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Racial Problems and the Indian Census Report, 1931*

THE publication of the Report of the Census Commissioner for India in 1931 not only marks the completion of a stupendous undertaking ; but also in its contents, which range far beyond the bare facts furnished by the enumerator, it serves as a reminder that whatever may befall in India in the course of the next generation—and it would be an act of extreme rashness to venture on prophecy—the contribution of the British official to the study of the peoples of India, their languages, their history, their customs and their institutions, will endure as a “monument more lasting than brass”. It little matters whether these studies were the outcome of a desire to satisfy intellectual curiosity in a country in which people, monuments and literature alike prompt inquiry into the past, or of the practical necessity for an understanding of the intricate ramifications of custom and religion in the administration of every-day affairs. It is enough that out of these inquiries there developed such great undertakings as the linguistic, archæological and epigraphic surveys of India, which became the work of government departments, or those remarkable compendia, the various provincial surveys of tribes and castes.

It was due to these interests that the Indian Census assumed its distinctive character. The organisation of the Census has been such as to include within its scope from time to time material which has given its reports an unequalled value as ethnographical documents, while the Commissioners have not failed to avail themselves on occasion of the opportunity for discussion of larger questions of scientific import affecting the peoples of India as a whole. Finally, it may be pointed out that these inquiries, or theories based upon them, have played no small part in determining the form of the political aspirations of the peoples of India, as well as in fostering the growth of a consciousness of national unity. Both the theory of Aryan supremacy and of the unity and indigenous origin of Indian culture have drawn largely for their intellectual support on racial theories founded on the research of European, and for the most part British, investigators.

The broad results of the Census of 1931 have already been considered in these columns (see NATURE, Jan. 28, p. 109) ; but it may not be out

* Census of India, 1931. Vol. 1: India. Part 1: Report. By Dr. J. H. Hutton. To which is annexed an Actuarial Report by L. S. Vaidyanathan. Pp. xv+518+13 plates. (Delhi: Manager of Publications, 1933.)

of place to recall some of the conditions which give the Census of India its unique character. The Census of 1931, the sixth of the enumerations which began in 1881, covered an area of 1,808,679 square miles, and a population of 353 millions. This area, as large as Europe excluding Russia, constitutes a sub-continent rather than a single country. It includes every variety of climate from tropical to temperate, and from arid, where the rainfall averages 5 inches, to humid, with an annual rainfall of 500 inches. Its inhabitants are as varied in their racial characters and their languages as in their environment. The census returns for 1931 show 225 languages, excluding dialects. Nearly three fourths of the population, however, speak Aryan tongues. In culture, the people show every phase from that of advanced Western civilisation to the primitive hunter and food-gatherer of the jungle.

In introducing his general report, Dr. J. H. Hutton, the Census Commissioner for 1931, who was seconded for this service from Assam, where his work in connexion with the ethnography of the hill tribes has conferred a lasting obligation on anthropological science, points to the difficulties which stand in the way of any general treatment of the mass of statistics resulting from the census enumeration. On the other hand, regional study, which in India obviously is of essential importance in its bearing upon a number of demographic questions, is precluded, except for restricted areas, in the provincial and State reports to which reference must be made for more detailed information, as the political and administrative boundaries do not coincide with, and indeed in many instances run counter to, the natural areas. Dr. Hutton has, therefore, confined his analysis and discussion of general questions to those relevant to the broad cultural unity of the India of to-day, such, for example, as the population problem, the interrelation and movement of rural and urban populations, migration, the distributions of age and sex, fertility, occupations, literacy and so forth.

Incidentally, reference is made to changes to be observed in Indian custom, which are not without importance in their bearing on the political future of India. Hinduism continues to gain strength through the absorption of the wild tribes, a feature to which reference is frequently made in relation to their future, but still more often in pressing the political claims of Hinduism. On the other hand, the changes affecting caste, especially in the

matter of personal contact in public places, are not regarded by Dr. Hutton as having the significance attached to them by some who profess to be in a position to judge. Although it would appear that a considerable proportion of the caste members now either take up subsidiary occupations or enter occupations other than those allotted to them by their caste, in all essentials caste is adjudged to be unchanged.

Important as these topics are in the study of Indian demography, they must be passed over here with no more than a brief mention in favour of what must be regarded as Dr. Hutton's specific contribution to the scientific study of the problems of Indian ethnology. This is contained in three chapters dealing with language, race and religion. They are of a speculative character, as the author admits. Opinions may vary as to whether a census report may be the most suitable vehicle for the discussion of such questions, which arise incidentally rather than directly out of the material of the report. In the present instance, in view of the line of argument followed, it is a question whether discussion may not be premature. On the other hand, Dr. Hutton has a noteworthy precedent in the theories on the racial and cultural dominance of the Arya in the composition of the Indian peoples, and on caste, put forward by Sir Herbert Risley in his census report thirty years ago. These have served as the starting point in Indian ethnological investigation ever since. Now, however, the time has come, in Dr. Hutton's opinion, for a restatement of the problem in the light of more recent research. It is evident, he points out, that there was much greater continuity in the development of the prehistoric civilisation of India than was once thought, nor did that development take place in the isolation which Risley postulated.

The dominant factor in Indian archaeological and ethnological studies in the last decade has been the discovery of the prehistoric civilisation of the Indus Valley, which by some has been held to confirm and consolidate the position of those, especially among Indian theorists, who attach an outstanding importance to the Dravidian, as opposed to the Aryan, element in Indian cultural history. This theory has indeed been used in political argument to advance the claims of Hinduism to paramount consideration as representative of the traditional India as a whole. On the other hand, the exact relation of the Indus Valley civilisation to the stream of Indian culture

and to that of the early Near and Middle East has still to be determined, even though discovery is rapidly making it more clear almost day by day.

As the result of an analysis of the archaeological, linguistic and ethnological evidence, Dr. Hutton arrives at the conclusion that the Indus civilisation is to be assigned to a Dravidian-speaking branch of the Mediterranean race, with possibly some Armenoid admixture, and in an acute study of Hinduism in which he assigns its contribution in that composite whole to each of the racial elements in the Hindu peoples, the prepotent and most characteristic features are assigned to the Mediterranean rather than the Aryan. It is significant, however, that he regards this whole as having been 'built up' locally.

We cannot enter now upon a consideration of the scientific bases of Dr. Hutton's conclusions. There can be no question, however, that discussion of his views hereafter will not be spared. In their practical aspect, which in India, where religion is the unifying political influence, is never far away, it may be said that the bearing of his theories is summed up in this sentence, in which he states: "it is not difficult to understand the claim of certain politicians that the term Hinduism should cover all religions having their origin in India, even though we hold that the original impulse came from the Mediterranean or Asia Minor".

The 24-Hour System of Time Reckoning

THE present method of counting longitudes east and west from a prime or zero meridian passing through the centre of the transit instrument at the Observatory of Greenwich, was decided upon at a conference held in Washington in October 1884 at which twenty-five countries were represented. The adoption, by international agreement, of a prime meridian passing through Greenwich, made possible the standard or zone system of reckoning time for civil purposes, which almost every country has adopted.

The Washington Conference in 1884 made other recommendations which did not secure such general acceptance. It expressed the hope that as soon as might be practicable, the astronomical and nautical days would be arranged everywhere to begin at mean midnight. This recommendation met with much opposition from astronomers, particularly from Prof. Simon Newcomb, whose name carried great weight. It was not until after the War that it was possible to secure agreement to this change, which was introduced at the beginning

of 1925; the principal national ephemerides for the year 1925 and subsequent years have used an astronomical day beginning at mean midnight. A third recommendation of the Conference was in favour of counting the hours of the day from zero up to twenty-four hours. This system of counting, which avoids the necessity for 'a.m.' and 'p.m.', and the ambiguity which results if these are omitted, has been adopted in railway time-tables and for other purposes in all Continental countries, in Canada, the United States, India and elsewhere, but it has never come into general use in Great Britain.

The 24-hour system of reckoning time has been permanently adopted in Great Britain by the Army, Navy and Air Force. It is not without significance that the three defence departments of the country have all adopted the system which eliminates the possibility of errors likely to arise when the hours are counted from 1 to 12 twice a day. The advisability of adopting the 24-hour system for official and other purposes was considered in 1919 by a Home Office Committee, presided over by Lord Stonehaven. The Committee went into the matter thoroughly, found no objection to it and unanimously recommended its adoption by the Post Office and railway companies. But although no legislative action was required, no steps were taken to adopt the recommendation. The matter has been raised on a number of occasions in the House of Lords without definite result. It will come up again for discussion on December 7, when a motion, to be introduced by Lord Newton, urging the adoption of the recommendations of the Stonehaven Committee, will be discussed.

On various occasions there has been correspondence in the *Times* and other daily papers on the subject of this reform. Opinion in favour of the change has largely preponderated, and it has been significant that those who have opposed it have been those having no experience of it, whilst those who have had experience of it have strongly favoured it. The railway companies intimated in 1931 and again in 1932 that they were prepared to adopt the 24-hour system if the Government would give the lead. When the matter was discussed in the House of Lords in 1932, the Earl of Lucan, speaking as the representative of the Home Office, stated that "The view of the Government is that so far the public has not shown that it wants the change". A weaker argument could not have been put forward,

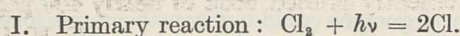
but this was the strongest argument against the reform that could be found.

The 24-hour system can be used along with the present system. For normal social and business purposes, there is little possibility of confusing a.m. and p.m.; nor is any alteration of clocks, by having a 24-hour dial or by having two sets of figures from 1 to 12 and 13 to 24, necessary. If the recommendations of the Stonehaven Committee are adopted, the 24-hour system would be used by the Post Office for timing letters and telegrams, on pillar boxes, etc., and the railway companies would use it in time-tables, and so avoid the necessity of different types for times before and after noon. The public would soon become familiar with the system and recognise its convenience. We strongly hope that the House of Lords will approve the motion to be introduced by Lord Newton on December 7, and that the Government will not delay in giving effect to the recommendation.

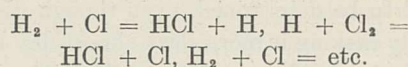
Chain Reactions

- (1) *Kettenreaktionen*. Von Klaus Clusius. (Fortschritte der Chemie, Physik und physikalischen Chemie, herausgegeben von Prof. Dr. A. Eucken, Band 21, Heft 5.) Pp. iv+73. (Berlin: Gebrüder Borntraeger, 1932.) 12.80 gold marks.
- (2) *The Kinetics of Chemical Change in Gaseous Systems*. By C. N. Hinshelwood. Third edition. Pp. vii+392. (Oxford: Clarendon Press; London: Oxford University Press, 1933.) 15s. net.

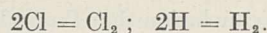
THE theory of chain reactions was introduced in order to account for the abnormally large yields which are often found in photochemical reactions, when compared with Einstein's 'Law of Photochemical Equivalence', according to which each quantum of absorbed light activates or decomposes one molecule of the absorbing medium. Thus Bodenstein in 1913 found that, in mixtures of hydrogen and chlorine, 10^5 molecules were decomposed by each quantum instead of only one. In order to maintain the validity of Einstein's law, he therefore postulated that a secondary action took place, in which the primary product was regenerated again and again, so that an indefinitely large yield of the product could be obtained. For the special case of hydrogen and chlorine, Nernst in 1918 postulated the following mechanism:



II. Secondary reactions (reaction chain):



III. End of reaction chain:



In this scheme, *atoms of chlorine* are the primary products of the photochemical action. Since atoms of hydrogen are not present in the system, the conventional double decomposition shown by the equation $\text{H}_2 + \text{Cl}_2 = [\text{2H} + \text{2Cl}] = 2\text{HCl}$ cannot take place and the action can only proceed by the action of atoms of chlorine on *molecules of hydrogen*. This action, however, leads to the liberation of an atom of hydrogen for each atom of chlorine that is used, $\text{Cl} + \text{H}_2 = \text{HCl} + \text{H}$. This atom of hydrogen in its turn can only interact with a *molecule of chlorine*, since atoms of chlorine are present only in minimal concentrations, and thus liberates another atom of chlorine, $\text{H} + \text{Cl}_2 = \text{HCl} + \text{Cl}$. The primary product of the photochemical change has thus been reproduced and the cycle can be repeated indefinitely as a *chain reaction*. If, however, *two atoms* should happen to collide, instead of *one atom and one molecule*, the interaction (in presence of a 'third body' to carry away the energy of combination) would not give rise to a free atom, and the chain would therefore be broken.

Chain reactions can be initiated by the action of α -particles or of swift electrons, as well as by the action of light; or the 'carrier' may be produced by an ordinary chemical reaction, as in Polanyi's experiments, in which atoms of chlorine were produced by the action of dilute sodium vapour on chlorine gas, $\text{Na} + \text{Cl}_2 = \text{NaCl} + \text{Cl}$. The free atoms or radicals thus produced are characteristic of 'material chains', but 'energy chains' are also possible, in which an activated molecule hands on its energy to another molecule. The life of these excited molecules is so much shorter than that of free atoms or radicals that 'energy chains' are likely to be much less frequent than 'material chains'; but the latter normally include also a transfer of energy, since the initiation of a chain depends on creating a centre of high activity, for example, by bringing about under the influence of light an endothermic dissociation with a high heat of activation; and this energy is handed on from one atom to another in the chain. The secondary reactions, on the other hand, must have a very low energy of activation, in order that the chain may be propagated easily, and must

either liberate energy or absorb only a small fraction of the energy of the initial reaction, since otherwise the energy chain would soon exhaust itself. If therefore the chains are sufficiently numerous, and are not broken sufficiently often (as by reaching the walls of the containing vessel), the temperature of the system will rise and the action may terminate in an explosion.

This overcrowding is specially liable to happen in the case of branched chains, that is, when the probability of reproducing the carrier is actually greater than unity; for example, because *two* active molecules are reproduced instead of only one, in a reaction in which much energy is liberated. The delicate balance between the multiplication and the breaking-up of the chains then gives rise to some remarkable phenomena, especially with respect to the influence of pressure. Thus Semenov established the existence of a lower critical pressure, amounting only to a fraction of a millimetre, below which the gaseous reaction between phosphorus vapour and oxygen scarcely takes place at all and above which it leads to an explosive ignition; and Hinshelwood and his colleagues have established the existence in mixtures of hydrogen and oxygen at relatively low pressures of an upper and a lower limit of pressure, above and below which the reaction is quite slow and between which explosion occurs.

Chain reactions have been of special interest in explaining the phenomenon of *negative catalysis*. Thus, it was not easy to understand how the oxidation of benzaldehyde or of aqueous sodium sulphite could be checked by the addition of a mere trace of an 'inhibitor' until it became clear that the oxidation was a chain reaction, which could be stopped at the source by poisoning the centres at which the chains were initiated, or to a large extent suppressed by interrupting the chains at any point in their course. An obvious analogy is found in the ability of a limited force of police to control a widespread conspiracy, either by arresting the leaders, or by severing some essential channel of communication between the conspirators, rather than by attempting to deal with them individually. In the cases cited above, the correctness of mechanism has been proved experimentally by Bäckström, who has shown (i) that the photochemical oxidation affects from 10,000 to 50,000 molecules for each quantum of light that is absorbed, (ii) that when alcohols are used as inhibitors they are themselves oxidised, but with unit quantum efficiency, that is, one

molecule of alcohol is sacrificed for each chain that is interrupted.

(1) The fascinating topic of chain reactions, which figured largely in the Faraday Society's discussion on "Homogeneous Catalysis" in Cambridge in 1928, forms the subject of a monograph by Clusius in Eucken's well-known series. An excellent introduction is followed by three special sections dealing with (i) "Stationary Chains", especially those which are concerned with the halogens and with oxidation, (ii) "Non-stationary Chains", including the phenomenon of critical pressures of explosion, and (iii) "Influence of Traces", including the phenomena of positive and negative catalysis, and the special case of 'anti-knocks' in the internal combustion engine. Four pages of references complete a most useful review of this important subject.

(2) In the third edition of Hinshelwood's book on "Kinetics of Chemical Change in Gaseous Systems" a chapter on "Chain Reactions", which made its first appearance in the second edition only four years ago, has now been expanded from 20 to 50 pages. Other features of the third edition are a new chapter on "Homogeneous Catalysis", which occupies some 30 pages of the text, and the addition to the introduction of 20 pages on "Some Quantum-Mechanical Considerations". The new chapter is of interest on account of its repudiation of Ostwald's analogy of a catalyst as a lubricant, in favour of the analogy with "a by-pass road with easier gradients", and for a critical review of the influence of moisture as a catalyst for homogeneous reactions; the behaviour of solutions (which the author has recently investigated extensively in collaboration with Moelwyn-Hughes) is also discussed in this chapter. As regards the section on "Quantum Mechanics", the reviewer cannot improve upon the author's own picturesque comment at the end of the second paragraph of the new preface.

Some apology is perhaps needed for reviewing under the heading of "Chain Reactions" a book which deals with a much wider field; but the citation in both publications of three papers in the *Proceedings of the Royal Society* under the names of Hinshelwood and Clusius is perhaps a sufficient justification for including them in a single review.

As evidence of the absurd prices that are now being charged for German publications, it may be noted that an unbound pamphlet of less than 80 pages is quoted at a higher price than a well-bound and excellently printed book of nearly 400 pages.

T. M. L.

Agriculture in the Southern United States

History of Agriculture in the Southern United States to 1860. By Lewis Cecil Gray, assisted by Esther Katherine Thompson. (Publication No. 430.) Vol. 1. Pp. xix+567. Vol. 2. Pp. ix+569-1086. (Washington, D.C.: Carnegie Institution, 1933.) n.p.

THE real history of agriculture in the southern United States began with the planting of the first crops by English colonists in Virginia in 1586, and from then onwards the pioneer farmers made their way by experiments along economic, biological and physical lines, until the present-day system of agricultural policy was evolved. Since 1908, Dr. Lewis Gray has been engaged in collecting and collating a wealth of material dealing with every aspect of this agricultural progress, and his published volumes make a permanent contribution to economic history, agricultural economics, technical agriculture and to the general social and political history of the South.

Geographical expansion and the beginnings of agricultural development progressed together throughout the colonial period, when such industries as lumbering and the production of tobacco, rice and indigo were gradually developed. The necessary labour was assured by the evolution of the plantation system, at first based on indentured servitude of white people, and later on the forced labour of introduced African slaves. The slave trade became an integral part of the life of the South, and agricultural policy and the problems of slavery were intimately interwoven.

In the post colonial period, from 1785 onwards, the cotton industry assumed increasing importance, and sugar was also cultivated in addition to other long-established crops. As geographical expansion and regional development continued, the agricultural problems of the older settled districts became more marked with the increasing areas of soil exhaustion, and the depressing influence of western competition. These conditions led to attempts at agricultural and economic reorganisation, culminating in the agrarian movement of the middle of the nineteenth century, when conventions and committees endeavoured to put the agricultural industry on a sounder basis.

The presentation of the mass of detail is done in such interesting style that doubtless many will be led to read from cover to cover, while detailed indexes of contents, charts and tables render the book of inestimable value as a work of reference.

The Interpretation of Life

(1) *The Universe and Life.* By Prof. H. S. Jennings. (The Terry Lectures.) Pp. v+94. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1933.) 7s. 6d. net.

(2) *The Coming of Man: was it Accident or Design?* By R. Broom. Pp. 238. (London: H. F. and G. Witherby, 1933.) 10s. 6d. net.

(1) THOSE who had the privilege of listening to the three lectures given by Prof. H. S. Jennings in Yale University, and now published in book form, must have found that his closely-woven argument demanded their keenest attention. "The purpose of these lectures," Prof. Jennings has written, "will be to show what positive outlook on life and the world is given by the study of biological science; and how this differs, if at all, from the outlook based on physics". In brief, these lectures represent the creed of one who is rightly regarded as one of the outstanding biologists of our time.

Prof. Jennings holds that the study of biology "lends no support to the doctrine of indeterminism that has become so rife in certain branches of physical science". Man may still hope for progress in body, mind and morals, for Nature's methods are really those of experimentation—ever leading on to new and more elaborate combination of characters and of qualities. He also holds that there are evidences of design everywhere, but the biologist, who seeks to explain contrivances in plants and animals by assuming the existence of an arch-designer, has to meet the still greater difficulty of explaining how such a contriving power came into being. The power of design is inherent in living matter. Further, Prof. Jennings maintains that there is no fact known to biologists which justifies the expectation of the return of life to things once dead, or the possibility of the human spirit existing outside the living human body.

These lectures are marked not only by great felicity of phrase but also by the manifestations of a courageous mind which has done its best to free itself from animus and emotion.

(2) This is the third book which Dr. Robert Broom has published since 1930. In the "Origin of the Human Skeleton" and in "The Mammal-like Reptiles of South Africa", he has drawn upon knowledge obtained during the many years he has devoted to the investigation of the fossiliferous

beds of South Africa. In the present work, "The Coming of Man", he again utilises his South African experience to elucidate the agencies which have brought about the evolution of man.

Dr. Broom differs from most writers on human evolution in supposing that man did not emerge from an anthropoid state until a comparatively late geological date, namely, lower Pliocene or possibly upper Miocene. Further, he regards *Australopithecus* as by far the most human of anthropoids so far discovered, and states that "a higher primate allied to *Australopithecus* . . . started the line that led to man".

Dr. Broom is particularly interested in the

agencies and forces which brought about human evolution. In his introduction, he gives his readers due warning as to the line of argument he is to adopt. "I fancy I can trace intelligence behind it all," he writes. Then he adds (p. 12), "We seem to see many agencies at work, some beneficent, some malignant; but amid it all some power has guided the main evolution to man". Chap. vii is devoted to the powers which are invoked by Dr. Broom; the title given to this chapter, namely, "The Possibility of a Spiritual Agency", will give some indication as to the kind of power invoked—one which will appeal to the theologian rather than to the scientific worker.

Short Reviews

Studies in the History of Ophthalmology in England prior to the Year 1800. By R. Rutson James. (Published for the *British Journal of Ophthalmology*.) Pp. x+255+9 plates. (Cambridge: At the University Press, 1933.) 15s. net.

MEDICINE is both an art and a science. To those who are most interested in it as a science, the history of medicine is peculiarly lacking in inspiration. Even from this point of view ophthalmology, perhaps by virtue of its dependence upon optics and neurology, is less sterile than most other branches of the subject. Even in the thirteenth century Robert Grosseteste "neglected altogether the books of Aristotle and by his own experiments . . . employed himself in the scientific questions which Aristotle had treated". But most of the ophthalmologists of whom the author writes in this admirable book were advertisers and quacks. This is true of most of the Royal oculists of the eighteenth century, such as Sir William Read, Queen Anne's oculist, who was the son of a cobbler, and his successor, Roger Grant, who "rested his pretensions to practise ophthalmology on the fact that he had lost an eye in the Emperor's service in the continental wars; thus reversing the case of the gladiator alluded to by Martial:

Oplomachus nunc es, fueras ophthalmicus ante.
Fecisti medicus quod facis oplomachus."

The most astounding of all was the Chevalier Taylor, oculist in ordinary to George II, whose extraordinary career, recounted by the late George Coats and reprinted here, reveals almost incredible effrontery. He had all the qualities of a perfect charlatan—"except ignorance, and this is his chief condemnation".

The book is an excellent piece of historical research and of such varied interest as to read in parts like a romance. It must not, however, be concluded that it is solely concerned with the vagaries of quacks. The specialist will find in it landmarks in the development of the treatment of the chief diseases of the eye, notably cataract.

(1) *Sailplanes: their Design, Construction and Pilotage.* By C. H. Latimer Needham. Pp. xx+268+26 plates. (London: Chapman and Hall, Ltd., 1932.) 15s. net.

(2) *Gliding and Motorless Flight.* By L. Howard-Flanders and C. F. Carr. Second edition. Pp. xiii+145+30 plates. (London: Sir Isaac Pitman and Sons, Ltd., 1932.) 7s. 6d. net.

THESE volumes will be welcomed by those who, like the reviewer, sometimes wonder what is the aim of gliding enthusiasts—sport or scientific study.

(1) Mr. C. H. Latimer Needham's book suggests the latter, and as a founder member of the British Gliding Association and chairman of its Technical Committee, his qualifications to write from such a point of view are unquestionable. Yet his book is weak, principally because it is too ambitious. It gives the impression that it has been pruned drastically and suffers from the sins of omission rather than of commission. For example, a discussion on the distribution of air loading on a wing omits to mention the possible alteration due to twist. This might easily be vital upon very high aspect ratio wings, the type always found on gliders for reasons of aerodynamical efficiency. Again, the part devoted to stressing is inadequate as an instruction to anyone contemplating designing a glider. The part of this dealing with airworthiness requirements is good, in that it emphasises the discrepancies between the strength requirements of different countries. The book can be recommended to a reader who wishes to begin to understand the technical points, that is, to do something more than mere aerial tobogganing.

(2) This book is in a different category. It is evidently meant to be a practical instruction manual, containing chapters on training, organising clubs, care and maintenance of gliders, etc. It fails because so much space has been given to purely popular writing, that might better have been devoted to a more detailed discussion of the subject matter in the technical chapters.

Recent Advances in Radium. By W. Roy Ward and A. J. Durden Smith. Pp. viii+324. (London: J. and A. Churchill, 1933.) 21s.

THIS volume is a valuable addition to Messrs. Churchill's "Recent Advances" series, and comes at an appropriate time, for it is true to say that a balanced, readable and competent account of the possibilities of radium therapy was never more necessary, both for the medical profession and for the public. The first part of the book deals with the occurrence and extraction of radium, its physical properties and their measurement, its mode of action on the tissues, radio-resistance and -sensitivity, and the intricacies and difficulties of dosage. The different types of applicators—surface, needles, tubes and bomb—and the screens employed are gone into in detail, as well as the methods for the protection of radium workers.

The second part deals with the treatment of cancer in the more important sites, and discusses the methods and results of the principal radium institutes of the world. A cursory survey of these chapters reveals the source of the popular belief in a specific destructive or curative action of radium in cancer, by a natural misinterpretation of its selective action in new growths of certain organs and types, but it is inconceivable how any medically educated person can lend support to this disastrous opinion. The limitations imposed by the varying radio-sensitivity of the normal tissues, as well as of new growths, are constantly brought into prominence by the authors, as the basis of the selection of the method of choice (surgery, radium, X-rays) in the cancers of various organs.

The third part deals with the use of radium in the treatment of a variety of non-malignant conditions.

J. A. MURRAY.

Modern Electric Clocks: Principles, Construction, Installation and Maintenance. By Stuart F. Philpott. Pp. vii+215. (London: Sir Isaac Pitman and Sons, Ltd., 1933.) 7s. 6d. net.

THE pioneer of the electric clock was Alexander Bain, whose patent was taken out in 1840. He was soon followed by others, and in 1851 C. Shepherd installed in the Great Exhibition a large electric clock having one great dial in the transept and two others at the ends of the building. Speaking of this and other clocks, Timbs said: "the application of electricity to the measurement of time for the purposes of the Great Exhibition was an appropriation in every way accordant with the spirit of the grand scheme of enlightenment as well as with the genius and skill evinced in the Great Building itself." Shepherd's clock attracted a good deal of attention and since then electric clocks have been extensively used in warehouses, factories, railway stations, offices and ships, and many types have been evolved, with all of which Mr. Philpott deals.

Among the latest and most useful electric clocks are the synchronous motor clocks, the current for which is obtained from alternating current mains.

This development has been rendered possible in Great Britain only by the frequency standardisation brought about by the Electric Grid. "Where time-controlled alternating current is available," says Mr. Philpott, "the synchronous motor clock is the best proposition for domestic time-keeping. Accurate time within a few seconds of Greenwich is assured and all the clocks indicate alike." Five such clocks can be run for 200 hours or more for one electrical unit. Mr. Philpott's book is clearly written, well-illustrated and thoroughly practical.

Social Development in Young Children: a Study of Beginnings. By Dr. Susan Isaacs. Pp. xii+480. (London: George Routledge and Sons, Ltd., 1933.) 15s. net.

AN outstanding characteristic of this book is its consistently maintained scientific outlook. For the author, facts are facts, even though they come within the category of things that are not 'nice'. But more than this, the survey of facts, in the form of records concerning actual children, precedes any attempt at interpretation and generalisation. In other words, in the author's hands the study of children passes the stage of mere opinion based upon a slender stock of observations, and reaches the stage of a real inductive inquiry. Though the main purpose of the investigation is simply the advance of knowledge, yet the author has some wise advice to give by the way to experienced teachers and to intelligent parents. She is clear, for example, that "the explosive material of the unconscious" can be safely touched only by the trained analyst, and she is cautious in her statements about the amount and kind of psychological instruction that is good for the amateur. Critical appreciation of her work must be left to the journals which specialise in child study; but we desire to recognise the value of this book as an example of scientific method applied to an elusive subject of inquiry. It worthily succeeds her former work on "Intellectual Growth in Young Children".

Organic Syntheses: an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. Vol. 13. W. H. Carothers, Editor-in-Chief. Pp. vii+119. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 10s. 6d. net.

THE thirty preparations described in this volume are characterised, as usual, by their variety. Organic reagents, for example, range from that old favourite, methyl iodide, to representatives of the newer technique, such as 2, 4-dinitrophenylhydrazine and perbenzoic acid (made from benzoyl peroxide and sodium methylate by an improved procedure). Among other interesting substances contained in the selection are azelaic acid, diphenyl triketone, Ph.CO.CO.CO.Ph, *p*-fluorobenzoic acid, and tricarbomethoxymethane, CH(CO₂CH₃)₃. The appended index covers volumes 10-13 of the series.

J. R.

The Status of Psychology as an Empirical Science*

By PROF. F. AVELING

AN empirical science is either one which, as the term implies, is supported by the evidence of the senses, or one which is built up out of the elements of experience. Physical science, beginning and ending in sensory phenomena, is an example of the first kind; psychology an example of the second. But the ordinary use of the term 'empirical' limits experience to that of a sensory nature. My plea is that this limitation is an arbitrary one and due to a philosophical prejudice. There is more in experience than sensory elements. Apart from the self and its states, affective and volitional, there are thought-things as well as sensed-things, relations as well as elements, correlates as well as original fundamentals, in experience. The universe of physical science, for example, consists of thought-things; it is a conceptual universe erected on the foundations of a sensed one.

The external world, as presented to us by contemporary science, possesses none of the glamour and richness with which it is clothed in sensory experience. It has no colour, nor sound, nor odour, nor warmth, nor extension, nor shape, nor material substance. Yet the physicists would tell us that they are dealing with 'reality'; and that 'reality' in itself is not what we naïvely suppose it to be. The world that has successively been conceived as a world of extended and solid objects, a world of atoms, of electrons and protons, of wave motions, is more physically 'real' for physics than the everyday world in which we consciously live.

In directing attention, however, to the distinction, it is not with the view of appraising the relative degrees of 'reality' of thought-things and sensed-things. It is in order to point out that both do in fact occur in our experience taken as a whole. A perfect mathematical plane triangle, when an object of thought, although the result of a purely mental process, and never encountered in any sensory fashion whatever, is an experience just as much as a seen or felt (and mathematically imperfect) triangle cut out of wood or paper is. Each is referred to 'some thing'; but both are experiences, whereas the 'some things' are not.

EMPIRICAL AND EXACT SCIENCES

Just as the sciences of Nature, concerning themselves with sensed-things, make a selection from among our experiences, omit many, and abstract from the fact that they are experiences of ours, so other sciences, concerning themselves with thought-things, make another selection of experiences, and consider them as if they also were independent of us. The former sciences derive the force of conviction with which they impress us from the fact that they are ultimately based upon the evidence of our senses—'seeing is

believing'. The latter likewise convince us by their proofs, because their conclusions evidently follow from their premises—'There is no proof like a mathematical proof'. The point to be stressed again, however, is that both these kinds of science are selective of their material and leave out of account much experience which, as such, is as good as any other. If seeing is believing, and mathematical proof convincing, the immediate living experience of myself knowing and feeling and willing is most impressive of all. Such experience is not merely believable or convincing; it is indubitable.

I suggest that these neglected experiences are necessary to explain the constructions of the empirical sciences of Nature; and I further suggest that it is psychology, concerned with the totality of experience, objective and subjective alike, and making no abstraction from the fact that it is experience, which provides an account of the empirical origin of principles of systematisation and explanatory concepts which are used in the other sciences. Though these principles and concepts are abstract, and indeed vary in degrees of abstraction, they are and must be abstracted from something; and if that something is not the sensory material with which physical science deals, then it must be discovered in some other region of experience.

To support this contention it is not necessary to have recourse to innate ideas; for it can be shown that observable mental processes, other than the apprehension of sensory experience, can account for the facts. These processes are the apprehension and abstraction of relations between any experiences, the production of correlates in respect of any experience, and the immediate awareness of the self energising, or being in one way or another busy with its objects.

CLASSIFICATION

The first step taken in any empirical science is to examine, describe, and classify the objects, or aspects of objects, with which it deals; such classification being made on the principle of similarity and difference, which does not involve inference, but depends upon the immediate experience of relations. The first step in psychology will accordingly be to observe, describe, and classify mental processes as such. Psychologists are fairly well agreed on the broad classification of these processes under the three heads of cognition, affection and conation, or knowing, feeling and willing, as aspects or actualisations of the self.

Classification, however, does not merely mean grouping together: it means separation as well. Thus cognitive processes separate into sensory perception, conception, judgement, reasoning and remembering, for each of which a different

* From the presidential address before Section J (Psychology) of the British Association, delivered at Leicester on September 8.

explanatory concept may be needed. Similarly, different concepts may be necessary to explain the experiences of desire, resolution, impulse and striving, whether they are classed under two heads or one, and no matter how closely one may be involved in the other.

STRUCTURAL ANALYSIS

The next step consists in the finer structural analysis of the phenomenological data. In psychology, this means the further splitting up of the products of mental processes. On analogy with the procedure of the chemist, who analyses a chemical compound into its constituent elements, or of the anatomist, who dissects out the fibres of a nerve trunk, the psychologist analyses a percept, memory, emotion or will-act. The proverbial seen orange yields in such an analysis sensory factors of an elementary kind—colour, odour, sapidity, smoothness, and the like. It cannot be said, however, that these are all actually seen, any more than the thinghood with which the orange is invested in our thought. Apart from the shape and colour, all the rest comes from other experience than visual. It has been objected that such analysis destroys the mental 'whole' so analysed, just as chemical analysis destroys the compound or anatomical dissection the preparation. Indeed, even though we are unable to separate one sensation from another in a percept, and can only distinguish them in our thought, this objection holds good. For, if we think the sensations separately, and then attempt to add them together conceptually, we discover that the mere sum of sensations is not the equivalent of the percept. This objection has been urged particularly against the work of the introspectionist schools, as if they were concerned only to find the mental elements out of which all consciousness was once supposed to be compacted. But introspection has discovered more than the mere sensations that have been distinguished. It has found relations which obtain between the sensations, as well as relations obtaining between abstract concepts, and between concepts and percepts also.

A similar consideration might be developed in respect of the psychology of volitional processes. The elements that enter into processes of resolution and attainment, and of choice, are analysed. But it would be a mistake to think that these elements, so analysed, when conceptually put together again, are the equivalents of the will-processes. Here also are discovered relations which obtain between them; among which is that most important of all real relations, namely, that of cause, which is so closely identifiable with the self. It is in virtue of this relation that a will-act from beginning to end is constituted as a temporal whole. If one keeps in mind the fact that both in spatial and temporal 'wholes' neither the sensory and volitional elements nor the relations occur in isolation, this procedure of structural analysis is justified.

FUNCTIONAL ANALYSIS

A further step is to discover by functional analysis the conditions or laws of occurrence of the various events with which the science is concerned. In psychology, this has meant in the past the attempt to relate physical stimuli and their intensities with psychological occurrences, as in the case of Weber's Law; or to relate physiological events with psychological ones, as in the localisation of sensory and motor functions in definite areas of the cortex, or conative and emotional changes with the physiological disturbances indicated by the pneumograph, sphygmograph or psychogalvanometer. The establishing of such relations between physical properties and physiological processes, on one hand, and psychological processes, on the other, requires, however, that we shall already have taken a step away from the empirical point of view in the first sense of the term; for here we are trying to equate a sensory experience with a thought-object, physical or physiological. This involves much conceptual and inferential procedure.

These inferential procedures, however, are thoroughly justified if we admit, as I think we must, that not only sensory experience but also all experience must be taken into account; and then we must concede a like right of citizenship to whatever we are able to discover within it. As we have seen, we find thought-objects as well as sensed-objects and relations both ideal and real. Above all, we find an active self busy with all these mental objects and relations in the various ways of sensing, thinking, feeling, willing, striving, and the like. It is in this complete, unselected experience that we discover the experiential grounds for all our inferences.

EXPLANATORY CONCEPTS

The last step is to find explanatory concepts to cover all the data. Like the conditions and laws of occurrence—for indeed they are reached by the same process of functional analysis—these may be physical, physiological or psychological. For the most part those that have been advanced have been physiological—special sensory organs, local cortical areas, inhibition centres, association fibres, resistance at synapses, drainage of neural energy, and so on. There can be no doubt that some of these concepts are illuminating for psychology, but again at the price of abandoning the purely empirical point of view in the first sense of the term, and borrowing from experience other than sensory in order to make explanatory use of them. Indeed the experience from which the loan is taken is precisely that for which no physiological explanatory concepts are available. While we may accept engrams as the physiological reading of retentiveness, association fibres as correlated with the linkages between ideas, and the like, there is no suggestion forthcoming from physiology as to what may be the physiological

bases of becoming aware of experience, abstracting relations, producing correlates, the volitional control of mental process, or the intimate and immediate awareness of self.

The physiological phenomena, like the physical ones, do not contain the principles of their own explanation within themselves. When we examine the segmentation of a cell under a microscope, we conceive of it as a process going on in an existent, material and unitary thing. Whence do these concepts of existence, matter, unity and thinghood come? When we stimulate the nerve of a nerve-muscle preparation and notice a contraction of the muscle, we conceive of the event as a causal one. Whence did we derive our notion of cause? When we measure the intake and output of a living organism, we do so in terms of energy. From what

experience is that concept of energy taken? The ground of none of these concepts is to be found in any one, nor in the sum total of observations made. All these and like beliefs are inferences from the phenomena, made in virtue of experiences of another kind. Physiology, accordingly, like physics, is an empirical science in the first sense because it concerns itself with certain selected sensory data; in so far as it is explanatory, it is an inferential science. It is none the worse for that, however, even if it must borrow some of its concepts from psychology. The point is that, generally without acknowledgment, it does so borrow from psychology in order to establish the very constructions it offers to reloan to that science as explanations of mental events.

(To be continued.)

Progress in Electrical Communication

IT is becoming almost commonplace to remark that the growth of modern civilisation has been dependent to a very considerable extent upon the progress made in the art of communication, and, in particular, upon the facilities provided by electrical communications in linking together portions of the earth geographically remote from one another. The British Empire, with its widely distributed interests, has special need of efficient long-distance communication, and it is perhaps, therefore, significant to recall how large a part Great Britain has played in the development of that special branch of science which has nowadays earned the title of "communications engineering".

On the occasion of the ninth annual Norman Lockyer lecture of the British Science Guild, delivered on Thursday, November 23, Prof. E. V. Appleton gave a discourse on "Empire Communication" in which he outlined the growth and development of both wire and wireless communication as employed to meet Imperial needs (British Science Guild, 6 John Street, Adelphi, London, W.C.2. 1s.). At the beginning of the lecture, the audience was reminded that the first two great pioneer achievements in long-distance communication were concerned with the linkage of Great Britain with her oldest colony, Newfoundland. For, in August 1858, cable communication was first established between Valencia in Ireland and Trinity Bay, Newfoundland; while in December 1901, Marconi's signals from Poldhu, in Cornwall, were successfully received across the Atlantic by means of a kite-aerial at Signal Hill, also in Newfoundland. In this manner was demonstrated the potentialities of the two methods of electrical communication, one making use of an electric current guided along a copper conductor, while the other utilises the propagation of free electric waves. In spite of the intense controversy which has at times taken place on the relative advantages of communication by submarine cable and by wireless transmission, experience has shown gener-

ally that each system, in its own particular sphere, supplements rather than competes with the other.

EMPIRE CABLE SERVICES

With its advantageous start of nearly half a century, it is natural to find that the submarine cable had practically interlinked all parts of the British Empire by the time that wireless communication was able to offer a practicable alternative. Following the laying of several Atlantic submarine cables, similar links were established between England and India, Australia, New Zealand and all parts of Africa, in the development of Imperial communication. More than half the world's long-distance cables now forms part of the great British merger known as Cables and Wireless, Ltd. (the holding company), and Imperial and International Communications, Ltd. (the operating company).

Lord Kelvin was responsible for initiating the electrical methods and many of the instruments used in submarine cable telegraphy; and essentially the same basic principles, of course with vastly improved technique, are still employed to-day. In the early days, sending was done with a special form of Morse key, whereas to-day automatic methods are employed at both ends for the transmission and reception of messages. Much of this terminal equipment is, of course, equally adaptable to wireless telegraphy stations, and in this sense the younger branch of the communication family has benefited by the experience and technique developed by its senior members.

After it was thought that the speed of signalling, and thus the message-carrying capacity, of the submarine cable had reached a limiting value, the development of high permeability nickel-iron alloys opened up further possibilities which have been rapidly exploited. The Western Electric Co. of America produced the first experimental continuously-loaded cable, in which permalloy was wrapped round the core of the cable in the form of a thin narrow ribbon. Another alloy, called

mu-metal, due to the Telegraph Construction and Maintenance Company, also became available for application to the copper cable core in the form of a continuous single-layer winding of thin wire. The fundamental principles of this form of loaded cables were first enunciated by Oliver Heaviside, and by application in the manner described, cable engineers have been enabled to increase the traffic-carrying capacity of many sections of the Empire cable routes to about ten times their former value. As an example, given in the lecture, the latest cable to link up Newfoundland with the Azores is stated to be capable of working at a speed of 340 words per minute in each direction simultaneously.

EMPIRE WIRELESS SERVICES

Prof. Appleton then outlined very briefly the growth of communication by wireless telegraphy from the early trans-Atlantic experiments referred to above. In the course of this work, most of which was of an empirical nature, it was found that, for long-distance communication, wave-lengths in the range 1,000-20,000 metres were required, and until about 1920, wave-lengths less than 1,000 metres and down to about 200 metres were restricted to the use of mobile services, such as ship communication. The introduction of the thermionic valve provided, amongst other things, an easy means for generating oscillations at wave-lengths well below 200 metres, and the first indication of the extraordinary possibilities of short-waves for long-distance communication came from the experiments of amateurs in December 1921. From this time the progress made by amateurs' experiments in signalling between different parts of the Empire on wave-lengths of less than 200 metres was very rapid, and it culminated in October 1924 with the establishment of communication between F. Bell in New Zealand and C. W. Goyder, a schoolboy at Mill Hill, near London. It has since become very clear, however, that much remained to be done in the way of development of technique and acquiring of knowledge and experience, before these short wave-lengths could be utilised for reliable commercial communications.

In March 1923, the British Government decided to erect, in the interests of national security, a large wireless station capable of communicating with the Dominions. The Post Office prepared to erect this station at Rugby, as well as to consider a proposal from the American Telegraph and Telephone Company for connecting the telephone system of America with that of Great Britain by means of a wireless telephone link. By the end of 1926, both these services were in successful operation on long wave-lengths.

Concurrently, the Marconi Company was busily developing the technique of short wave transmission and reception, and the work of C. S. Franklin is notable in the adaptation of aerial array and reflector systems for the production of directed beams for point-to-point communication.

By the end of 1927, four short-wave beam stations were completed by the Marconi Company for the Post Office for communication with Canada, Australia, South Africa and India. These stations have proved very successful and are capable of traffic speeds of 300 words per minute.

Following upon these stations, the Post Office has established wireless telephony services in recent years between Great Britain and different parts of the Empire. The beam sending stations for this purpose have been built at Rugby, while the corresponding directional receiving stations are installed at Baldock, both being controlled from a telephone exchange in London. These short-wave links, in conjunction with the long-wave trans-Atlantic telephone service mentioned above, have been developed of recent years to such an extent that London has become literally the world's switching centre for the majority of long-distance telephone conversations between all continents.

Passing from the application of wireless telephony for the private use of ordinary telephone subscribers, it is natural to inquire as to its possibilities for long distance broadcasting purposes, and here Prof. Appleton recalled that on December 19 of last year, the first series of Empire broadcasts for overseas listeners was inaugurated. Utilising all the experience obtained in the other applications of short-wave beam systems, two sending stations were installed at Daventry with a series of different aerial systems to direct the beam in the appropriate direction for the benefit of the distant listeners. The first year of this Empire broadcasting is drawing to a close, and with the aid of more than 10,000 reports of reception in various parts of the world, it is expected that both the technical and programme sides of this service may be improved, although, with some exceptions, these may already be considered to be fairly satisfactory in view of the various difficulties which had to be encountered.

SOLAR ACTIVITY AND WIRELESS TRANSMISSION

It is nowadays quite adequately established that long-distance wireless communication is only brought about by the reflection or refraction of the waves in passing through the electrified regions of the upper atmosphere, now generally known as the ionosphere. In making a wireless journey around the earth, the waves are reflected alternately by the ionosphere and the ground. Modern research on this phase of wireless communication, to which Prof. Appleton has himself been a notable contributor, has shown that the electrification in the upper atmosphere is not by any means constant. It is usually denser by day than by night, and denser in summer than in winter, facts which indicate quite definitely that the electrification is controlled by the sun. It is now known that there are two main regions of intense electrification in the upper atmosphere, and that long waves are reflected at the lower of these, while short waves are reflected at the upper region.

The shortest wave-length that can be reflected depends on, amongst other things, the density of electrification; and there is therefore a lower limit to the wave-lengths which may be used for long distance communication. The limiting wave-lengths which penetrate the ionosphere without return to earth vary from somewhat less than 10 metres for a summer noon to 23 metres for a winter night.

Since the propagation of waves to long distances is so dependent upon the state of electrification of the upper atmosphere, any variations in this electrification produce variability in the wave transmission, and as experience shows, the effect is more marked with short than with long waves. The electrification of the ionosphere is not only subject to diurnal and seasonal variations; it is also profoundly affected by changes in solar activity, with its accompanying production of magnetic storms and auroral displays. Much speculation has taken place as to the means by which the appearance of a group of sunspots influences the earth's magnetic field and produces auroræ. On one hand, Birkeland and Størmer, the Norwegian investigators, have suggested that streams of electrified particles are shot with great speed from the sun and, on reaching the earth's atmosphere, give rise to intense circulating currents resulting in the effects observed. The tracks of the charged particles will be influenced by the earth's magnetic field so as to intensify the magnetic and auroral phenomena in polar regions. Within the last few years, however, Maris and

Hulbert, rejecting the corpuscular theory, have suggested that all the observed effects may be due to the arrival in the upper atmosphere of intense ultra-violet radiation emitted from abnormally hot spots on the sun's surface.

Whatever may be the means by which the occurrence of solar activity is conveyed to the earth, there is little doubt as to the effects observed. The electrical currents circulating in the upper atmosphere induce corresponding currents in the earth, and these in turn affect cable communication, which is always worked with an earth return circuit. Although cable engineers have devised methods of mitigating the influence of these spurious signals, there are still occasions, particularly in years of sunspot maximum, when the effects are so strong and variable that many services are put out of action. In wireless transmission, the influence of solar activity is even more marked, particularly on the shorter wave-lengths. The result is almost always to produce an increased absorption of the waves during their passage through the atmosphere, which may be sufficient to interrupt communication completely for days at a time. In view of the comparatively immature state of short-wave technique, there is little doubt that, as a result of the research now being vigorously pursued by both the physicist and the communications engineer, considerable improvement in long-distance communication will accompany more complete knowledge of the relations between the sun and the earth.

The Baffin Bay Earthquake

A GREAT earthquake was recorded on the night of November 20 at West Bromwich, Kew and other observatories. The first tremors reached Kew at 11h. 38m. 24s., p.m., and the disturbance registered there was of an intensity that is reached only about ten times a year. The record shows that the epicentre lay about 2,400 miles north-north-west of Kew, in Baffin Bay, and this determination is supported by records at Bombay (distant 5,700 miles) and in the Canadian observatories.

The interest of the earthquake lies in the fact that it occurred in a district hitherto supposed to be free from earthquakes, and this has led to the suggestion that the shock may have been caused by the fall of an unusually large meteorite. There is nothing improbable in this, for the impact of the great Siberian meteorite of June 30, 1908, produced waves that were recorded, though feebly, at Jena, distant 3,250 miles (Dr. F. J. W. Whipple, *Quart. J. Roy. Met. Soc.*, 56, 287-301; 1930). On the other hand, the movement registered at Kew was of great magnitude, and there seem to have been no remarkable air-waves such as were recorded in 1908 by barographs in British observatories.

The recent earthquake has directed attention to the rarity of earthquakes in the polar regions. It

thus seems desirable to obtain some estimate of the distribution of earthquakes in relation to latitude. The only records that are of service for this purpose are those provided by seismographs. Taking the shocks contained in the valuable "Catalogue of Earthquakes 1918-1924" edited by the late Prof. H. H. Turner (*Brit. Ass. Rep.*, 1928, pp. 214-304) and representing by 100 the number of earthquakes in the zone between 0° and 10° N. lat., the numbers occurring within equal areas in the zones bounded by successive parallels of 10° N. lat. are 100, 430, 512, 1770, 1541, 532, 130, 164 and 145. For the southern hemisphere, the corresponding figures are 413, 403, 234, 142, 87, 78, 20, 17 and 0. The large numbers for the mid north temperate zones are no doubt due chiefly to the close distribution of seismographs.

Confining ourselves to earthquakes registered more than 80° from their origins, the corresponding numbers for the northern hemisphere are 100, 77, 81, 108, 129, 136, 4, 19 and 0, and for the southern hemisphere 93, 72, 48, 41, 22, 19, 0, 5 and 0. These figures thus point to a somewhat higher seismicity in the zones between 30° and 60° N. lat., while in the southern hemisphere they show a nearly regular decline southwards. Moreover, the occurrence in both polar zones of great earthquakes like that of November 20 is clearly most unusual.

Obituary

DR. ERNST HARTERT

THE whole ornithological world will deplore the death of Dr. Ernst Hartert, which took place at Berlin on November 10, shortly after his seventy-fourth birthday. His loss will be particularly severely felt in Great Britain, where he had done his best work, for he had spent the greater part of his life as director of Lord Rothschild's Museum at Tring.

Hartert was a master of his subject. Not only had he a wider knowledge of the birds of the world than probably any other ornithologist, but also his knowledge of those of certain regions was extremely intimate. For many years we enjoyed the advantage of having this great authority in our midst, and his influence on systematic ornithology was immense. He was the apostle of an orderly system based on a thorough-going belief in geographical forms or sub-species as a part of the natural scheme, and the grouping of these by means of a trinomial nomenclature governed by rules of strict priority. His views met with great opposition at first from most of the older and most influential ornithologists of the time, but gradually the system he adopted and perfected began to be used, until to-day it has become universal.

Hartert was born in Germany and spent much of his youth in East Prussia; although he lived in England from 1892 until 1930, and became naturalised soon after his arrival, he always retained his natural German characteristics, which were not, however, at all of the aggressive type usually associated with Prussia. That a foreigner should have achieved so great a success in so heretical a mission in Great Britain, where the Ornithologists' Union is the oldest in the world, tells more than any words of the strength of character, the tenacity of purpose and the soundness of judgment Hartert brought to his task, and these traits were reinforced by intense sincerity and keenness, a constant readiness to help and advise, as well as by an original and very likeable personality.

This achievement was intimately connected with the two great works of Hartert's life. First, the building up of the collection of birds at Tring, and secondly, his intense study of the birds of the Palæarctic region. These tasks could only have been accomplished by untiring zeal and constant work. To build up such a collection there must be money, but money alone is of little use: there must be continuous and persistent search and organisation year in and year out to find out what gaps must be filled and how it shall be done. It was this constant adding of birds not represented in the collection which enabled Hartert, so ably backed up by Lord Rothschild, to bring together a collection which was not only enormous in point of numbers—there were 280,000 skins—

but was well collected and representative of the birds of the world.

This wonderful collection, which was especially complete in Palæarctic birds, gave Hartert the main material for his great work "Die Vögel der paläarktischen Fauna", publication of which commenced in 1903, was suspended from October 1914 to March 1920, and was completed in 1922. In 1933 a "Nachtrag" was published, while in 1932 was commenced an "Ergänzungsband" of which two parts have been issued. These supplements are extremely valuable to specialists, but the original work will always stand out as a most complete and perfect systematic account of the birds of this great region.

In 1912 was published the "Handlist of British Birds", in which Hartert was responsible for the classification and nomenclature employed, and it was this book, even more than his great Palæarctic work, that brought to a head the intense opposition to his system in Great Britain. Later, when the "Practical Handbook of British Birds" appeared (1919-24), with Hartert as specialist in the same subjects, the system had become generally adopted.

In his early days, Hartert travelled extensively, making expeditions in search of birds to northern Nigeria, the East Indies, the West Indies and Venezuela, as well as to Morocco, the Canaries and Madeira. Later, in company at times with Lord Rothschild, he made many expeditions to North-West Africa. He knew more about the birds of "Africa minor" at first hand and by subsequent study than anyone, and the Tring Museum became celebrated for its very complete series of birds from that region. He was a splendid collector and made beautiful skins, every one of which had its scientific value.

Hartert's first work in England was writing the account of the swifts and goatsuckers for the sixteenth volume of the "Catalogue of Birds in the British Museum". He contributed to other standard works and wrote a large number of valuable technical papers which appeared in various ornithological journals, and notably *Novitates Zoologicae*, the organ of the Tring Museum. He described hundreds of new birds from all over the world and his name has been perpetuated in numbers of birds described by others.

Mention must be made of Hartert's fine attitude during the War, when his dearest friends in two nations were opposed, and his only son, having joined the British Army, was killed in action. It was he who was chiefly instrumental in reviving after the War the International Ornithological Congress, and it was fitting that he should be president of the first post-War Congress at Copenhagen in 1926.

On his seventieth birthday, October 29, 1929, a "Festschrift" was published in Germany in Dr. Hartert's honour, and the British Ornithologists'

Union presented him with the Godman-Salvin gold medal. Shortly afterwards he went to live at Berlin, and here he had a room in the Museum where he continued to work at birds until within two or three days of his death.

The retirement of Hartert in 1930, the sale of the great Tring collection to New York in 1932, and now the death of this great figure in the bird world, close an important chapter in the history of ornithology.

H. F. W.

SIR R. FORSYTH SCOTT

WE regret to announce that Sir Robert Forsyth Scott, master of St. John's College, Cambridge, died on November 18, at the age of eighty-four years. He had for some time been in failing health but he retained his keen interest in the affairs of the College and was glad to see his friends until a few days before his death. Only a few weeks before, he had completed fifty years in the service of the College, twenty-five years as senior bursar and twenty-five years as master. To this service he gave himself without reserve. His acute mind, with a combination of mathematical and legal training, added to his knowledge of and sympathy with men, made that service invaluable to the College during a long period of difficult finance.

Scott was born at Leith on July 28, 1849, son of the Rev. George Scott, minister of the Established Church of Scotland at Dairsie, Fife. He was educated at the Edinburgh High School and afterwards in Stuttgart. After spending a time as a student at King's College, London, he went into residence at St. John's College, Cambridge, with an entrance exhibition in mathematics. A fellow student was William Burnside, who however migrated from St. John's to Pembroke—it is said to do more work. In the Tripos of 1875, Scott was fourth wrangler, Burnside being bracketed with Chrystal just above him: three Scots. Remaining in residence for two more years, Scott maintained his interest in mathematics and at the same time continued to row in the College boats; his interest in the success of the College on the river, begun then, he continued throughout his life.

In 1876 Scott was elected to a MacMahon law studentship, and in 1877 to a fellowship. For two years after that he held an assistant mathematical mastership at Christ's Hospital, but he had chosen the law as a profession and in 1880 he was called to the Bar by Lincoln's Inn. The end of his active career as a mathematician was marked by the publication in that year of his "Theory of Determinants", one of the earliest of the advanced mathematical treatises published by the Cambridge University Press. Written in a fresh, unpretentious style, this book must be counted a great achievement in the state of mathematical teaching in Cambridge at that time. It has remained until the present day, in the form of the second edition revised by G. B. Mathews, as the only substantial

work on the subject in English, and present-day developments in mathematics are causing its value to be appreciated again. From 1880 until 1884 he was a member of the Council of the London Mathematical Society. Glaisher is remembered to have said that Scott was a great help to the Society in a time of considerable difficulty.

After practising in Lincoln's Inn for three years, Scott, somewhat reluctantly, abandoned the legal profession to accept the invitation of his College to become senior bursar. But, like everything else he had attempted, he made an outstanding success of his new work, and laid well the foundations of prosperity for the College. At the same time he entered with great interest into undergraduate life. It is said by one who knew him well that in 1888 he was one of the most effective and yet popular of proctors. His breakfasts given to the College boats when in training will not be forgotten by those who partook of them. His gift for public affairs was turned to good account as a member of the Council of the Senate and of the Cambridge Town Council. In 1898 he married a daughter of Lieut.-General T. E. Webster. Ten years later he became master of St. John's and in 1910-12 was vice-chancellor of the University.

As master of St. John's, Scott showed how deeply the College had taken root in his affections by the labour which he bestowed on the College records. He had published in 1903 the second volume of the "College Admission Register" with biographical notes; and the accumulated work of his period as master was published so recently as 1931 in the third volume of the "Register". This work is rich in interest, and the biographical notes display the same human interest and sense of humour which characterised him at all times.

Scott was an honorary LL.D. of the University of St. Andrews, and in 1924 he received the honour of knighthood.

WE regret to announce the following deaths:

Dr. F. G. Crookshank, a well-known medical man and author of "The Mongol in Our Midst", on October 27, aged sixty years.

Mr. B. H. M. Hewett, engineer-in-charge of the Mersey Tunnel Scheme, who was also connected with the construction of the London Underground railways and with tunnelling projects in New York and Mexico, on November 14, aged fifty-nine years.

Mr. John Lister, a well-known antiquary, a founder-member of the Halifax Antiquarian Society and for about thirty years its president, on October 12, aged eighty-six years.

Prof. Wilhelm Mielck, director of the Heligoland Biological Station, on October 5, aged fifty-four years.

Prof. L. R. Sutherland, emeritus professor of pathology of St. Andrews University College, Dundee, on November 6, aged seventy years.

News and Views

Mr. W. T. Astbury

THE University of Lille has recently awarded a medal to Mr. W. T. Astbury, lecturer in textile physics in the University of Leeds, in recognition of the valuable work which he is carrying on in the Textile Industries Department of the University of Leeds in connexion with the investigation of the structure of animal fibres by means of X-rays. His recently published book on "The Fundamentals of Fibre Structure" shows great originality and has been very well received. Readers of NATURE will recall that much of Mr. Astbury's work has been described in letters and articles in our columns. Mr. Astbury received an invitation to deliver a lecture on this subject at a full session of the Thirteenth Congress of Industrial Chemistry which was held at Lille in September of this year. The University of Lille, in bestowing this honour upon Mr. Astbury, has wished to testify its appreciation of the value of his work in this field, and in particular to commemorate, in a tangible form, his contribution towards the success of the Congress at Lille.

Future of International Broadcasting

WE are afraid that next month will be an anxious time for the future of international broadcasting. Eight countries, including some not far distant from Great Britain, have refused to ratify the plan agreed to by the majority at Lucerne. It is highly probable that some of them will not accept the new wave-lengths suggested to them. Parts of the wave band of broadcasting will therefore become useless to many owners of receiving sets. The interference also is much increased by the excessive power used by many of the transmitting stations. Luxembourg, which uses the most powerful broadcasting transmitter outside Russia, is now at work on an unauthorised wave-length. Another difficulty, but not a serious one, is the use of broadcasting for advertising. The attempt to prevent this by the B.B.C. is neutralised to a certain extent by foreign transmissions. Several French stations will limit this in the future, but we suppose that Athlone will continue its advertisements of Irish sweepstakes, a practice forbidden in Great Britain. More objectionable is the increasing use of broadcasting in languages other than that of the country of the transmitting station for propaganda purposes. The new 500 kw. station of the Comintern at Moscow is apparently used for transmitting Communist propaganda in English, French, German and Italian at a strength which enables it to be heard by a small set almost anywhere in Europe. This may lead to retaliatory measures which will not improve the hearing of broadcasting. In Luxembourg and Alsace-Lorraine, the emissions are of necessity in both French and German. The *Electrician* of November 24 suggests that this demonstrates the impossibility nowadays of building a ring fence against new ideas and may possibly in the long run have a salutary effect.

New Wave-lengths for Broadcasting Stations

IN accordance with the Lucerne plan, a considerable redistribution of the wave-lengths allocated to European broadcasting stations will take place early in 1934. Recent issues of the *Wireless World* have given the first details of the scheme which has been organised by the International Broadcasting Union to effect a smooth and orderly change-over on the night of January 14-15, 1934. Broadcast listeners who are sufficiently interested have here a valuable opportunity both of calibrating their receivers and of following each broadcasting station on to its new wave-length. According to the arrangements described, all European stations will cease transmission at or before 11 p.m. G.M.T. on January 14. Then, one by one, according to special schedules now being prepared, the stations will resume broadcasting on their new wave-lengths. These will be checked systematically by one or other of the ten official control points which are under the direct supervision of the Union's own frequency-checking station at Brussels. Immediately a control station has completed its measurement of the frequency of a transmitter, the fact will be announced through one of five high-power stations specially selected by the International Broadcasting Union. To assist rapid identification, each transmitter will broadcast its name and country at least every two minutes during its transmission period. The transmissions will consist of gramophone records the titles of which will have been previously communicated to the control posts. Most British listeners will probably tune-in Radio-Paris, which will be announcing the progress of the change-over at the broadcasting stations in Belgium, France, Great Britain, Holland, Iceland, Ireland, Luxembourg, Morocco, Portugal, Spain and Switzerland. It is anticipated that this scheme will obviate the difficulties experienced in making changes under previous 'plans' due to the varying accuracies of the calibrations of wavemeters at individual broadcasting stations.

Electrical Interference with Radio Reception

AN outstanding difficulty in the engineering development of the reception side of radio broadcasting services arises from the operation of electrical machinery. Any device in which the electric current varies produces a parasitic current in the receiving set, often causing an objectionable noise at the loud speaker or headphones. In the case of television it produces mutilation of the picture. In a paper on this subject read to the Institution of Electrical Engineers on November 22 by Mr. A. Morris, the effects produced on the receiving set by a number of domestic electric appliances were shown both aurally by gramophone records and visually by a cathode ray oscillograph. Experiments indicate that in order to ensure high quality reception the ratio of signal to noise must be at least 40 decibels. Amongst domestic apparatus the chief offenders are vacuum cleaners, electric bells, vibrators, electric wiring and

high-frequency medical apparatus. Amongst small commercial apparatus are refrigerators, coffee grinders, dental drills, hair driers and clippers. Amongst large apparatus are generators, motors, flashing signs, traffic signals and overhead transmission lines. The interference due to traction plant for trains, trolley buses and electric trams is often serious. The petrol engines of automobiles and aircraft with coil or magneto ignition sometimes cause trouble. Experience shows that the amount of radio interference is becoming greater and its distribution more widespread. The remedy can be applied by the radio engineer in many cases at the receiving set, but the general level of the disturbance can be controlled only by suitable devices at the source. The present-day trouble is not primarily an electrical one, but is to find out a method of reconciling the economic aspects of the various interests concerned.

Physical Investigations of Psychical Phenomena

It has been suggested on several occasions that the time has come for the critical and objective study of certain psychical ('para-normal') phenomena by the accredited experimental methods of physics, physiology and psychology. How these methods may be applied to such a problem as, for example, telekinesis (the movements of objects without physical contact but in presence of an entranced 'medium') has been investigated in Paris by Dr. Eugène Osty, working with infra-red rays (see NATURE, November 25, p. 801). These curious effects have also been studied by Mr. Harry Price at his National Laboratory of Psychical Research in London. Fortunately, research into such para-normal happenings requires no belief in the truth or falsity of spiritualism; it is the outcome of the unprejudiced study of very special phenomena by the methods of the modern laboratory. Prof. Fraser-Harris, writing from The Athenæum, Pall Mall, S.W.1, informs us that an effort is to be made to endow and equip an institute for the critical study of psychical phenomena by the *objective* methods of registration. The promoters of the scheme realise that such things as the nature of the trance-state of a teledynamist, the 'direct voice', and materialisations ('ectoplasm') are now amenable to be investigated by delicate instruments and by exquisite methods which were non-existent a generation ago. Photography by ultra-violet light and by infra-red rays, the reception and transmission of sounds and voices by the microphone and gramophone, are sufficient to indicate that science is equipped as never before to attack problems apparently the most mysterious. It is hoped that funds may be forthcoming to make it possible to endow and equip an institute of psychical research worthy of the importance of the subjects to be investigated. Our own view, however, is that such an institute should be attached to the psychological department of a university or college, or to a responsible scientific society, and not be under the control of a private governing body. If established under such auspices it might maintain the reputation of Great Britain as the traditional home of genuine, unfettered and fearless research.

Pictorial Representation of Data

ONE of the characteristics of scientific management in modern industry is the use which is made of graphical methods. The importance of the pictorial representation of facts and data has also been widely realised by the various movements aiming at the prevention of accidents whether in industry or in the streets. It is, however, only within the last ten years that pictorial representations have been fashioned on definite scientific principles, and the value of the pioneer work of the Mundaneum Institute, Vienna, is now becoming widely recognised. During the last decade, under the leadership of Dr. Otto Neurath, basic principles for visual presentation have been developed. Charts or illustrations constructed on these lines reveal what is most essential at a first glance; the important details stand out on a second glance and more exact details are evident to a third glance. The method has been applied with conspicuous success to technical and to social facts and data, and the work of the Mundaneum has become known through a series of publications such as *Gesellschaft und Wirtschaft*, *Technik und Menschheit*, *Die Bunte Welt* and *Bildstatistik*. Branches have now been established in Amsterdam and London (c/o World Association for Adult Education, 16, Russell Square, W.C.1) through which the services offered, including the preparation of charts, the loan of exhibits, issue of publications and provision of material, and advice on principles of visual presentation may be more accessible. The new technique provides an international cultural factor of high importance, but if its full advantages are to be reaped, its introduction into different countries should proceed on uniform lines under the guidance of the Mundaneum itself.

Unemployment and Training Schemes

AN article on "Training and Unemployment" by Mr. Morris S. Viteles appears in the *Human Factor*, 7, No. 9. Mr. Viteles points out that the feeling of economic insecurity consequent upon unemployment and fear of unemployment is responsible for a great deal of the individual maladjustment in industry at the present time. Training schemes applied to entrants have tended to increase their efficiency and stability. At the same time, injustice has been done to workers of many years' standing, who are not given the benefit of this aid to efficiency, on the assumption that their experience makes it unnecessary, and that they would resent it. The writer advocates the training of older workers as well as new, and also the incorporation of instruction in allied tasks and processes into every training scheme—so that the mobility and adaptability of the workers within any given organisation unit may be at a maximum. Considerable increase in the worker's sense of security would follow, since he is good for more than one job. The chief psychological problems involved are those concerning the nature of motor skills and the probability of a general underlying factor; the transference of skill; and the possibility of accurately

assessing individuals before giving them training. Mr. Viteles does not suggest that training is the panacea for unemployment, but he does maintain that when the more fundamental problems are solved, and further knowledge of occupational trends is available, it will be of ever-increasing value.

Mimicry in Animals

ON November 24, Prof. G. D. H. Carpenter, Hope professor of zoology in the University of Oxford, delivered the second part of his inaugural lecture (see NATURE of November 25, p. 813). Dealing with the imitation of inedible or distasteful by edible species (Batesian mimicry), and the resemblances between inedible models (Müllerian mimicry or synaposematism), he laid stress on the fact that edibility and the reverse are not absolute but relative. The results of experiment accord well with theory, as is shown by Prof. Carpenter's own observations with monkeys, Moreton-Jones's with birds and Cott's with frogs. The fact of preferential feeding is well established. The polymorphism often shown by mimetic species is also in accordance with theory. It is evident that while models would gain, on the principle laid down by Müller, by diminishing diversity between their appearances, mimics on the other hand would find advantage by increasing it. Mimicry cannot be simply the result of coincidence due to a limited range of colour, nor can it be accounted for by supposing a parallel drift of variation. Mimicry might deceive an artist, not an anatomist. The only available key to the diverse phenomena of mimicry is the principle of natural selection.

Evolution in the Light of Past Ages

STUDENTS of life in the past have followed with interest a course of three lectures on "Palæobiology and Evolution", which have just been given at University College, London, by Prof. O. Abel, of the University of Vienna. The first lecture, delivered on November 24, dealt with the methods and aims of palæobiology. Prof. Abel stressed the importance of regarding even fossil animals as living creatures. Leaving aside the problems of phylogeny, with which palæontologists have so largely concerned themselves, he concentrated his discussion on what might perhaps be called the ecology of past ages. He showed how, from such evidences as tracks in the sand, fractured or diseased bones or small invertebrates imprisoned in amber, one can piece together a picture of the conditions of life and habits of animals now known only by their fossil remains. His second lecture was entitled "Palæobiology and Phylogeny"; in the third, a life-picture of the fauna of the Great Ice Age was presented.

Acquisitions at the British Museum (Natural History)

MAJOR P. H. G. POWELL-COTTON has presented to the Department of Zoology a collection of mammals, mostly large ungulates (including skins and skeletons), shot in the Sudan by him during his recent expedition in North-East Africa. This series of specimens is of exceptional interest as each one has a perfect skeleton, including a Sudani Giant Eland. There have been

two notable additions in the Department of Geology; one, a slab, 8 ft. high, containing a reconstructed group of palm leaves, from the Tertiary beds of Italy, presented by the Right Hon. Lord Rothschild; the other a small but select assemblage of British fossil vertebrates, collected by Mr. S. L. Wood, and presented by him, including Eocene mammalian and bird remains from the Isle of Wight and Liassic reptiles from Dorsetshire and Yorkshire. Presents to the Department of Minerals include crystallised sprays of native gold from the City Deep mine, Witwatersrand, from the directors of the Central Mining and Investment Corporation, Ltd.; and tektites (billitonites) from Billiton, Dutch East Indies, presented by Engineer R. J. van Lier. A large series of rocks and minerals has been collected for the Department by Mr. W. Campbell Smith in the United States and in Canada, and material was also selected by him from the duplicates of the United States National Museum and the United States Geological Survey.

COL. A. H. WOLLEY-DOD has presented his collection of British brambles (*Rubus*) to the Department of Botany. It comprises about one thousand sheets, most of which have been examined by critical workers in the group. Most of the specimens are from Cheshire. The plants collected by Mr. T. G. Tutin on the recent Cambridge expedition to British Guiana under Dr. G. S. Carter have been presented to the Department. There are about 900 specimens, well preserved and in good series, principally from the region of the Cuyuni River. A further 230 flowering plants from Tanganyika territory have been purchased from H. J. Schlieben. These have been identified by Dr. J. Mildbraed of Berlin.

Engineering Exhibition at Cardiff

THE Engineering Exhibition at Cardiff on November 22-December 2, held under the auspices of the South Wales Institute of Engineers, was the twelfth annual exhibition run by the Institute and, notwithstanding the depression in the mining industry of South Wales, the exhibitors staged some excellent examples of the latest developments of machinery and plant. Among the new features in the exhibits this year was a display by the Department of Scientific and Industrial Research. This exhibit included material for the survey of the coal seams of Great Britain which is being undertaken to determine their physical and chemical characteristics; a model coal cleaning plant in operation; exhibits illustrating recent progress in the carbonisation of coal and hydrogenation; pulverised fuel and the suspension of coal in oil. This combined research exhibit must have been of great value to those who are responsible for the mining industry in South Wales. Other special features of the exhibition were coal breaking and dry cleaning plants, steel girder arches and continuous steel lining for underground roads, electric plant, switchgear and mine signalling apparatus, woodwork machinery plant, mechanical stokers, electric welding plant, steel pit props, coal tar products for use on roads, an oxygen 'cutting'

machine, oxyacetylene welding, turbines, steel tubes, steel wire ropes, etc. The object of the South Wales Institute of Engineers in organising these exhibitions is mainly educational, and all students from the university colleges, the technical colleges, the county council mining schools, and members of all engineering societies and institutions are admitted free to the Exhibition. Another object is, of course, to bring the manufacturer into touch with the consumer, and so help in developing the industries of the district.

Popularity of the Electric Trolley Omnibus

THE use of the electric trolley omnibus is rapidly increasing. Not only has it replaced electric tramways operating on unremunerative routes, but it has also sometimes replaced petrol buses. It will have to be taken into consideration when new transport schemes arise. In the *Metropolitan-Vickers Gazette* for November, the application of this method to town and inter-urban transport is discussed. It is stated that at the present time there are 24 installations of this kind in Great Britain, operating over 250 route miles of track. Its operating flexibility lies between that of a tramcar which is confined to its rails and a petrol bus which has complete freedom of movement. The acceleration of a trolley bus is twice that of a motor bus and it has no gear changing jars. Its schedule speed is high, although it does not exceed the maximum speed laid down by the Ministry of Transport. Compared with a tramcar it has the great advantage of being able to draw up to the kerb. This is a great convenience to passengers, and avoids obstructing the traffic. The absence of reciprocating and wearing parts in the electrical equipment results in a low maintenance cost, and very little time is spent in the repair shops. Its life is fifty per cent longer than that of the petrol bus. The most doubtful feature seems to be the cost and upkeep of the overhead equipment. If this cost is very high the motor bus may be the more economical. From the driver's point of view, the light foot-operated controller takes the place of the motor bus accelerator pedal. The absence of gears leaves the driver's hands entirely free for steering. The driving of a trolley bus therefore requires much less skill than driving a motor bus. With this system also, Great Britain is using its national fuel resources and not imported fuel.

Exhibition of Types of Native Boats

AN exhibition of the main types of native boats, and their distribution throughout the world, will be opened at the Science Museum, South Kensington, on December 2. The exhibition deals with the boats which are used for transport, and for fishing, in the rivers and along the coasts of the different continents, but is not concerned with the larger ocean-going vessels, or with the steel-built ships of the more civilised races. In any locality the design of a boat and its method of construction depend on the service for which the boat is required, the material available, the racial affinities of the builder, and the contacts of the builder and of his ancestors with other races. As a result of the interaction of these factors, we

find very great differences between boats used under apparently similar conditions in neighbouring districts, while we equally find marked similarities between boats built by totally different races and in widely separate parts of the world. Thus punt-shaped boats are commonly used on nearly all the rivers and inland waterways of Europe and over a great part of Asia. Their form is suitable for use on rivers, and long planks, produced either by splitting or by sawing, can be obtained along the banks of these rivers. But it is at least doubtful whether the prevalence of this punt-shaped type indicates any racial affinities between east and west, or even early contacts. Contrary to the usual practice, the exhibits are being arranged in accordance with their forms and types of construction, instead of geographically, and it is hoped that this grouping will serve to bring into prominence differences and similarities which the more usual arrangement has failed to disclose.

Statistical Methods in Industry and Agriculture

THE first meeting of the newly-formed Industrial and Agricultural Research Section of the Royal Statistical Society was held on November 23, when Dr. R. H. Pickard, director of the British Cotton Industry Research Association, gave an address on "The Application of Statistical Methods to Production and Research in Industry". Dr. Pickard referred to the important part now being played in the study of the technical problems of industry by the statistical methods initiated by Prof. Karl Pearson forty years ago. He pointed out the similarity between the statistical technique used in problems arising in cotton trade research and that developed by Prof. R. A. Fisher at Rothamsted in agricultural research. He gave a number of illustrations taken from the work of the British Cotton Industry Research Association showing the wide scope and utility of modern statistical methods applied to the sampling problems occurring in that industry. Discussing the question of the employment of fully-trained statisticians in industry, Dr. Pickard emphasised the need for the statistician to be well-trained in a knowledge of the processes of the industry. It is proposed to hold four meetings each session of the new Section and to publish a supplement to the Society's *Journal* (published four times a year) which will be devoted to the subject of statistical methods applied to industry and agriculture.

Royal Ontario Museum

THE Royal Ontario Museum at Toronto was officially reopened on October 12 by the Prime Minister of Ontario in the presence of the Lieutenant Governor and other officials of the Province and of the University of Toronto. The Museum was originally opened in 1914 as a combination university and provincial museum. The interior of the old building has been completely remodelled and a large addition constituting the main section of the building erected at a cost of nearly 2,000,000 dollars. The front section houses the natural history galleries, including those of geology, mineralogy, palæontology and zoology, and the connecting link, and the old

section those of archaeology. In connexion with the opening ceremonies honorary degrees were conferred by the University of Toronto upon Dr. C. G. Abbott, secretary of the Smithsonian Institution, Washington, Mr. J. B. O'Brian, chairman of the Board of Trustees, Mrs. H. D. Warren, vice-chairman, and Mr. Sigmund Samuel, member of the Board.

Microchemical Club

A MICROCHEMICAL CLUB is being formed by a number of scientific workers interested in the use and improvement of microchemical methods, for the purpose of developing interest in the science, pooling ideas, and subscribing to certain journals. The new technique of microchemistry, with which the names of Profs. Behrens, Emich and Pregl are particularly associated, has rapidly established itself as a valuable tool for research, and recognition of the importance of microchemistry led to the award of the Nobel prize to Prof. Pregl in 1923. The methods have been of inestimable value in noted researches in many fields of science. While microchemical methods are widely used in universities, research institutes and industrial laboratories on the Continent and in the United States, Great Britain has hitherto lagged behind. The importance of the new methods is now beginning to be realised in Great Britain, and the Microchemical Club hopes to foster the development of this new technique in pure chemistry, metallurgy, geology, biochemistry, medical science and other branches of scientific study. The secretary of the Club, Dr. M. Healey, Wellcome Physiological Research Laboratory, Beckenham, Kent, will be pleased to answer inquiries from anyone who is interested.

Relics of the Barents Expedition

It is reported in the *Moscow Daily News* that an expedition, organised by the Arctic Institute of the U.S.S.R. which has recently returned to Leningrad, has discovered relics of the Barents expedition which perished in 1597. William Barents was a Dutch navigator born about the middle of the sixteenth century. In 1594 he left Amsterdam with two ships to search for a north-east passage to eastern Asia, but failed. He commanded another expedition of seven ships in the following year, but was too late to find open water. His third journey resulted in catastrophe. After rounding the north of Novaya Zemlya in 1596, Barents' vessel was beset by ice and compelled to winter in the north. It was the first winter ever experienced by Europeans in polar regions. Barents' ship was not released until 1597. His party left in two open boats on June 13, and most of its members escaped. Barents himself died on June 30, 1597, with four members of his crew. The expedition of the Arctic Institute of the U.S.S.R. discovered on August 18 last some relics of the hut in which Barents wintered on the north-east extremity of Cape Spora Novolsk. These relics will be preserved in the Museum of the Arctic Institute in Leningrad.

Map of Columbus

No authentic map of Columbus was known until Prof. P. Kahle in 1929 found among a number of

old charts in the Seraglio at Istanbul a coloured Turkish map of the Atlantic with its islands and coasts. One of the several legends on the map shows it to be the work of Piri Re'is in 1513. Piri Re'is is known as the writer of an important work on the Mediterranean published in 1521. Prof. Kahle has prepared an account of this map, with a reproduction (*Geog. Rev.*, October 1933). It is clearly only the western part of an original world map. On the extant part, there is a list of sources which includes reference to a map drawn by Columbus. Prof. Kahle adduces evidence in favour of this map having been drawn by Columbus during the earlier part of his third voyage, since it incorporates his discoveries up to that time but not his later experiences on the third voyage or discoveries on the fourth voyage. It is known that during his third voyage Columbus sent to Spain the only map of his about the existence of which there is no doubt. It was evidently a copy of this map, of which several are known to have been made, which fell into the hands of Piri Re'is in 1501. It is noteworthy that the list of sources on the map contains no reference to the reputed map and letters of Toscanelli.

Social and Economic Problems

REFERRING to the leading article on "Social and Economic Problems" in *NATURE* of October 28, Dr. J. F. S. Ross, principal of Wigan and District Mining and Technical College, writes: "Surely what is wanted is not the multiplication of ungainly—and probably bored—committees, but the stimulation of larger numbers of scientists to the active study of social and economic questions, so that scientific method may be utilised towards the solution of the desperately urgent problems that politicians and professional economists seem unable to solve, or even in many cases to recognise. Not a proliferation of committees is needed, but more unbiassed scientific research into the realities of politics, sociology and economics. For such work the training, knowledge and outlook of physicists, biologists and scientific engineers is an invaluable basis, and the lack of such a basis must be held responsible for the futility and unreality of much political and economic discussion."

Mr. Theodore C. Rigg

MR. THEODORE C. RIGG has been appointed director of the Cawthron Institute, Nelson, New Zealand, on the retirement of Prof. T. H. Easterfield. Mr. Rigg was an 1851 Exhibition scholar in 1912 and carried out post-graduate research at the School of Agriculture, Cambridge, until 1914, returning after the War to study at Rothamsted. He was appointed agricultural chemist at the Cawthron Institute in 1919, and has since held positions as head of the Agricultural Department and as assistant director. He has been in charge of the Mineral Content of Pastures Investigation of the Nelson Territory since 1928, and has directed the Reconnaissance Soil Survey of the North Island. His work on animal nutrition, and particularly on the cause and prevention of bush sickness, is well known.

Dr. I. W. Wark

DR. IAN W. WARK has been awarded the H. G. Smith Memorial medal for 1933 by the Australian Chemical Institute. The medal is presented annually to the research worker who, in the opinion of the council, has contributed the most valuable additions to chemical science in Australia during the previous ten years. For the past four years, Dr. Wark has been investigating, for a group of mining companies, the theoretical basis of the flotation process for the concentration and separation of minerals. His work has also been recognised by the University of Melbourne, which awarded him both the Syme and Grimwade prizes for 1933.

Announcements

A DISCUSSION on "Heavy Hydrogen", to be opened by Lord Rutherford, will take place at the meeting of the Royal Society to be held on Thursday, December 14.

THE Christmas lectures this year at the Royal Institution, which will be the one hundred and eighth course of six lectures "adapted to a Juvenile Auditory", will be delivered by Sir James Jeans on December 28 and 30 and January 2, 4, 6 and 9 at 3 p.m. The title of the lectures will be: "Through Space and Time".

PROF. H. S. RAPER, Brakenbury professor of physiology in the University of Manchester, has been appointed a member of the Medical Research Council in succession to Prof. Edward Mellanby, who recently resigned his membership on accepting appointment as secretary of the Council.

At a meeting of the Geological Society of London held on November 22, the following foreign members were elected: Prof. Ray S. Bassler, of the United States National Museum, Washington; Dr. Arthur L. Day, of the Geophysical Laboratory, Washington; Prof. Carl F. Kolderup, of the University of Bergen. The following foreign correspondents were also elected: Prof. Michele Gortani, of the Royal University of Bologna; Dr. J. S. Lee, of the National Research Institute of Geology, Shanghai; Prof. F. L. Ransome, of the California Institute of Technology, Pasadena; and Prof. H. Yabe, of the Tôhoku Imperial University, Sendai, Japan.

At the anniversary meeting of the Mineralogical Society held on November 9 the following officers were elected: *President*, Sir Thomas Holland; *Vice-Presidents*, Sir William H. Bragg and Mr. Arthur Russell; *Treasurer*, Mr. F. N. Ashcroft; *General Secretary*, Mr. W. Campbell Smith; *Foreign Secretary*, Prof. A. Hutchinson; *Editor of the Journal*, Dr. L. J. Spencer.

At the annual general meeting of the London Mathematical Society held on November 16, the following officers were elected: *President*, Prof. G. N. Watson; *Vice-Presidents*, Prof. A. C. Dixon, Prof. G. H. Hardy, Prof. G. F. J. Temple; *Treasurer*, Dr. A. E. Western; *Librarian*, Prof. H. Hilton;

Secretaries, Mr. F. P. White, Mr. W. L. Ferrar; *New Members of the Council*, Dr. M. L. Cartwright, Dr. G. B. Jeffery.

AN exhibition of cinematograph apparatus at the Dorland Hall, Piccadilly Circus, London, W.1, was opened on November 27 and will remain open until December 9. On Mondays and Fridays (10 a.m.-6 p.m.), the exhibition and demonstration rooms are given over to educational and cultural films; on Thursdays (5 p.m.-7 p.m.), films of medical interest are being shown.

THE annual congress of the British Institute of Radiology will be held at the Central Hall, Westminster, on December 6-8, under the presidency of Dr. Stanley Melville, who will deliver his address on the first day of the meeting. The fourteenth Mackenzie Davidson memorial lecture will be delivered on December 7 by Mr. N. S. Finzi, who will speak on "X-Ray and Radium Treatment in the Future", and the sixteenth Silvanus Thompson memorial lecture on December 8 by Dr. A. Bouwers, who will discuss "Modern X-Ray Developments". Throughout the congress there will be an exhibition of X-ray and related apparatus.

THE Swiney lectures on geology under the direction of the British Museum (Natural History), will be delivered by Dr. R. M. Craig, lecturer in economic geology in the University of Edinburgh, in the Royal College of Science, Old Building, Exhibition Road, South Kensington, London, S.W.7. The title of the course will be "Geology in the Service of Man"; the twelve lectures will be given on Mondays, Wednesdays and Fridays at 5.30 p.m. from December 11 until December 22, and from January 3 until January 15. Admission to the lectures will be free.

AN attractive greeting card for bird lovers is published this year by the Royal Society for the Protection of Birds. It reproduces in colour a picture, specially painted and presented to the Society by the bird-artist, Mr. Archibald Thorburn, of a cock chaffinch in full summer plumage on a branch of hawthorn. The card may be obtained from the offices of the Society, 82, Victoria Street, London, S.W.1, price 4s. 7d. a dozen.

THE Central Information Bureau for Educational Films, Kingsway House, 103 Kingsway, London, W.C.2, is producing a monthly *Bulletin*, the first copy of which has just appeared (price 1s., free to subscribers to the Bureau). This journal marks the beginning of the second year of the Bureau's existence; it will include film reviews, reviews of books on cinematography and education, articles on scientific advances in cinematography and so on.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant engineer in the Chief Engineer's Department of the London County Council—The Clerk of the Council, County Hall, Westminster Bridge, London, S.E.1 (Dec. 15). A research assistant to the Burden Mental Research Trust—Honorary Secretary, B.M.A. House, Tavistock House, London, W.C.1 (Jan. 9).

Letters to the Editor

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

Cathode Secondary Emission: a New Effect in Thermionic Valves at very short Wave-lengths

THE object of this note is to describe a case in which electrons were observed to arrive at the most negative electrode in a thermionic valve with sufficient energy to cause secondary emission.

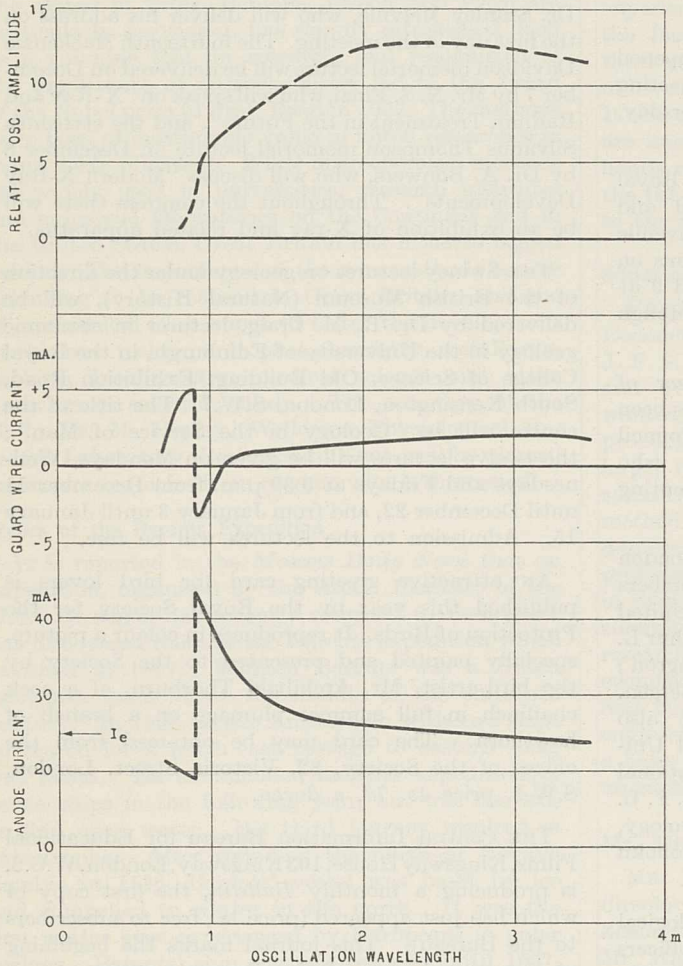


FIG. 1.

During a recent investigation¹ of short-wave oscillations produced by magnetron valves of the divided anode type, it was found that in some cases the mean anode current during oscillation exceeded the original total emission of electrons from the filament. Abnormally high values of anode current were first observed when using the falling characteristics of the valve to produce oscillations at wave-lengths a little above the lower limit set by electron inertia. Further investigation showed that such effects were absent at longer wave-lengths and that

the anode current increased as the minimum wave-length was approached. It was also found that the effect was independent of the gas pressure in the valve over the range representing a normally good vacuum. These results suggested that the effect was due to bombardment of the filament by electrons and not by positive ions. That some bombardment of the filament occurred was indicated by the fact that its brilliancy increased visibly when oscillations were started under conditions giving high anode current.

Experimental evidence of electronic bombardment was obtained by mounting a pair of 0.5 mm. molybdenum wires parallel to the 0.17 mm. tungsten filament and about 1.0 mm. distant from it in a valve with a divided anode 10 mm. in diameter.

Fig. 1 shows how the anode current and the current to the molybdenum 'guard wires' varied with oscillation wave-length when the magnetic field strength was adjusted for maximum oscillation amplitude. The 'guard wires' were connected through a milliammeter to one end of the filament. The anode voltage was 1,200 v. and the original filament emission 25 ma.

It will be seen that a current of the order of several milliamperes reached the 'guard wires', although they were at the same potential as the filament, and that this current reversed its direction near the minimum wave-length. The maximum reverse current occurred at the same wave-length as the maximum anode current. By giving the 'guard wires' an increasingly negative potential with respect to the filament, it was proved that the reversal was due to the emission of negative charges and not to the arrival of positive ones. This was confirmed by isolating the 'guard wires' and measuring their potential as the wave-length was reduced from a few metres to the minimum value. Just above the minimum wave-length the potential changed suddenly from about -200 v. to about +10 v.

These results lead to the conclusions that the 'guard wires', and by inference the filament also, are bombarded by electrons the energy of which increases as the short wave limit is approached and that the average efficiency of the bombarding electrons in producing secondary electrons may exceed 100 per cent near the short wave limit.

By measuring the resistance of the filament under oscillating and non-oscillating conditions in a valve without 'guard wires', an estimate has been made of the relative importance of the direct effect (increase of filament temperature) and the indirect effect (secondary emission) of the electronic bombardment on the electron emission from the filament.

In a typical case the maximum secondary emission from the filament appears to be several times greater than the extra primary emission resulting from the increase in filament temperature.

The fact that some of the electrons emitted from the filament can return to it with much more than their initial energy is due to the time of transit becoming an appreciable fraction of the oscillation period. Those electrons which traverse the path filament-anode-filament while the potential gradient

in their neighbourhood is falling have the possibility of transferring energy from the oscillatory circuit to the filament.

It seems likely that cathode secondary emission may be a factor of considerable practical importance in the production of very short wave-lengths. It probably occurs in the Barkhausen type of oscillator² as well as in magnetron valves, but to a smaller extent. It is not to be expected in the ordinary 'reaction' type of triode oscillator. Okabe³ has recently described a 'cold cathode oscillator', using a magnetic field, for very short wave-lengths. From his description of the results obtained, it is probable that this oscillator functions by means of cathode secondary emission.

E. C. S. MEGAW.

Research Laboratories of the
General Electric Company, Ltd.,
Wembley.

Oct. 23.

¹ *J. Inst. Elect. Eng.*, **72**, 326; 1933.

² Barkhausen and Kurz, *Phys. Z.*, **21**, 1; 1920.

³ Okabe, *J. Inst. Elect. Eng. (Japan)*, **53**, 369; 1933.

Sunspot Number and the Refractivity of Dry Air*

EXISTING data on the refractivity of dry air as determined by various observers show disagreements which are larger than the errors which seem probable in many of the recent measurements. The constancy of composition of the atmosphere at the earth's surface has been repeatedly questioned and the use of dry air free from carbon dioxide is being abandoned¹ as a standard reference medium for specific gravities of gases, because it is too variable in its normal density.

In view of these facts, I have examined the refractive index data on air for evidences of systematic variations. Since 1912, at least 19 series of absolute measurements of the index of air have been performed, and the mean of the resulting indices of refraction for the *D* lines of sodium is 1.0002923, for 0°C. and 760 mm. pressure². Some of the observers used air containing carbon dioxide, and it is not certain that all the results are computed for the same value of gravity; but these uncertainties are very small in the seventh decimal place of index. Nevertheless, about 50 per cent of the deviations from the mean value are so large as $\pm 5 \times 10^{-7}$. Moreover, when listed according to date of publication (or a more precise date for the experiments, if such information is available), eight of the first ten residuals are negative and the nine which follow are either positive or approximately zero. These two groups, one having negative and the other positive residuals, differ in average index by 5.4×10^{-7} and they lie almost entirely within the two opposite phases of the current magnetic cycle of sunspots which began in 1912 and extends to 1934, approximately. Consequently, since sunspot numbers are appreciably higher in the first half of this 23-year period, a correlation (negative) between sunspot numbers and the refractivity of air is suggested.

Computation gives a Pearson correlation coefficient, $r = -0.52$ with a probable error of ± 0.11 , and the data, with the characteristic (or regression) lines, are shown in Fig. 1. Although the number of observations is small, this result seems of sufficient

significance to indicate that a hypothesis relating refractivity and sunspots should be sought. Degree of storminess of the earth's atmosphere has already been correlated (positively)³ with yearly relative sunspot numbers, and thus it seems possible that a decrease in the average rate of stirring and mixing of the air during the second phase of the magnetic

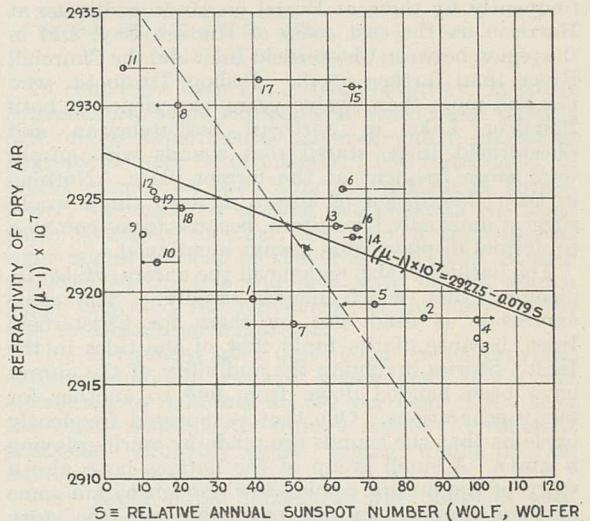


FIG. 1. Correlation between refractivity of air and sunspot number. The Pearson coefficient of correlation is $r = -0.52 \pm 0.11$. Arrows show the change in solar activity during a one-year period within which an experiment is not definitely dated. These data cover the interval 1912 to date, and are numbered in the approximate chronological order of the observations as follows: 1, Howell, J. T.; 2, Posejpal, V. (1917); 3, Meggers and Peters; 4, Peters, C. G.; 5, Posejpal, V. (1918); 6, Traub, W.; 7, Stoll, E.; 8, Rusch, M.; 9, Perard, A. (1922); 10, Zwetsch, A.; 11, Quarder, B.; 12, Perard, A. (1924); 13, Cheney, E. W.; 14, Opladen, M.; 15, Tausz and Hornung; 16, Lowery, H.; 17, Tausz and Görlacher; 18, Sears and Barrell; 19, Kösters and Lampe.

cycle allows certain denser components (associated molecules or isotopes) to settle and produce at the earth's surface a gaseous mixture having a slightly higher index of refraction.

L. W. TILTON.

Department of Commerce,
Bureau of Standards,
Washington, D.C.
Sept. 27.

¹ Landolt-Börnstein, "Physikalisch-Chemische Tabellen", Erster Ergänzungsband, 160-163; 1927.

² The Landolt-Börnstein "Tabellen" (5th edition) list many of the results. Other sources are: V. Posejpal, *Ann. Phys.*, (4), **83**, 629-646; 1917. V. Posejpal, *J. Phys.*, (16), **2**, 85-92; 1921. A. Pérard, *Procès-Verbaux des Seances*, x, 16; 1923. A. Zwetsch, *Z. Phys.*, **19**, 398-413; 1923. Tausz und Görlacher, *Z. tech. Phys.*, **12**, 19-24; 1931. Sears and Barrell, *Phil. Trans. Roy. Soc.*, A, **231**, 126-127; 1932. Kösters and Lampe, result obtained in 1932 at the Phys. Techn. Reichsanstalt and privately communicated to me. C. G. Peters, unpublished result obtained in 1917 at the U.S. Bureau of Standards with apparatus different from that used by Meggers and Peters.

³ Ellsworth Huntington, "Earth and Sun", p. 29, Yale University Press, 1923.

Audibility of the Aurora and Low Aurora

AN extensive inquiry among traders, policemen, missionaries and Eskimos concerning the audibility of the aurora was made by members of the Canadian Polar party stationed near Chesterfield Inlet on the west coast of Hudson Bay. The majority of the white people who were questioned had more than twenty years' experience in the eastern Canadian arctic. The Eskimos were questioned only after we found that they were calling us "foolish white men",

* Publication approved by the Director of the Bureau of Standards of the U.S. Department of Commerce.

because we had said that the aurora was inaudible. Natives living in the region extending from Repulse Bay in the north to Eskimo Point in the south, and from Baker Lake in the west to Southampton Island in the east were included in the inquiry.

All the white people insisted that they had heard rustling or swishing sounds accompanying brilliant auroral displays. These sounds were heard more frequently by them at Burrel on Hudson Straits, at Harrison on the east coast of Hudson Bay, and in the region between Chesterfield Inlet and the Churchill River than farther north. Bishop Turquetil, who has had more than twelve years' experience at both Reindeer Lake in northern Saskatchewan and Chesterfield Inlet, stated that sounds with aurora were more frequent at the former place. Nothing in their description of aurora at such times would suggest unusually low aurora, because forms common to normal displays were always mentioned.

The natives in this region call the aurora, *akshanik*, meaning that which moves rapidly. The same expression is used also by them for Chesterfield Inlet, because of the rapid flow of the tides in the Inlet. Stories involving the audibility of the aurora have been handed down from one to another for many generations. One that is repeated frequently explains that the sounds are made by spirits playing a game. A small group of the natives have also a story of the aurora coming low enough to kill some of their people. In this particular case the story may have originated from the effects of a destructive lightning flash, although lightning is so rare in this region that the natives often seek shelter with white men during even the mildest storms.

Very few natives from Baker Lake, Chesterfield Inlet, and north of these places, had heard the aurora, although all knew people who had heard it. Natives from Southampton Island knew of no one who had heard it there. Practically all natives from south of Chesterfield Inlet had heard the aurora, and described the sounds by blowing through rounded lips. According to them the aurora was heard more frequently during some winters than others. None had heard it during the winter of 1932-33. Nothing of a definite nature concerning low aurora could be found from them.

The collected testimony of both whites and natives indicates that the region of maximum audibility lies in the region of maximum auroral frequency. Unfortunately, this does not distinguish between an objective or a subjective explanation of the sounds, since the greater the number of aurora seen the more likely it is that conditions favourable to either effect may occur.

The extent to which the testimony of natives can be relied upon is debatable. As observers of unusual occurrences in their native habitat they are superior to the average white man. However, traditional accounts of the sounds may be faulty and have induced a greater susceptibility to a subjective effect.

The members of the party listened occasionally for auroral sounds during brilliant displays, but were unsuccessful except on the night of March 20, when J. Rea, assistant observer, heard sounds with a brilliant display. We were occupied with double station photographs at the time and listened carefully but unsuccessfully for the sounds. Our failure to hear the sounds may have been due to less sensitive hearing, since conditions for detecting objective sounds were extremely good. During the day, a

pilot balloon had been followed for 138 minutes, and the same clear, calm conditions prevailed during the night with a minimum temperature of -17°F . During the interval in which the sounds were heard, brilliant greenish-white flashes were darting overhead from south to north, and some of these may have come momentarily lower than usual. Height determinations have yet to be made from the double station photographs taken at this time, but the plates show no unusual displacements. Rea is of the opinion that the sounds did not occur simultaneously with the flashes.

One account which we heard of audible aurora indicates a subjective origin for the sound. In this case the aurora was heard in central Saskatchewan from the observation platform of a moving train. Here the noise of the train would have drowned all sounds coming from the aurora, and having the low intensity commonly reported.

On at least three occasions at Chesterfield an auroral condition prevailed which may explain the reports of individuals who claim that they have walked in the aurora. Following an active display with ray structures predominating, a continuous auroral glow covered the whole sky except for a small area in the north. The light from this glow, together with the light reflected from the snow, made it difficult not to feel that one was in an auroral mist or fog.

Continuous records were taken of atmospheric potential gradients from March to the end of August. No effect could be detected on the recording galvanometer during auroral storms.

F. T. DAVIES.

B. W. CURRIE.

Canadian Meteorological Office,
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Magnetorotation with Alternating Fields of High Frequency

SOME time ago we carried out experiments¹ to determine whether the rotation of the plane of polarised light still takes place when the frequency of the magnetic field is very high, for example, ten times that of the Larmor precession frequency. Polarised light from an arc lamp (or preferably a sodium arc) is polarised by a nicol prism, then passes through a tube containing sodium vapour at low pressure (about 7.5×10^{-4} mm.) and finally is analysed by a second nicol. The tube containing the sodium vapour is placed inside a coil forming part of a resonance circuit tuned to a high frequency valve oscillator. The plane of polarisation of the light was rotated on passing through the sodium vapour in the presence of the oscillatory magnetic field. The intensity of brightness after the second nicol was compared for high frequencies (n) with that for 50 c.p.s. No diminution in this ratio was found when the frequency n was about nine times the Larmor frequency O_L corresponding to the magnetic field amplitude

$$H_0(O_L = \frac{1}{2} \frac{e}{m} \frac{H_0}{c}, H = H_0 \cos nt).$$

It was nevertheless considered possible that the existence of such an integral quadratic effect makes the above results not strictly conclusive for the persistence of gyration at high frequencies, as for example

a partial depolarisation of light would give a similar effect. We have therefore determined directly the amplitude of magnetorotation for a high frequency magnetic field using the following procedure. Polarised light passes first through a tube containing a liquid, such as benzene, which gives the usual diamagnetic rotation, and then through a nicol at 45° with respect to the first. The tube is placed on the axis of the coil supplying the magnetic field. The small magnetic rotation causes a very feeble periodic variation of the intensity of light, which is superimposed on the continuous intensity. The beam then falls on a photoelectric cell connected to a powerful resonance amplifier, the input circuit of which is tuned to that of the magnetic field. Only the very slight modulation of the photoelectric current is amplified, whilst the great intensity of the continuous light does not affect the readings of the compensated microammeter in the output circuit.

As the amplification depends to a large extent on the frequency, an optical calibration method has been developed, using as source of light a Kerr cell with a definite alternating potential on its plates. The magnetic field frequencies ranged from 0.15 to 4.0×10^6 c.p.s., whilst the peak values of the magnetic field employed were 0.97 and 0.29 gauss, the corresponding maximum Larmor frequencies being 1.36 and 0.49×10^9 respectively. Within experimental error, no diminution of rotation was observed when the frequency n exceeded the Larmor frequency O_L .

EGON BRETSCHER.

Physikalisches Institut der
Eidg. Techn. Hochschule,
Zürich.

¹ Bretscher and Deck, *Helv. Phys. Acta*, 6, 229; 1933.

Paper Hygrometers

DR. GRANT and Mr. Mellanby^{1,2} have commented on the different periods required for paper to attain stretch equilibrium when this property is being used for hygrometric measurement. The following curve (Fig. 1) which is included in the paper quoted under

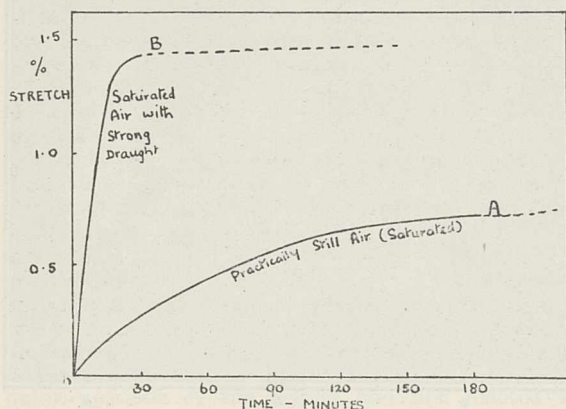


FIG. 1. Rate of attaining stretch equilibrium.

my name by Dr. Grant, may throw some light on the difficulty.

It will be seen that air velocity has a very great effect and that in comparatively still air the rate of change, after an initial period, may become so small that conditions resemble those of equilibrium.

The paper used in this case was a rosin sized mixed wood furnish and rather thicker than those advocated by Dr. Grant, being 100 gm./sq. m., but nevertheless the air velocity factor should be carefully watched.

PHILIP H. PRIOR.

Research Laboratory,
Aylesford Paper Mills.
Oct. 30.

¹ NATURE, 132, 66, July 8, 1933.

² NATURE, 132, 677, Oct. 28, 1933.

IN connexion with Dr. J. Grant's letter¹, on paper hygrometers, some experiments made some months ago on an experimental paper-operated indicating hygrometer may be of interest. The instrument, in aspect similar to the 'Edney' paper-metal hygrometer, was made by causing two pieces of the same paper to adhere together, the grain of one being at right angles to that of the other. A light pointer attached to the free end of a strip of this double paper indicated the movement as the strip curled due to differential expansion.

This instrument gave quite good results provided extreme humidity was not encountered, but if one attempted to calibrate at 100 per cent R.H., then the other scale points always moved to different positions. Probably cyclic 'ageing' would provide reliable movements.

Very rapid initial indication was obtained with this instrument, but final steady values could only be obtained after ten or fifteen minutes, even using very thin Japanese rice paper. It was mainly for this reason that further experiments were abandoned, and also because it was found that until the case had reached the air temperature of a fresh atmosphere, discrepancies resulted due to the slight warming or cooling of the air which was operating the element as it passed through the case.

G. R. R. BRAY
(Chief of Electrical Laboratory).

The British Thomson-Houston Co., Ltd.,
Rugby.
Nov. 6.

¹ NATURE, 132, 677, Oct. 28, 1933.

X-Ray Investigation of Tridymite-glass

THERE has been a lengthy controversy between G. W. Morey¹ and A. Dietzel² concerning the nature of the crystallites in devitrified glass in region B of the phase diagram of the system: SiO_2 Na_2O CaO (see ²). Morey, from microscopic investigations, thought that tridymite was present in this devitrified glass, whereas Dietzel, with the further help of expansion curves, decided in favour of cristobalite. Microscopic work on such a problem is very difficult, especially when dealing with crystallites incrustated in a vitreous mass. On the other hand, expansion curves are quite useless. There are three anomalies in the expansion of pure tridymite. The first occurs about 120°C ., the second around 165°C . and the last at 420°C . A solid rod of 36 mm. of glass B does not give any appreciable anomaly of expansion. A rod of the same dimensions made from a powder of this devitrified glass also gives a negative result. X-ray powder analysis on the contrary gives a definite solution of the problem. A devitrified glass of the initial percentage composition: SiO_2 78, CaO 12, and Na_2O 10 (glass B) gives an unmistakable pattern of tridymite (Co-K α -50 m.a.h.).

It is necessary to emphasise the unreliability of thermal expansion curves, so far as tridymite and cristobalite, in glass or in mixtures, are concerned. The transition $\alpha \rightarrow \beta$ cristobalite is a very capricious one. Cristobalites of different origin will give various temperatures of transformation between 200° and 280° C. Some investigators³ have even suggested the existence of β cristobalite at 170° C. Because of the fact that tridymite is obtained with difficulty in artificial preparations or because of the rather peculiar aspect of an occasional expansion curve, many workers have, in doubtful cases, decided in favour of cristobalite instead of tridymite⁴. X-ray work has been handicapped by the use of too short wavelengths. In a note to be published elsewhere, in collaboration with Dr. Hägg, of Stockholm Hogskola, we give experimental evidence of the existence of tridymite, and not cristobalite, for example, in artificial mullites (bauxites calcined at 1,300° C.) containing free silica⁵. This proof has been made possible by the use of the appropriate wave-length, that is, calcium K, and with a camera of very high dispersion *in vacuo*.

M. E. NAHMIAS.

Physical Laboratories,
Victoria University of Manchester.
Nov. 1.

¹ *J. Amer. Cer. Soc.*, 683, 713, 922; 1930.

² *Glass Ber.*, 307; 1931.

³ Heindl, P. and M., *Bur. of Stan. J. of Res.*, Feb. 1932, 199.

⁴ Randall, R. and C., *Z. Kr.*, 75, 196; 1930.

⁵ M. E. Nahmias, *Z. Kr.*, 85, 355; 1933.

Occurrence of *Doliolletta gegenbauri* (Uljanin) in the North Sea

IN a recent issue of NATURE, Delsman¹ refers to the appearance of large numbers of *Doliolum nationalis* at Den Helder in 1910–12, presumably carried there from the English Channel. It may be of interest to record the presence of another doliolid in the North Sea this year. The material was collected in the course of investigating the relations between herring and the plankton by means of the Hardy plankton indicator², and was forwarded to Prof. Garstang, who kindly identified phorozoids and gonozoids as *Doliolletta gegenbauri* (Uljanin). Oozoids were also present, but the identification of these is as yet uncertain.

The importance of the appearance of either doliolids or salps in the North Sea or Channel as indicators of exceptionally strong Atlantic drifts and high temperatures has been repeatedly stressed: in particular by Schmidt³, Garstang⁴, Bowman⁵, Russell and Hastings⁶ and Fowler⁷. In addition to Delsman's record, Schmidt³ and Bowman⁵ record large swarms of *Salpa fusiformis* passing into the northern North Sea in 1905 and 1920 respectively.

The present doliolids were obtained from two positions: (a) 125 miles east of Aberdeen (57° 35' N., 1° 40' E.) and (b) 67 miles N. 5° W. (mag.) of position a. They were more abundant at the northern station, where on September 10 and 11 nine samples yielded an average of 452; at position a on September 8 and 9 ten samples yielded an average of only 44, and none was taken there in twenty-two samples between September 1 and 5.

Doliolids are considered to be indicative of warmer water than salps. The fact that *D. gegenbauri*, which is normally found in Indian, Mediterranean and Atlantic waters, had penetrated into the North Sea,

presumably from the north, to a position much farther south than that in which *S. fusiformis* has been recorded, appears to show a very considerable Atlantic inflow. The similarity in the climatic conditions of 1910–12, 1921 and 1933 is striking; all have been characterised by dry summers and high temperatures in the North Sea (the chief engineer of the trawler taking these samples recorded in September of this year the highest temperature he has observed in the North Sea—16.7° C.).

It may be of interest too to record a diurnal variation in the numbers of *D. gegenbauri*. In the northern position the following catches were obtained for 20-minute hauls with an indicator having an opening of only 1¼ in. diameter:

0800 hours	375 caught	0800 hours	275 caught
1100 "	580 "	1100 "	1050 "
1400 "	790 "	1300 "	450 "
1700 "	125 "	1500 "	325 "
2000 "	100 "		

This variation would appear to indicate a vertical migration in which the animals are to be found near the surface at night and sink during the day; all the samples were taken from a depth of approximately 30 metres.

C. E. LUCAS.

University College, Hull.
Nov. 7.

¹ Delsman, NATURE, 132, 640, Oct. 21, 1933.

² Hardy, *Min. Agric. and Fish., Fish. Invest.*, 2, 8, No. 7; 1925.

³ Schmidt, *Rapp. Cons. Explor. Mer.*, 10, No. 4; 1909.

⁴ Garstang, *J. Mar. Biol. Ass., N.S.*, 3, 210; 1894.

⁵ Bowman, *Rep. Brit. Assoc.*, 1922, p. 367.

⁶ Russell and Hastings, *J. Mar. Biol. Ass., N.S.*, 18, 635; 1933.

⁷ Fowler, *Proc. Zool. Soc.*, 10, 580; 1898.

Types of Foliage of Yews

I HAVE recently examined the very old, I think the second largest, yew tree in England, in the churchyard at Stoke Gabriel in Devonshire. This tree shows the horizontally spreading type of growth characteristic of the English yew, *Taxus baccata*, though the

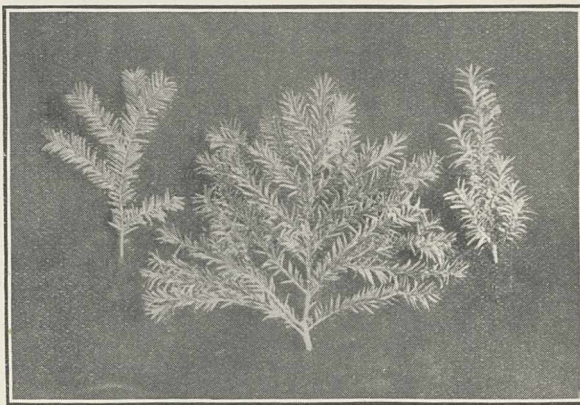


FIG. 1. a, Stoke Gabriel yew; b, Irish yew; c, English yew.

drooping branches suggest the 'weeping' character found in some ash, birch and other trees. The arrangement of the twist of the leaves on the secondary branches, however, is not strictly parallel and horizontal, but more nearly resembles that seen in the Irish yew (*T. fastigata*).

The Stoke Gabriel tree is a female, aril bearing tree, and the age—as judged by the girth of the trunk, and the date on a tombstone (1680) now well within the circle covered by the branches—must be well over three hundred years and probably very much older, perhaps a thousand years.

The Irish yew (*T. fastigata*) originated as a mutational form in Ireland some hundred and fifty years ago.

I have already pointed out¹ that all the Irish yew trees in the cemeteries and churchyards in England are, so far as is known, female or aril bearing trees; and have presumably been propagated by cuttings.

*F*₁ hybrids between the female Irish and the male English yew have been reared by Hurst and myself. These vary in character, some being typically Irish, some English, and some intermediate in type of foliage.

The Stoke Gabriel tree, owing to its great age, cannot be a hybrid between the Irish and the English species, and the question arises whether the peculiar foliage is due to age, or whether the tree represents another variety or species of *Taxus*, other than *T. baccata*, or whether it is a mutational form intermediate between *T. baccata* and *T. fastigata*.

I have received through the kindness of a friend branches from another old female tree, from Upton churchyard, Bucks, which also shows the same intermediate foliage characters, and it would be interesting to know whether other examples exist, especially among the very old yew trees which still exist in some of the churchyards in England. In the Upton yew tree there is evidence of disease, possibly gall infection, which may have affected the character of the foliage.

C. J. BOND.

Fernshaw,
10, Springfield Road,
Leicester.
Nov. 1.

¹NATURE, 110, 810, Dec. 16, 1922.

Vitamin C in the Adrenal Gland of the Human Fœtus and the Physical State of the Vitamin in the Gland Cell

IN a previous communication¹ I described a cytological method of demonstrating a substance which was believed to be vitamin C in the cells of the adrenal glands of various animals. A modification of this method has been applied to the adrenal glands of a 55 cm. human fetus.

The glands were obtained shortly after the fœtus had been removed from the mother, and placed in a 2 per cent solution of silver nitrate in 70 per cent alcohol and allowed to remain there for twenty-four hours; they were then removed and sectioned.

It was found that the whole of the gland had blackened—the cortex rather more so than the medulla. Microscopically, it was observed that the outer portions of the cortex had not reacted so strongly as the deeper portions. The region known as the 'fœtal cortex' exhibited a very strong reaction and the nuclear aggregation of the argentophile granules was so great that the nuclei were in many cases quite obscured.

Nuclear aggregation did not occur to anything like the same extent in the outer regions of the cortex. In the medulla, the perinuclear aggregation was also not so marked as in the 'fœtal cortex'.

Assuming that the 'fœtal cortex' possessed some definite secretory importance in fœtal life, the intense perinuclear aggregation would perhaps indicate that it is assisting in some synthesis taking place in this region of the gland.

It is of interest to consider the physical condition of the vitamin in the gland cell. From its ready solubility in water, vitamin C may be present in the gland cell in molecular solution (existing either in the ionised or unionised condition), in which case, on fixation, the vitamin C will run together to form droplets which will give rise to the granular formations observed on staining with silver nitrate and other substances². If the vitamin is in molecular solution in an unionised condition, it is difficult to account for its aggregation at membranes unless we assume that the vitamin has definite ability to reduce surface tension, in which case it will obey the Gibb's law. If the vitamin is ionised, then there will be a tendency for the negative ions to be adsorbed at the nuclear membrane, provided the nucleus has an acid pH compared with that of the cytoplasm. If the molecules are in aggregates of colloidal dimensions

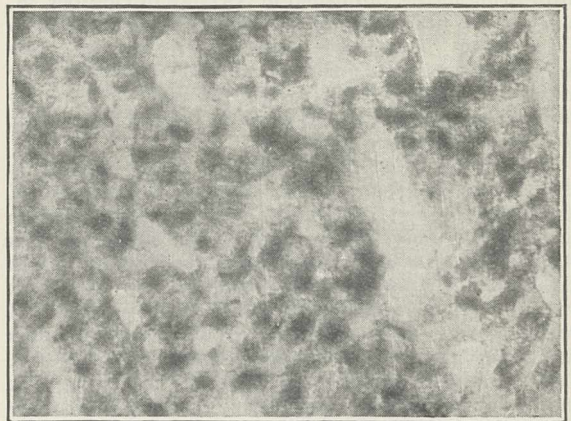


FIG. 1. Portion of fœtal cortex showing blackened nuclei due to aggregation of vitamin C granules.

or bigger, the distribution of the vitamin at the membranes may be quite simply explained as being due to surface tension effects.

The typical granular form of the vitamin is not invariable. At times argentophile aggregations of varying size make their appearance and occasionally resemble the Golgi apparatus. This possibility of relation to the Golgi apparatus is, however, precluded by the fact that these results have been obtained with alcoholic silver nitrate as well as the aqueous solution, and also following previous treatment of the tissue with ether or chloroform. There is a possibility that different adrenal lipoids may be concerned at times in this silver reaction. This possibility is, however, discussed in my paper in press (see above). Apart from the question of lipoids, these variations in the typical vitamin C form may be due to imperfect penetration (in certain cases only) of the vaporous fixative, thus allowing the vitamin to run together in larger masses, or perhaps the morphology of the vitamin varies with different physiological states of the various adrenal cells. In addition, preparations have been occasionally obtained in which the gland becomes black in silver nitrate but does not exhibit granule formation on

sectioning. These facts incline me to the view that the physical condition of the vitamin varies over a period of time, dependent upon factors as yet unknown, certainly modified by the physiological state of the adrenal cells, and undoubtedly modified to a certain extent by the reagents used upon the gland.

GEOFFREY BOURNE

(Hackett Research Student).

Department of Biology,
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Aug. 25.

¹ NATURE, 131, 874, June 17, 1933.

² Bourne, *Aus. J. Exp. Biol. Med. Sci.*, in press.

The New Volcanic Island, Krakatoa

To a botanist or zoologist the birth of a new island from beneath the sea is an event of considerable interest. A number of questions occur to him and he will almost inevitably speculate as to the first forms of life to colonise it, and the date of their appearance. In Dr. W. Docters van Leeuwen's interesting letter, published in NATURE of October 28, a list of the first seedlings to colonise Anak Krakatoa IV is given. These were collected in May 1932, but his reference to an observation four months earlier indicates that seedlings were present at least as early as seventeen months after the island first began to appear above sea-level.

Happening to be in the vicinity of the Krakatoa Islands in February 1931, I took advantage of assistance offered me by the volcanological service to stay four days there, and in the course of this stay I crossed the three miles separating Anak Krakatoa IV from the other islands. On the black volcanic ash composing the islands black cinders and white pumice were sprinkled, whilst along its shores driftwood and other vegetable debris were strewn. Careful search showed me that at this date, six months after the first appearance of the island, none of the plant seeds which were in evidence had taken root or germinated, but in spite of this a small fauna had already established itself. This consisted of a collembolan (*Mesira calolepis* Börner) and a beetle (*Anthicus oceanicus* Laf.), both in abundance amongst the decaying vegetation, and three species of spider (*Trochosa reimoseri* Bris., *Ctenus periculosus* Bris. and *Maso krakatauensis* Bris.). Three other species of insect—a leaf-mining moth (*Cosmopteryx*), a mosquito and a male ant (*Camponotus (Tanaemyrmex) variegatus*, F. Smith)—were probably stray arrivals which could not at that time establish themselves.

In the *Proceedings of the Zoological Society*, Pt. 4, 1931, I attempted to summarise our knowledge of the present fauna of the Krakatoa Islands, and a list of the spiders I collected there myself is appearing in a forthcoming part of the same *Proceedings*, but here it may be interesting to record that in May 1884, nine months after the terrific eruption which destroyed all the animal and plant life, the only sign of life which Cotteau could find was a solitary spider, whilst later in the same year Verbeek saw a few blades of grass. To-day there are nearly 300 kinds of plants and about 700 arthropods, apart from birds, bats, rats, reptiles, crustaceans, molluscs and worms.

W. S. BRISTOWE.

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London, W.11.

Flint Implements of Early Magdalenian Age from Deposits Underlying the Lower Estuarine Clay, Co. Antrim

SOME time ago (August 16, 1930, and May 14, 1932) there appeared in NATURE two short statements relating to my discovery both on Islandmagee and at Larne, Co. Antrim, of flint implements of Late Magdalenian age within the Lower Estuarine Clay which underlies the gravels of the 25-foot raised beach.

Lately, by reason of the construction of a small harbour on the western side of Islandmagee, I have been afforded an exceptional opportunity for examining the beds situated beneath the Lower Estuarine Clay.

The complete section exposed reveals:—

9. Gravels of the 25-foot raised beach (often reconstituted):
8. Black sand:
7. Lower estuarine clay:
6. Black sand:
5. Gravel, sub-angular, fine and black:
4. Black sand:
3. Gravel, sub-angular, fine and black:
2. Land surface:
1. Boulder clay containing-cliff rising abruptly on the landward side.

In deposits Nos. 3, 4, 5 and 6 I have found unrolled artefacts of the Early Magdalenian period: these, together with the molluscan and plant remains which the layers in question contain, will be described in the *Antiquaries Journal* early next year.

30 Southwick Street,
London, W.2.
Oct. 28.

J. P. T. BURCHELL.

Tunny in the North Sea

MR. F. S. RUSSELL¹ is certainly correct in assuming that the occurrence of tunny (*Thunnus thynnus* L.) in the North Sea is not of recent date. The Fisheries staff, during their investigation of herring trawling in 1912 and 1913, frequently observed this magnificent fish in September and October in an area between the Dogger Bank and the coast, and made several (unsuccessful) attempts to capture it. The records made at this time are being extracted from our log-books and will be available shortly.

E. S. RUSSELL.

Ministry of Agriculture and Fisheries,
43, Parliament Street, S.W.1.
Nov. 20.

¹ NATURE, 132, 786, Nov. 18; 1933.

A Seal in the Thames

ON November 14, at about 2 p.m., a seal was observed swimming in the Thames between the landing stage and the entrance to the docks at Tilbury, just opposite the Tilbury Hotel. Eventually it climbed up on to the wooden causeway from the hotel gardens to the river and remained there for some time. It appeared to be a three-quarter grown specimen of the common seal, *Phoca vitulina*, but with the exception of the hind flippers was practically pure white in colour. Passing boats alarmed it and it dived from the causeway several times, and finally disappeared, swimming strongly down-stream.

A. S. BUCKHURST.

Plant Pathological Laboratory,
Ministry of Agriculture,
Harpenden. Nov. 21.

Research Items

Races and Languages in India. Sir Edward Gait's communication under this title to Section E (Geography) of the British Association at Leicester appears in full in the *Journal of the Royal Society of Arts*, 81, No. 4224, Oct. 20, 1933. Sir Edward states that the number of languages spoken in India is 223. [The figures of languages given in the actual census is 225 not 223.] The Indo-European languages (27) are spoken by 257 million persons, the Dravidian (14) by 72 million, Tibeto-Chinese (156) by 15 million and the Austro-Asiatic (19) by 5 million. There are a few unclassified languages of little numerical importance. The main Dravidian-speaking area lies south of a line Goa-Berar-Puri (Bay of Bengal). Tibeto-Chinese languages are current in Burma, the hill district of Assam and the sub-Himalayan tract from Assam to the borders of Kashmir. Throughout the rest of India, Aryan languages predominate. The Austro-Asiatic languages are scattered over a wide area and the numbers speaking them are small. They are a survival; but Dravidian Telugu, the Aryan languages of the Gangetic plain and the Tibeto-Burman languages of the Himalayan area all show signs of Austric influence. Their place in northern India was taken by Dravidian languages which in turn were displaced by Aryan languages. The physical type of the races who brought in the Aryan languages predominates in north-west India as far as Patiala. In the Himalayan area, and where the Tibeto-Chinese languages are spoken, the inhabitants are of the Mongoloid type. To the south of Rajputana and the Ganges valley, the people are commonly known as Dravidians, among whom two types are now generally recognised, the more primitive being proto-Australoid. Dr. Hutton in the recent Census of India suggests two waves of Dravidian migration, the later having an Armenoid admixture, and an incursion of Alpine peoples speaking an Aryan tongue. There is, however, little evidence of Mesopotamian or Caucasian affinities in Dravidian, and none that the Alpine invaders had adopted an Aryan form of speech before they came to India.

Stuttering. Dr. G. Seth (Edinburgh) read a paper before Section J (Psychology) of the British Association at the recent Leicester meeting on some clinical aspects of stuttering, and recorded observations based on the study of about a hundred cases. The percentage of stutters in five educational areas ranges from 0.72 to 1.30, with an average in the region of 0.95 per cent. This agrees with the general finding that about one per cent of the school population are stutters. The proportion of stuttering boys to stuttering girls is 6 to 1 in one area and 3 to 1 in another area. It is practically impossible to trace a connexion between the speech disorder and any immediate causative factor. It seems, therefore, that stuttering must be regarded as a developmental disorder most commonly of gradual onset, in which the predisposition, whether it be the result of inheritance or of fixation, becomes effective in most cases under the conditions and within the circumstances of development itself. The state of the mother before the birth of the child, difficult birth and difficulties in weaning, may all play a part in the causation of stuttering.

The Thymus in Filipinos. J. C. Nafias (*Phil. J. Sci.*, 51; 1933) describes the relations and size of the thymus in 338 Filipinos ranging in age from birth to adolescence. At birth the Filipino infants possess a proportionately heavier thymus in relation to body-weight than is reported for American newborns, but in late childhood and in adolescence the Filipinos have a proportionately smaller thymus than the American group, and it is suggested that this is dependent on the existence of nutritional unbalance or dietary insufficiency. If to the degree of under-nourishment and the deficiency in vitamins A and B, which is claimed to exist in the majority of Filipino children, is added the aggravating condition of high incidence (97 per cent) of intestinal parasitism in the children, the seriousness of the nutritional condition which may hasten the premature involution of the thymus may be realised. The author points out the detrimental effect of this early involution on the vigour, the resistance to disease and the intelligence of the young population, and the importance of the problem if the race is to advance.

Prehistoric Shells in a Javanese Cave. In excavating Sampeng Cave near Ponorogo, Java, several molluscs were found ("On Prehistoric Shells from Sampeng Cave (Central Java)" by Tera van Bentham Jutting. *Treubia*, vol. 14. Livr. 1. 1932). These are partly land, fresh-water and brackish water, partly marine. The marine species, including *Haliotis*, *Nerita*, *Natica*, *Cypraea*, *Nassa*, *Marginella* and *Venus* evidently came from far away and were used as ornaments. The non-marine mollusca were almost certainly used as food. The present natives of Java eat many shellfish and the early cave dwellers apparently ate even more. Nearly all the shells have been broken as if to extract their contents. Most of the gastropods (*Hemiplacta*, *Amphidromus*, *Cyclophorus* and *Pila*) have the spine broken away, the *Melania* being whole and the animal probably extracted from the aperture in the same way as periwinkles are eaten. *Melania* also was sometimes pierced in the last whorl near the aperture or, more rarely, in the earlier whorls, and in this case they may have been used for ornaments. The bivalves, particularly the freshwater mussels, had been mostly broken at the siphonal end, the easiest part to break, pointing to the fact that they were crushed and eaten raw. The age of these deposits is estimated at about 1000 years B.C. and it is impossible that the Mollusca found are fossil; moreover the list includes only names represented in the actual Javanese fauna, and even in the much older Trinil beds in Central Java all non-marine Mollusca, except one, belong to recent species.

Mounting Microscope Sections on Mica. The current issue of Messrs. Watson's *Microscope Record* contains a note on the method of mounting microscope sections on mica sheets. The best quality of mica is essential. The mica is thinly smeared with glycerine and albumen, a film of distilled water is added and the sections placed on this in straight rows, close together, and the sheet placed on a hot plate to flatten the sections. The water is drained off and the mica sheets are put in a drying oven. The remaining treatment is identical with that used in staining sections on glass slides, including the

dehydration and clearing in xylol. If the sheets are to be stored, they are dipped in melted paraffin wax (45° C.), and stored until required. The sheets may be divided with scissors into rows of sections or single sections, which are treated with xylol to remove the wax, and mounted. If the sections on the mica are to be mounted immediately after dehydration and clearing in xylol, the sheet is placed in a dish containing thin Canada balsam, and cut, the sections or the rows of sections are mounted on glass slides in ordinary Canada balsam and covered.

Kiln-Seasoning of Timber. The Forest Products Research Laboratory at Princes Risborough has issued a second report on the principles of kiln-seasoning. The first report (*NATURE*, 122, 76, July 14, 1928) dealt with the types of kilns in commercial use. The present one is entitled "Practical Kiln-drying" by W. A. Stevens (For. Products Research—Special Report No. 3, May 1933. H.M. Stationery Office). In the past, the drying kiln, with its potentialities for the improvement or deterioration of large quantities of timber, has not always been regarded in the same way as a wood-working machine of the same cost and importance: it has received neither the thought, care nor attendance that such a piece of plant merits. With the enormous and ever-increasing demand for wood material of all types at the present day, the prolongation of the life of the article into which it is converted is of primary importance. This is the aim of the seasoning kiln. The method in use for centuries was to leave the material, stacked or otherwise, to season in the open for varying periods. The few valuable timbers in use in different parts of the world for so many centuries were seasoned in this fashion and, in the minds of some, it is doubtful whether the kiln can better this natural seasoning of large-sized timbers of valuable species. But for practical purposes this is not the object aimed at. It is the smaller sized commercial material, so largely in demand, which is chiefly the subject of experiment and tests. Mr. Stevens deals with seasoning; the general principles and factors concerned in drying kilns and types of kilns; kiln design and kiln-drying routine; and test of kiln conditions with an appendix of drying schedules.

Geology of Sirohi State, Rajputana. Since 1924, A. L. Coulson has been intermittently engaged on the geological survey of Sirohi State, and his results, which are of considerable petrological interest, are now published, together with a coloured map (Part I of the *Mem. Geol. Sur. India*, 63, 166. Calcutta, 1933). The stratified rocks, apart from recent deposits, belong to the Archæan and Purana groups, and while the question of the correlation of the Arivalli and Delhi systems is important, the chief feature of the geology lies in the wealth of igneous rocks that are represented. Basic tuffs and lavas are interbedded with the earlier members of the Arivallis. Following the uplift, folding and denudation of these Archæan rocks, similar activity was renewed either during or shortly after the laying down of the sediments of the Delhi system. Granite and accompanying pegmatites and quartz reefs were next intruded into all the above rocks, this acidic phase being of gigantic magnitude. Another series of basic rocks followed, including basalts, dolerites, gabbros, pyroxenes and sodalite-syenites. A second intrusion of acidic material then occurred on an immense scale, introducing the Idar granite and its accompanying hypabyssal and volcanic representa-

tives. The igneous history concludes with the intrusion of dolerites into the older rhyolites and porphyries. The area has been quietly eroded from the time of intrusion of these post-Malani basic rocks down to the present day.

Radiography with γ -Rays. The August and September numbers of the *Journal of the Franklin Institute* contain articles by G. E. Doan on the use of γ -rays in the radiographic examination of thick metal objects. The work has been performed with the co-operation of the U.S. Navy Department, and indicates that γ -rays may usefully be employed to detect flaws in thick steel. Since the rays are more penetrating than X-rays, the contrast obtained with a flaw of given size is lower, but against this must be set the more favourable distribution of the scattered rays, which are thrown strongly forward in the case of γ -ray and cast shadows in the same direction as the primary beam. On the whole, it seems that γ -rays are useful only for the thicker sections. The times of exposure may be greatly reduced by using intensifying screens, and a number of objects may be arranged around the source and radiographed simultaneously. The cost of the exposure may then be made comparable with X-rays even for the thinner objects. The article incidentally contains interesting information about the present world supply of radioactive elements.

Spectra of Solid Metals. The *Physical Review* of October 1 contains an article by Osgood and a letter from O'Bryan and Skinner on the spectra obtained when solid metals are bombarded with electrons. The spectra are produced by processes in which electrons from the conduction group make transitions to replace electrons which have been ejected from atomic *K*- or *L*-levels. Since the conduction electrons occupy a wide band of energy levels, the resulting spectra consist of broad bands. The *K* band of beryllium, examined by O'Bryan and Skinner, gives close agreement with the elementary Sommerfeld theory of the conduction levels, a conclusion which had been disputed by earlier workers. The width of the bands observed for a number of the lighter elements is in general agreement with the Sommerfeld theory, but for carbon there is a marked disagreement and the bands are much narrower than is required by the theory. This work shows a new method of attack on the problem of the conduction electron, which seems very suitable for examining its energy distribution in detail.

Analysis of High Excitation Spectra. Miss Payne has recently published a very useful list of lines in the spectra of CII, NIII, OIV, together with an identification of the lines which occur in the Wolf Rayet stars (*Z. Astrophysik*, 7, 1, 1933). The Wolf Rayet spectra fall into two classes, those which show carbon and those which show no carbon. The spectroscopic data to which Miss Payne directs attention are derived chiefly from the work of Edlen, and form a notable addition to the material with which the astrophysicist has to work. Compilations of such data are always very welcome. At the moment, attention is being focused on high excitation spectra by recent identifications made at Harvard, including the identification recently noticed in *NATURE*, of the coronal lines which appeared in the spectrum of Nova Ophiuchi. These lines are assigned by the Harvard workers to the high excitation spectrum of oxygen, in which they are forbidden transitions.

The Quaternary Glaciation of England and Wales

By DR. K. S. SANDFORD

A NUMBER of attempts have been made recently to co-ordinate the rapidly growing body of information on the Quaternary glaciation of England and Wales; and of these the most important is Prof. P. G. H. Boswell's presidential address to Section C (Geology) of the British Association at the York meeting in 1932. A report upon the subject was prepared by me for a committee of the International Geological Congress at Washington in July 1933, and the present article, based upon it, is published with the encouragement and approval of Dr. Victor Madsen (director of the Geological Survey of Denmark and organiser of the committee), and of Prof. Boswell. In preparing the report for Dr. Madsen's committee, I took Prof. Boswell's address as a standard of reference, with its writer's permission, and sought the opinions and constructive criticisms of some twenty-five authors actively engaged in Pleistocene research. Useful replies were received from twenty-one, all of whom are mentioned by name in the address. To the best of my knowledge, all literature published since the address was also taken into account and references to some of the outstanding papers are attached to these notes.

Two groups of destructive criticism should be noted: they apply equally to all attempts at correlation:—

(1) Some prominent palaeontologists have stated in the past, and some continue to uphold the view, that, so far as palaeontology is concerned, the evidence will not admit of more than one glacial phase in the British Isles, and that at a comparatively late date in the Pleistocene. Some botanists also support such a view. On the other hand, many members of both sciences are satisfied with the geological evidence of the alternation of glacial and interglacial episodes in this country. Even so, the warning should be repeated that the geological point of view—or that expressed by the majority of my correspondents—does not meet with unqualified support, and the differences of opinion in some instances are so complete that one or the other must assuredly be wrong.

(2) Criticism of the power of archaeologists to assess the culture-stages of Palaeolithic implements is noticeable. Some geologists are not convinced that the opinion of the archaeologist is always sound enough for him to regard groups of flint implements as infallible 'zone fossils'. If the geologist is thus led astray in these matters much of the work of correlation falls to the ground. Conversely, some geologists feel that the archaeologist is inclined to be incautious in the uses he makes of geological observations and evidence. The complexity of geological relationships, particularly where land-ice is concerned, the inevitable dependence on altitudes sometimes measured with relation to datum-levels of unproved worth, the frequently thin, patchy, or discontinuous nature of the deposits, all these and other factors render the utmost caution necessary in deciphering or interpreting Pleistocene geology. In his turn the archaeologist may tend to feel that the geologist is uncompromising, almost irritating, in his cautious answers to apparently simple and straightforward questions.

With these reservations duly noted, however, we seem to have gained much ground in the last few years.

There seems to be a growing belief in a four-fold glaciation of England at any rate—the Norwich Brickearth, Chalky-Jurassic Boulder Clay, Upper Chalky Drift, Brown and Hessle Boulder Clays (in part). In South Wales¹, however, only two glaciations are recognised—Mousterian and Aurignacian, the former the main period of domestic ice. Earlier episodes may yet be identified there, if their deposits have not been totally destroyed or reincorporated. In the same district also the position of a raised beach (*Neritoides*) seems to be fixed between the two glaciations: the 'pre-glacial' (?) *Patella* beach is not devoid of far-travelled erratics. The *Neritoides* beach has been identified on the opposite side of the Bristol Channel and takes its place in an important sequence that is in accordance with the 'orthodox' views expressed in Prof. Boswell's address².

In the north and north-east of England a number of important investigations are still in progress and it is too early to estimate their final results. In general, however, there seems to be a belief that in the Lake District, Northumberland, Durham, Yorkshire and Lincolnshire, some amplification and modification of the existing scheme will be proved on the following lines³:—(1) Amplification of the older part of the sequence; some doubt as to the position of the Basement Clay. (2) Belief that the maximum glaciation of these districts occurred, as in other parts of England and Wales, in Upper Chalky Drift times (correlated with Upper Purple Boulder Clay and with the Mousterian culture-stage), not later. (3) Division of the Hessle Boulder Clay into an Upper and a Lower part, the lower perhaps synonymous with the Upper Purple Boulder Clay. On the east coast this is associated with the interpretation of the lateral movements of the coastal glacier passing southward from Scotland and the Cheviots. (4) Opinions vary as to the significance of a fifth glacial incursion of parts of the area in late Upper Palaeolithic times.

In the immediately adjacent counties to the south, Lincolnshire, Norfolk and Suffolk, Prof. Boswell's sequence still stands with little modification in spite of the energy of the well-qualified and vigorous investigators at work there. The position of the Cromer Till remains in discussion: the Chalky-Jurassic Boulder Clay seems to be the greatest—not the Upper Chalky Drift which predominates in the north-north-west, and in South Wales. At the Upper Palaeolithic end of the sequence the Hunstanton Brown Boulder Clay is still the object of special inquiry, and a great elaboration of the beds younger than it has been set forth⁴.

In the Midlands and Upper Thames basin so far east as the Chiltern Hills, Prof. Boswell's conclusions meet with almost unqualified support⁵. In the Middle and Lower Thames new interpretations, based in considerable measure on archaeological evidence, have been, or are about to be, published. In the Lower Thames it is now suggested that a deep channel was cut before the formation of the Taplow, 50-foot, or Mousterian terrace⁶, and that that terrace is older than a Coombe Rock (associated with a cold climate).

On the whole, opinions tend to support the following:—(1) Glacial deposits older than and including

the Chalky-Jurassic Boulder Clay fall into the Older Drift of the old classification, each separated by a hiatus of weathering and erosion. (2) The remaining glacial phases constitute the Newer Drift, of slight extent in the south but very strongly developed in the north and west⁷. (3) The most marked interglacial phase followed the Older Drift. (4) In East Anglia, or parts thereof, the Chalky-Jurassic Boulder Clay (youngest member of the Older Drift) was the maximum glacial invasion: in northern England and South Wales the maximum was the Upper Chalky Drift (oldest member of the Newer Drift). The flourishing condition of British highland ice at this later episode is of particular interest.

At the present juncture few British geologists seem to be prepared to interpret the British chronology in terms of the Alpine sequence. This has been attempted on archaeological evidence⁸, but there is a strong feeling that it is better to establish the initial

sequence on its own merits, and not to introduce unnecessary complications until the second stage—European correlation—is attempted.

¹ T. Neville George, *Geol. Mag.*, May 1933, pp. 208-232, and other recent contributions by the same author therein mentioned.

² L. S. Palmer, *Proc. Geol. Assoc.*, 42, 345, 361; 1931.

³ W. S. Bisat, *Naturalist*, July and October 1932; F. M. Trotter and S. E. Hollingworth, *Geol. Mag.*, August 1932; A. Raistrick, *Trans. Northern Naturalists' Union*, 1, Pt. 1, 1931, and *Proc. Yorkshire Geol. Soc.*, 22, Pt. 1, November 1931. Dr. C. T. Trechmann is also taking an active part in these investigations.

⁴ J. D. Solomon, *Proc. Geol. Assoc.*, 43, 241-271; 1932. J. P. T. Burchell and J. Reid Moir, *Man*, February 1933.

⁵ For bibliography and correlation of this region, with special reference to important work by Miss M. E. Tomlinson and F. W. Shotton, see some notes by the author of this review in *Geol. Mag.*, January 1932.

⁶ J. P. T. Burchell and J. Reid Moir, *ibid.*, and *NATURE*, May 27, 1933, p. 756. Authorities on this district like Messrs. Chandler, Dewey, and others are still considering special problems.

⁷ This was made especially clear in Mr. E. Dixon's correspondence with the writer.

⁸ M. C. Burkitt, *Handbook of the Prehistoric and Protohistoric Sciences Congress, London, 1932.* (Oxford University Press.) H. Breuil, *Bull. Soc. Préhistorique Française*, No. 12, 1932.

Statistical Weather Forecasting

PROF. EMILE BOREL, the distinguished mathematician and former Minister of Marine in the French Government, gave a course of three lectures at the London School of Economics on November 14, 15 and 16, on "Quelques applications de la statistique aux prévisions économiques (crises) et aux prévisions météorologiques". The first lecture, at which the French Ambassador presided, was devoted to a consideration of problems relating to the rate of interest and the devaluation of currency.

In his second and third lectures, Prof. Borel outlined a method of forecasting weather conditions. He first showed that, on the basis of observations at the Parc St. Maur Observatory near Paris over a period of fifty years, the greater the number of consecutive days upon which rain has fallen, the greater is the statistical probability that rain will fall on the next day. Likewise, the longer the duration of a rainless spell, the greater is the chance that the succeeding day will be rainless.

Taking the record of rainless days and of days of rain in the months October-January in the fifty years, 1874-1923, Prof. Borel pointed out that rain fell on 52 per cent of the days. The probability that rain would fall on any one day between October 1 and January 31 is therefore 0.52. He has also tabulated the frequency of occurrence of spells of different durations of consecutive days of rain and of consecutive rainless days. The frequency of spells of one day of rain is 1,075. The probability of rain falling on any day being 0.52, the expected number of second successive days of rain is 559. The actual number is considerably greater, namely, 680, corresponding to a probability of 0.63 that after a first

day of rain, at least one more day of rain would occur. The probability that after two consecutive days of rain at least one more would ensue is still higher, namely, 0.66. Despite some irregularity due to insufficiency of numbers of observations, the probability that, after an n th day of rain, precipitation would occur on the following day, increases with the value of n . The irregularities disappear if the probabilities are averaged in groups of three, except for a fall in the probability curve at about the fourteenth day. Prof. Borel believes that there may possibly be a critical period in winter rainfall in Paris, in the sense that a change is more likely to occur after about fourteen consecutive days of rain than at any other time. Analysis of the frequencies of continuous spells of rainless days reveals a similar increasing probability of continuance with increasing duration, and a similar indication of a critical period at about the fourteenth day.

Examining frequencies of the number of days classified according to the quantity of rain falling during the 24 hours, Prof. Borel finds indications that the probability that, n units of rain having fallen in a day, further rain would fall that day, increases with the value of n . He directed attention, however, to the fact that the units in which he has worked (millimetres) are arbitrary units, and different results might have been obtained if other units (say, inches) had been used.

Prof. Borel concluded by emphasising the desirability of basing further work on more abundant data than are yielded by the records of fifty years at a single meteorological station, as even this period gives small frequencies for spells of long duration and days of heavy rainfall.

F. B.

Quantitative Analysis of Vegetation

SEVERAL attempts have been made in recent years to apply quantitative methods to the analysis of vegetation. The present position of such investigations formed the subject of a discussion held at the Linnean Society on November 23. The methods used may be divided into two classes: (i) those in which the object is to find a quantitative expression for the association as a whole; and (ii)

those which are used to investigate the distribution of individual species within the association.

(i) Associations in Britain are conventionally described by a morphological method. The species are listed with approximate estimates of their relative abundance (dominant, frequent, rare, etc.). The variation from place to place in the association is described, and the description is illustrated by photo-

graphs. This is, in fact, a close analogy of the description of a species in a flora. The question at issue is: Can the application of quantitative methods improve on these morphological methods of description?

In Scandinavia a method for the analysis of vegetation is in use based on the 'percentage frequency' technique of Raunkiaer. In this technique the association is sampled many times with a quadrat and the presence or absence of species noted. The species are then classified into those which occur in 90-100 per cent of the quadrats, 80-90 per cent, and so on. These values are known as the percentage frequencies. When the numbers of species in each frequency class are plotted against the classes, a frequency curve which is generally U-shaped is obtained. This U-shaped distribution is considered to be characteristic of the species composing a homogeneous community; that is, in such a community many species occur in 90-100 per cent of the quadrats, many in 0-10 per cent, and few in the intermediate classes. The U-shaped distribution becomes L-shaped or J-shaped according to the size of quadrat used but it is never a normal distribution. Does the reason for this abnormality lie in the method or in the vegetation itself?

The answer to this question is given by a comparison of the percentage frequency obtained with the reality measured, that is, the number of individuals per unit area (density). The relation between these values is not linear but logarithmic. The classes in the percentage frequency distributions are therefore not of equal width. The 90-100 per cent class includes a far greater range of densities than any other class. It is concluded, therefore, that the percentage frequency method of analysis is not a satisfactory measure of the distribution of species within an association, since the scale on which the frequencies are expressed is distorted.

The Uppsala school of ecologists describes an association from the number of 'constants' (for example, species in the 90-100 per cent class) and the minimal area. Since their estimations are based on a percentage frequency technique, and for several other reasons, the method is of little value in describing associations. One must conclude, in fact, that the quality of an association has so far eluded any adequate quantitative expression, and the association must still be described in morphological terms.

(ii) Quantitative methods of the second class are employed to determine the distribution of individual species within the association. If a small quadrat is used and the chance of finding an individual is small, the quadrat throws may be classified into those in which no individual occurs, those in which one occurs, those in which two occur, and so on. If the individuals of the species are distributed at random, the successive frequencies follow the terms of a

Poisson series, e^{-m} , me^{-m} , $\frac{m^2 e^{-m}}{2!}$. . . and from the

0 class the whole distribution may be calculated. Although the Poisson series is not strictly applicable to all such data, it serves as a test of 'randomness' of distribution. In pastures, it appears that the common species are often distributed at random, while the rare species are not. Wherever aggregation occurs, as for example where reproduction is vegetative, distribution is usually not at random. In making such determinations, it has been shown that a rectangular quadrat may be nearly twice as efficient as a square quadrat of the same area.

Quantitative methods have been used also to test the differential effect of some environmental factor on two species in an association. From the data collected from random samples, contingency tables may be prepared and the χ^2 test applied.

In view of the attempt which is being made to standardise the methods of description of plant communities, it is important that the shortcomings and limitations of quantitative methods should be fully realised. It would appear that while quantitative methods are inadequate for the description of plant communities, they are valuable in studying the distribution of individual species within the community.

E. A.

University and Educational Intelligence

CAMBRIDGE.—Miss Mary Stuart Greg, of Hornby, Lancaster, has bequeathed £500 for the purpose of assisting agricultural research. The money is to be devoted to an investigation upon "the problem of sampling and the analysis of co-variance in plant populations at variable spatial intervals".

Mr. W. O. Henderson, Downing College, has been appointed University lecturer in the Department of Geography.

A University lectureship and a part-time University lectureship in the Faculty of Mathematics are vacant and appointments will be made in the Lent term. Candidates are requested to send their names, with any evidence of qualifications they may desire to submit, to Mr. M. H. A. Newman, Secretary to the Faculty Board of Mathematics, St. John's College, Cambridge, on or before December 16.

LONDON.—Mr. R. W. Searff has been appointed University reader in morbid anatomy and histology at Middlesex Hospital Medical School. He has been, since 1931, acting as senior pathological assistant in the Bland Sutton Institute of Pathology at that Medical School.

The title of emeritus professor of psychology in the University has been conferred on Dr. Beatrice Edgell, on her retirement from the professorship of psychology at Bedford College.

OXFORD.—On November 21, a sum not exceeding £100 was voted by Congregation towards the expenses of the Oxford University expedition to Ellesmere Land, north of Baffin Bay. At the same meeting of Congregation a grant of £50, in addition to an amount formerly allocated, was voted to the School of Rural Economy for an expedition to a district of the Southern Sudan with the view of investigating extreme conditions of drought and rainfall in their bearing on agricultural development.

The Right Hon. Lord Irwin, president of the Board of Education, has been elected Chancellor of the University, in succession to the late Lord Grey.

THE twenty-first election to Beit fellowships for scientific research will take place on July 13, 1934. Not more than three fellowships will be awarded, each of which will be of the annual value of £250 and will be tenable for two years at the Imperial College of Science and Technology. Further particulars can be obtained from the Rector, Imperial College, South Kensington, London, S.W.7.

Calendar of Nature Topics

Third 'Buchan Warm Spell'

The last of Dr. A. Buchan's well-known warm and cold spells comes on December 3, when he supposed that a period of relatively high temperatures began, and continued almost until the middle of the month. On examining the smoothed daily averages of temperature for 90 years at Greenwich, it is seen that a rise does actually begin on December 3, the temperature reaching a maximum on December 5 and 6, but the amount of the rise is negligible—only 0.6° F. After this there is a fall to a minimum on December 10–11. In individual years there appears to be no special tendency for Buchan's period to be abnormally warm, but the fluctuations of temperature in England are so rapid that the chances are in favour of any 12-day period including a few warm days. On the whole, it cannot be said that the existence of Buchan's third warm spell is supported by the statistics for London.

Predatory Mammals and Game Birds

That the losses of the game preserver due to foxes may be reduced, where rabbits and small rodents are present in sufficient numbers, is suggested by a study of the food of foxes on an 800-acre estate in Michigan (Dearborn, 1932). The estate, which is mainly rough and uncultivated land, well provided with low-growing vegetation and rich in wild fruits, is heavily stocked with pheasants. Several hundreds of reared birds are liberated annually to maintain the stock. Feeding stations scattered throughout the area are kept supplied with grain over a considerable part of the year. The insect fauna, especially grasshoppers, is abundant.

The ample food and cover designed for the pheasants encourage a large population of rabbits and field mice, voles, etc. The red fox (*Vulpes fulva*, Desmarest) breeds in the area, but appears to do little harm to the game. This is confirmed by detailed examination of 68 fox droppings, which were found to contain 73.2 per cent by bulk of remains of small mammals, 15 per cent fruit, 6 per cent insects and 5.8 per cent birds, the few pheasant remains being chiefly from young birds.

Examination of the droppings of the American badger (*Taxidea taxus* Schreber), which is legally protected for part of the year throughout Michigan, showed that, like the European badger, it does little harm to game or other birds. Remains of insects and small rodents accounted for 98.2 per cent of its droppings, with only 0.2 per cent egg-shells.

Last of the Guadalupe Caracaras

On December 1, 1900, a flock of eleven of the scavenging falcons, or caracaras (*Polyborus lutosus*), flew towards Rollo H. Beck in Guadalupe, and in that gentleman's own words, "of 11 birds that flew towards me 9 were secured; the other two were shot at but got away. The eleven birds were all that were seen, but judging by their tameness and the short time I was on the island I assumed at the time that they must be abundant". So far as is known, Mr. Beck in so doing exterminated the Guadalupe caracara, and there was little excuse for the slaughter, for all told, before Beck's specimens were killed, only twenty-eight specimens had ever been recorded (C. G. Abbot in *Condor*, 35, 10; 1933).

About 1875, Dr. Palmer collected about a dozen

skins, knowing the bird to be "a rare bird in process of extinction". At a later date, Harry Drent, a goat hunter, captured four caracaras alive, by a trick he learned in South Africa. "The first bird I winged with a shotgun. I then made him a prisoner and staked him near a large boulder. I then took a string, fastened it to a stick and made a loop similar to a cowboy's lariat. I then hid myself behind a rock, knowing the other birds would come to the captive. I threw the rope and captured a second bird. I then made him a prisoner with the other. By this method I secured four out of the seven birds on the island."

Codling Moths begin to emerge in New Zealand

The codling moth (*Cydia pomonella*) is a European insect which has been carried to, and flourishes in, almost every part of the world where apples are grown. The damage it causes is everywhere serious—in 1907 the annual loss in the United States alone was reckoned at 12,000,000 dollars, probably it is now double that amount—and since the effectiveness of control measures depends upon an intimate knowledge of the life-history, the insect has been studied in detail in many countries.

The life-history shows great variation: in the far southern States there are three generations in a year, in the northern States even the second generation is a small one; in New South Wales there are two broods and a partial third brood, but, strange to say, in New Zealand, L. J. Dumbleton has just shown that in most localities only one brood occurs each year (*New Zealand J. Sci. Tech.*, 14, 112; 1932). By a method of bait-trap collecting, he proved that the adult moths begin to emerge in November and emergence continues until the end of January. The larvæ commence to emerge from the apples about the second or third week in January, and then hibernate under the bark during the winter months. About the second week of October the over-wintered larvæ begin to pupate. The details of the life-history fluctuate in different districts in accordance with mean temperatures and the number of rainy days per month, and in any district emergence of the moths may be delayed by rough and cold weather.

Brussels Sprouts

The picking season for this crop is now in full swing and will extend throughout the winter months. A day's 'brussling', as the men call it, is a good test of stamina and resistance to cold, for the plants are usually wet and the sprouts only a few degrees above freezing point.

This is one of the crops gradually spreading from the market garden to the farm, where it is grown by large-scale methods, its very success bringing problems of disposal and marketing in its train. Brussels sprouts, like all species of *Brassica*, are very variable; even a casual observer looking over a crop can scarcely fail to be struck by the difference in size and conformation of the plants and the lack of uniformity in the sprouts themselves. Races of sprouts displaying uniformity in the commercial qualities of size, hardness, colour, resistance to frost and freedom from 'blowers', that is, the habit of forming open rosettes instead of solid sprouts, are eagerly sought for by the growers. This need is more likely to be met by systematic scientific work than in any other way, and the outlook is more promising since a study of these problems has been taken up at the Horticultural Research Station, Cambridge.

Societies and Academies

LONDON

Royal Meteorological Society, November 15. J. EDMUND CLARK, I. D. MARGARY and C. J. P. CAVE: Report on the phenological observations in the British Isles, December 1931–November 1932. Exceptional warmth again prevailed until February, which was also excessively dry. But the year was most notable for its wetness and dullness, above all, April, May and July. These gave half as much rain again as usual and only three-quarters of the sunshine average. June and early autumn largely saved the situation for field and garden crops and gave a fine floral display from August onwards. Plant events after April to early July were ten days late or more in England and Wales, but a bare week for the British Isles as a whole, since Scotland and Ireland fared much better. The names and stations of all observers are given. V. V. SOHONI and M. M. PARANJPE: Fog and relative humidity in India. Association of fogs with unsaturated air is fairly common in India. Although thick fogs are predominantly associated with relative humidities of more than 90 per cent, thin fogs are equally prevalent with humidities of 90–70 per cent.

EDINBURGH

Royal Society, October 23. C. H. LANDER (Bruce-Preller Lecture): Liquefaction of coal. Hydrogenation, as a method of converting coal into liquid fuels, is very flexible, and by suitable modifications can be made to yield mainly either heavy oils or motor spirits, according to the demand. The process is carried out at pressures of 200–250 atmospheres and temperatures of 450°–500° C. The mechanism of the process was discussed in the light of work on pure hydrocarbons by Haber, Bone and others, together with the accepted thermal data. The exothermism of the reaction has rendered large-scale working practicable, but emphasises cooling problems. Projected large-scale plants incorporate recycling of the heavier fractions in order to obtain the maximum yields of light spirits. The new preference of 4*d.* per gallon on motor spirit will enable the process to be tried out commercially.

PARIS

Academy of Sciences, October 16 (*C.R.*, 197, 801–876). ERNEST ESCLANGON: The fall of shooting stars of October 9, 1933. This was the most important shower of shooting stars since the fall of November 1885. Many determinations of the position of the radiant were made in French observatories. The mean of concordant figures was $\alpha = 266.1^\circ$, $\delta = +55.0^\circ$ in close agreement with Crommelin's figure for the 1926 swarm. M. GHERMANESCO: Finite differences equations. W. NIKLIBORC and W. STOZEK: The logarithmic potentials of the double layers. M. LLE. H. SZMUSZKOWICZOWNA: Quasi-analytical functions. JACQUES DEVISME: Hypergeometric functions and one of their extensions. STANISLAW KOLODZIEJCZYK: The error of the second category in the problem of Student. J. LEROUX: A hypothesis of Poincaré. MME. M. L. DUBREIL-JACOTIN: The rigorous determination of permanent periodic waves of finite amplitude. GUSTAVE ANDRÉ MOKRZYCKI: The possibility of raising and landing aeroplanes with the aid of a rocket. A. BUHL: Very

general propagations indifferently undulatory or corpuscular. P. CHAMBADAL: The fractional removal of gases from hot and cold water by the Claude-Boucherot method. GEORGES CLAUDE: Remarks on the preceding paper. JACQUES WINTER: The theory of diffusion of high voltage electrons. R. FREYMANN and A. NAHERNIAC: The study of the absorption spectra of some benzene derivatives in the region 1.0 μ with the aid of a recording spectrometer. The instrument used for the study of the absorption in the infra-red is a thallium oxysulphide photoresistance cell, in connexion with a valve amplifier and a galvanometer, the record being obtained by a system of three mirrors. A. DUFOUR: An interferometer with polarised pencils. L. MÉDARD and H. VOLKRINGER: The Raman effect of nitric acid alone, or in solution. The position of the lines is affected by dilution with water, but in chloroform solutions the Raman spectra are simply the superposed spectra of 99.8 per cent nitric acid and chloroform. P. SWINGS and M. MIGEOTTE: The fluorescence of the diatomic molecules of arsenic. C. G. BEDREAG: The physical system of the elements. EDOUARD RENCKER: The dilatometric study of some ternary silica-soda beryllium glasses. The experimental results are summarised in two diagrams. R. CORNUBERT and M. DE DEMO: Skita's trans α 'dimethylcyclohexanone should be a *cis* isomer. JACQUES BOURCART: The stratigraphical situation and probable age of the subatlantic detritic formation in the Haut-Atlas of Marrakech. J. P. AREND: The conditions of formation of the oolitic deposits and the movements of the earth's crust. JEAN BARLOT: The distillation of the bituminous schists of the Franche-Comté Jura. The yield in oil of these schists is variable according to the mode of treatment. The conditions for maximum yields on distillation are given: the oils contain not less than 30 per cent of petrol boiling below 205° C. V. FROLOW: The undecennial component of the Nile and of the sun. The relative value of the undecennial component is sensibly greater for the sun than for the Nile and the Seine. MME. F. BAYARD-DUCLAUX: The influence of the water of imbibition of rocks on their electrical conductivity. The electrical conductivity of dry rocks is nil and their conductivity in the normal state is entirely due to the moisture present. When a dry rock is allowed to absorb water slowly, the conductivity at first increases very slowly, but after a certain amount of water has been absorbed, the increase is very rapid. It would appear that the first water absorbed combines with the rock without forming mobile ions: later the conductivity becomes electrolytic. C. ARAMBOURG: Observations on the northern edge of Lake Rodolphe. PIERRE DAN-GEARD: The vacuome of pollen grains and pollen tubes. RAYMOND-HAMET: The identity of Karrer's corynantheine and the amorphous alkaloid extracted by Fournneau from *Pseudocinchona africana*. Utilising the fact that the chlorhydrates of these alkaloids are readily soluble in chloroform, it is shown that Fournneau's amorphous alkaloid and Karrer's corynantheine are identical. H. GESLIN: The law of growth of wheat as a function of the climatic factors. The experimental method has led to a general law of the growth of wheat, and to the conception of a heliothermic constant. If such constants, already of interest for a given place, should prove to hold for the whole of a region such as France, it will allow of fixing the extreme dates of sowing and determining the possibilities of the culture of a given variety in

a fixed place. MLE. A. MICHAUX: The contents of the total calcium in blood and the elimination of this element by the kidney in the course of chronic scurvy and acute scurvy. MAURICE ROSE: An infusorian (Foettingeridæ) parasite of the Siphonophores. JEAN FELDMANN and ADRIEN DAVY DE VIRVILLE: The relations between the physical conditions of the flora of the sea-shore pools of the coast of Albères. RAOUL M. MAY: The formation of the nerve terminations in the suckers of the regenerated limb of the cephalopod, *Octopus vulgaris*. H. M. FOX and J. ROCHE: Crystallised chloroaurine. The method of preparation of the crystallised pigment is described. The results of micro-analysis are compared with those given by hæmoglobin of the horse: the proportions of sulphur and iron are higher in the chloroaurine (see also NATURE, Sept. 30, p. 516).

Forthcoming Events

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

Monday, December 4

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Capt. R. B. W. G. Andrew: "The Somali Coast".

Wednesday, December 6

SCHOOL OF SLAVONIC AND EAST EUROPEAN STUDIES, at 5.30—(at 40, Torrington Square, London, W.C.1). N. B. Jopson: "Pagan Slav Marriage and Funereal Customs".*

ROYAL SOCIETY OF ARTS, at 8.—G. G. Blake: "Radio-metric Condensers and Inductances".

Friday, December 8

ROYAL SOCIETY OF ARTS, at 4.30.—E. J. Mackay: "Further Excavations at Mohenjo-daro" (Sir George Birdwood Memorial Lecture).

ROYAL INSTITUTION, at 9.—Major R. M. Weeks: "The Making of a Sheet of Glass".

BRITISH INSTITUTE OF RADIOLOGY (Annual Congress at the Central Hall, Westminster), December 6-8.

Dec. 6, at 5.—Dr. Stanley Melville (presidential address).

Dec. 7, at 2.30.—Discussion opened by Prof. Woodburn Morison: "Tumour of Bone".

At 5.—N. S. Finzi (Mackenzie Davidson Memorial Lecture): "X-Ray and Radium Treatment in the Future".

Dec. 8, at 10 a.m.—Discussion opened by Dr. F. Hernaman-Johnson, W. M. Levitt, G. F. Stebbing and Russell J. Reynolds: "Review in regard to Radiation of Neoplasm with Special Reference to the Value of Hard and Soft Rays".

At 2.30.—Dr. A. Bouwers (Silvanus Thompson Memorial Lecture): "Modern X-Ray Developments".

Official Publications Received

GREAT BRITAIN AND IRELAND

Journal of the Royal Microscopical Society. Series 3, Vol. 53, Part 3, September. Pp. xvi+203-297. (London: Royal Microscopical Society.) 10s. net.

Second Interim Report (June 1933) of the Furunculosis Committee appointed July 1929 by the Rt. Hon. William Adamson and the Rt. Hon. Noel Buxton. Pp. 81. (Edinburgh and London: H.M. Stationery Office.) 2s. 6d. net.

Department of Scientific and Industrial Research. Report of the Building Research Board; with Report of the Director of Building Research for the Year 1932. Pp. x+133+6 plates. (London: H.M. Stationery Office.) 2s. 6d. net.

The National Smoke Abatement Society. Fourth Annual Report, 1933. Pp. 26. (Manchester.)

Journal of the Society of Glass Technology. Edited by Prof. W. E. S. Turner. Vol. 17, No. 67, September. Pp. viii+239-347+301-406+xxiv. (Sheffield.) 10s. 6d.

Proceedings of the Royal Society. Series A, Vol. 142, No. A847, November 1. Pp. 361-714. 18s. Series B, Vol. 114, No. B786, November 1. Pp. 103. 6s. (London: Harrison and Sons, Ltd.)

Battersea Polytechnic. Report of the Principal for the Session 1932-33. Pp. 42. (London.)

The North of Scotland College of Agriculture. Report on the Work of the North of Scotland College for the Year 1932-33. Pp. 35. (Aberdeen.)

The Proceedings of the Physical Society. Vol. 45, Part 6, No. 251, November 1. Pp. iv+755-854. (London.) 7s. net.

Proceedings of the Royal Irish Academy. Vol. 41, Section A, No. 12: An Investigation on the Penetrating Radiation from Potassium. By F. D. Greeves. Pp. 129-136. (London: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

OTHER COUNTRIES

Meddelanden från Statens Meteorologisk-Hydrografiska Anstalt. Band 6, No. 3: Vinden i Sveriges Högre Luftlager: Resultat av Pilotballongobservationer utförda under åren 1919-1929. Av C. J. Ostman. Pp. ii+38. 2.50 kr. (Stockholm.)

Abisko Naturvetenskapliga Station. Observations météorologiques à Vassijaure. 3: Du 1^{er} août 1907 au 31 juillet 1908. Exécutées par Erik Bergstrand et Lennart Stridsberg. Rédigées par Erik Bergstrand et Bruno Rolf. Pp. ii+54. (Stockholm.)

U.S. Department of Agriculture. Circular No. 270: Orchard Insects of the Pacific Northwest and their Control. By E. J. Newcomer. Pp. 77. (Washington, D.C.: Government Printing Office.)

The Medical and Scientific Archives of the Adelaide Hospital. No. 12 (for the Year 1932). Pp. 84+3 plates. (Adelaide: Government Printer.)

Japanese Journal of Geology and Geography. Transactions and Abstracts, Vol. 11, Nos. 1 and 2, September. Pp. ii+155+7+15 plates. (Tokyo: National Research Council of Japan.)

The Rockefeller Foundation. Annual Report, 1932. Pp. viii+455. (New York City.)

Smithsonian Miscellaneous Collections. Vol. 89, No. 8: Morphology of the Insect Abdomen. Part 2. The Genital Ducts and the Ovipositor. By R. E. Snodgrass. (Publication 3219.) Pp. 148. (Washington, D.C.: Smithsonian Institution.)

Division of Fish and Game of California: Bureau of Commercial Fisheries. Fish Bulletin No. 40: The California Mackerel Fishery. By Richard S. Croker. (Contribution No. 125 from the California State Fisheries Laboratory.) Pp. 149. (Terminal Island, Calif.: California State Fisheries Laboratory.)

Field Museum of Natural History. Geology Leaflet 14: A Forest of the Coal Age. By B. E. Dahlgren. Pp. 39+2 plates. (Chicago.) 25 cents.

University of Toronto Studies: Geological Series, No. 35: Contributions to Canadian Mineralogy, 1933. Pp. 64+3 plates. (Toronto: University of Toronto Press.) 50 cents.

Proceedings of the United States National Museum. Vol. 82, Art. 30: New Genera and Species of Parasitic Mites of the Superfamily Parasitoidæ. By H. E. Ewing. (No. 2971.) Pp. 14+4 plates. (Washington, D.C.: Government Printing Office.)

U.S. Department of Commerce: Bureau of Standards. Research Paper 585: Effect of Temperature and Frequency on the Dielectric Constant, Power Factor and Conductivity of Compounds of Purified Rubber and Sulphur. By A. H. Scott, A. T. McPherson and Harvey L. Curtis. Pp. 173-209. (Washington, D.C.: Government Printing Office.) 5 cents.

Annual Report of the Department of Agriculture, S.S. and F.M.S., for the Year 1932. By Dr. H. A. Tempamy. Pp. iv+78. (Kuala Lumpur.)

National Research Council of Japan. Report, Vol. 2, No. 1, April 1931-March 1932. Pp. iii+70. (Tokyo.)

Publications of the Dominion Observatory, Ottawa. Vol. 10: Bibliography of Seismology. No. 18: April, May, June, 1933. By Ernest A. Hodgson. Pp. 305-318. (Ottawa: Government Printer.) 25 cents.

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. First Series (Mathematics, Physics, Chemistry), Vol. 22, No. 4. Pp. 633-914. (Tokyo and Sendai: Maruzen Co., Ltd.)

Journal and Proceedings of the Asiatic Society of Bengal. New Series, Vol. 27, 1931, No. 4, October 1933. Pp. clxxxvi. (Calcutta.) 4.14 rupees.

Indian Journal of Physics, Vol. 8, Part 2, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 17, Part 2. Conducted by Sir C. V. Raman and Dr. K. S. Krishnan. Pp. 95-170+plates 6-9. (Calcutta.) 2 rupees; 3s.

The Journal of the Osmania University College. Vol. 1. Pp. viii+107+12 plates. (Hyderabad.)

Sveriges Geologiska Undersökning. Ser. C, No. 379: Untersuchungen über Tonerdzement. 1: Die mineralogische Beschaffenheit der Schmelzemente von Valle Viken, Schweden und von Ciment fondu der Soc. An. des Chaux et Ciment de Lafarge et du Teil, Frankreich, von N. Sundius; 2: Die Reaktion zwischen Tonerdzement und Wasser, von Gunnar Assarsson. Pp. 60. (Stockholm: P. A. Norstedt and Söner.) 2.00 kr.

Instituto Geográfico, Catastral y de Estadística. Anuario del Observatorio Astronómico de Madrid para 1934. Pp. 376. (Madrid.)

CATALOGUES

Neue Bücher für naturwissenschaftlich Gebildete. Pp. 16. Bücher über den Ständestauf und die berufständische Gliederung. Pp. 16. (Jena: Gustav Fischer.)

The Applications of Marmite (Yeast Extract) in Medicine and Dietsetics. Pp. 23. (London: The Marmite Food Extract Co., Ltd.)

Knowles Patent Electrolytic Cells for producing Pure Hydrogen and Oxygen. Pp. 21. (Chester: The International Electrolytic Plant Co.)