June 21.

[1] Delf, *Publ. S. Afr. Inst. Med. Res.*, **2** (No. 14), 47 (1921).
[2] Levy and Fox, *S. Afr. Med. J.*, **9**, 181 (1935).
[3] Bernhauer, Görlich and Kocher, *Biochem. Z.*, **286**, 60 (1936).
[4] Křiženecký and Nevalonnyj, *Z. Untersuch. Nahr. u. Genussm.*, **66**, 278 (1933). (Quoted by Bernhauer *et al.* (3).)
[5] Hermann and Fodor, *Biochem. Z.*, **276**, 323 (1935).
[6] Fox and Levy, *Biochem. J.*, **30**, 208 (1936).
[7] Tauber, Kleiner and Mishkind, *J. Biol. Chem.*, **110**, 211 (1935).
[8] Medes, *Biochem. J.*, **29**, 2251 (1935).
[9] Zilva, *Biochem. J.*, **30**, 1215 (1936).
[10] Srinivasan, *Biochem. J.*, **30**, 2077 (1936).
[11] Fujita, Akiji and Ebihara, *Biochem. Z.*, **290**, 182, 192 (1937).

Absorption of the Soft Component of Cosmic Radiation

IT is now generally accepted that the soft component of cosmic radiation consists of electrons which are absorbed mainly by emission of light quanta and subsequent production of pairs (cascade showers). The absorption of these particles is usually measured by two or more counters separated by a plate of some absorbing material of variable thickness. This method measures the probability of a primary electron either itself penetrating the plate or producing at least one secondary electron emerging from the bottom of the plate.

Since the probabilities for the relevant processes are proportional to Z^2, it is often assumed that the absorption curves for the soft component should be independent of the material when plotted on a scale proportional to NZ^2 (N = number of atoms per c.c.). This assumption, however, rests on an erroneous interpretation of the theory for the following reason.

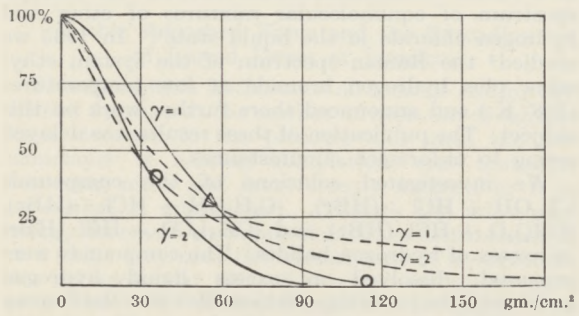

Fig. 1.

The production of secondaries by the cascade process only takes place if the energy is higher than the critical energy E_z at which the energy loss by radiation is equal to the energy loss by ionization. E_z is larger for light materials than for heavy ones. ($E_z = 10 \times 10^6$ e.v. for lead; 60×10^6 e.v. for aluminium; 150×10^6 e.v. for air.) Thus, the shower electrons from light materials will be more energetic than those from heavy materials. Naturally, the probability for the production of fast secondaries is smaller than that for slow ones. If we plot, therefore, the absorption curves on a Z^2-scale, we should expect the curves to fall off more rapidly for light elements than for heavy ones.

We have calculated, on the basis of the quantum theory[1], the probability for an electron penetrating a plate of certain thickness or producing at least one secondary with energy greater than E_z. The curves obtained depend on the primary energy spectrum of the electrons. We have assumed a $dE/E^{\gamma+1}$ law and have put $\gamma = 1$ and 2. For E smaller than the critical energy E_z for air, we assume the energy spectrum to fall off rapidly, the exact shape of the energy spectrum being of no importance for the result. The shape of the absorption curves is mainly determined by primary electrons with comparatively small energies, for which the validity of the theory is proved by direct experiments[2] (that is, up to 3×10^8 e.v. for lead and 10^9 e.v. for aluminium). The high-energy part of the spectrum only affects the tail end of the curves, which in any event cannot readily be distinguished from the hard component. (In Fig. 1 the curves are calculated assuming that the theory is valid for all energies.

Fig. 1 shows the theoretical absorption curves for lead (full) and aluminium (dotted) on an ordinary gm./cm.² scale. We see that to a rough approximation the curves follow an *ordinary mass absorption law*. The experimental points (○ for Pb, △ for Al) are taken from the measurements by Auger, Ehrenfest and Leprince-Ringuet[3]. They are in good agreement with the theory for γ between 1 and 2. The accuracy is, however, not high enough to determine γ exactly.

W. HEITLER.

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[1] Carlson and Oppenheimer, *Phys. Rev.*, **51**, 220 (1937). Bhabha and Heitler, *Proc. Roy. Soc.*, A, **159**, 432 (1937).
[2] Blackett and Wilson, *Proc. Roy. Soc.*, A, **160**, 304 (1937). Anderson and Neddermeyer, *Phys. Rev.*, **50**, 263 (1936).
[3] *J. Phys. Radium*, **7**, 58 (1936).

Capture of Orbital Electrons

IN two recent papers[1] Møller has shown that on the present theory of β-decay for a heavy nucleus emitting positrons of low maximum energy, the ratio F_k/F of the probability of K-electron capture to that of positron emission may be large. On the other hand, experiments by Jacobsen[2] for a light nucleus (radio-scandium, $W_0 = 1{\cdot}1 \pm 0{\cdot}1$ MV., $Z = 21$) show that this ratio is $< 1/10$. We wish to point out that Jacobsen's result is in agreement with a modified form of the theory[3], but that this form makes a definite prediction about the low energy end of β-spectra.

The usual procedure of writing the interaction term as

$$(\psi_N^* \mathbf{A}'\psi_P)\,(\psi_e^* \mathbf{A}''\psi_n) \qquad \ldots\ldots\ldots \quad (a)$$

where (N,P) (n,e) represent the heavy and light particles respectively, leads to a transition probability[4]

$$A \left| \int \psi_N^* \psi_P d\tau \right|^2 (\psi_e^* \psi_e)\,(W_0 \pm W)^a \quad \begin{matrix} a=2 \\ a=4 \end{matrix} \begin{matrix} \text{Fermi} \\ \text{Konopinski-Uhlenbeck} \end{matrix}$$

The $\pm$ sign depends upon the electron being absorbed from a state of positive or negative energy. For the ratio F_k/F the evaluation of $(\psi_e^* \psi_e)$ from the known form[5] of the wave-functions for a K-electron, gives for small Z

$$F_k/F = 2\pi\gamma^3 (W_0 + 1)^a \Big/ \int_1^{W_0} W(W^2-1)^{1/2}(W_0 - W)^a \quad \begin{matrix} a=2 \\ a=4 \end{matrix} \begin{matrix} \text{Fermi} \\ \text{Konopinski-Uhlenbeck} \end{matrix}$$

where $\gamma = Z/137$.

If $Z = 21{\cdot}0$, $F_k \sim 0{\cdot}22$ for $\alpha = 2$, and $2{\cdot}3$ for $\alpha = 4$. F depends sensitively upon the exact value of W_0, varying from $0{\cdot}63$ to $1{\cdot}17$ in the Fermi case, and from $0{\cdot}39$ to $1{\cdot}0$ in the Konopinski-Uhlenbeck case, as W_0 varies from $2{\cdot}2\ mc^2$ to $2{\cdot}4\ mc^2$. We therefore require a very precise knowledge of W_0 to determine F_k/F exactly. Even with $W_0 = 2{\cdot}4\ mc^2$, F_k/F is about $1/5$ for $\alpha = 2$, and $2{\cdot}3$ for $\alpha = 4$, so that the K-electron capture could scarcely have been overlooked, particularly in the Konopinski-Uhlenbeck case.

There is the further possibility of writing the interaction term in the form

$$(\psi_N^* \mathbf{A}'\psi_n)\,(\psi_e^* \mathbf{A}''\psi_P) \qquad \ldots\ldots\ldots \quad (b)$$

(This corresponds to the case $C = -1$ in the note recently published by Mercier[6]. For this value of C, however, the formulæ there given are not applicable.)

For $Z \sim 20$ the components ψ_1, ψ_2 of the K-electron are small compared with the components ψ_3, ψ_4. Similarly, ψ_P has two large and two small components differing by a factor of the order of 1/10. We may suppose $\mathbf{A}''$ to be an operator combining the two small components of ψ_P with the two large components of ψ_e^*. This arrangement gives a factor 1/100 in the terms containing the small proton components, and a factor 1/200 in the terms containing the small electron components. Thus, by addition, F_k/F will contain a factor 3/200 from this combination; that is, for $Z = 21{\cdot}0$, we may take F_k to be 0·003 for $\alpha = 2$, and 0·035 for $\alpha = 4$. The positron emission will now be given by

$$F = A_1 \int^{W_0} (W + 1)(W^2 - 1)^{1/2} (W_0 - W)^\alpha dW \quad (c)$$

$\alpha = 2$ Fermi; $\alpha = 4$ Konopinski-Uhlenbeck

F will again depend sensitively upon the value of W_0, but we can take as suitable values 1·5 for $\alpha = 2$ and 0·75 for $\alpha = 4$. This gives for F_k/F approximately the values 1/500, $\alpha = 2$, and 1/25, $\alpha = 4$. It is possible that K-electron capture for the ratio 1/25 has escaped detection, although its existence should be revealed by further experiments. The interesting point arises that, if the $\alpha = 4$ interaction is assumed, we obtain a definite prediction of the low-energy end of the positron spectrum, which is given by the integrand of (c). This leads us to expect a large number of slow positrons. It is important to note that this latter conclusion seems to hold only for allowed transitions. For forbidden transitions (c) has a more complicated form.

In the Fermi theory, F_k/F is about 1/3 or 1/500 according as one adopts the law (a) or (b). The actual interaction law may also be a linear combination of (a) and (b), and it is easy to calculate the proportion necessary to give any intermediate ratio. It should be noted that, as this ratio decreases from 1/3, we require a rapid increase in the percentage of (b); for example, when the ratio has decreased to 1/30 we already need more than 90 per cent of the interaction (b).

We see that if we accept the experimental evidence that the probability of absorption of a K-electron relative to that of positron emission is less than the value required by the Konopinski-Uhlenbeck theory, then the theory must be replaced by a modified form which gives many more slow positrons and fewer slow electrons. This appears to be in reasonable agreement with the direct observation of the spectrum.

F. HOYLE.

Emmanuel College,
Cambridge.
June 10.

[1] Møller, *Phys. Rev.*, **51**, 84 (1937); *Phys. Z. d. Sowjetunion*, **11**, 9 (1937).
[2] Jacobsen, NATURE, **139**, 879 (May 22, 1937).
[3] Hoyle, *Proc. Camb. Phil. Soc.*, **33**, 286 (1937).
[4] Fermi, *Z. Phys.*, **88**, 171 (1934).
[5] Darwin, *Proc. Roy. Soc.*, A, **118**, 674 (1928).
[6] Mercier, NATURE, 139, 797 (May 8, 1937).

Structure of Hα of Hydrogen

THE structure of the lines of the Balmer spectrum of hydrogen was investigated in this laboratory some years ago. Recently we have attacked the problem again, using two Lummer plates, not crossed as in the investigations of Kent, Taylor and Pearson[1], but dispersing in the same plane. With this arrangement, the microphotometer curves of the resultant pattern reveal clearly four distinct components of Hα with intensities and positions roughly as given by theory. There are no ghosts in the Lummer plates and the interference of lines of the secondary spectrum of hydrogen has been eliminated.

We are now engaged in obtaining quantitatively the intensity and position of these components.

We feel that this method (new, so far as we know) may be of service in the study of the fine and hyperfine structure of the spectrum lines of other elements.

NORTON A. KENT.
Boston University. ROYAL M. FRYE.
June 1. WILLIAM H. ROBINSON.

[1] *Phys. Rev.*, **30**, 266 (1927).

Raman Spectra of Oxonium Compounds

M. WOLKENSTEIN and G. K. Syrkin have published in a recent communication in NATURE[1] the Raman spectrum of equimolecular mixtures of ether and hydrogen chloride in the liquid state[1]. In 1935 we studied[2] the Raman spectrum of the system ethyl ether plus hydrogen bromide at low temperatures (228° K.) and announced there further work on this subject. The publication of these results was delayed owing to unforeseen circumstances.

We investigated solutions of the compounds $CH_3OH + HCl$ (HBr), $C_2H_5OH + HCl$ (HBr), $(CH_3)_2O + HCl$ (HBr) and $(CH_3)_2CO + HCl$ (HBr) in excess of hydrogen halides. The compounds were prepared, dissolved in excess liquid hydrogen halide and the resulting solution filled into the Raman tube, all in one operation, in a high vacuum apparatus at low temperatures, thus eliminating all possibilities of chemical reaction (formation of R. Hal.). Under these conditions, we obtained spectra of the solutions, which were characteristically different from the spectra of the components. We obtained the following frequencies:

CH_3OH . . . HCl ($t = -75°$ C., molecular ratio = 1 : 1·8). 465(2), 645(3), 991(4), 1083(5), 1181(1), 1357(3), 1449(5), 2956(10), 3019(7), 3364(3).

CH_3OH . . . HBr ($t = -62°$ C., mol. ratio. = *c.* 1 : 5). 391(3), 497(4), 629(4), 887(2), 984(3), 1066(3), 1449(3*b*), 2907(4), 2970(10), 3047(5).

C_2H_5OH . . . HCl ($t = -75°$ C., mol. ratio = 1 : 2·1). 398(3), 507(2), 613(2), 646(2), 873(3), 1021(3), 1094(2), 1281(2), 1343(3), 1450(6), 2928(8), 2977(10), 3357(1).

C_2H_5OH . . . HBr ($t = -65°$ C., mol. ratio = *c.* 1 : 5). 431(2), 520(4), 597(4), 708(2), 829(5*b*), 925(1), 1048(2), 1290(1), 1377(2), 1450(6), 2940(8), 2984(10).

$(CH_3)_2O$ . . . HCl ($t = -80°$ C., mol. ratio = 1 : 2·5). 356(1), 432(3), 506(3), 890(7*sb*), 947(1), 1006(1), 1063(3), 1444(8*b*), 2828(6), 2928(10), 3002(9).

$(CH_3)_2O$ . . . HBr ($t = -32°$ C., mol. ratio = 1 : 1·7). 268, 395(6), 506(2), 824(7*b*), 896(2), 965(1), 1023(1), 1440(8*b*), 2834(4*b*), 2948(10*b*), 3037(9*b*).

$(C_2H_5)_2O$ . . . HCl ($t = -80°$ C., mol. ratio = 1 : 3·5). 327(1), 418(2), 491(3), 767(2), 823(2*b*), 955(2), 997(3), [1058(1)], 1270(3), 1450(7), 2878(1), 2942(10), 2981(10).

$(C_2H_5)_2O$ . . . HBr ($t = -43°$ C., mol. ratio = 1 : 2·5). 303(1), 406(5), 470(1), 678(1*sb*), 830(0), 920(0), 996(4*b*), 1071(1), 1137(0), 1263(1), 1459(6b), 2866(0), 2940(10), 2984(10).

The detailed discussion of the spectra led to the conclusion that the compounds do not exist in solution of excess hydrogen halide as 'oxonium' compounds $\left(\begin{matrix}R\\R\end{matrix}\right)O\,H)^+ X^-$, but as compounds with tetravalent oxygen. We propose calling this type of compound an 'oxan' compound.

The question whether the former addition compounds appear as oxonium or oxan compounds is to a high degree dependent on the physico-chemical conditions (temperature, state of aggregation, solvent, etc.). By varying the conditions, a gradual transition from the 'oxonium' to the 'oxan' form is possible. It is not improbable that equilibria exist between the two above-mentioned extreme types. We have started a more intensive examination of this question.

A detailed account of the Raman investigations, as summarized above, will be published in the *Zeitschrift für physikalische Chemie* (*B*).

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Visible Adsorbed Films and the Spreading of Liquid Drops at Interfaces

THE adsorption isothermals of benzene and methyl alcohol vapours at the surface of mica are of sigmoid form, concave to the pressure axis until the first monolayer is nearing completion, and thereafter becoming more and more steeply inclined to it as saturation is approached. Though the adsorption energy decreases on completion of the first monolayer to a value very near the normal heat of liquefaction, the polymolecular films formed at saturation have properties quite different from the bulk liquids. This is strikingly demonstrated in a series of experiments we have recently carried out, a few of which are briefly recorded in this note.

When a freshly split mica plate is placed under a jet of the supersaturated vapour of benzene, methyl alcohol or water, condensation of bulk liquid does not occur until a film of critical thickness has been built up. By suitably controlling the conditions, films of thickness less than this, *yet thick enough to show interference colours*, are readily produced. A drop of the same liquid, placed on such a film, may flatten, but does not lose its identity as a lens, showing that the angle of contact, though small, is finite. Methyl alcohol, which spreads rapidly on fresh mica in the open air, will not do so in the presence of its own supersaturated vapour; on the contrary, a spread film was found to break up into drops when brought under the vapour jet. The alternative view as to the origin of the film colours, namely, that they may be due to diffraction from a mist of invisible droplets, is not borne out by the facts; for example, we were able to float lenses of different liquids right across the films without disturbing them in any way.

Much evidence has been found by us in favour of Hardy's view[1] that a drop of pure liquid placed on a clean solid surface invariably reaches a stable state only when a single lens is in equilibrium with an adsorbed film. Without permitting ourselves this degree of generality, we would emphasize the marked sensitiveness of the contact angle to changes in the degree of saturation of the vapour phase, and to the presence therein of even traces of a second adsorbable component; both these effects are often neglected in making measurements of contact angles.

Interesting effects are produced by placing drops of different liquids near each other on a mica plate, and these are at least rendered less incomprehensible by the realization that adsorbed films can be thick, and that the energy relations at the edge of a drop are markedly dependent on the *local* concentration of the second component of the film. If a drop of concentrated acetic acid, containing enough water to prevent its spreading, is placed near one of the very dilute acid (or of water) resting on clean mica, the former first elongates, then advances towards the dilute acid. Before contact, however, the latter drop is sharply repelled and driven forward to the edge of the plate. Arriving there, it is usually repelled by the edge, with the result that it dodges round its pursuer (which is attracted to the edge and remains clinging there), and comes to rest in the centre of the plate. A similar behaviour has been observed with other pairs of liquids, though the 'edge' effect is often less noticeable; for example, a lens of *n*-hexane will drive one of benzene in front of it until the former has all evaporated.

The highly convex lenses formed by hexane drops on mica spread immediately when brought under the jet of benzene vapour, whilst *lenses* of benzene condense on the spread film. The incomplete miscibility of hexane and benzene in the form of drops on mica is astonishing, though numerous other examples might be quoted. If a drop of hexane is placed on top of one of benzene as it rests on mica, the mixture divides itself into two parts—a spread film which quickly evaporates, showing interference colours, and a lens (mainly of benzene) which is repelled rapidly to the edge of this film. The possible application of such phenomena as a means of effecting separations immediately suggests itself. The drops used in these experiments must of course be small.

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[1] Hardy, Sir W. B., *Proc. Roy. Soc.*, A, **88**, 313 (1913); *Phil. Mag.*, **38**, 49 (1919); Institut Internat. de Chimie Solvay, Brussels (1925).

Reliability of Pacific Seismological Stations

IN a former paper I gave a comparison of the accuracies of seismological stations, based on the residuals for *P* in the International Seismological Summary[1]. The fraction of the residuals between $\pm 4s$ was taken as the standard and called the 'reliability'. It came out rather low for most of the Pacific stations, though I suggested that the estimates might be too low, on account of errors in the epicentres due to too little weight having been given to the near stations. In some work on southern earthquakes, preparatory to a further study of the core waves, I have re-determined a large number of Pacific epicentres (up to the end of 1931), taking into account the effects of the ellipticity of the earth; the result is a great improvement in the reliabilities. They are now as follows:

Riverview, 17/17 = 1·0; Melbourne, 14/16 = 0·9; Apia, 8/10 = 0·8; Adelaide, 11/16 = 0·7 (probably too low as distant earthquakes give 11/12 = 0·9); Manila and Wellington, 13/17 = 0·8; Christchurch, 8/11 = 0·7; Amboina, 10/15 = 0·7; Batavia, 11/16 = 0·7; Honolulu, Perth and Malabar, 0·5; Sydney, 0·4; the rest, nearly as before.

Most of the change is due to the correction for the ellipticity of the earth, provided by Bullen[2]. At

large distances this varies with azimuth by nearly 5 seconds when geographical co-ordinates are used, and introduces a large systematic error into southern epicentres if it is not allowed for. Bullen and I found on determining epicentres from the nearer stations[3], that southern earthquakes habitually showed negative residuals of about $-4s.$ at great distances, and attributed these to slight focal depth; it appears now, however, that they were entirely due to the ellipticity. The great majority of Pacific earthquakes can be taken as having foci at an inappreciable depth.

The law of error in seismological observations seems to be practically the normal law with a uniform distribution superposed. The standard error corresponding to the normal part is found to be $2{\cdot}0s.$ both for the good and for the intermediate stations; the difference between them is not in the accuracy of the normal observations, but in the frequency of defective ones, usually attributable to microseisms and weak beginnings.

There appears to be a slight difference between Pacific and continental travel times, amounting to about $2s.$ for $P.$ between 5° and 50° out of a total time of 8 minutes, and indicating a higher velocity below the Pacific. This might be expected if there has been more cooling below the oceans than under the continents. Larger differences have been claimed previously, of the order of 10 per cent, but these are rendered impossible by the observations now available.

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Magnetic Quality of Nickel Wire as Influenced by the Surface

IN a previous note[1], test data were given which showed the very large increase of magnetic permeability of nickel wire which could be obtained by applying to the surface a thin skin of copper and allowing it to soak for some hours at a sufficiently high temperature.

The influence of the surface of a wire on its magnetic quality has been examined further as follows:

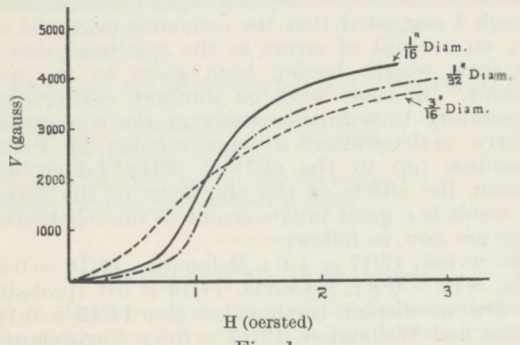

Fig. 1.

Commercially pure nickel wires of diameters 1/32 in., 1/16 in., and 3/16 in. respectively, were heated in an atmosphere of hydrogen for a sufficiently long time to reach a condition of maximum permeability in each case. After having cooled slowly to room temperature, the magnetization curves for each wire was obtained and these curves are shown in Fig. 1.

It will be seen that the initial portion of the curve for the 1/32-in. diameter wire is very flat and this part of the curve becomes steeper as the diameter increases. That is to say, the greater the ratio of surface perimeter to cross-sectional area, the less easily is the wire magnetized for low values of H. In other words, the magnetic characteristic of the wire is intimately dependent upon the diameter. The tests have also shown that the remanence and the coercive force are both considerably greater for the wire of 1/32 in. diameter than for the other wires.

These results have important theoretical and practical implications, which will be considered in a paper which is now in course of preparation for publication elsewhere.

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[1] NATURE, **139**, 928 (May 29, 1937).

Darkening of some Commercial Titanium Dioxide in Daylight

DURING an investigation of the discoloration by light of some ceramic glazes containing titanium compounds and of the subsequent fading of the discoloration when the glaze is kept in the dark[1], it was observed that certain varieties of commercial titanium dioxide are themselves affected by daylight. These varieties pass from their normal creamy colour to a deeper yellow-brown tint on exposure. The original colour is restored in the dark. This property of some commercial titania appears to have escaped notice in Great Britain, though Lee[2], in his study of reversible photo-sensitivity in hackmanite, draws an analogy with a certain brand of titania which showed the property mentioned in this letter.

The samples of titanium dioxide studied were stored in ordinary glass vessels exposed to daylight transmitted through the glass of the laboratory windows. The darkening of the titania, observed against samples kept in the dark, was apparent after only three hours in some instances. The effect is shown by those particles or perhaps portions of particle-surfaces adjacent to the illuminated glass wall of the container. Hence it is important that the powdered titania should move as little as possible during illumination if the darkening is to be obvious.

No experiments were made with the photo-sensitive brands of titania as components of paints or pigments, but they conferred similar properties on some ceramic glazes containing them. However, ceramic glazes darkening in light were made from titania and from rutile where these materials themselves showed no apparent darkening.

A definite explanation of the darkening of titania cannot be cited, though it appears likely that the colours shown by the exposed and by the unexposed material mark the establishment of an equilibrium condition of either a chemical or a physical nature. A chemical explanation might involve the oxidation of ferrous iron present in the titania to a more deeply coloured ferric compound (cf. the possible

mechanism for the darkening effect of titania on the colour produced by iron in enamels[3]). Titania is a source of photo-activation of chemical processes, including some oxidation processes[4]. Less likely is a change in the state of oxidation of the titania itself. (Renz discusses the reduction of titania in light in the presence of certain organic liquids and reducing solutions[5].) Among physical explanations, changes in the crystalline variety of titania present (cf. the crystalline phases known to mineralogists as rutile, anatase and brookite) or in the grain-size of the titania do not seem very probable. Alteration in the degree of dispersion of some colloidal material suspended in the titania is another possibility (see, for example, the summary of Doelter's work given by Lee[2] and the references provided by Clarke[6]).

The above suggestions are by no means exhaustive, and the possibility of a connexion between the darkening of some titanium dioxide by light and the darkening of titania on heating should be borne in mind. Meanwhile, notice of the phenomena described may be of value to those workers interested in titanium and its compounds.

I wish to thank Dr. Harry W. Webb for reading through this letter.

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A New Form of Resorcinol

A NEW form of resorcinol has recently been investigated in this Laboratory which compares as follows with the structure already described by Robertson[1].

	α-Resorcinol	β-Resorcinol (new form)
space group	C_{2v}^9 (*Pna*)	C_{2v}^9(*Pna*)
axes : *a*	10·53	7·91
b	9·53	12·57
c	5·66	5·50
cell volume	568 A.^{3}	547 A.^{3}
molecules per cell	4	4
molecular symmetry	none	none
calculated density	1·278	1·327

The principal intensities and higher orders of single crystal X-ray photographs show that the molecules in the β-crystals have turned round to align themselves in the *b*-axis direction.

The new form is conveniently prepared by slow evaporation of benzene solutions at ordinary temperatures, using specially dried air[2]. Vacuum sublimation of resorcinol under certain conditions gives a preponderance of β-crystals, in large shiny flakes, which can easily be distinguished from the long needles of the α-form. According to Lautz[3], resorcinol undergoes a transformation above 70·8° C. into a denser modification, which is perhaps identical with the β-form.

The two forms of resorcinol are of considerable interest for the theory of intermolecular resonance, since the hydroxyl 'bonds' in the two structures need not necessarily be of the same length. Although this point can only be decided by a quantitative measurement of intensities of reflection, the manner of discovery of the β-form suggests that a difference in the hydroxyl bonds is quite possible. Repeated crystallization of resorcinol from 99·6 per cent 'heavy' water gives a deutero-resorcinol which, according to Munzberg[4], has the structure $C_6H_2D_2(OD)_2$. Whereas $C_6H_4(OH)_2$ when crystallized from boiling benzene gives good crystals of the α-form, the deuterium compound gives poor feathery crystals of the β-form; in one case a crystal was obtained which had the α-structure at one end and the β-structure at the other. On vacuum sublimation, $C_6H_2D_2(OD)_2$ again behaves differently in giving a preponderance of crystals with the α-structure.

The thermodynamic relationship between the two forms and their magnetic anisotropy are being measured. The possibility of a transformation from one form to the other in the solid should perhaps be considered in connexion with temperature effects described by Nilakantan[5].

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[1] Robertson, J. M., *Proc. Roy. Soc.*, A, **157**, 79 (1936).
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Carbon-Halogen Distance in the Methyl Halides

IN attempting to correlate the data on interatomic distances in polyatomic molecules, certain serious discrepancies have come to light between the spectroscopic method and the diffraction method as regards the carbon-halogen distances in the methyl halides. The differences are tabulated in Table 1. The reason that this had not been noticed earlier is that certain mistakes have been present in the deductions from the spectroscopic data and also that many new data are available. These results are particularly interesting when compared with the corresponding distances in the carbon tetrahalides,

TABLE 1.

	Old spectroscopic value[1]	New spectroscopic value	Diffraction value[2]	Value in CX_4[3]
CH_3F	1·4	1·385±0·004	1·42±0·02	1·36 ±0·02
CH_3Cl	1·8	1·66 ±0·05	1·77±0·02	1·755±0·005
CH_3Br	2·0	1·88 ±0·08	2·06±0·05	1·93 ±0·03
CH_3I	2·05	2·12 ±0·15	2·28±0·05	—

which are given in the last column. Thus it will be seen that, according to the diffraction method, in the methyl halides the carbon-halogen distance is always greater than, or equal to, the corresponding distance in the tetrahalides, whereas the spectroscopic method would seem to indicate that exactly the opposite is the case. The latter seems much more likely from consideration of the mutual repulsion of the halogen atoms in the tetrahalides.

Further support for this interpretation comes from an examination of the force constants for the C-halogen bond in the two cases. These are compared in Table 2, where it will be noticed that the force constant is always considerably larger in the methyl

halide than in the tetrahalide. The force constants in the first column were obtained by the method of Sutherland and Dennison[3], while those in the second were obtained by that of Urey and Bradley[4].

TABLE 2.

Carbon-halogen force constants in 10^5 dynes/cm.

	C—F	C—Cl	C—Br
CH_3X	5·8	3·6	2·9
CX_4	4·0	1·8	1·4

One may not convert this difference in force constant into a difference in internuclear distance directly by means of the Clark[5] or the Badger[6] relation, since the bonds are under considerable strain in the tetrahalides. Badger, however, has shown how it is possible to make an allowance for this and has actually predicted a difference of 0.19 A. between the C—Cl distance in CH_3Cl and CCl_4. This is of the same order as that found above.

Duchesne[7], and Linnett and Thompson[8] have recently remarked on the apparent large change in the C—C force constant in going from C_2H_4 to C_2Cl_4, and have suggested interpretations involving resonance between different structures. It seems probable, however, that at least a part of this change is due to the C—C bond being under a strain in C_2Cl_4 from the mutual repulsions of the Cl atoms. The potential functions used by Duchesne took no account of interaction between the Cl atoms.

A full treatment of these matters will be published in due course.

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[2] Brockway, *Rev. Mod. Phys.*, **8**, 231 (1936).
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[5] Douglas Clark, *Phil. Mag.*, **18**, 459 (1934).
[6] Badger, *J. Chem. Phys.*, **3**, 710 (1935).
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[8] Linnett and Thompson, NATURE, **139**, 509 (1937).

Œstrogenic Substances in the Dead Sea

THE Dead Sea, situated at one of the deepest points of the earth, contains a high concentration of salts (more than 25 per cent). In the depth of the Dead Sea there is a sandy mud which we have found to exhibit a certain œstrogenic activity. For the mud of the southern part of the Dead Sea the œstrogenic activity is about three times as great as for the northern part. The deep sea water contains 100 M.U. per litre, while the surface water is free of œstrogenic substances. The salt manufactured from the Dead Sea (salsana) contains 100 M.U. per kgm. Our results are given in the following table.

Part of the Dead Sea	Depth	Hormone activity (M.U. per litre)
A. Water.		
North near Kallia	Surface	Less than 6·6
" " "	Near the bottom	100
South	Surface	Less than 20
B. Mud	M.U. per kgm.	M.U. per kgm. dry weight
North near Kallia	30	45
South	100	100
C. Salsana		100

Other steroid hormones (male sex hormone, progesterone) could not be detected.

The mud was found to contain a yellow dye-stuff which according to its physical properties (absorption and fluorescence spectra *inter al.*) belongs to the lyochrome group.

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Maturation in the Thelytokously Parthenogenetic Tenthredinidæ

SINCE Doncaster's preliminary work in 1906[1], nothing has been recorded on the maturation of the thelytokously parthenogenetic Tenthredinidæ. This author concluded that the chromosome number in the oocyte, polar nuclei and egg pronucleus was 8, and that there were two maturation divisions giving rise to an egg pronucleus and three polar nuclei[2]. Recent work on the species *Pristiphora pallipes* Lep., by our colleague, Mr. L. C. Comrie, raises strong doubts regarding Doncaster's interpretations on chromosome number and behaviour, but confirms him regarding the number of maturation divisions and polar nuclei.

In the thelytokously parthenogenetic species *Thrinax macula* Kl., we find that in the female-producing egg there occurs only one maturation division, non-reductional, with the formation of one polar nucleus. Evidently there exist different methods of maturation in the thelytokously parthenogenetic saw-flies.

Doncaster's species are thelytokous, with rare males, whilst *Thrinax macula* reproduces by obligatory parthenogenesis (in the laboratory at least), though certain females parthenogenetically produce all-male (or almost all-male) broods, such males being found reproductively useless.

The female chromosome constitution is $2n = 14$, that of the male possibly $n = 7$. Good oogonial figures, not easily obtained, show 12–16. Chromosomes of the maturation spindle at no time exhibit tetrad formation; each of the 14 chromosomes is split longitudinally; 14 travel to each pole, arranged, very often, temporarily as 7 couples. Two vesicles are formed, the inner sinking into the yolk without further maturation.

The polocyte is either extruded or it divides on a wide asterless spindle and displays clearly 14 large rod-shaped chromosomes split longitudinally. The outer group derived from this division is extruded from the egg, but the inner group becomes vesicular, may undergo a further division, and ultimately degenerate.

Embryonic tissues show approximately 12–14 very small chromosomes. Follicle cells from pupal ovaries best show the number (14), morphology and arrangement of the chromosomes. Corroborative counts from other tissues are obtainable during metamorphosis, though polyploid spindles are more common, especially in tracheal and gut cells.

Spermatogonia have not been obtained. The first spermatocyte division is abortive and a minute cytoplasmic polar bud is nipped off. The second spermatocyte with 7 chromosomes produces two spermatids each with 7 chromosomes. In several cases were seen whole cysts of cells with 7 loosely arranged pairs of chromosomes; we interpret them

provisionally as 7 split chromosomes of the first spermatocytes preparing for the second (equational) division. The cytology of male maturation and spermateleosis therefore closely resembles that typical of Hymenoptera.

Attention is directed to these considerations regarding *T. macula*: (1) In our experience the chromosome number of 14 is very exceptional among saw-flies, for some 40 species studied by ourselves and our colleague, Dr. F. Greenshields, show that 16 is usual (possibly it is 12 in a species of *Claudius*). (2) Its autoregulation behaviour is 'orthodox', for such occurs in the majority of animals thelytokously parthenogenetic. (3) It is uncertain whether the female chromosome constitution (14) is double that of the male, though the count of 7 in the male spermatocyte supports this view.

Our conclusions have been reached from intensive study of abundant material. The usual fixatives were used, but Petrunkewitsch gave the best result with eggs; for the most part we stained with iron hæmatoxylin, but gentian violet, safranin and Fuelgen's reagent gave good results.

This work has been done with the assistance of a grant from the Department of Scientific and Industrial Research and whilst one of us (A.R.S.) is a teaching fellow under the Carnegie Trust. To both these bodies we give our thanks.

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[1] Doncaster, L., *Quart. J. Micro. Soc.*, **49** (1906). (These species, *vide* Enslin, *Beihefte Deut. Entom. Z.*, 1918, are: *Empria abdominalis* F., *E. pulverata* Retz., *Croesus varus* Vill., *Hemichroa crocea* Geoffr.)
[2] Doncaster, L., *Quart. J. Micro. Soc.*, **51** (1907).

Body Orientation in Crustacea

THERE is, I think, a fallacy which is frequently made in many of the problems dealing with the body orientation of Crustacea. I believe that practically all biologists dealing with this subject have accepted the idea that the position of the centre of gravity is a matter of great importance. Thus, to quote just one of the many statements which have been made along these lines: S. R. Williams[1] says, "A sinking animal, like a lifeless body, always falls with the heavy end downwards." Lifeless bodies do not sink with the heavy end downwards unless their specific gravity is considerably greater than the liquid in which they are sinking. Not only can this be demonstrated by experiment but also it is in agreement with standard text-book hydrodynamics.

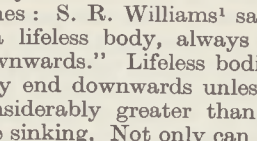


Fig. 1.

A CONE OF THIS SIZE AND SHAPE MADE OF ASH, SPEC. GRAVITY 0·817, SINKS HORIZONTALLY IN PETROL, SPEC. GRAVITY 0·74 AND RISES HORIZONTALLY IN A MIXTURE OF ALCOHOL AND WATER, SPEC. GRAVITY 0·95.

Recently I have made a series of cones of different materials (Fig. 1). In all cases the diameter at the base was a quarter of the length, but, in addition, the broad end of the cone was made hemispherical. The centre of gravity of the cone itself would, of course, be three quarters of the distance from the tip, while the hemispherical attachment would bring the centre of gravity still farther from the point. The cones were made of different kinds of wood, box, mahogany, ash and ebony while the liquids used were water, water and alcohol, petrol. Ash floats in water but sinks in petrol. Box just floats in tap-water but will sink after it has been soaked for several days. Another excellent material is the ordinary carrot, which will always sink slowly in tap-water. The size of the cones varied from half an inch in length to six inches. It is unnecessary for me to give the actual figures for the specific gravities here; suffice it to say that a cone of the shape figured either sinks or rises horizontally, although the position of the centre of gravity is very definitely towards the one end.

To get satisfactory results, the specific gravity of cone and liquid must be reasonably close, and it is much easier to obtain the horizontal position with small cones. Cones were made of zinc, tin, lead and iron, and any of these drop through tap-water with the heavy end first.

From the above experiments, it is, I think, definitely proved that provided the lifeless body sinking or rising is doing so in a liquid that approximates its own specific gravity, the position of the centre of gravity has very little influence. There is very little definite information about the actual specific gravity of living Entomostraca. Several attempts have been made to find it, but since these have all been made either with a dead or narcotized animal which was made to float in liquids of known specific gravity, the result can only be a rough approximation.

However, it is quite certain that in most cases the animals are just slightly heavier than the liquid in which they are swimming. According to Williams, the specific gravity of *Cyclops albidus* is 1·022 while that of *Cypridopsis vidua* Müller (an ostracod) is 1·046; since the specific gravity of any natural water must be above 1·0, it is fairly clear that an additional spine or a slight increase in the extension of the head of a *Daphnia* cannot affect body orientation by influencing the position of the centre of gravity.

This is scarcely the place to discuss the somewhat voluminous literature on the subject, but the position of the centre of gravity plays a very large part in Woltereck's theory[2], which has been discussed somewhat fully by Skogsberg[3] and accepted. It has also been accepted by Wagler[4]. From the mathematical point of view (I am greatly indebted to one of my colleagues, Mr. H. C. Nest, for looking up this theorem for me) the matter is treated fully by Ramsey in "A Treatise on Hydromechanics", Part 2: "Hydrodynamics", p. 196, "Stability". At the end of the theorem it is stated that "this accords with the observed tendency of a body to turn its flat side or its length across the direction of its motion".

To put the matter more crudely: when a body is sinking through a liquid, the most stable position is one in which it presents the greatest area in the horizontal plane. In other words, there is a very definite tendency which brings the greatest possible plane into the horizontal position; but if the speed of sinking is at all great, other factors may influence the attitude taken up by the sinking bodies. Small Entomostraca, even though the specific gravity of

chitin may be as high as 1·4, are incapable of sinking rapidly. Actually the chitinous casts of Daphnids sink quite slowly; so do those of freshwater ostracods.

The swimming, floating and sinking of these minute crustaceans at present constitutes an almost impossible problem, and it depends, I believe, entirely on the nature of the eddies and vortices set up. Mere speculations, though they may be very attractive, are not likely to carry one very far; but I think one can safely conclude that with organisms comparable in size and specific gravity to *Daphnia* or *Chirocephalus* the position of the centre of gravity plays no part whatsoever as a factor determining body orientation.

A. G. LOWNDES.

Marlborough College,
Wilts. June 16.

[1] Williams, S. R., "The Specific Gravity of some Fresh-water Animals in Relation to their Habits, Development and Composition", *American Naturalist*, **34**, 95–108 (1900).

[2] Woltereck, R., "Uber Funktion, Herkunft und Entstehungsursachen der sogen". "Schwebe-Forstatze pelagischer Cladoceren", *Zoologica*, **26**, Heft 67 : 2 (Stuttgart, 1913).

[3] Skogsberg, T., "Studies on Marine Ostracods". Part 1. (Cypridinids, Halocyprids and Polycopids.) Pp. 109 (1920).

[4] W gler, E., "Branchiopoda, in Kükenthal and Krumbach's Handbuch der Zoologie", Bd. 3. H.1 (1926–27), pp. 358–359, p. 416.

Points from Foregoing Letters

Prof. I. M. Heilbron, A. E. Gillam and Drs. E. Lederer and V. Rosanova have spectrographically examined the liver oils and vitamin A concentrates from more than sixty batches of seven different species of freshwater fish, and find that the main absorption bands are at 693 mμ (and inflection 620 mμ) for chloroformic antimony trichloride, and 345 mμ for alcohol. These properties are in contrast to those of marine fish and mammalian liver oils and concentrates, where the corresponding maxima are 620 and 328 mμ respectively, and may possibly be due to a second vitamin A with some degree of specificity for freshwater fish.

A substance with absorption bands at 350 and 287 mμ, giving a green colour with antimony trichloride ($\lambda_{max.}$ 693 mμ), is stated by Drs. J. R. Edisbury and R. A. Morton, and G. W. Simpkins to appear in the liver, viscera and sometimes eyes of fish, particularly freshwater fish. It resembles vitamin A so closely that it is tentatively designated 'vitamin A_2'.

F. W. Fox and W. Stone state that a substance other than ascorbic acid and having no antiscorbutic activity is formed in large quantities in Kaffir beer. It behaves as ascorbic acid with indophenol at a *p*H higher than 2·0, with the folin uric acid reagent, and with ascorbic acid oxidase. It does not react as ascorbic acid with norite charcoal or with indophenol at a *p*H between 1·2 and 1·8.

Theoretical curves for the absorption of the soft component of cosmic radiation by lead and aluminium have been calculated by Dr. W. Heitler on the basis of the quantum theory. The few available values from experimental measurements fall satisfactorily on these curves.

F. Hoyle states that, to account for the result of Jacobsen's recent experiments, it is necessary to assume a β-decay interaction term which combines the wave-functions of the heavy and light particles in a more interrelated form than the expressions proposed by Fermi and Konopinski-Uhlenbeck. This modification makes more definite predictions of the low-energy end of positron and electron spectra, which seem to give reasonable agreement with the empirical β-decay curves.

From the Raman spectra of solutions of ethyl ether in excess halogen acids, Dr. G. Briegleb and W. Lauppe conclude that, in solution, they form 'oxan' compounds containing tetravalent oxygen.

By directing jets of supersaturated vapours of common liquids against surfaces of mica, Prof. D. H. Bangham, S. Mosallam and Z. Saweris have produced films which give rise to interference colours, and yet have properties very different from the bulk liquids; these they regard as thick adsorbed films.

Taking into account the ellipticity of the earth, Dr. Harold Jeffreys has redetermined a large number of epicentres of Pacific earthquakes, and finds great improvement in the reliability of Pacific seismological stations.

Further experiments by Dr. T. F. Wall on the influence of surface treatment on magnetic properties show that nickel wires, heated in hydrogen and then cooled (for low values of the magnetic field strength), the greater the ratio of the surface perimeter to the cross sectional area, that is, the smaller the diameter, the less easily magnetized they are. An increase in the coercive force and in the remanence is likewise observed as the diameter decreases.

W. O. Williamson directs attention to the reversible darkening of some commercial titanium dioxide under the influence of light, and indicates a number of possible explanations.

A new crystal form of resorcinol is described by A. R. Ubbelohde and Dr. J. Monteath Robertson. This resembles the beta form of the tetradeuteroresorcinol crystals, and the authors suggest that there is a difference in the hydroxyl bonds in the two crystal forms, due to a difference in the intermolecular resonance.

The distance between the carbon and the halogen atoms in the methyl halides, recalculated from the spectroscopic data by Dr. G. B. B. M. Sutherland, are markedly smaller than the previously accepted ones and those obtained by the method of electron diffraction. The revised values appear the more likely to be correct on comparison with the corresponding distances in the carbon tetrahalides and with the force constants for the carbon-halogen bond in the two cases.

Prof. A. D. Peacock and Dr. Ann R. Sanderson find in the thelytokously parthenogenetic saw-fly, *Thrinax macula*, that the female chromosome constitution is $2n = 14$, that of the rare male (from second spermatocytes) $n = 7$, and that there is only one maturation division, non-reductional, in oogenesis. The work of Doncaster and of Comrie with other species of thelytokously parthenogenetic saw-flies shows two maturation divisions in oogenesis, and Peacock, Sanderson and Greenshields find that the female chromosome constitution in some 40 species of saw-flies is $2n = 16$. Accordingly, autoregulation of chromosome number in saw-flies is maintained by at least two methods, whilst *T. macula* is exceptional in its chromosome constitution.

Research Items

The Oolitic Limestone Escarpment in Bronze Age France

MISS MARGARET DUNLOP, in a study of the significance of the Oolitic limestone escarpment in the Bronze Age in France (*Man*, July 1937), points out that the grouping of Bronze Age finds in France is such that it is possible to discern three types of environment—maritime, riverine and plateau. In the cooler, wetter conditions of the Middle Bronze Age in the ninth century B.C. the forest-tree plateau, and the Oolitic limestone ridges in particular, are significant in the distribution of certain objects of material culture. They form a natural region imposing topographic restrictions on those using them, and may be said to be a distinct, though secondary, cultural province in the life of Bronze Age France and a feature of vital importance in the maintenance of exchange and some semblance of organization during the unsettled conditions of the Hallstatt phase of readjustment. The major Bronze and Early Iron Age cultural spreads affecting the French Oolite are as follows: *c.* 1750 B.C., an infiltration from the Rhine Valley and south Germany, characterized by the large broad triangular dagger and the flanged axe; (Jura, Dauphiné, down Rhone, etc.); *c.* 1400 B.C., invasion from south Germany and Bohemia—dagger with blade with two rivets, simple sword (Jura, Charente, south to Gard and Puy de Dome, tumuli of Côte d'Or and Jura, Herault); *c.* 1200 B.C., invasion and infiltration from north European plain—riveted pistiliform sword, winged lance with eyelet holes, terminal winged axe (Aube, Marne, S. Brittany); *c.* 850 B.C., first Hallstatt invasion from south Germany and western Austria—short bronze sword (Oolitic outcrop, eastern tumuli); *c.* 600 B.C., renewed invasions from same sources—iron sword with bronze rivets, hilt terminating in double circle (distributed as in previous period, concentration around iron mines of Chatillonais, north of Côte d'Or).

Extinct Mammals and Man in America

FURTHER evidence relating to the contemporary existence of man and an extinct mammalian fauna was obtained in pluvial deposits near Clovis, New Mexico, in the course of 1936. An account of the results of the work of the expedition, which was under the direction of Dr. E. B. Howard, acting on behalf of the Philadelphia Academy of Natural Sciences, has been prepared by Mr. John Lambert Cotter (*Proc. Acad. Nat. Sci. Philadelphia*, 89). The site under investigation was that known as "the gravel pit" in Blackwater Draw, between Portales and Clovis. The stratigraphy of the pit is characterized by the occurrence of three more or less distinct layers, aggregating approximately seven feet: first, brownish sand, extending two and a half feet from the surface; second, a bluish material containing sand, grit and clay, three feet; third, a speckled sand, one and a half feet thick. The blue stratum and the speckled sand were found to contain certain bone remains, with which were associated two Folsom-like points, a fragmentary point, a scraper, several flakes, all of chalcedony, and two bone artefacts, such as have not previously been associated with a Folsom industry. The occurrence of the bones resolves itself into certain characteristics: the bones of the bison, except for a cannon bone and a scapula, occurred in the blue material immediately above the mammoth. The mammoth bones occupied the contact between the blue material and the speckled sand. Below the mammoth bones in the speckled sand were horse bones and traces of turtle-shells, thirteen inches below the contact of blue material and speckled sand. The lithic and bone artefacts were in definite association and contemporaneous with the mammoth bones. The bone artefacts show bevelled surfaces at their ends, which are compared with the splicing technique of the Eskimo and Indians of North America.

The Hæmorrhagic States

THE hæmorrhagic states were the subject of a discussion at a combined meeting of the Sections of Medicine and Pathology, Bacteriology and Immunology of the British Medical Association at its recent meeting in Belfast. Prof. L. J. Witts delivered the opening paper. He said that these conditions did not lend themselves to rigid classification. In the treatment of hæmophilia, the local application of coagulant snake venoms was an important advance, but liver extract, œstrin and moccasin venom had been failures. For the idiopathic thrombocytopenic purpura removal of the spleen was the most successful treatment, but its mode of action was uncertain. Vitamin C was of value in scurvy only, and not in other hæmorrhagic states. Dr. Capon discussed hæmorrhagic conditions occurring occasionally in the newborn (about one in 400 cases) and found that the majority were relieved by an intramuscular injection of whole blood. Dr. Timperley maintained that an extract of egg-white, prepared by his special method, controlled internal hæmorrhage in hæmorrhagic states, but its efficiency was not confirmed by other speakers.

Grass-drying

SINCE the Agricultural Research Council issued its first report in 1935 on the preservation of grass and other fodder crops, much new information on the subject has been obtained and considerable advances made. While fewer than a dozen driers were in use in Great Britain during 1935, nearly fifty were at work in 1936. A survey of the problems connected with grass-drying and its effect on the economy and management of farms has been made by E. J. Roberts, and published as a report entitled "Grass Drying" to the Committee of the Council (London: H.M. Stationery Office. 2*s.* net). An introductory chapter describes the different methods of preserving grass, while others follow which deal with the extent of the grass-drying movement, the production of suitable herbage, the water content of the herbage,

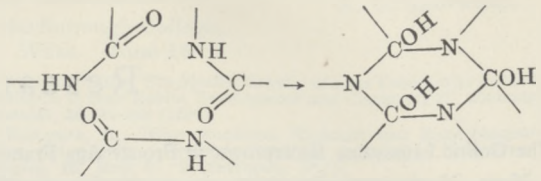
cutting and hauling, furnaces, fuels and power, grass-drying machines and the feeding value of young grass. In the concluding chapter, the cost and profitableness of producing dried young grass are considered. Drying only becomes worth while if the special nutritive qualities of young grass can be conserved, and in wet seasons when growth is so rapid that the drier cannot deal with all the produce, definite areas should be devoted to hay-making or ensiling. The collection of short young grass originally offered some difficulty, but machines have now been devised which overcome this. The cost of production of dried grass in 1936 varied considerably on different farms; but the average figure, allowing for rent, overhead expenses and depreciation, was about £6 per ton, a figure which at the present price of concentrated feeding stuff allows a margin on true nutrient values. The chief obstacle to an extension of the process is the high capital cost of driers; but doubtless these will be lowered as experience is gained, and the enthusiasm shown both by the farmers and by the manufacturers of driers will go far to overcome the difficulties at present encountered.

The Soviet North Polar Station

Reports received in Moscow by radiogram from the floating observatory in the vicinity of the North Pole and supplied by the Soviet Union Year Book Press Service have already announced some results of interest. In lat. 88° 54′ N. long. 21° W. the depth of the Arctic Ocean was found to be 2,345 fathoms (4,290 metres) and in lat. 88° 47′ N., long. 10° W. 2,391 fathoms (4,374 metres). These readings compare with Peary's 1,500 fathoms (2,743 metres), no bottom, within five miles of the Pole and Amundsen's 2,050 fathoms (3,750 metres) in lat. 87° 43′ N., long. 10° 21′ W. Since the station is steadily drifting farther important soundings may be expected. In relation to Wilkins's sounding of 2,974 fathoms (5,440 metres) in lat. 77° 45′ N., long. 175° W., it would appear that the deepest parts of the arctic basin occur in the Beaufort Sea and adjoining the wide Asiatic continental shelf. Another discovery of importance is the occurrence of a layer of water at a depth of 275–600 metres with a temperature above 0° C. and a high salinity. This would appear to be the Atlantic water which Nansen discovered to be sinking, in the Spitsbergen area, below the colder and less saline polar water. Lastly, plankton determinations show a much more abundant pelagic life than had been anticipated.

Patterns of Proteins

In a recent paper (*Proc. Roy. Soc.*, A, **160**, 59; 1937), Dr. D. M. Wrinch presents a reasoned account of her theory of the molecular constitution of proteins. This is an attempt to provide a unitary explanation of three characters common to all soluble proteins: (*a*) The molecules are largely made up of amino- and imino-acid molecules. They contain peptide linkages but few free NH_2 groups. (*b*) There is a general uniformity among proteins of widely different chemical composition. (*c*) A large number of crystalline proteins have highly symmetrical crystals. These properties she claims to explain on the basis of higher order polymerization of amino-acids. The simple peptide link can only give rise to rings or chains of amino-acids. To get more complex aggregates it is necessary for each molecule to be linked to three or four others. This can be done by an inner transformation according to the scheme:



On the basis of this transformation, it is possible to build up trigonal plane groups of different stages of complexity. These 'cyclol' sheets have, owing to the fact that all the amino-acids are of the α type—an observation which here, it is claimed, obtains significance for the first time—have all their side chains on one side of the plane. They can further be attached together either by means of these side groups or by hydroxyl bonds, thus forming larger aggregates, which must necessarily be integral multiples of the smallest of them, as Svedberg had found. Owing to their unsymmetrical character, such cyclol plates will be surface-active and the hypothetical structure gives a good agreement for the surface densities of protein films. Owing to the great complexity of protein chemistry, it may be long before it is possible to verify any of these hypotheses, but it must be admitted that the solution offered, although it contains arbitrary elements, is both simple and elegant.

Observation of a Fireball Train

In a recent paper (*J. Brit. Astro. Assoc.*, **47**, 7; May 1937), Mr. M. A. Ellison describes a fireball observed on March 21 about $19^h\ 02^m$ U.T. The brightness was greater than that of Venus, and the colour was a golden-red. The most important point about this fireball was the velocity of the train. Mr. Ellison estimates that, at a height of 60 miles, the drift velocity was 133 miles per hour. From the configuration of the train, it is possible that the middle portion was subject to a current of even higher velocity than the ends. Many will be surprised at this velocity in the higher regions of the atmosphere, where it is believed that diffusion is a more potent factor in mixing the gases than currents of wind. If Mr. Ellison's figures be correct, it is obvious that the latter cannot be ignored in the stratosphere.

Aerodynamic and Electrodynamic Equations

N. P. Kasterin (Report of Academy of Sciences, U.S.S.R., December 9, 1936) has attempted to account for many phenomena, usually explained by relativity or quantum mechanics, on a strictly classical basis, merely by adding small extra terms to Maxwell's electrodynamical equations. At the same time he adds similar terms to Euler's equation of hydrodynamics, and unites these two sets of equations into a common system. It is claimed that the new hydrodynamic equations, as applied to vortex motion of gases (which is of great importance in aviation) explains several well-known phenomena inexplicable by the old equations. As for the new form of Maxwell's equations, the extra terms are non-linear, and involve a variable velocity of light. It is stated that the quantum properties of the field can be deduced from this basis. The grounds for this assertion are not fully explained, but they appear to be connected with an analogy between moving tubes of force and gaseous vortices.

Validity of Laws of Electrodynamics

IN the course of an investigation carried out for an electrical engineering company, I found that some generally accepted laws of electrodynamics were incorrect, and that serious mistakes were therefore being made by electrical engineers. As the laws here

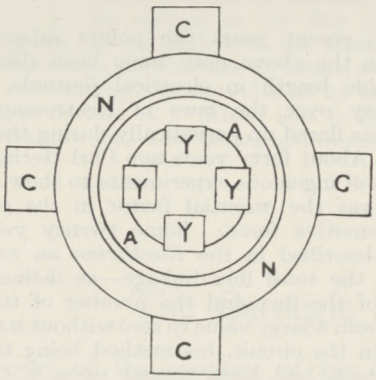


Fig. 1.

referred to have been taught by such high authorities as Maxwell and Jeans, they are naturally being repeated in most of the text-books that are now used at our universities and technical colleges: in fact, one of these laws (which has already caused patents to be taken out for circuit breakers that will work in a very different way from what was expected, and for electric motors that will not work at all) is taught in all text-books that deal with the subject, including those used on the Continent and in America.

The law to which I have just referred is sometimes ascribed to Laplace, sometimes to Biot and Savart, sometimes to Ampère, and sometimes to Maxwell; but all teachers appear to regard that law as infallible. It may be stated as follows, though it is more frequently stated in a less complete form.

When a straight conductor element of length dx carries a current i in the OX direction of rectangular co-ordinates (right-handed) and lies in a magnetic field where the flux density has a component b in the OY direction, it is acted upon by a force $i.b.dx$ in the OZ direction.

The units here referred to are, of course, those of the C.G.S. system usually employed in text-books of electromagnetism. The current is accordingly in dekamperes and the force in dynes. In view of the doubt with regard to the name of the investigator by whom this law was first enunciated, I propose calling it 'the *i.b* law'. This name seems appropriate, since the law says that *i.b* is the force intensity (dynes per centimetre length of conductor) at the point in question.

But when the *i.b* law is applied to the case shown in Fig. 1, which is an end-view of a direct-current slip-ring dynamo designed by Dr. A. E. Clayton, it tells us that the machine will work, though Dr. Clayton found that it would not. From his description of the machine, in the *Electrician* of July 2, 1915, it appears that he may not have designed it with the idea that it would work, but with the idea that its failure would disprove Faraday's law of electromagnetic induction. He evidently overlooked the fact that its failure has disproved the *i.b* law; for he continued to teach this law, which is repeated in his latest books on dynamo design. But the following considerations will make it clear that the *i.b* law has been conclusively disproved by the failure of this machine.

In Fig. 1, C, C, C, C are the ends of the straight iron cores upon which the field coils are wound, N is the ring-shaped north pole of the magnet, A is the ring-shaped core of the armature, and Y, Y, Y, Y are the ends of the straight iron yokes that connect this armature to a similar one at the south pole end and rotate with these armatures. All the rings here referred to were of rectangular cross-section, and the armatures were ring-wound on the parts between the yokes.

The machine should evidently work as a motor, according to the *i.b* law, when the windings are suitably fed with direct current through the slip-rings; for the conductors that are in the main flux (between the armature cores and the magnet poles) should be subjected to a force much greater than any opposing force acting on conductors in the leakage flux, owing to the great permeance of the magnetic path in the iron yokes. Actually, however, the machine would not work; and this will be understood when attention is directed to the fact that the amount of flux linking the winding would not begin to change when the armature began to rotate, with the consequence that (according to Neumann's law) no back-e.m.f. would be generated.

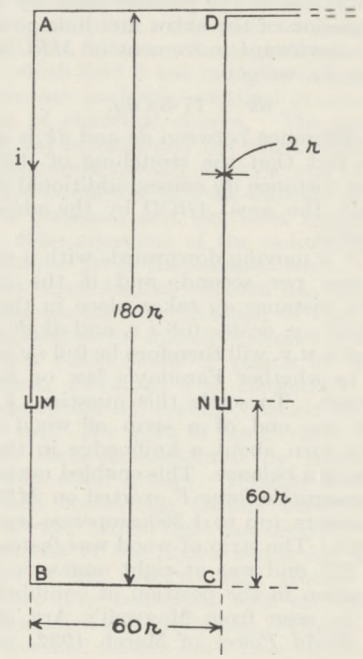


Fig. 2.

Dr. Clayton eventually came to the conclusion that his machine was a failure from every point of view: that is to say, it not only failed to work, but also (in his opinion) failed to give a disproof of Faraday's law. His present view is that Faraday's "lines of magnetic force" were rushing from yoke to yoke when the armature was rotating, cutting the inside conductors on their way, and thereby generating an e.m.f. that counterbalanced the one generated in the outer conductors. Many electrical engineers are unable to see any justification for this view; and Dr. Clayton will certainly find it useless as a defence of Faraday's law against the following argument.

Fig. 2 shows an experimental circuit-breaker arrangement, with mercury cups at M and N (where the arcs would be formed when the actual circuit breaker began to open). When this arrangement is surrounded by air, or by any other medium of unit permeability in the C.G.S. electromagnetic system, the amount of flux dc that is cut during a downward movement of $MBCN$ through the distance dy, with the current kept constant, can be calculated by methods explained in text-books of electromagnetism. It will thus be found that dc consists of a part

$$2\,i\,dy\,(0{\cdot}054 + 0{\cdot}161)$$

that comes from $MADN$ and is cut by BC, and a part

$$2\,i\,dy\,(0{\cdot}054 + 0{\cdot}030)$$

that comes from $MBCN$ and is pulled across AD, so that

$$dc = 0{\cdot}6\,i\,dy.$$

According to Maxwell (see Art. 541 of his "Treatise on Electricity and Magnetism"), the total amount of flux-cutting must be equal to the total increase in the flux that links the electric circuit. But when we try to verify this in the present case, by making a direct calculation of the extra flux linkage dk that is due to the downward movement of $MBCN$ through the distance dy, we get

$$dk = 17{\cdot}5\,i\,dy.$$

The great difference between dc and dk is accounted for by the fact that the stretching of AB and DC through the distance dy causes additional flux to be sent through the area $ABCD$ by the added lengths dy at M and N.

If $MBCN$ is moving downwards with a velocity of v centimetres per second, and if the movement through the distance dy takes place in the time dt, we have $dy/dt = v$, $dc/dt = 0{\cdot}6\,i\,v$, and $dk/dt = 17{\cdot}5\,i\,v$. The induced E.M.F. will therefore be $0{\cdot}6\,i\,v$ or $17{\cdot}5\,i\,v$, according to whether Faraday's law or Neumann's law is correct. To settle this question, I attached $MBCN$ to one end of a strip of wood that was arranged to turn about a knife-edge in the manner of the beam of a balance. This enabled me to measure the electromagnetic force F exerted on $MBCN$ when various currents (up to 1,300 amperes) were flowing in the circuit. The strip of wood was fastened to the middle of BC, and was at right angles to the plane of $ABCD$ when in the position of equilibrium.

As will be seen from Maxwell's Art. 583 or my article in *World Power* of March 1932, the energy equation is either

$$F\,dy = \tfrac{1}{2}\,i\,dc \quad . \quad . \quad . \quad . \quad (1)$$

or

$$F\,dy = \tfrac{1}{2}\,i\,dk, \quad . \quad . \quad . \quad . \quad (2),$$

according to whether Faraday's law or Neumann's law is correct; and a measurement of F with any given value of i will show whether (1) or (2) is the correct equation. In each of the numerous cases that were tried, with various ratios of BM to BC and of BM to BA, the measured force was in close agreement with equation (2), though it was frequently (as in the case of Fig. 2) between 20 and 30 times as great as the force indicated by equation (1).

It may therefore be concluded, not merely that there is sometimes a great difference between the dc and dk that Maxwell thought to be identical, but also that Neumann's law is right and Faraday's is wrong.

W. F. DUNTON.

DURING recent years the points raised by Mr. Dunton in the above note have been discussed at considerable length in electrical journals. Indeed, controversy over the laws of electromagnetic induction has flared up periodically during the last half century. About forty years ago Carl Hering devised a number of ingenious experiments to show that 'flux cutting' was the essential factor in the generation of electromotive force. Some twenty years later, Blondel described in the *Electrician* an experiment in which the total flux linkage—as defined by the product of the flux and the number of turns—was reduced from a large value to zero without E.M.F. being induced in the circuit, his method being to unwrap a coil which had been wound upon a cylindrical magnet. A few years prior to this, I had carried out a number of experiments in an attempt to establish discrepancies between the 'flux cutting' and the 'rate of change of flux' theories, and in the correspondence consequent upon the publication of Blondel's work, I described one of the models I had made for that purpose.

This model is the one described above by Mr. Dunton; before it was built it was anticipated that no E.M.F. would be generated in its winding, and its behaviour on test fulfilled those expectations. However, I finally concluded that the action of the model was in line with that of the slotted armature generators now universally used, and the result of my investigations was to lead me to conclude that the total amount of 'flux cutting' is always equal to the change in the flux linkages. In short, my conclusions were in agreement with Art. 541 of Maxwell's classic book.

The behaviour of the model as a motor was never considered, but it follows that if its behaviour as a generator is in line with the slotted armature machine, such will also be the case for motor action. The action of motors with slotted armatures is well known, and it is also well known that the torque developed between stator and rotor is altogether greater than would correspond to the product of the current in the conductors and the flux density in the slot. In my opinion the model gave no evidence regarding the laws of electromagnetic induction and electrodynamics other than that long since available with slotted armature machines.

For the past few years, Mr. Dunton has, in a most energetic and far-reaching manner, challenged the validity of some of the commonly accepted laws. His work arises out of calculations connected with expanding circuits—such calculations being of particular importance in the design of circuit-breakers. One such example is given in Fig. 2 of Mr. Dunton's communication. Now the flux linked with a circuit may be changed in various ways, of which one (*a*) is by changing the current carried by the circuit, and

another (*b*) is by maintaining the current constant and expanding the circuit as indicated, for example, by Mr. Dunton's Fig. 2. To my mind, there is no essential difference between these two cases. Nothing is to be gained by confusing the issue with mathematics, for the only real issue involved is the manner in which the magnetic field comes into being. If it be taken that the growth of the field in (*a*) is accompanied by a corresponding flux cutting it surely must follow that any new flux created in (*b*) also necessitates a corresponding flux cutting.

Quoting now from Mr. Dunton's letter: "The great difference between *dc* [that is, the flux cutting] and *dk* [that is, the change in the flux linkages], is accounted for by the fact that the stretching of *AB* and *DC* through the distance *dy* causes additional flux to be sent through the area *ABCD* by the added lengths *dy* at *M* and *N*". From this it is evident that Mr. Dunton has not concerned himself with how this additional flux comes into being, and if his interpretation of flux cutting be taken there is no flux cutting in case (*a*) above. It is my view, therefore, that Mr. Dunton's arrangements of expanding circuits give no evidence—in support or otherwise of the validity of Art. 541 of Maxwell's "Treatise on Electricity and Magnetism"—other than that presented by the case of simple circuits carrying changing currents.

The issue involved is, of course, one of pure physics. With the great developments that are taking place in atomic physics one can look forward to the time when physicists will wrest further secrets from Nature and give to electrical engineers a clearer conception of what is really happening in magnetic fields, and of the 'mechanism' by which E.M.F. is actually induced in a circuit. But at the moment I see no reason for abandoning existing conceptions.

A. E. CLAYTON.

The Carnegie Institution of Washington

THE report of the president of the Carnegie Institution of Washington for the year ending October 31, 1936, reviews the relationship of its existing policies to research, and examines some of their implications as well as giving a brief account of researches in progress (Washington, D.C.: Carnegie Institution, 1937). The Institution has so far limited itself largely to securing new data and to the organization of information relating to mathematical research, investigation of natural phenomena and to history. The value of science in terms of its contribution to meet human needs is shown in many ways, but the Institution has also been concerned with the ways in which science can be effectively utilized to deal with difficult human relations such as those represented by economics and government. These possibilities have been recognized with the assumption that the best method of procedure is by co-operation between the sociologist, economist, or student of government and representatives of sciences with closely allied methods or problems.

The Institution has endeavoured to secure the practical application of results of research, whether from the physical or biological sciences or in human values, as in psychology, and the importance of bringing together, in appropriate organizations, scientific workers and engineers and students of social and economic problems, with a view to the utilization of new ideas and techniques, is stressed. Responsibility in this field rests in part upon the scientific worker, and it is essential that the possible influence of science upon thought, and in the development of techniques which influence modes of thought, should receive close attention. Even in international relations the cultural and economic significance of science should not be overlooked.

In the field of astronomical research the work of the Mount Wilson Observatory has reached a stage when the accumulation of data permits the formation of new patterns with new theories and new points of view. The appearance of a bright nova in the constellation of Lacerta on June 18, like that of Nova Herculis, has received careful study, while a super-nova has been discovered in one of the extra-galactic nebulæ of the Virgo cluster. An extensive preliminary survey has been made of the number and distribution of the extra-galactic nebulæ corresponding to the Milky Way, and measurements of the red shift of remote nebulæ have received intensive study. The Department of Terrestrial Magnetism, in addition to studies on the causes of fluctuations in the earth's field, has investigated the question of magnetic disturbances, including world-wide magnetic storms, as well as the relation of magnetism to atomic physics, in which field it has been shown that protons and neutrons are probably identical in every respect except that of electrical charge. The Geophysical Laboratory has investigated the equilibrium between crystalline minerals, usually silicates, and their melts, including the equilibria of rock-forming silicates at atmospheric pressure, and has been responsible for a series of determinations of the radium content of samples obtained from the ocean-bottom.

Important seismological research has been carried out at Pasadena, and the Division of Plant Biology has been responsible for intensive studies of individual functions and components of plants as well as in photosynthesis, including the carotenoid pigments and the absorption of carbon dioxide by the unilluminated leaf. The work of the Division of Animal Biology has been characterized by increasing co-operation with other groups. Definite evidence has been obtained concerning factors involved in the origin of tumours. Much light has been thrown upon the development of the layers which are defined in early stages of the embryo, and studies in endocrinology have been concerned with the influence of prolactin, and the milk-producing hormone.

Other important studies have been concerned with genetics and nutrition, while the Division of Historical Research has concentrated attack on the early history of the Maya and major questions relating to the advance of civilization which have emphasized the value of data from other civilizations for testing modes of life and growth of an advancing civilization.

Fourth International Grassland Congress

THE paper-reading sessions of the fourth International Grassland Congress were held at Aberystwyth on July 14–18, under the presidency of Prof. R. G. Stapledon. A preliminary tour was arranged from Oxford through Leicestershire, the Cotswolds, Herefordshire and central Wales; a party of two hundred delegates left Oxford on July 10 and arrived in Aberystwyth on July 14. Delegates who participated in this tour had excellent opportunities of studying the modern developments in English grassland farming, such as the use and production of pedigree seed, artificial drying of grass, etc., and were therefore in a better position to appreciate the papers read afterwards by British specialists at the Aberystwyth meeting.

The numerous papers offered for presentation to the Congress were divided among plenary and sectional sessions. The plenary papers were divided into three groups, dealing with nutritional questions, herbage plant breeding and general grassland respectively. The sectional sessions, held on July 16, covered the six subdivisions of grassland research, namely, (1) grassland ecology, (2) seed mixtures, (3) plant breeding and seed production, (4) manures and fertilizers, (5) nutritive value of pastures and fodder conservation, and (6) management, yields and economics of pastures.

The subject-matter of the papers read is perhaps best dealt with according to country; this Congress differed in scope from its three predecessors, held in Germany, Scandinavia and Switzerland respectively, as the 450 delegates came from thirty-seven countries in all parts of the world, and were therefore interested in more varied aspects of the grassland problem than at the earlier conferences.

The British papers were concerned chiefly with the breeding of pure-bred grasses and clovers (T. J. Jenkin and R. D. Williams, Aberystwyth), the production and marketing of seed of pure-bred strains (T. E. Miln, Warrington, and Gwilym Evans, Aberystwyth), the use of lime and phosphate in grassland improvement (J. A. Hanley, Newcastle, and R. G. Heddle and W. G. Ogg, Edinburgh and Aberdeen), the production and nutritive value of artificially dried grass (H. E. Woodman, Cambridge, and E. J. Roberts) and the economics of grassland improvement (John Orr, Manchester).

An important European paper was that delivered by A. I. Virtanen, Finland, on the associated growth of legumes and non-legumes; the old-established fact that non-legumes benefit by an association with legumes has been explained by recent work in his laboratory at Helsinki. Exact work with sterile culture technique has conclusively shown that nitrogenous compounds are excreted into the soil from legume nodules, and that this excretion commences immediately upon the formation of nodules. The excreted nitrogen compounds are products of nitrogen fixation and not decomposition products of proteins; the excretion products have been studied in an attempt to shed light on the mechanism of nitrogen fixation. The excretion is apparently an equilibrium reaction. Excretion of amino-acids has been demonstrated with all legumes so far examined (different species of clover, peas and lucerne). Application of nitrate appears to lower markedly the excretion.

A wide range of topics was covered by readers from other European countries. The Scandinavian countries have always been in the forefront as regards breeding of herbage plants; they were here represented by N. Sylvén and H. Osvald, Sweden, and O. Valle, Finland. C. K. van Daalen, Holland, also stressed the importance of using indigenous or pure-bred seed when sowing down pastures.

Papers on the grasslands of Hungary, read by K. T. Kolbai and J. von Piukovich, indicated the rapidly increasing interest in the subject in that country, where there are now three grassland unions with 60,000 farmer members. Another paper from the same country, by N. von Bittera, dealt with the peculiar problems of applying fertilizers to arid grassland, a subject of direct importance to the delegates from North America, Africa and Australia.

The profitability of applying nitrogenous fertilizers was discussed by readers from Sweden, Holland and Germany, the conservation of grassland herbage in the form of silage by delegates from Great Britain, Switzerland and Germany, and the good effect of alpine pasturing upon the health of stock by V. Vezzani and E. Carbone of Italy. One of the leading grassland experts from Germany, E. Klapp of Bonn, compared the effects of mowing and grazing upon pastures in general and upon certain herbage grasses and legumes in particular.

The outstanding value of pastures in erosion control has been an important factor in the rapid growth of pasture research in the United States and Canada in recent years. It was therefore not surprising that these two countries should be well represented at the Congress; the American delegation, under its chairman, P. V. Cardon, principal agronomist in charge, Division of Forage Crops and Diseases, Bureau of Plant Industry, U.S. Department of Agriculture, numbered fifty persons, the majority of whom were travelling in one party under the guidance of Dr. D. B. Johnstone-Wallace, Cornell University, on a tour of centres of grassland and scenic interest in Great Britain, Scandinavia, Germany, Austria, Switzerland and France.

Papers representing the current American outlook were read by three members of the U.S. Department of Agriculture, namely, P. V. Cardon (Bureau of Plant Industry), W. R. Chapline (U.S. Forest Service), and C. R. Enlow (Soil Conservation Service), who dealt respectively with the new herbage plant breeding programme, the revegetation and rehabilitation of the range lands of the western States and the value of pastures in erosion control. D. B. Johnstone-Wallace described his experiments with wild white clover at Cornell University in New York State, which have been attracting so much attention in recent years among the pasture agronomists working in the more humid parts of the eastern United States.

L. E. Kirk discussed the herbage plant breeding problems of eastern and western Canada, while O. McConkey directed attention to the serious mineral deficiencies in the pastures of eastern Canada.

H. R. Marston presented in scientific terms the Australian sheep farmers' argument that "sown pastures ruin the wool" of the merino sheep. Improvement of the nutritional level of a pasture from

one which has seriously handicapped production will certainly affect the quality (fineness) of the fleece, but this change may just as certainly be made, if need be, by the alteration of the type of sheep used for wool-growing on these areas. Small-framed, densely covered breeds of merinos which have been selected to produce fine wool when grazed on richer areas are well known.

E. Bruce Levy described the conversion of rain forest to grassland in New Zealand; the forests converted are mainly of two types: rain forest proper and sub-antarctic southern beech forest. The stages of the conversion to the famous pastures of New Zealand were described in full, particular credit being given to the pioneer back-country bush settlers. A similar topic was discussed by G. H. Holford, New Zealand, who illustrated his talk with a colour film.

The changing agricultural outlook in South Africa, resulting from the ravages of soil erosion, was described by the representative of the South African Department of Agriculture, J. W. Rowland. A re-orientation of the principles of arid land farming must come about, governed by a full consideration of the land, in the light of the complex inter-relationship between the soil, the plant and the climate.

The Congress ended with a tour through Northumberland to Edinburgh, when a day was spent in the Central Highlands of Scotland and the Trossachs.

The report of the Fourth Congress, containing the full text of all papers read, together with their English and German abstracts, will be published in October or November of this year, price £2 per copy. A volume containing the abstracts only (in English and German) is now available, price 5*s*., and may be obtained from the joint Secretaries, Fourth International Grassland Congress, Aberystwyth.

At the general meeting of the International Grassland Congress Association on July 16, Dr. D. S. Huizinga of the Netherlands repeated the invitation, already given at the Third Congress at Zürich, to hold the Fifth Congress in the Netherlands in 1940. The invitation was gratefully accepted, and Dr. Huizinga was elected president of the Fifth Congress The Association was invited by Count Teleki of Hungary to hold its sixth meeting in that country in 1943.

Geology of Jersey

THE claims of Jersey in the Channel Islands as a field of research for British geologists and as a most suitable locality for field classes for students has more than once been urged. The chief reason why Jersey is not more widely used for the latter purpose, in spite of its undoubted attractions, is the lack of a modern complete connected account of the geology of the island.

In September 1934, the Geological and Mineralogical Society of Brittany visited the island under the direction of A. J. Robinson and A. E. Mourant. The report of the excursion has recently been published as a memoir of the Society[1], and should prove invaluable to geologists intending to visit Jersey. The work is in French; but it is typical scientific French, and the writers clearly realized that many of its readers would be English-speaking. Probably for this reason, the work of those English geologists who established the succession and relationships of the rock groups of Jersey is barely mentioned. In justice to them, however, it should be stated that the relationships described by Wells and Wooldridge[2] are accepted by the writers of the memoir, with one exception; they claim that no important break occurs between the St. Lo shales and the volcanic group.

A broad outline of the geology of Jersey is condensed into the first few pages, while the rest of the first part of the memoir is taken up by a detailed day-by-day account of the excursion. The memoir is, however, much more than a mere itinerary: it includes discussions of the many problems of age and field relations which still await complete solution. Thus the commonly accepted view that the lavas are of Pre-Cambrian age and probably to be correlated with the Uriconian volcanic rocks of Britain, is re-examined in the light of a careful comparison between the Jersey lavas and those of the mainland of Brittany, and in view of the claim strongly urged by M. Y. Milon, of the University of Rennes, that the lavas of Paimpol are of Carboniferous, not Pre-Cambrian, age.

M. Milon himself contributes interesting "Notes and Observations on the Geology of Jersey and Armorica". In particular, the age and conditions of accumulation of the Rozel conglomerate group are discussed, and it is concluded that these rocks, so strikingly similar to the Permian breccio-conglomerates of eastern Devonshire, were deposited on the borders of a Permo-Triassic cuvette, under 'continental' conditions.

In addition to the solid geology, the Pleistocene deposits, the raised beaches and the caves are adequately described by M. A. Bigot in the second part of the memoir.

Although natural inland outcrops are few in Jersey, the island provides a magnificent series of coastal exposures in the cliffs and extensive wave-cut platforms. In the main, these exposures are not difficult of access; but the casual visitor is liable to disappointment unless the tides are studied and the routes so chosen as to take full advantage of the periods of low water. With commendable foresight, the authors recommend in the introduction that the conditions are most favourable during the period comprising the three days before new or full moon and the five days which follow. The authors are resident in Jersey, and their detailed local knowledge has ensured that in the course of the five journeys described the time would be used to the best advantage and the maximum of geology would be seen. Each route is clearly shown on a sketch-map, with localities numbered to correspond with the text. For those with more time at their disposal, additional excursions are suggested.

Among the nineteen figures included in the text are several geological sketch-maps on a generous scale, while a folding geological map on the scale of 1 : 50,000 and five plates are incorporated.

A. K. W.

[1] "Contributions à l'étude géologique des Iles de la Manche et du Trégorrois." *Mem. Soc. Géol. et Min. de Bretagne.* **3** (1936). Obtainable from Prof. Y. Milon, Institut de Géologie, Rennes (30 francs), and the Museum, 9 Pier Road, Jersey (5*s*.).

[2] *Proc. Geol. Assoc.*, **42**, 78 (1931).

Science News a Century Ago

The Entomological Society

AT a meeting of the Entomological Society held on August 7, 1837, Mr. Bowerbank exhibited specimens of cork infused by termites while on board ship, and suggested measures to prevent attack by such insects; Mr. Bainbridge spoke of the damage to apple trees in the neighbourhood of Lambeth by a small species of moth; and Mr. Westwood gave an account of an entomological visit he had lately made to Paris, noticing among other things a disease called muscadine with which silkworms had been very extensively attacked in France. The malady was a parasite which gradually enveloped the whole body in a white fungus and destroyed the worm, the mischief being produced by the explosion of a fungus, which is taken in by the spiracles or pores of the skin, as has been proved by M. Audouin, who has inoculated several worms and beetles with it. In concluding, Mr. Westwood made some remarks on the progress of entomology in France, which he stated to be in advance of Great Britain, there being more working cultivators, and the collection at the Jardin des Plantes being superior to that at the British Museum; M. Audouin had just completed a course of fifty lectures on entomology.

Bradley's Zenith Sector sent to the Cape

WHEN Maclear became Astronomer Royal at the Cape of Good Hope in 1833, one of his first tasks was to re-measure and extend the arc of meridian measured by the French astronomer Lacaille in 1752. To further this work, Airy, on February 24, 1837, wrote to Captain Beaufort, the hydrographer at the Admiralty, suggesting that Bradley's sector then at Greenwich should be used for verifying the astronomical determinations. The Admiralty agreed to the suggestion, the sector was re-mounted, careful drawings were made of every part, instructions were prepared for its use, and on August 10 it was sent to Woolwich Dockyard and shipped for the Cape. Maclear commenced his verifications of Lacaille's arc in 1838, between 1840 and 1847 the field work was accomplished, and the sector was returned to Greenwich in 1850.

The sector was originally made by George Graham for Bradley in 1727. It had a radius of 12½ ft. and a range of 12½°. It was mounted by Bradley at his aunt's house at Wanstead, and it was from observations made with it that he was led to the discovery of aberration and mutation. In 1742, Bradley succeeded Halley as Astronomer Royal, and in 1749 the sector was removed to Greenwich. It is now preserved with other historic instruments at the Royal Observatory.

Sir Thomas Maclear, who was born in 1794 and died in 1879, was director of the Cape Observatory until 1870. He was knighted in 1860, and for his geodetical work received the Lalande Medal of the Paris Academy of Sciences and a Royal Medal of the Royal Society. He is buried in the grounds of the Observatory.

Magneto-Electric Currents

"M. AUGUSTE DE LA RIVE has been studying the properties of magneto-electric currents, and among other results he finds that the helix of a metallic thermometer heats to 7° when there are but two currents alternating contrary every second; to 55° with nine currents; to 100° with twenty currents; and to 133° with forty currents; and that a fine wire of platina has been heated red-hot when the succession of currents have been even more rapid. Chemical effects are subject to the same influence, only that there is a limit at which the heat of decomposition slackens. The influence of this speed is also felt in physiological processes, which acquire much greater energy than when produced by voltaic currents; a phenomenon which may be attributed to the interruption and alternatively contrary direction of magneto-electric currents, and which, perhaps, may become advantageous in the practice of the medical art" (*Athenæum*, Aug. 12, 1837).

Typhoid and Typhus Fevers

THE issue of the *American Journal of Medical Sciences* of August 1837 contains the first clear distinction between typhoid (dothinenteritis) and typhus fevers. The writer was Dr. W. W. Gerhard, physician to the Philadelphia Hospital, Blockley, and his paper was entitled "On the Typhus Fever which occurred at Philadelphia in the Spring and Summer of 1836". The principal differences between the two diseases are summed up as follows: "Dothinenteritis is usually a sporadic disease, although it sometimes appears to be a widespread epidemic. In the latter case the symptoms are so well marked that these are never doubtful except in a few of the earliest examples. Now typhus is rarely sporadic, and if scattering cases do occur, they are generally connected with an epidemic and follow it. . . . (2) Typhus is evidently very contagious; in the epidemic of 1836 it is quite as contagious as small-pox. . . . Dothinenteritis is certainly not contagious under ordinary circumstances, although in some epidemics we have striking reason to believe that it becomes so. (3) The initial symptoms of the two affections chiefly differ in the greater stupor, dullness and prostration of typhus, which are in strong contrast to the moderate cephalalgia and disturbance of the senses in dothinenteritis. . . . When the disease is completely formed, the characters on which the distinction between the two forms of fever rest are: (1) The suffusion of the eyes, which occurs in every case, or nearly every case of typhus fever, with the dusky red aspect of the countenance. (2) The extreme stupor and inactivity of the mind, even when positive delirium does not exist. (3) We also observe in typhus no constant abdominal symptoms, and at first merely dullness on percussion and feebleness of respiration at the posterior surface of the lungs. If to these symptoms be added the peculiar eruption of petechiæ which is scarcely ever absent in whites, there remains hardly a possibility of error."

A Female Rhinoceros in the Zoo

THE August issue (No. 59) 1837 of *Neue Notizen aus dem Gebiete der Natur- und Heilkunde* contains the following announcement: "A female rhinoceros in the garden of the Zoological Society of London is the latest and most interesting acquisition which this menagerie has made. It is a very fine young animal, but only half the size of the male rhinoceros which has been in the possession of the Society for several years. This is the first time, so far as we know, that a rhinoceros pair (male and female) has been exhibited at the same time in Europe."

Societies and Academies

Dublin

Royal Irish Academy, May 31

J. J. HARTLEY: The Dalradian rocks of the Sperrin Mountains. The paper dealt with the Dalradian sequence as developed on the borders of Counties Derry and Tyrone in Northern Ireland. The stratigraphical succession was described, and a detailed correlation suggested with Kintyre and Corval in south-west Scotland. Attention was directed to the influence the important faults which traverse the area have upon the structure and the light which they throw on the character of the folding. The question of the metamorphism was briefly discussed.

J. KAYE CHARLESWORTH: A map of the glacier lakes and local glaciers of the Wicklow Hills. This portrays the distribution of the local glaciers (in the main after A. Farrington) and of nine chains of glacier lakes impounded by the extraneous ice on either side of the Wicklow Hills.

K. G. EMELÉUS, E. B. CATHCART and C. M. MINNIS: Some electrical and optical properties of iodine vapour. The intensity distribution and absolute intensity in the iodine atom electron affinity spectrum have been calculated for typical discharge conditions from the results of probe analysis and theoretical capture cross-sections. The main part of the spectrum is usually in the far ultra-violet. The intensity in the near ultra-violet is so small as probably to preclude its observation. A high-frequency discharge with a constricted positive column is described which is of interest in connexion with the mechanism of the positive column. The effect of formation of negative ions in hindering removal of impurities by the discharge is pointed out.

Paris

Academy of Sciences, June 7 (*C.R.*, 204, 1693–1768).

HYACINTHE VINCENT: The antitoxic power of glutathione on the diphtheritic and tetanic toxins. Glutathione shows a slight but distinct antitoxic power towards the toxin of diphtheria.

ANDRÉ BLONDEL: The experimental study of coloured signals intended for navigation.

WOLFGANG DŒBLIN and ROBERT FORTET: On two notes of Kryloff and Bogoliouboff.

W. STEBODZINSKI: A class of surfaces of affine space.

HENRI DULAC: Research on limit cycles.

DRAGOSLAV S. MITRINOVITCH: A differential equation of the first order occurring in various problems of geometry.

ANDRÉ MACHIELS: Concerning a criterion of the reality of the velocities of nebulæ. Criticism of the method of E. Hubble based on spectroscopic and photometric data.

GÉRARD PETIAU: The matrix representation of the Maxwell equations.

GEORGES ALBERT BOUTRY and GEORGES TRÉHERNE: Commutable and stable electrical contacts. The variation in the resistance of sliding or plug contacts is too large for use in high-precision electrical thermometry. A new form of contact is described (mercury-platinum in a vacuum) giving resistances constant to within two microhms.

OLEG YADOFF: The electrical and mechanical ageing of copper conductors under the prolonged action of the electric current. Prolonged passage of current (two years) through copper conductors produces a loss in mechanical strength and a slight increase in the electrical conductivity.

ROBERT FORRER: The intensity of orbital interaction in compounds with multiple ionization.

GABRIËL BOSSCHIETER and JACQUES ERRERA: The infra-red absorption spectra of water, liquid, solid and in solution. Comparison of the infra-red spectra of water in the liquid and in ice with solutions in carbon tetrachloride and carbon bisulphide.

MLLE. DINAH BIQUARD: The Raman spectra of some ketones. The influence of ring formation.

STANISLAW ROUPPERT: The action of the magnetic field on the absorption of selenium.

AUGUSTE ROUSSET: New measurements of the factor of depolarization of light diffused by argon. Improvements in the construction of the apparatus lead to a factor of depolarization for argon equal to 3×10^{-4} with incident parallel polarized light. The factor is certainly below 10^{-3}.

SALOMON ROSENBLUM and MARCEL GUILLOT: The γ spectrum of RaB and RdAc.

PIERRE BARCHEWITZ and RENÉ FREYMANN: The complexity of the (OH) infra-red absorption bands.

JOSEPH LAISSUS: The cementation of nickel by beryllium. The Brinell hardness of nickel cemented by beryllium is one of the highest determined on metallurgical products.

MARCEL PRETTRE: The heterogeneous combustion of mixtures of carbon monoxide, hydrogen and oxygen on a vitreous surface. The heterogeneous combustion of most mixtures of hydrogen, carbon monoxide and oxygen is controlled by the velocity of oxidation of the hydrogen.

ANDRÉ CHRÉTIEN and JEAN KRAFT: The uranyl phosphites. The sole product of the interaction of solutions of phosphorous acid and uranyl acetate is a neutral uranyl phosphite, $UO_2HPO_3 2H_2O$.

MLLE. SUZANNE HÉMAR: The precipitation in the cold of a copper salt by an alkaline carbonate.

HENRI GUÉRIN: The magnesium arsenates.

H. CLÉMENT and J. SAVARD: The halide of pentamethylmagnesium.

LOUIS LONGCHAMBON: The dehydration of coals.

HELGE G. BACKLUND: Some eruptive rocks of the basalt series from the eastern coast of Greenland.

HENRI HUMBERT: *Gentianothamnus*, a new genus of Gentianaceæ from Madagascar.

ROBERT WEILL: The existence of a monocnidome in the medusoid of a polypus (*Pennaria*(?) *tiarella*) with tetracnidome.

ERNEST KAHANE and MLLE. JEANNE LÉVY: The mechanism of the sensitization with acetylcholine.

MLLE. ETIENNETTE BIZET and RAYMOND-HAMET: The opposed effects of two alkaloids from the same vegetable drug.

EMILE F. TERROINE, MLLES. A. M. DE LA BERNARDIE and PAULE LELU: Action of the external temperature on the metabolism of creatinine and creatine.

ANDRÉ BOIVIN and MME. LYDIA MESROBEANU: The existence of a thermo-labile toxin and neurotrope (exotoxine) in the bacterial bodies of the Shiga bacillus.

LÉON BINET, CHARLES JAULMES and GEORGES WELLER: The antitoxic power of glutathione. Researches on the tetanus toxin.

ERNEST FOURNEAU, JACQUES TRÉFOUËL, FEDERICO NITTI, DANIEL BOVET and MME. JACQUES TRÉFOUËL: The anti-streptococcic action of organic sulphur derivatives.

Moscow

Academy of Sciences, *C.R.*, 15, No. 1 ; 1937.

N. S. KOŠLIAKOV : A transformation of definite integrals and its application to the theory of Riemann's function $\zeta(s)$.

E. LIUSTICH : Some methods for mechanical integrators.

V. G. ČELIDZE : The derived numbers of a function of two variables.

V. NIEMYTZKI : (1) The integral non-linear equations comparable to the linear equations. (2) The most generalized integral non-linear equation.

N. PISKUNOV : The limit problem for an equation with partial derivates of hyperbo-parabolic type.

E. J. PEREPELKIN : An apparatus for quick and accurate reduction of self-registering micro-photometer records.

A. A. ŠIŠLOVSKIY : A comparison of absorption and fluorescence spectra of anthracene in different states of aggregation.

F. A. KOROLEV : The application of Toeppler's method to measuring the absorption of ultra-sounds in liquids.

K. G. MIZUĆ : Side processes of oxidation during the reduction of nitrogen compounds of the aromatic series (2). Action of a bivalent iron salt on aryl-hydroxylamines.

I. B. PLEŠAKOV : The stratigraphy of the Tertiary oil-bearing beds of the south-eastern part of the Soviet Sakhalin.

A. G. EBERZIN : The Pontic rocks of Mingrelia.

I. A. SMORODINCEV, N. N. KRYLOVA and V. I. PASONINA : Changes of protein fractions in meat ripening.

V. A. NOVILOV : Derangement of metabolism in the leaves of lucerne when infected with the rust *Uromyces striatus* Schröt.

N. DRAGOMIROV : (1) Experimental induction of retina in amphibian embryos. (2) Influence of the adjoining ectoderm on the organization of the eye bud.

Vienna

Academy of Sciences, May 13.

BERTA KARLIK and KARL PRZIBRAM : Infra-red luminescence spectrum of samarium. The spectrum found by Tomaschek is ascribed to divalent samarium.

MARIETTA BLAU and HERTHA WAMBACHER : Measurement of the length of proton tracks by the photographic method. A few tracks have been recorded of protons liberated by neutrons from a polonium-beryllium source and of a length corresponding to an energy of between 7·9 and 10 million electron volts. The percentage of these high-energy neutrons is determined.

MARGARETHE HOLUBA : Influence of absorption in the interior of a radioactive preparation on the emitted radiation.

K. W. F. KOHLRAUSCH and R. SKRABAL : Studies of the Raman effect (71). Cyclopropane carboxylic acid, acrylic acid and their derivatives.

A. W. REITZ and R. SKRABAL : Studies of the Raman effect (72). Nitrogenous bodies (4). Nitriles.

S. FEITELBERG and H. LAMPL : Determination of the point of attack of drugs affecting the brain by measurement of the heat developed in different parts of the brain.

KLAUS UNNA and LEOPOLD WALTERSKIRCHEN : Influence of pituitrin on the action of some diuretics.

Appointments Vacant

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

JUNIOR SCIENTIFIC OFFICERS in the Electricity, Radio and Aerodynamics Departments of the National Physical Laboratory, Teddington—The Director (August 9).

LECTURER IN MECHANICAL ENGINEERING in the Batley Technical College—The Director of Education, Education Offices, Batley (August 14).

ASSISTANT (grade II—engineering) in the Admiralty Technical Pool—The Secretary of the Admiralty (C.E. Branch) (August 16).

TWO DEMONSTRATORS IN INORGANIC CHEMISTRY in the University of Leeds—The Registrar (August 23).

JUNIOR LECTURER IN MYCOLOGY in the Imperial College of Tropical Agriculture, Trinidad—The Secretary, 14 Trinity Square, London, E.C.3 (August 31).

ASSISTANT LECTURER IN MATHEMATICS in the University of Manchester—The Registrar (September 1).

ASTRONOMER ROYAL FOR SCOTLAND AND PROFESSOR OF ASTRONOMY in the University of Edinburgh—The Private Secretary, Scottish Office, Whitehall, S.W.1 (September 13).

UNIVERSITY PROFESSOR OF PHARMACOLOGY in the College of the Pharmaceutical Society of Great Britain—The Academic Registrar, University of London, W.C.1 (September 14).

UNIVERSITY READER IN BACTERIOLOGY in the British Postgraduate Medical School—The Academic Registrar, University of London, W.C.1 (September 15).

ASSISTANT LECTURER IN ELECTRICAL ENGINEERING in the Manchester Municipal College of Technology—The Registrar (September 20).

METALLURGIST, ENGINEER OR CHEMIST for the Mond Nickel Co.—The Manager, Research and Development Dept., The Mond Nickel Co., Ltd., Thames House, Millbank, S.W.1.

TECHNICAL ASSISTANT in the Information Department of the Automobile Research Laboratories—I.A.E., Research Department, Great West Road, Brentford, Middlesex.

Official Publications Received

Great Britain and Ireland

National Trust for Places of Historic Interest or Natural Beauty. Freehold and Leasehold Properties of the Trust and Protected Properties. Pp. xv+38+26+8 plates. Report, 1936–1937. Pp. x+140. (London : National Trust.) [87

Institute of British Geographers. Publications Nos. 4 and 5 : (4) Transactions and (5) Insolation and Relief : their Bearing on the Human Geography of Alpine Regions. By Alice Garnett. Pp. xvi+71. (London : George Philip and Son, Ltd. ; Liverpool : Philip, Son and Nephew, Ltd.) 12*s.* 6*d.* [87

Report of the Import Duties Advisory Committee on the Present Position and Future Development of the Iron and Steel Industry. (Cmd. 5507.) Pp. 117. (London : H.M. Stationery Office.) 2*s.* net. [97

Other Countries

Transactions of the San Diego Society of Natural History. Vol. 8, No. 23 : A Further Report on Birds from Sonora, Mexico, with Descriptions of Two New Races. By A. J. van Rossem and the Marquess Hachisuka. Pp. 321–336. Vol. 8, No. 24 : Paleontology of the Pleistocene of Point Loma, San Diego County, California. By Robert W. Webb. Pp. 337–348. Vol. 8, No. 25 : Descriptions of New Mammals from Arizona and Sonora, Mexico. By Laurence M. Huey. Pp. 349–360+plate 23. Vol. 8, No. 26 : A Northwestern Race of the Mexican Black Hawk. By A. J. van Rossem and the Marquess Hachisuka. Pp. 361–362. (San Diego, Calif. : San Diego Society of Natural History.) [57

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 89. Zoological Results of the George Vanderbilt African Expedition of 1934. Part 7 : Reptiles and Amphibians. By Arthur Loveridge. Pp. 265–296. (Philadelphia : Academy of Natural Sciences.) [57

Imperial College of Tropical Agriculture. Sixth Annual Report on Cacao Research, 1936. Pp. 51. (Trinidad : Government Printing Office.) 5*s.* [57

National Research Council of Canada. Heat Loss through Windows : a Summary of Available Information. By R. Ruedy. Pp. 38. (Ottawa : National Research Council.) [67

Union of South Africa. Report of the South African Museum for the Year ended 31st December 1936. Pp. 18. (Pretoria : Government Printer.) [67

Union of South Africa : Department of Mines. Bulletin No. 8 : "Wonderstone". By Dr. Louis T. Nel, Dr. H. Jacobs, J. T. Allan and G. R. Bozzoli. Pp. 44+6 plates. 6*d.* Bulletin No. 9 : The Ochre Deposits of the Riversdale District, Cape Province. By D. J. L. Visser. Pp. 21. 3*d.* Memoir No. 31 : The Pegmatite Area south of the Orange River in Namaqualand. By Dr. T. W. Gevers, F. C. Partridge and G. K. Joubert. Pp. 180+16 plates. 7*s.* 6*d.*, including Map. (Pretoria : Government Printer.) [67

Baltische Geodätische Kommission. Sonderveröffentlichung No. 6 : Relative Bestimmungen der Schwerkraft auf den Landeszentralen. Ausgeführt von der Baltischen Geodätischen Kommission in den Jahren 1930 und 1935. Pp. iii+128. (Helsinki : Baltische Geodätische Kommission.) [87