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## British Maps and the Metric System

### Proposed Grid for Ordnance Maps

IF it were possible to make a clean sweep of British units of measurement and substitute for them the metric system, probably no one would benefit more than the surveyor and map maker. No one who has had practical experience in the use of the metric system would not prefer it to our complicated and almost barbaric weights and measures. Great Britain is the only country in Europe which has not adopted the metric system (though it was legalised in 1897). The U.S.S.R. adopted it as recently as 1927, and Japan in 1924. We should probably have had it now, had the metre not been identified with the French Revolution, which was not popular in England. The subject crops up every few years both in and out of Parliament. Select committees have discussed it, and on one occasion even recommended compulsion. But the dead weight of public opinion has always opposed every effort, and nothing has been done.

In a paper read at a recent meeting of the Royal Geographical Society and summarised in this issue (p. 196), the Director General of the Ordnance Survey, though not advocating the adoption of the metric system generally, suggested the use of metric units for a proposed map grid designed to cover all scales of the Ordnance maps.

A map grid is a graphic representation of a plane rectangular co-ordinate system. To apply a grid to any series of maps, the whole series must be projected on a single plane. The Ordnance Survey large-scale maps (the 1/2500 and six-inch) are projected on no less than forty-one planes,

each containing only a single county, or a small group of counties. To apply a grid it would, therefore, be necessary to re-project the whole series on a single plane, and this would have to be done in order to carry out the Director General's proposals.

At present the Ordnance Survey large-scale maps are on Cassini's projection; that is to say, points are defined by 'co-ordinates' which are really arcs. The 'Y' co-ordinate is the perpendicular from the point on to the central meridian, and the 'X' co-ordinate is the intercept on the meridian between the foot of the perpendicular and the origin. These two arcs are plotted on the map as straight lines. The effect is to introduce a 'scale error'—or stretching of the surface—in a north and south direction, which increases progressively with the distance from the central meridian.

For the proposed new arrangement the whole country has to be brought on to a single projection; and another system, the Gauss conformal projection, based on the meridian of 2° W. would be used. In this projection there is a similar stretching of the surface, increasing with the distance from the central meridian, but instead of being stretched only in a north and south direction the surface is stretched also east and west, by an exactly equal amount. The result is that the scale, though increasing as before with distance from the central meridian, remains the same in all directions at any given point. The projection, in short, is orthomorphic.

The amount of stretch, or 'scale error', introduced by the projection—an unavoidable necessity whenever the curved surface of the earth has to be represented on flat paper—is inappreciable when the area represented does not exceed the size of an English county, but when the whole country has to be shown on a single plane this is not so. The maximum stretch in Great Britain is of the order of  $1/1000$ , but its absolute magnitude can be reduced by the device—adopted by the Ordnance Survey—of applying a 'scale factor' which reduces the whole representation in the proportion of 2499 to 2500. On the  $1/2500$  map the effect of this is to make the scale along the central meridian  $1/2501$  instead of exactly  $1/2500$ , and at the edges of the country about  $1/2499$ , while the exact figure of  $1/2500$  occurs along two north and south grid lines each at 180 kilometres from the central meridian.

It remains to be seen whether these small variations of scale—which are, of course, far less than the normal expansion and contraction of paper—will cause any practical inconvenience. Even if this proves to be the case, the inconvenience will certainly be far less than that of the present arrangement of the  $1/2500$  map in numerous separate county series.

To the representation of the surface of the country thus flattened, a grid system can be applied. This is another and still greater advance in cartographic practice, for which the public will certainly be grateful when its uses are understood. The grid is—as explained—a system of co-ordinates and is formed by lines parallel respectively to the co-ordinate axes and at fixed distances therefrom. These lines form a network of squares covering the whole area of the projection, which can be applied to maps of every scale, and which provide a simple and unambiguous means of indicating the position of any and every point on the surface to any desired degree of precision.

The grid forms a complete reference system which, once it comes into general use, will doubtless be as valuable to the public for civil purposes as it was and is to the Army in war; while the rectangular co-ordinates which it represents are, of course, by far the easiest medium in which to carry out any survey operations—this is an important point.

The question then arises: What should be the size of these grid squares? This depends on two considerations: the grid unit and the scale of the

map. The Director General explains that, as the Ordnance Survey publishes maps on many scales, there cannot be a grid square of the ideal size on *all*. He suggests that the unit of the grid should be selected so as to make the square suit the  $1/2500$  map, which is the basis of all Ordnance maps, and that the other scales must look after themselves. Practically, the choice lies between the yard and the metre, and of the two he prefers the latter, his main arguments being that the metric grid is intrinsically more suitable, and that it is less likely to require changing in future. The adoption of a metric grid now might also assist the general introduction of metric measures into Great Britain, while a grid in yards would have the opposite effect.

In our opinion the arguments put forward by Brigadier MacLeod are sound and conclusive, yet the suggestion that any assistance should be given to people who want to use the metre seems to have alarmed some writers in the newspaper press, who think, apparently, that it is the birthright of the Briton to be compelled to use as complicated a system—or lack of system—of measures as it is possible to advise. The complexity of British units is a sore handicap in trading with foreigners, who, throughout the Old World, have abandoned their native systems in favour of the metric system. The United States supports the Old Country in its resistance to change and still measures with feet and yards—but (tell it not in Gath) its foot is not quite the same as the English foot, being in point of fact derived from the international metre!

Although the introduction of metric map grids will not compel any Briton to admit the metric invader into his castle, it is by no means impossible that ere long the demands of international aviation, which insists on measuring heights in metres, may make a breach in the British front and perhaps bring about the ultimate surrender of the fortress. Some of the garrison has already gone over to the enemy. The world of science did so long ago, and industry has begun to follow suit, and would doubtless follow faster were it not that it cannot afford to leave the public behind. Whether the fortress will ever fall, and if so how and when, we will not venture to predict; but at least we may prophesy that if the introduction of a metric grid upon Ordnance maps contributes to its fall, it will prove in the long run to be not the least of the benefits which the Ordnance Survey has conferred upon the nation.

## The Egyptian Bedouin

Sons of Ishmael: a Study of the Egyptian Bedouin

By G. W. Murray. Pp. xv+344+32 plates. (London: George Routledge and Sons, Ltd., 1935.) 18s. net.

DURING the period of something more than a quarter of a century that Mr. Murray has been engaged in desert surveys, he has used his opportunities to observe and record the customs and ideas of the nomads—both Arab and Beja—with whom his profession has thrown him in contact. The knowledge so acquired and systematised has resulted in a notable book containing so much new information concerning the social usages of the Arabs, though its geographical field is limited to Egypt and Sinai, that it immediately takes rank with such classics as Burekhardt's "Bedouins and Wahabys". Moreover, the book is almost as much one for the general reader as for the sociologist, the former being catered for by the mass of interesting detail to be found in every chapter, often enhanced by a somewhat grim attitude (the author calls it "nomad") authentically of the desert.

To understand the Arab it is necessary to appreciate the camel, the Arab's most valuable property. A happy man is he who, sitting on the ground, sees his horizon limited in every direction by the bellies of his camels, or is kept awake all night by the bellowing of his camel-calves. It is possible to walk across Africa with donkeys; the reviewer has been in the villages built by Fellata (the Sudan term for Western folk, whose homes may be as far away as the northern territories of Nigeria and the Gold Coast) in the Red Sea Province, and seen the donkeys that accompanied them, the longest distance between wells on the pilgrim route being about eighty miles. There cannot, however, have been much steady travel in the desert before the introduction of the camel, which may well get through the six cool months of the year without water if the grazing is good. Mr. Murray actually records nearly four hundred miles travelled by easy stages in a little more than four months: "The camels of my caravan drank near Mersa Sha'b on November 22nd, and did not drink again till March 28th, when they were watered at Bir Umm Bishtit. During the intervening 126 days they had moved my camp 375 miles by very easy stages." Such easy travel bears no relation to hard work in hot weather. In these conditions, Ahmed Bey Hasanein's march of

270 miles in ten nights in May, from 'Uweinat to Erdi, is about the utmost that can be done without either water or grazing.

From camels to tracking, and from tracking to warfare. The stories of our youth are all actually or potentially true. No Bedouin hopes to escape detection of his raid—the evidence is there for his enemies to read; his only chance is a good start and superior speed. In his chapter on raiding and warfare, one of the most interesting in the book, Mr. Murray brings out the fact that there is a true national sense among the Bedouin—a fact implicit in Doughty's writings, though less easily recognised—which is certainly not extended to embrace townfolk. Even nowadays camels are commonly lifted, though the organised raid, *ghazu*, of one tribe on another no longer occurs in Egyptian territory. During these raids bloodshed was avoided as far as possible—unless there was an unsettled blood feud between the parties—though if two armed parties met honour demanded that they fought. Women and children were untouched, and prisoners were usually liberated later when the excitement had died down.

With regard to the other world, the nomad Arab, as Mr. Murray points out, takes a somewhat Confucian view. "Pay all respect to spiritual beings but keep them at a distance", comes near to his attitude. General unbelief in unorthodox spiritual agencies seems almost as sturdy as the disbelief which the reviewer found among the Kababish of the Kordofan steppe. Still, there are indications of contact with Egypt, that reservoir of old and unorthodox beliefs, though there is little fear even of the *jinn* whose existence is accepted. Here in the north, as among the nomads of the Sudan, it is the *weli*, the (dead) saint, who protects and intercedes and in whose charge, that is in the vicinity of whose shrine, valuable property may safely be left. Moses is still associated with Mount Sinai, and the rainfall of the peninsula is believed be more or less under his control; an excessive flood in 1867, which drowned forty of the Wilad Sa'id, is ascribed to the celebrated Sheikh Musa Nassir overdoing his prayers for rain:

"The prophet is supposed to have told his namesake on that occasion that the rain would no longer be withheld; in fact, Musa Nassir was given to understand that he had better get home quickly and warn his people. But the Sheikh's riding camel was by no means swift enough to outrun the Divine (but sudden) generosity."

Interesting and often exciting as the whole book is, by far the most important chapters are those dealing with Bedouin law. Mr. Murray, recognising that the ancient institutions are rapidly vanishing, has set down all that he has been able to collect of the old code from the men who used to administer it. In Sinai, as in Arabia, this code is simply the practice of the ancestors transmitted orally by each judge to his son. Though varying slightly from tribe to tribe, it is so widespread and so unchanging that the Bedouin apply to it the term '*urfi*', "sanctified by custom". To understand the Arab point of view, it must be realised that in the old days—which ceased scarcely fifty years ago—recourse to the law was entirely optional, and there was little recourse to a *qadi* (selected by mutual consent) until disputes, generally of long standing, were felt to have become intolerable.

"The '*urfi*' law is still in the state where individual rights and wrongs are kept strictly within the family circle; so all that the Bedouin *qadi* has to decide is a dispute in which one family seeks compensation from another. Into this purely civil code the idea of a crime against the community enters only as a violation of the honour of the tribe. So it comes about that a Sinai father may kill his daughter without having to answer to the tribe for her life, and when, in 1904, a son killed his father, he was merely 'sent to Coventry' by his tribe for the murder. As they said 'Everyone spat at him and refused to speak to him. So he pined away and died'."

The Bedouin system is the precise converse of ours, where the jury find the man guilty and the judge sentences him. The Bedouin *qadi* is no official, but a man of professional standing skilled in settling disputes and recognised as learned in the set of rules of thumb which have worked well

in the past. Moreover, his responsibility is greatly diminished by his being permitted no discretion in his sentence:

"The full compensation decreed by the law must always be awarded, to be later whittled down by the good sense of the community. For should the penalty appear to those in court severe, and it generally does, since the law has been framed to meet extreme cases, all the prominent people present beseech the successful litigant, saying, 'Let him off one camel for my sake, let him off two for mine'. So . . . the imposing award made by the *qadi* soon dwindles down to a very modest sum."

In practice, all disputes are settled by the intervention of third parties; a murderer takes refuge with a stranger, disputed property is carried off and deposited in a neutral's tent, and a lover, taking advantage of this, may even abduct his mistress without damage to her reputation.

All these matters are discussed at length in Mr. Murray's book, and the actual incidents cited give an extreme vividness to the picture. The volume contains chapters that in fact constitute a tribal gazetteer, a good general account of the Northern Beja, and a short epilogue on the future or lack of future for the Bedouin, with the recognition that in spite of the intelligence and subtlety of mind of these desert dwellers, there is little that can be done for them.

"Material help, short of altering the climate, can do little more than tide the Bedouin over a bad year now and then. Yet could learning bring to their logical minds some lesson more stirring than resignation to the will of God, I would not despair of the Bedouin."

C. G. SELIGMAN.

## Lizards of British India

The Fauna of British India including Ceylon and Burma. (Published under the authority of the Secretary of State for India in Council.) Reptilia and Amphibia. Vol. 2: Sauria. By Malcolm A. Smith. Pp. xiii+442+1 plate. (London: Taylor and Francis, 1935.) 30s.

CONSIDERED from the systematic point of view, the herpetological fauna of India is now tolerably well known. But much patient investigation in field and laboratory is yet necessary before our knowledge of the distribution, economic status, life-histories and habits of reptiles and amphibians can be brought into line with that of

higher groups such as birds and mammals, which have hitherto attracted an undue share of the attention of naturalists. It is a somewhat unaccountable fact that lizards—which form so conspicuous an element in the terrestrial fauna of a tropical country—have been comparatively little studied in this respect: indeed, ecological studies in herpetology offer an extensive and promising field for future research in this as in other parts of the globe.

The introduction of a great deal of valuable information in the volume under notice—collected from scattered sources and from the author's own observations—on the bionomics of many species

is therefore an important feature in which the present edition differs from the first, and one to which Dr. Malcolm Smith has given careful attention. Amateur naturalists living on the spot frequently have unique opportunities for recording observations of scientific value; and if their previous lack of interest in the natural history of reptiles is due in part to the need for a book containing, besides a ready means of identifying species, readable information on the natural history of this fauna, then the author's hope, expressed in the introduction to Vol. 1, that his work "will stimulate some to pay more attention to this fascinating branch of the subject", deserves well of fulfilment.

During the forty-five years which have elapsed since the publication of Mr. Boulenger's "Reptiles and Batrachia" in the Fauna of India series, observations and systematic collection have added much to our knowledge of this branch of zoology. Though based upon the earlier volume, the present work has been entirely rewritten and brought up to date, and the thoroughness with which it has been prepared testifies to the author's skill and diligence. A considerable body of new matter has been introduced, the number of pages devoted to lizards being increased from 180 to 442.

The revision has involved certain modifications in classification in accordance with recent views.

Addition to the number of species is due in part to the extension of the area covered by the present work to embrace the whole of the Indo-Chinese sub-region, but mainly to the inclusion of some 62 species described since the publication of Mr. Boulenger's volume in 1890: these additions come mainly, as might be expected, within the extensive families Gekkonidæ, Agamidæ and Scincidæ. Other notable additions include a concise introductory section treating of the group from structural, evolutionary, zoogeographical and economic aspects, and containing among other interesting features an account of evolutionary changes in the eye and ear, the author's researches on the latter forming a basis for certain taxonomic changes in the Agamidæ: this section terminates with a useful note on methods of preserving and examining specimens. Geographical features of the region are shown in two maps, the second of which gives a clear key to the hill districts of the area dealt with. A plate, and some 93 excellent text figures, the great majority of which are original, add to the usefulness of the volume.

Amateurs and serious students alike owe a debt of gratitude to Dr. Malcolm Smith for this, the second volume of the new edition, and will welcome the two further promised volumes, which, dealing respectively with the snakes and amphibians, will complete the work.

HUGH B. COTT.

## Science of Rubber

### Rubber:

Physical and Chemical Properties. By T. R. Dawson and B. D. Porritt. A Technical Handbook produced by the co-operation of the Rubber Growers' Association, Inc., and the Research Association of British Rubber Manufacturers. Pp. xi+700. (Croydon: Research Association of British Rubber Manufacturers, 1935.) 45s.

THE authors in the introduction state that the purpose of the book is to present a set of tables of detailed quantitative data of the properties of rubber together with some additional chapters dealing with other aspects of the properties of rubber. The fact that this monumental work was produced by a research association which has created for itself an international reputation for the quality of its technical literature, especially its "Summary of Current Literature", would lead one to expect a work of great accuracy, scope and ease of reference, and there is little doubt that the user—this term is used in preference to reader—

will not be disappointed in all these respects. It is highly probable that "Dawson and Porritt" will soon become as indispensable to the rubber technologist as "Beilstein" is to the organic chemist. In fact, we are to be congratulated upon producing this classical work in Great Britain, especially in view of the fact that the United States, Germany and Japan recognise the importance of 'rubber science' while we still relegate the subject to the limbo of minor technologies.

Apart from its obvious use to rubber technologists, the volume should prove of the greatest help to consumers of rubber goods in helping them to draw up specifications and tests. In addition to describing the many tests to which rubber can be submitted, the authors have most conscientiously detailed the shortcomings of such tests. This is most important, otherwise an entirely wrong conception of the value and interpretation of laboratory tests would be obtained. Furthermore, the book should be brought to the notice of every serious student of chemistry, physics and

engineering, since rubber science offers a vast field of academic and utilitarian investigation and the present position of our knowledge in this field is admirably set out in this work. One excellent feature of the handbook is the synopsis which precedes each section. These synopses are written in such a way that no previous knowledge of rubber technology is essential for their full appreciation. It is important to emphasise this point, since from the title of the work one might not expect to find such readable matter.

Another novel feature of the work is the index of rubber mixings arranged on the lines of that of

complex organic compounds in "Beilstein". In general, the indexing leaves nothing to be desired, since a reference can be traced from the most meagre information. The possessor of this work has, in fact, the very essence of the unique library of the Rubber Research Association on his desk. Only when one realises that rubber information is scattered throughout the hundreds of journals dealing with chemistry, physics, engineering and rubber technology, can the real magnitude of the task and the satisfaction derived from its achievement be appreciated.

W. J. S. NAUNTON.

## Folk Medicine

### Healing Ritual: Studies in the Technique and Tradition of the Southern Slavs

By P. Kemp. (Published in conjunction with the School of Slavonic and East European Studies, University of London.) Pp. xvi+335+24 plates. (London: Faber and Faber, Ltd., 1935.) 21s. net.

IN eastern Europe, and more particularly in the Balkans, folk medicine may be studied as a 'going concern' more thoroughly than in any other part of the Continent. It has not yet attained, or fallen to, the status of a superstition: among the southern Slavs it is still an integral element in the everyday system of thought. For this, partially, the absence of the medical practitioner, in the modern sense, in country districts to some extent is responsible. In Macedonia, for example, a few years ago in a large area around a country town not far from Salonika, the only medical attention available was that provided by a community of Roman Catholic Sisters, whose surgical appliances, simple as they were, would have seemed a little crude and antiquated even on Molière's stage.

Miss Kemp has not only made a thorough study of the technique of the healing art as practised by the Balkan peoples; but has also submitted it to a detailed analysis in order to demonstrate the

physiological and pathological theories which underlie practice, as well as the sociological, magical and religious concepts which are implied. As she points out in many connexions, the concepts which are involved are of a complex nature, and any attempt at a classification of the underlying purpose or theory of causation in the art of medicine among these peoples is apt to lead to a cross-classification. Thus individual therapy, which is purely magical, is apt to shade into a group prophylaxis, in the ritual of which it is difficult to draw the line between magic and religion. As an instance may be cited the seasonal festivals and observances, some of which, it may be said without exaggeration, are kept up solely with the object of providing medicine through their ritual. The elaborate rites at an eclipse seem also to have little other purpose. No less ambiguous is the interpretation of the hospitality shown to a stranger, for among other motives may be the hope that when he leaves he will carry with him the evil and disease which might bring harm to the community.

Miss Kemp's work is a valuable contribution to the study of folk psychology, in which students will count, among other matters for gratitude as not least, a bibliography which includes Eastern European sources freely.

### Resistance of Materials

By Prof. Fred B. Seely. Second edition. Pp. xii+436. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 18s. 6d. net.

IN this second edition of Seely's "Resistance of Materials", the book has been completely re-set, various changes based on experience and suggestions having been made, chiefly in giving further emphasis

to the engineering significance of the subject. The first part consists of a complete undergraduate course for advanced students; the second part contains a brief treatment of a number of special topics in stress analysis, likely to be helpful to the young graduate engineer who wishes to study further on his own initiative. The applications are kept in sight throughout, and many instructive examples are given in the text and at the end of each chapter.

**Race Relations :**

Adjustment of Whites and Negroes in the United States. By Prof. Willis D. Weatherford and Prof. Charles S. Johnson. (Heath Social Relations Series.) Pp. x+590. (Boston, New York and London : D. C. Heath and Co., 1935.) 15s. net.

WITH Miss Cunard's encyclopaedic anthology ("Negro", Wishart, 1934), this book deserves the serious attention of all students of Negro problems. Distinguished by a graceful style, it provides a general survey of the philosophy of ethnic relations, a crisp account of American slavery and its effects on the body-politic, and a review of the present status of the Negro in the American 'melting pot', which together form the best concise history of Afroamerican development known to the reviewer. An extensive bibliography completes the volume.

The social object of the authors is to stimulate mutual tolerance, and they regard their own work, the first sociological text-book written jointly by a white man and a Negro, as "a concrete expression of racial coöperation and, they believe, of racial goodwill and understanding". They are accordingly careful not to offend the susceptibilities of American 'liberalism', the Negro author by confining himself to objective statement, the white by occasional indulgence in moralising and special pleading which would have been better excluded from a work of professedly scientific purpose. Such propaganda does, of course, attract 'sympathy'; but it also antagonises those who, like the reviewer, believe in a rational approach to social problems.

It is not surprising, therefore, to find Prof. Weatherford emphasising the popular compromise of 'parallel racial development' (while his colleague stresses the impossibility of a separate Afroamerican culture) in a country where racialism is already more obviously ludicrous than in any other. To-day, the 'purest' Afroamerican cannot establish freedom from comparatively recent white or Indian admixture, while the supposedly white Americans have been extensively impregnated with Negroid or Mongoloid genes during the last three centuries. C. D.

**L'Organisation de l'œuf chez les chordés : étude d'embryologie causale**

Par Prof. Albert Daleq. (Collection des Actualités biologiques.) Pp. viii+322. (Paris : Gauthier-Villars, 1935.) 65 francs.

THIS is an interesting exposition of modern work on the organisation of the egg in the Chordata. Beginning with the researches of Conklin on the normal development of *Styela* and of *Amphioxus*, the author proceeds to describe and discuss the development of isolated blastomeres of Ascidians and *Amphioxus*. He then gives an account of the normal development of *Amphioxus* and an analysis of the investigations designed to elucidate the organisation of the amphibian egg. The experimental work on the latter subject up to 1930 forms the subject of one chapter, which is followed by an admirable chapter of about sixty pages on the results in this domain published between 1930 and 1933. The tabular presentation and classi-

fication of the researches in the experimental embryology of Amphibia, especially of the Urodela, is useful. A chapter is devoted to a consideration of the organisation of the eggs of fishes, birds and mammals. In a final chapter, the views on ontogeny due to Goldschmidt, Lillie and Wintrebert are presented and discussed.

The whole work is noteworthy for clearness of presentation. It contains one hundred illustrations, including three plates in colour, and a classified bibliography; but there is no index.

**The Two Sources of Morality and Religion**

By Henri Bergson. Translated by R. Ashley Audra and Cloudeley Brereton, with the assistance of W. Horsfall Carter. Pp. viii+278. (London : Macmillan and Co., Ltd., 1935.) 10s. net.

FOR years past, it has been a learned game among philosophers to attempt the formulation of a Bergsonian ethics on the basis afforded by the metaphysical and psychological works of the author of "Creative Evolution". The game is now over; for Bergson himself has given the world a most inspiring and unexpected sketch of his ethical views, in a fundamental work of which we have now this excellent translation.

Bergson does not pretend to give his readers any special rules of conduct, but merely to discuss the true bearings of the fundamental concepts of morality and the distinctive functions of static and dynamic religion. This discussion is not merely academic, but involves also all the concepts which are operative in our modern problems. The most remarkable conclusion of this analysis is perhaps Bergson's plea for asceticism and a science of the spirit as the necessary counterpart to centuries of material progress. As to the merits of the present translation, a comparison with the original French shows readily that in spite of the difficulties of the undertaking, the translators have given an excellent rendering of this epoch-making work. T. G.

**Handbuch der Experimentalphysik**

Herausgegeben von W. Wien und F. Harms. Band 17, Teil 1 : Schwingungs- und Wellenlehre, Ultraschallwellen. Bearbeitet von E. Grossmann, H. Martin, H. Schmidt. Pp. x+561. (Leipzig : Akademische Verlagsgesellschaft, m.b.H., 1934.) 45 gold marks.

THIS volume of the "Handbuch" is in three parts. The first part, by H. Martin, deals with the theory of oscillations, and includes mechanical, acoustical and electrical methods of production, conditions for stability, oscillations of coupled circuits, overtones and undertones. The second part, by Harry Schmidt, is a full survey of unidimensional, two-dimensional and three-dimensional problems of wave-motion. In the third part, E. Grossmann discusses the subject of supersonics; methods of production and reception of supersonic waves, their propagation, absorption and their mechanical, chemical and physiological effects are detailed in turn. The references are, as usual, extensive.

## Formation of Anthocyanins in Plants\*

By Prof. R. Robinson, F.R.S.

**D**ISTINCT lines of investigation converge on the problem of the formation of anthocyanins in plants, our information being derived from studies in plant physiology, in genetics and in the organic chemistry of the pigments and related members of the flavan group. Anthocyanins are frequently produced when photosynthetic activity at the site of eventual pigmentation is diminished through seasonal changes or various kinds of injuries to the plant (mechanical, fungus disease, etc.). Under such conditions, carbohydrates and other synthetic products tend to accumulate as the result of interference with the translocation currents. Abundant nutriment favours anthocyanin formation, which can, in many cases, be accelerated by artificial feeding with sugars.

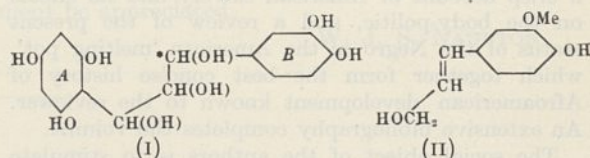
To all generalisations in this field of experiment there are exceptions, but the formation of anthocyanin from simple carbohydrates may be regarded as established. A low temperature, light, and access to oxygen favour the appearance of the colouring matter; plants which form abundant anthocyanin in the dark are equipped with reserves of food-stuffs, an example being the tulip.

Experiments on vines have made it very probable that the anthocyanin forerunners are synthesised in the leaves, but undergo specific modifications in the coloured fruits.

There is no physiological evidence of an essential stage of *reduction*, whereas *oxidation* is definitely indicated as a step in the phytosynthetic mechanism. The state of oxidation of pelargonidin derivatives is that of normal carbohydrates, whereas cyanidin and delphinidin glycosides are more oxidised to the extent of one and two oxygen atoms in the molecules respectively.

Biogenetic schemes for the anthocyanins, flavones, catechins and related substances were advanced by the author in 1921 at the Edinburgh meeting of the British Association, and these require no modification at the present time. The  $C_{15}$  system ( $C_6-C_3-C_6$ ) is regarded as built up from hexoses and triose by means of aldol condensations; if neither oxidation nor reduction by external reagents occurs, this requires that one, and only one, of the aromatic nuclei eventually produced will retain the carbohydrate state of oxidation. The other nucleus is auto-

matically reduced giving (I) as the normal (hypothetical) intermediate, in which ring *A* is unreduced and ring *B* reduced (one oxygen atom less than a hexose).



The three central carbon atoms are unprotected, and are found in various natural products in almost every possible state of oxidation. Thus oxidation of the asterisked  $\cdot\text{CH}(\text{OH})$  to  $\text{CO}$  and dehydration gives rise to cyanidin derivatives.

An important corollary of this hypothesis is that the phytosynthetic process is a condensation of  $C_6(B)$  with  $C_3$  followed by one of  $C_6(B)C_3$  with  $C_6(A)$ .

Now many  $C_6-C_3$  substances (in which  $C_6$  is benzenoid) are known among natural products, and coniferyl alcohol (II) is cited as a single example because many chemists take the view that lignin is largely constructed from coniferyl units; hence (II) may be a plant product of fundamental significance. The interesting point is that the range of orientation of phenolic groups in all the  $C_6-C_3$  types is the same as that in the *B*-nucleus of the anthocyanins and flavones. Such biogenetic schemes are based on statistical surveys of groups of plant products and can only indicate the broad lines of molecular architecture; more searching analysis is the task of the biochemist.

In the meantime, reinforcements have arrived from a somewhat unexpected quarter, and Lawrence and Scott-Moncrieff in their studies of the garden *Dahlia* have founded what is in effect the new subject of chemical genetics. It is not suggested that genetics and chemistry have never previously been considered together; but this pioneering work shows not only how to apply chemical methods of examination to the routine of genetic work but also, what is much more novel, how to interpret the results so as to throw light on the actual mechanism of synthesis in the plant.

The complex data cannot be conveniently summarised, but the main conclusions are fully justified by the experiments. The anthocyanins and flavones are regarded as produced divergently from two plant substances. One of these is present in limited amount, and is a component for all the

\* Substance of a lecture at the University of Liverpool under auspices of the Chemical Society on Dec. 10, and of a paper to the Glasgow University Alchemists Club on Dec. 11, 1935.



pigments. The second component is produced in amount and variety dependent on the factorial influences and interactions. This interpretation is in good agreement with the views expressed above. The limited, common intermediate would be  $C_6(A)$  at some stage in its history;  $C_6(B)C_3$  corresponds to the variable component in the hypothesis of Lawrence and Scott-Moncrieff.

Little can be advanced in favour of most of the special theories that have been proposed to account for anthocyanin formation in plants. There is, for example, a curiously persistent idea that anthocyanins result in Nature from the reduction of flavonols. But the physiological evidence shows that oxidation rather than reduction is requisite, and the fact of occurrence of analogous flavones and anthocyanins together in a plant has no unique applicability to the flavonol-reduction theory. We must anticipate it also on the basis of the parallel formation-mechanisms mentioned above. Thus the  $C_6-C_3 \rightarrow C_6$  hypothesis of partly independent routes to anthoxanthin and anthocyanin implies the probability of similar orientations of phenolic groups in the aromatic nuclei of the xanthic and cyanic pigments. Accordingly we might expect to find, as we do, pelargonin with apigenin; the flavonol-reduction theory, however, requires the anthoxanthin to be a derivative of kaempferol in this case.

Actually, the constitutions of congeneric anthocyanins and flavones do not often correspond closely, and the flavones (flavonols) cover a wider structural range than the anthocyanins. It is especially to be noted that correspondence of *unusual* structures in the two groups is not observed; the joint appear-

ance of cyanidin and quercetin derivatives is not surprising because these are the most widely distributed representatives of their types.

Hypotheses depending on oxidation of known flavan types such as the catechins (state of oxidation of tetrahydro-anthocyanins) are in better accord with the facts, although there is little positive evidence in favour of them. Tetramethylcatechin affords bromotetramethylcyanidin bromide on treatment with bromine in dioxan containing peroxide, but the conditions for the oxidation of catechin itself to cyanidin have not been ascertained. More significant perhaps is the recognition of the wide distribution of leuco-anthocyanidins (probably possessing the state of oxidation of dihydro-anthocyanins) which are found in almost all kinds of plant material. Inevitably the transformation of these substances into colouring matters of flavylum type must occur in Nature occasionally, but it does not follow that this route represents the standard mechanism. Two dihydroanthocyanidins, namely, cyanomaclurin and peltogynol, have been isolated and characterised; these are stabilised by the possession of a glucose-like oxide ring, and the related anthocyanidins are not found in the form of naturally occurring anthocyanins. The true leuco-anthocyanidins usually afford cyanidin on hydrolysis and autoxidation.

It is too early to attribute a predominant role to the leuco-anthocyanidins, but it is already safe to assume that their modification represents an auxiliary pigmentation process. It is possibly operative in autumnal reddening and in the coloration following injuries or decortication of leaves.

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## The Fulmar Petrel

By Seton Gordon

THE spread southwards of the fulmar along the coasts of the British Isles during recent years is remarkable. The earliest known British colony of fulmar petrels was on St. Kilda. This, indeed, was the only known colony in the British Isles until the year 1878, when a dozen fulmars founded a colony on Foula, in Shetland. In the following year the colony had increased to 20 pairs (*Zoologist*, 1879, p. 380). From that time until the present day the fulmar has spread, and is still spreading, down the coasts of Britain, and is establishing new colonies yearly along the rock-bound coasts of Scotland, England and Ireland.

Whence has come this great stock of birds? It is generally supposed that they are descendants of the St. Kilda colony, which has overflowed east and south. Harvie-Brown's notes in his "Vertebrate Fauna of the North West Highlands and Skye", published in 1904, are therefore interesting. At that time the fulmar was only beginning to extend its range, but even then Harvie-Brown was inclined to question the generally accepted belief that St. Kilda was the birthplace of these new colonists.

He writes:

"While there may be reasonable and probably just cause for supposing that SOME AT LEAST

of our new colonies are off-shoots from the St. Kilda group (it is even possible they may ALL be so) still the difficulty intrudes itself that the earliest new colony—that of Foula—is situated furthest away from St. Kilda. It may be argued that there is no reason for attempting to prove an advance-line, either from St. Kilda, or from Faroe, in the case of such a wanderer and skimmer of the ocean as the fulmar petrel indeed is. If we only look at this one species, very likely students of dispersal and migration and distribution may 'get no furdurer', but there may be more behind

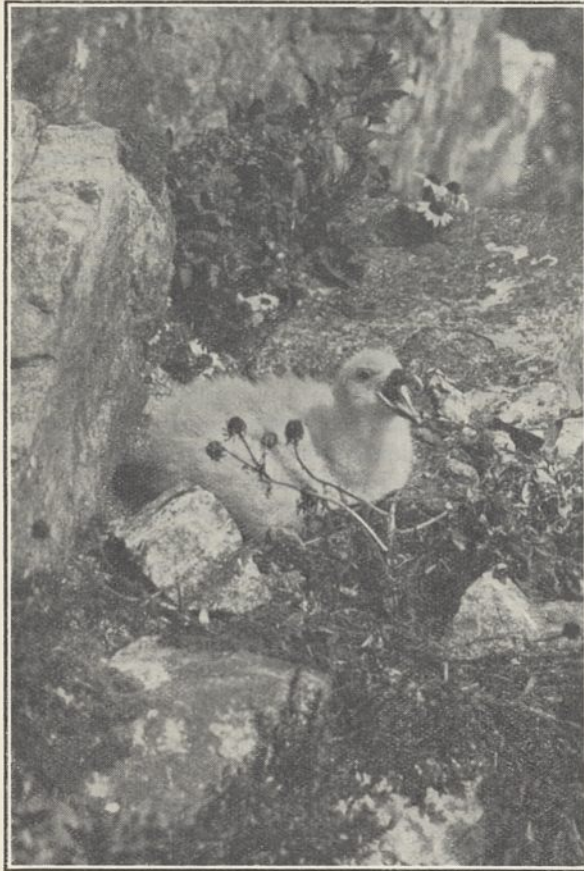


FIG. 1. A young fulmar petrel. (Photograph by Seton Gordon.)

THESE KNOWN FACTS. I think we have often in our series tried to define lines of advance and retreat and have perhaps a little forced our views with iteration. In this case I will not reiterate, but leave my readers to judge for themselves which may be the origin of our new fulmar colonies—Faroe, from the north, or St. Kilda, from the south.”

St. Kilda is now uninhabited, but a number of years before the people left the island they had ceased, or almost ceased, to kill the young fulmars, and thus a large increase of the species was to be expected.

Martin, who visited St. Kilda in 1697, writes thus of the fulmar :

“The Inhabitants prefer this, whether Young or Old, to all other. The Old is of a delicate Taste, is a mixture of Fat and Lean, the Flesh White, no Blood to be found but in the Head and Neck. The Young is all Fat except the Bones, having no Blood but in the Head. When the Young Fulmar is ready to take Wing upon being approached, ejects a Quantity of pure Oil out of his Bill, and will be certain to hit any that attack him, in the Face, though Seven Paces distant. This he uses by way of Defence, but the Inhabitants take care to prevent it, by surprising the Fowl behind, having for this purpose a Wooden Dish fixed to the end of their Rods, which they hold before his Bill as he spouts out the Oil. They surprize him also from behind, by taking hold of his Bill, which they tie with a Thread, and upon their return home they untie it with a Dish under to receive the Oil. This Oil is sometimes of a Reddish, sometimes of a Yellow Colour, and the Inhabitants and other Islanders put a great Value upon it, and use it as a Catholicon for Diseases, especially for Pains in the Bones, Stitches, etc. Some in the adjacent Isles use it as a Purge, others as an Emetic: it is hot in Quality, and forces its passage through any Wooden Vessel.”

Martin calculated that sixteen thousand eggs of sea birds were given by the people of St. Kilda to his party during their three weeks' stay on the island. It is therefore evident that an incredible number of eggs were gathered annually, and when the young birds that were killed are also taken into consideration, it can be realised that the fulmars, and other St. Kilda birds, must now be increasing greatly and overflowing each season from that lonely island group.

In Seton's "St. Kilda" (published in 1878) occurs the following :

“Fulmar fowling begins on the 12th of August and lasts between two and three weeks. The fowlers are usually accompanied by a few of the younger women, some of whom can carry about two hundred pounds' weight of birds. The oil is extracted from the stomachs of both the young and the old birds, and enclosed in long distended bags, formed of the stomachs of old solan geese. The receptacle is held open by one man, while another, squeezing the body of the fulmar, forces the oil through its gaping bill. Each fulmar contains about half a pint of oil. The estimation in which the fulmar is held by the islanders may be gathered from the following words of a St. Kildan which are recorded in the pages of Macaulay, 'Can the world exhibit a more valuable commodity? The fulmar furnishes oil for the lamp, down for the bed, the most salubrious food, and the most efficacious ointment for healing wounds. Deprive us of the fulmar, and St. Kilda is no more'.”

That the fulmar is a comparatively recent arrival on the Faroes and is not everywhere welcome is shown by the following extract, also from "St. Kilda":

"We must look also at the other side of the picture. What says the worthy Sysselmand, the King's Sheriff in Faroe, and deeply learned in fowl-lore? 'Thirty years ago, the fulmar knew his place: our fishers saw him out at sea 100 miles away, and only a stray bird now and then was driven hither by a heavy gale, but now he has set his ugly foot on my Holm of Myggenoes, and on the Goblin's Head of Sandö, and every year he spreads further and further, and breeds in more places. Nasty stinking beast! Why, even his egg keeps its stench for years: his flesh no man can eat, and yet this fellow thrusts his nose in among my gannets, and is slowly but surely driving them away'."

This account from Faroe is interesting, and it would appear that the fulmar was a resident on St. Kilda centuries before it colonised the Faroes, and the curious possibility arises that, even if the British coasts have been colonised by fulmars from Faroe and not from St. Kilda, they may be all the same the descendants of St. Kilda birds which overflowed at an earlier date to Faroe!

During the last thirty years, the fulmar petrel has steadily increased and extended its range. It nests in Orkney and Stroma, and among its Hebridean haunts are North Rona, Lewis, Pabbay, Bernera of Barra Head, Haskeir, the Flannan Isles, the Shiant Isles (where there is a considerable colony), Skye, Canna, the Treshnish Isles, Colonsay, and many other places. It nests freely along the mainland coast of Sutherland, and has spread to Ireland, where I saw a colony on Rathlin Island in 1935. It also nests on Tory Island in considerable numbers, and in other localities along the Irish coast. On the east coast of Scotland the fulmar nests from Duncansbay Head in Caithness, through Moray, Banff, Aberdeen and Kincardine, to St. Abb's Head. In Northumberland are several colonies, and it has now spread south to Flamborough Head and beyond it.\* So far, the British Isles are the southerly limit of the fulmar's nesting range; it will be interesting to see whether colonies at some future date will be founded on the French coast on the Atlantic seaboard.

There are very few records of the fulmar feeding her young, and it is believed that the nestling must be fed chiefly during the hours of darkness. Mr. Armstrong, head lightkeeper of Rathlin, has given me an interesting account of the feeding of the

young fulmar in the late summer of 1935. He writes:

"I have watched the fulmar returning to the young bird on the nest, and have noticed that she alighted about a yard from the nest and then seemed to disgorge food from the craw to the gullet. She then ambled up to the nest, opened her bill wide, and the young fulmar immediately put its beak down into the gullet of the old bird. It seemed to eat some sort of mashed substance, as it took its beak out after a few seconds and then worked its beak and swallowed. There was mashed material then adhering to the upper and lower

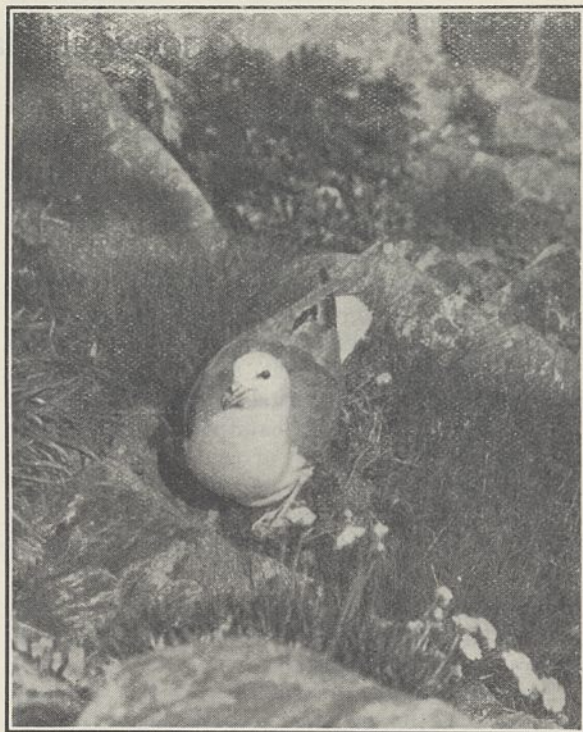


FIG. 2. Fulmar brooding on the nest; note the conspicuous raised opening to the nostrils. (Photograph by Mrs. Seton Gordon.)

portion of the bill. I saw this scene enacted several times in the evening."

I believe it to be no exaggeration to say that each year a new fulmar colony is established somewhere on the coasts of Britain. It is, apparently, a peculiarity of this sea-bird of graceful, gliding flight that it colonises a sea cliff for a season, perhaps even for two or three seasons, before eggs are laid. There is a recently formed colony on the cliffs of northern Skye, near my home, and although at least thirty pairs of birds are seen soaring around their rock in April and May, very few eggs seem to be laid, and I doubt whether six birds in all have been reared during the last two summers. It is, of course, possible that gulls and grey crows steal the eggs; but I do not think this is the

\*The Northumberland fulmars had already arrived at the nesting rocks early in January of the present year.

explanation, for this absence of eggs has been remarked upon at many newly-formed fulmar colonies. It seems more likely that these early colonists are immature birds.

The flight of the fulmar petrel is so beautiful and inspiring a thing that it is pleasant to watch this increase in the species, but it must be admitted that other sea-fowl do not like the fulmar as a nesting neighbour, perhaps because of the strong smell of the birds and of their young.

To see the fulmar in its greatest numbers one must journey to the Arctic. In Spitsbergen it nests inland, laying its egg on icy ledges amid the eternal snows three thousand feet and more above sea-level. There is something uncanny in the passing, always in silence, of fulmars through a desolate snowy valley by the pale light of the midnight sun. The fulmar nests in Franz Josef Land and Novaya Zemlya and in Iceland, and also in Arctic America. In winter it ranges south to lat. 43° N.

## Physiological Bases of Nutrition

ONE of the outstanding developments of recent years has been the steady progress throughout the world of the idea that the State is responsible for the material well-being of its individual members. A liberal food supply has always been regarded as one of the essentials for material well-being. Until recently, however, it was not realised how far the attainment by an individual of good physique, vigorous health and freedom from disease, could be brought about by attention throughout the whole period of his life to certain qualitative aspects of his habitual diet. It is now becoming plain to many of the Governments of States that they cannot afford to leave out of consideration the provision for their populations of food of the kind which tends to promote health.

It is obviously no easy task to change the feeding habits of millions of people. The kinds of food considered desirable must be available in sufficient quantity and at reasonable prices before any considerable changes can be effected. It has therefore become a matter of no little political importance to investigate the possibility of planning local, imperial and world agricultural and economic policies which would enable a sufficient supply of the more desirable kinds of food to be produced, transported and marketed, to meet the nutritional requirements of the populations of the world.

Such investigations have already been undertaken on behalf of certain Governments, and for some years the Health Organisation of the League of Nations has been interested in problems of this kind. The Assembly of the League invited the Council last September to appoint a committee, including agricultural, economic and health experts, to submit a report on the whole question to the next Assembly. The Health Committee appointed without delay a panel of twelve health experts to report on the fundamental problem which would determine the action to be taken afterwards by the agricultural and economic experts, namely, the

definition of the nutritional needs of the human being in the course of his development from conception to adult age.

The Health Experts met in London last November, under the chairmanship of Prof. E. Mellanby, and have now issued their report\*. This report is divided into two parts, the first dealing with the energy, protein and fat requirements, and the second with the mineral and vitamin requirements. The energy requirements are based on the calculation that an adult, male or female, not engaged in manual work, needs 2,400 calories a day. Those engaged in work should receive extra calories based on the nature of the work and the length of time they are engaged in such work. These extra requirements range from 50 calories an hour for light work up to 200 calories or more for very hard work. The calorie needs of children can be calculated from a table of coefficients giving the basic requirements, to which are to be added extra calories to meet the needs for muscular activities; such activities may be considered to be equivalent to light work in the case of boys and girls aged seven to eleven years and of girls aged eleven to fifteen years, and to be equivalent to moderate work in boys aged eleven to fifteen years. For nursing women a basic allowance of 3,000 calories is suggested.

The protein allowance for all adults should be at least 1 gram for every kilogram of body-weight, and it is considered desirable that part of it should be of animal origin. During growth, pregnancy and lactation, some animal protein is considered necessary, and in the growing period it should form a large proportion of the total protein. It is recommended that pregnant and nursing women should receive 2 grams of protein per kilogram of body-weight. It is not thought possible to define

\* League of Nations. Health Organisation. Report on the Physiological Bases of Nutrition by the Technical Committee appointed by the Health Committee. (Meeting held in London, November 25-29, 1935.) C.H.1197. Pp. 19. (Geneva, 1935.)

the quantity of fat to be included in the diet, though a certain amount ought to be present.

The section of the report dealing with mineral and vitamin requirements directs attention to the fact that modern diets are deficient in foods rich in minerals and vitamins, that is, protective foods, rather than in foods rich in calories. The protective foods include, first and most important, milk and milk products, eggs and glandular tissues; then green-leaf vegetables, fruit, fat fish and meat (muscle). Among the energy-bearing foods of little or no protective power are sugar, milled cereals and certain refined fats. Pregnant and nursing women should be regarded as in greatest need of protection, and a dietary schedule has been drawn up to indicate how they may obtain adequate supplies of the necessary protective elements. This diet contains a litre of milk, eggs, cheese, potatoes and green vegetables. It is recommended that cod liver oil should be added except in sunny seasons and sunny countries.

Special attention has been given to diets suitable for infants and children up to the age of five years. The importance of breast feeding for nine months is urged. The diet after weaning should contain a litre of milk, eggs, green and root vegetables, cod

liver oil and raw fruit or vegetable to supply vitamin C.

Certain general recommendations are made to ensure that the average individual's diet contains a sufficiency of protective elements. Variety in diet tends to safety, though even a varied diet may be deficient in important elements. White flour is deprived of valuable food constituents, and its partial substitution by lightly milled cereals and by potatoes is recommended. The consumption of excessive amounts of sugar is condemned. Milk should form a conspicuous element of the diet at all ages. Fresh fruit and vegetables should always be constituents of the normal diet. By the inclusion in the diet of optimum amounts of the protective foods, adequate provision of all vitamins except vitamin D is readily accomplished.

This report represents the considered opinion of experts in the field of nutrition from Great Britain, the United States of America, France, Sweden, Norway and Russia. The universal adoption of their recommendations would require notable changes in agricultural and economic policies throughout the world, and it now remains for experts in these fields to consider how far it is possible to give practical effect to the recommendations.

S. J. C.

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## Obituary

Mr. P. C. Gilchrist, F.R.S.

MR. PERCY CARLYLE GILCHRIST, who died on December 16, had for a long time lived in retirement, and was scarcely known to the present generation of metallurgists. Nearly sixty years ago, however, he was associated with the late Sidney Gilchrist Thomas, his cousin, in experiments which ultimately led to the establishment of the basic Bessemer process.

In 1855, Bessemer discovered that a stream of air when blown through molten pig iron removed its carbon and silicon by oxidation, the heat evolved being sufficient to retain the metal in a molten condition. The metal thus produced was brittle owing to its oxidised condition. A year later, Mushet made the important discovery that if manganese was added to the molten metal in the form of ferro-manganese, it removed this absorbed oxygen and enabled sound and malleable ingots to be cast. It so happened that in his early experiments Bessemer used Swedish pig iron which was low in phosphorus. These discoveries led to the establishment of the acid Bessemer process in which the lining of the converter is a siliceous refractory material. This was the beginning of the age of cheap steel. Any irons which had a suitable content of silicon and were low in phosphorus could

be treated by this method; but phosphoric cast irons were not amenable to this treatment, since with an acid lining the phosphorus remains in the finished steel and renders it brittle.

In 1870 Sidney Gilchrist Thomas, at that time a junior clerk in the Metropolitan Police Force at a salary of £90 a year, attended a course of lectures at the Birkbeck Institute. For some years he had been devoting his spare time to the study of natural science and in particular of chemistry. At one of these lectures, Mr. George Challoner, the lecturer, said: "The man who eliminates phosphorus by means of the Bessemer converter will make his fortune". Thomas never forgot this, and from that time he became a constant reader of all the literature on the subject. In 1872 he studied in the advanced course of mineralogy at the Royal School of Mines and obtained a first-class. In the following year he was awarded a first-class in the advanced course in inorganic chemistry. After some preliminary experiments, he enlisted the help of his cousin Percy Carlyle Gilchrist, who was then a chemist to certain works at Cwm Avon in South Wales. The original theory of the dephosphorisation process was due to Thomas. At the outset, Gilchrist was doubtful about it, but undertook to make some experiments. Both

men were at a disadvantage, for they could only work in their spare time, and their means were slender. Thomas had managed during twelve years service as a clerk to save £800. This money enabled them to take out two patents—No. 4422 in 1877 and No. 289 in 1878.

Thus far the work had demonstrated the possibility of their process but no more, and they then entered upon a period of difficulty and shortage of money. Mr. Martin, the general manager of the Blaenavon Steel Company in South Wales, came to their assistance, and on March 6, 1878, another patent, No. 908, was taken out. After this, rapid progress was made, and at the autumn meeting of the Iron and Steel Institute, held that year in Paris, they presented a paper entitled "On the Elimination of Phosphorus in the Bessemer Converter". So little was its importance realised that it was not even read, but was adjourned until the meeting in 1879, when it was read by Thomas and published in the *Journal* of the Institute.

Actually this delay was a fortunate occurrence. Among the members attending the meeting was E. Windsor Richards, of Bolckow, Vaughan and Co., Ltd. He made the acquaintance of Thomas, and was so impressed by the importance of the discovery and the personality of the inventor that he determined there and then to urge his directors to give the process a trial. This consent was forthcoming. Windsor Richards and J. E. Stead, consultant to the company, then undertook, in collaboration with Thomas and Gilchrist, the practical development of the process. The difficulties which had to be overcome are well described by Stead in his presidential address to the Iron and Steel Institute in 1920. Certain conditions had to be satisfied. It was necessary to line the converter with a basic material, not merely of the correct composition but also of the requisite texture and stability so that its adhesion to the converter walls during the 'blow' was maintained. It was also necessary to form a rich basic slag at an early stage of the process. Finally, it was found that while the carbon, silicon and manganese in the iron were removed at an early stage of the blow, the phosphorus was not sensibly diminished until later. This necessitated the so-called 'after blow', during which about 80 per cent of the phosphorus that is removed is eliminated.

The first successful charge was blown on April 4, 1879, using an experimental 30-cwt. converter which had been erected for the purpose. A brochure issued by Bolckow, Vaughan and Co. in 1929, the fiftieth anniversary of this event, contains the details of the actual blow and the elimination of the various impurities from the iron. Accordingly, when Thomas read the paper at the spring meeting of the Iron and Steel Institute, practical success had been achieved. In this way the basic Bessemer process was established, and for many years proved to be one of the main processes for producing cheap steel on a large scale. Provided an iron contained the requisite amount of phosphorus, it could be treated by this process. In this way the great phosphoric iron ore deposits were rendered amenable to treatment.

In one respect, the basic Bessemer process is more important than the acid Bessemer process. In the latter the ferruginous slag is a waste product. In the former, Thomas and Gilchrist had discovered the chemical conditions necessary to fix in a stable form the phosphoric acid produced by the oxidation of the phosphorus in the pig iron. A highly basic phosphate of calcium is produced which is similar in composition to the mineral phosphates of North Africa. It is eminently suitable as a plant food, and a demand for basic slag as a fertiliser grew rapidly. Strictly speaking, there is no by-product in the basic Bessemer process, for both steel and slag find a market. Both the steel industry and agriculture are thus greatly indebted to the work of Thomas and Gilchrist.

In Great Britain, the basic Bessemer process has been, to a great extent, superseded by the basic open-hearth process, which enables much larger charges to be worked; it does not require the same limits of composition of the iron, and is amenable to better control. But it has never been completely superseded, and to-day there is indeed a tendency to return to it for certain purposes. A large steel plant which is operating in the Midlands at the present time is working this process.

Gilchrist was the son of Mr. Alexander Gilchrist, a barrister. He was born at Lyme Regis on September 27, 1851. He attended Felsted School and the Royal School of Mines, where he became Murchison medalist. He was elected a fellow of the Royal Society in 1891. He was a vice-president of the Iron and Steel Institute, a member of the Society of Chemical Industry, and a fellow of the Royal Society of Arts. He was also a Chevalier of the Legion of Honour. He married in 1887 Nora, daughter of Captain Fitzmaurice, R.N., and had a son and a daughter. He has survived his collaborator Thomas for more than fifty years.

H. C. H. C.

#### Dr. Albert A. Gray

DR. ALBERT A. GRAY, who died in London on January 6, at the age of sixty-seven years, spent his active professional life in Glasgow, where he held the post of lecturer in otology in the University and of aural surgeon to the Infirmary.

Dr. Gray was known at home and abroad as the author of "The Labyrinth of Animals" (2 vols.). This magnificent work demonstrated the naked eye structure of the internal ear of vertebrate animals in a new way. He improved the technique of clarifying specimens to a degree which permitted him to expose in all its detail the internal ear within the transparent temporal bone of all vertebrate animals. In this way he was able to add many new facts to the comparative anatomy of the ear. He sought to found the practice of the ear surgeon on a scientific basis, applying himself in particular to that prevalent cause of deafness known as otosclerosis.

Many marks of recognition were received by Dr. Gray from his professional brethren; he was elected president of the otological section of the Royal Society of Medicine and of the corresponding section of the British Medical Association.

## News and Views

### Wilhelm Junk

WILHELM JUNK, the well-known publisher of natural history books, will be seventy years of age on February 3. He was born in Prague on February 3, 1866, and comes from a family with strong leanings towards natural history, which had been living there for centuries. Since his youth he has combined successfully his work as an antiquary and publisher with his inherited inclination towards the descriptive side of natural science. The "Coleopterorum Catalogus" of which, since 1910, 145 parts have appeared; the "Lepidopterorum Catalogus" which, begun one year later, contains 70 parts up to the present; the "Fossilium Catalogus", divided in two sections—animals and plants—of which 90 parts have appeared; the "Animalium Cavernarum Catalogus" accompanied by a number of valuable catalogues; then the standard work, unique in the province of biology, namely, the "Tabulæ Biologicae", containing tables of data dealing with biology which, through being continuously supplemented by the "Tabulæ Biologicae Periodicae", keep abreast with the latest development of science, are among the works he has published. The untiring services which Junk has rendered to scientific activities have been rewarded by the granting of honorary doctorates by the Universities of Frankfort-on-Main and Innsbruck, and he has been elected an honorary member of the Svenska Linné Sällskapet in Stockholm. Junk is continuing unabated his activities as a publisher, and is planning the publication of new works, among them the large edition of the "Hymenopterorum Catalogus" and the supplementary volumes to Oppenheimer's "Fermente".

### The National Geographic Magazine

AN article in the January issue of the *National Geographic Magazine*, which begins the sixty-ninth volume, records the remarkable growth of interest in the publication and its widespread circulation. Nominally the organ of the National Geographic Society of Washington, U.S.A., the magazine began as a slim brochure in 1889, a year after the Society was founded. A membership role of 165 increased to 1,000 by 1899, but efforts to improve the circulation met with little success. Most of the members were in Washington, where the Society provided lectures: few were outside and practically none overseas. The Society was poor and had no premises of its own. Then in 1900, Mr. G. Grosvenor became the editor, a position which he still occupies. This marked a new era in the destinies of the Society and its magazine. Henceforth, instead of the Society supporting the magazine, the position was reversed and the continually expanding circulation of the magazine has brought large revenues to the Society, which has employed them in financing many

important expeditions, of which the most recent was that of Capt. A. W. Stevens to the stratosphere. Mr. Grosvenor set a new standard for the magazine in width of interest, authoritative articles, topical matter and, above all, abundance of fine and often unique illustrations. To that has been added in recent years natural colour photographs in every issue and the frequent addition to the black and white maps in the letterpress of large supplementary coloured maps.

THE National Geographic Society is now housed in a large block of buildings in Washington, where there is stored its library of a quarter of a million photographs from every part of the world, including many taken by its own staff photographers. Every issue of the magazine contains pictures of exceptional value and in numbers unequalled in any similar publication. Many of the issues include articles on birds, mammals and marine life. The circulation of the magazine has now reached more than a million copies a month, and may well be said to be worldwide. Naturally, most of the members, for every subscriber is a member of the Society, are resident in the United States, but a hundred and fifty thousand members live outside the United States. Great Britain and Ireland have more than forty thousand, India has more than two thousand and China nearly as many. It would be difficult to find a country where the magazine does not circulate. Thus Afghanistan, Arabia, Liberia, Basutoland, Iceland and the Solomon Islands may be cited as lands that each have more than a dozen subscribers. Even the New Hebrides, Norfolk Island and Siberia figure among the list of members. The Society deserves to be congratulated on its wonderful achievement.

### The Curvature of the Earth

ON the occasion of his ascent to the stratosphere above Dakota in November 1935, Capt. A. W. Stevens took a number of photographs of great interest. The National Geographic Society, which organised the balloon ascent, directs particular attention to one of these photographs which was taken at a height of 72,395 ft. This picture, which covers 33,000 sq. miles, includes a stretch of horizon 220 miles in length taken at a distance of approximately three hundred miles. A stratum of haze lies above the horizon, but the curve of the horizon can be noted when the picture is projected on a screen, or, more clearly, when a ruler is laid across the picture. The photograph is not yet published, but the *National Geographic Magazine* of January, which contains a long account of the flight by Capt. A. W. Stevens, contains an earlier photograph taken by him in the Andes from a height of 21,000 ft. which also shows the curvature of the horizon.

### Degrees of Frost

DR. J. SATTERLY, of the Physics Department, University of Toronto, writes to ask whether it is a fact that in England  $x$  degrees of frost means a temperature  $x$  degrees below  $30^{\circ}$  F., not  $x$  degrees below  $32^{\circ}$  F., the reason being that English meteorologists consider that the "freezing of plants" or the killing of tender plants by frost does not begin at  $32^{\circ}$  F. but two degrees lower. The answer to this question is, of course, that both for the public and professional meteorologist  $x$  degrees of frost ordinarily means a temperature  $x$  degrees below  $32^{\circ}$  F., but the method of reckoning *ground frosts* adopted by the Meteorological Office is to account as an occasion of ground frost every night on which a thermometer freely exposed to the sky, with its bulb resting on the top of short grass, indicates a temperature of  $30^{\circ}$  F. or lower. Such a thermometer is peculiarly well placed for recording low temperatures; the underlying turf protects it from heat conducted from the soil; it experiences very little wind, the action of wind being to prevent it from cooling much below the temperature of the surrounding air. The result is that a lower temperature is generally indicated than is reached by plants. This alone would make it improbable that vegetation would suffer frost damage every time the exposed thermometer fell slightly below  $32^{\circ}$  F., but in addition there is the fact that the freezing point of sap would normally be below  $32^{\circ}$  F. This official practice is a very old one, and it is difficult to know whether both these considerations were borne in mind by those responsible for it. It is a matter of common observation that there are many occasions when readings substantially lower even than  $30^{\circ}$  F. are obtained without vegetation suffering; much depends, no doubt, upon the length of time during which the temperature has been below  $30^{\circ}$  F., and whether any plants exceptionally liable to frost damage are present and also bearing sensitive new growth such as might appear during a sudden spell of unseasonable warmth and moisture.

### Origin of Fluted Doric Columns

MISS A. D. BETTS, Thorn Cottage, Byways, Berkhamsted, Herts, writes to suggest that the fluted columns of Greek architecture were copied from plant stems, such as those of an umbelliferous plant. From inquiries we have made upon this subject, it appears that there is a lack of decisive evidence as to these columns having been modelled from plant life, though the subject has been considered on a number of occasions and by various writers. In discussing these columns Whibley ("A Companion to Greek Studies") states, "The origin both of this practice and of the essential form of the column is very obscure". According to the same writer, the earliest of the Doric columns were merely substitutes for wooden tree trunks that had served the same purpose. It is probable that the fluted column may have arisen quite independently of any model or pattern afforded by plant life. No example occurs to us of a woody species indigenous to Greece with a constantly fluted stem or bole. Fluted stems are found not uncommonly

among herbaceous plants. This is particularly noticeable in the family Umbelliferae, where the fluting exhibits greater regularity perhaps than in other families. Regular fluting is also conspicuous on the leaf-sheaths of some of the coarser-growing grasses, particularly when dried, also in certain of the sedges. A large number of umbelliferous plants occur in Greece as in other Mediterranean countries. Many of these have economic uses, and were known and commonly employed by the ancient Greeks on account of their esculent or medicinal properties; for example, fennel (*Foeniculum vulgare*), dill (*Peucedanum graveolens*), cumin (*Cuminum cyminum*), coriander (*Coriandrum sativum*), caraway (*Carum Carvi*). Another species apparently well known to them and occurring in Greece at the present day is the so-called giant fennel (*Ferula communis*), of which it is stated, "the tough stems were used by school-masters as ferules" (Whibley). From an examination of the dried material of this plant the stems do not appear to be conspicuously fluted.

### Victorian Physicists

IN his presidential address on January 24 to the Physical Society on "Some Reminiscences of Scientific Workers of the Past Generation, and their Surroundings", Lord Rayleigh urged that the history of science is quite as much involved with the personalities of the men who have made it as is any other kind of history. He suggested that some knowledge of the personalities of the scientific workers of past generations, the conditions of their lives and the points of view from which they worked can often provide a useful corrective to the limitations, narrowness and sacrifice of historical perspective that all too frequently result from the familiar, but necessary, process of digesting original memoirs into text-books. He described many details and incidents, specially valuable and interesting because they derived from personal friendship and acquaintance with the subjects themselves, of Kelvin in his later years, of Dewar and his work at the Royal Institution, of Dewar's remarkable and gifted assistant, Lennox, and his very important share in the liquefaction of hydrogen, of Crookes and his many interests, and of Schuster, an unfortunate victim of the hysterical spy-mania prevalent in England in the early years of the Great War. Lord Rayleigh further urged all those with the good fortune to be in personal contact with the great workers of the generation above them to record such knowledge of this kind as might possibly be valued by posterity, a duty, he considers, which has been too little regarded in the past.

### The Soaring Cycle

A NEW journal, the *Soaring Cycle*, has recently been issued by the Soaring Flight Co., Departmental Bank Building, Washington, D.C. (10 pp., 25 cents). The object of this new serial is the promotion of insight into soaring flight by studying that of birds, and the first number consists of about forty extracts from various writers. The general idea is admirable; but it works out rather unfortunately owing to the nature of the material employed. There are three



chief ways in which a bird can fly without flapping : (a) gliding spirally upwards in an ascending current ; (b) using the rapid increase of wind with height near the surface of the ocean during strong winds ; (c) steering so as to use the turbulence within strong winds. The principles involved were laid down by Rayleigh half a century ago. But observers of birds in the tropics have not usually been trained physicists, and have known little of Rayleigh's work or of measurements made in wind-tunnels ; so when they have tried to interpret what they saw, their handling has at times confused the issues. Accordingly, the serial contains extracted statements that one would be sorry to defend : that birds cannot soar in ascending currents when there is no wind (pp. 2, 3), or that a bird can travel over a plain for miles dead on to a gale without change of height or using ascending currents (pp. 3, 5). Soaring without a wind has often been seen ; and sailing for long periods in a gale has been dominated by turbulence so that it has been very changeable in direction. As the last date on an extract is 1923, we hope that the next issue will contain the results of the successful expedition of Idrac to Africa to examine the soaring conditions. Doubtless also use will be made of the experience of the soaring that is now an essential feature of the gliding movement. The interest in soaring and sailing flight is rapidly growing, and tends to air-mindedness ; so all success to this new venture.

#### Jaguars at the London Zoo

FOR more than a year, the Gardens of the Zoological Society of London could show no specimen of the jaguar. It is welcome news, therefore, that two fine adults have just been purchased by the Society. The jaguar, the largest of the New World Felidae, seems now to be by no means common in its native wilds, which range from Texas to Patagonia. To the general public, this animal is of interest on account of its handsome coloration, which appeals even more intensively to the naturalist, who will once more be enabled to make comparisons with the leopard and other spotted cats. For this particular pattern is among them presented in many forms more or less closely correlated with their mode of life. In both leopard and jaguar this pattern takes the form of more or less complete rings of black on a tawny background. With the jaguar a central spot of black is generally present in the centre of the ring. Thus a series of 'rosettes' is formed running in longitudinal lines, forming a 'concealing coloration' in very diverse surroundings ; for both leopard and jaguar are great tree-climbers. This is specially true of the jaguar, which makes its way among the great branches in a series of prodigious bounds in pursuit of monkeys. On the ground, owing to its large size, it is enabled to prey upon animals as large as the tapir, and in times of scarcity on cattle and horses. It displays a marked preference for the neighbourhood of water, where it batters on that giant rodent the capybara, varying its menu with turtles and their eggs, alligators, and fish. Unfortunately, this animal rarely breeds in captivity ; but transferred to Whipsnade, they might be induced to do so.

#### Culture Contacts in Buckinghamshire

ARGUMENTS for the diffusion of culture are so frequently a matter of inference, resting on a balance of probabilities, that any instance of the effect of extraneous cultural influence, which rests on well-attested historical evidence, is a welcome accession to the material of discussion. An instructive lesson may be derived from a letter from Mrs. Wishaw, the well-known authority on Spanish archaeology and cultural history, appearing in *The Times* of January 24, in which she directs attention to the relation between the pillow-laces of Buckinghamshire and those still made on occasion at Niebla in the Province of Huelva, which derives in the English county from the interest taken in it by Katherine of Aragon, the consort of Henry VIII. Not only does Mrs. Wishaw record a tradition still current in Huelva connecting the Spanish princess with the Andalusian lace ; but she also points out that at the present day this lace retains in its *motifs* the prehistoric Egyptian five-petalled lotus and the birds of life on either side brought to Andalusia by Coptic workers, who introduced the art into Spain in the eighth century A.D. under the rule of the Yemenite Arabs. Thus we have a tenuous if well-attested line of connexion between 'prehistoric' Egypt and Britain, which might well have been called in, in default of documentary evidence, to support the famous prehistoric blue faience Egyptian bead (now assuredly crushed under the weight that has been laid upon it!), and to 'prove' the existence of a culture complex in Britain. The moral would seem to be that an attitude of caution is necessary towards the bold hypotheses of cultural movements, which carry no intrinsic evidence of the chronological relation of their component elements. An analogous instance is the resemblance between the arts of early China, Polynesia and Central America, to which attention has been directed, where the time gaps may aggregate as much as two thousand years or more.

#### Roman Cemetery at Verulamium

THE exploration of Verulamium by Dr. R. E. Mortimer Wheeler has added importance and interest to any finds in what may be termed subsidiary areas in the vicinity. Local archaeologists, fortunately, are fully alive to the importance of this branch of investigation in their studies ; and the St. Albans and Hertfordshire Archaeological Society has undertaken a comprehensive survey of an area in the parish of St. Stephen, immediately to the south of the site of Roman Verulamium. Here in the churchyard a glass burial urn was found in 1848, and other finds have been made since then at various times, though without any precise records being kept. The work of the survey has been carried out by Dr. Norman Davey, assisted by a band of voluntary helpers. The erection of some cottages on the south side of King Harry Lane, which runs in a north-westerly direction towards the Roman wall from the churchyard, made it possible to collect sufficient evidence to establish the position of forty cremation burials and a brick-lined cremation chamber. A small strip of waste land on the north side of the lane was also thrown open to

investigation by the owner, and has proved rich in finds. Of these, one of the most interesting, according to a preliminary account which appeared in *The Times* of January 24, is a structure, which proved to be the abutment of a bridge carrying a track over a ditch. On the east side of the track were two cremation burials and on the west side forty-two cremation burials and two inhumations, one of a child and one of an adult. No sort of order or alignment seems to have been observed. None of the pottery is certainly later than A.D. 160, but it is interesting as showing the development in design from Belgic to Roman. Of the forty-four cremation burials twenty-one consisted of the urn only; but the remaining twenty-three included smaller vessels, beakers, jugs, dishes of Samian ware, and a small glass tear bottle. A report by Dr. Davey will be presented to the Society shortly.

#### Empire Exhibition at Johannesburg

THE rapid development of South Africa was outlined by Lord Riverdale of Sheffield, speaking on January 23, under the auspices of the British Empire League, at the British Empire Club. His main subject was the Empire Exhibition which is to be opened in Johannesburg on September 15. Last year marked the twenty-fifth anniversary of the Union of South Africa; between 1910 and 1935 the European population increased by more than fifty per cent and the native population by more than forty per cent. These important years have seen a tremendous increase in agricultural products and mineral development. Conspicuous progress has been made in the fruit industry, the value of exports of fresh fruit having risen from an average of £15,000 a year in pre-War years to £2,270,000 in 1934. In recent years rapid industrial development has also taken place. As an export market for United Kingdom goods, South Africa ranks second only to British India, and in 1934 took goods to the value of some £32,000,000. The imports into the Union for the first six months of 1935 showed an increase of £5,600,000, and of this total the United Kingdom supplied forty-nine per cent. This will be the first Empire Exhibition which has been held outside Great Britain and is receiving the full support of the Union of South Africa Government and the Government of Great Britain. After enumerating many of the features of the forthcoming exhibition, Lord Riverdale said that, from a business point of view, he could thoroughly recommend it as being an opportunity of showing what British manufacturers can do for the South African market with a view to the expansion of our trade. In metals and manufactures, including machinery and vehicles, South Africa imported more than £24,000,000 in 1934, and Great Britain supplied only £12,000,000 in this item alone. If the market was studied and our goods shown in the right way, there lies a large field for further expansion. The same might be said for the item of fibres, yarns, textiles and apparel. In 1934 the Union's total imports for these were 15½ millions, of which the United Kingdom's share was less than £10,000,000.

#### The National Institute of Sciences of India

WE welcomed recently (*NATURE*, 135, 59, 410 (1935)) the formation in India of the National Institute of Sciences, a major function of which will be the co-ordination of the activities of the three co-operating academies in Calcutta, Allahabad and Bangalore. We have now received the first two volumes of the *Proceedings* of the new Institute. The first volume contains a full account of the inaugural meeting together with a list of the foundation fellows. We have referred already to the scholarly address by the president, Sir Lewis Leigh Fermor, and a perusal of the list of foundation fellows shows that the Institute has received the enthusiastic support of all men of science working in India. In the past, India has suffered in that it has had no body of organised scientific opinion capable of representing it at international conferences. It is not the least notable of the functions performed by the Indian Science Congress that it has been responsible for the foundation of the Indian Institute of Sciences, which will supply this want.

THE second volume of the *Proceedings* prints a number of scientific communications read before the Institute. They cover a wide field of research since they comprise papers on botanical, anthropological, physical and chemical subjects. We had not anticipated from the president's inaugural address that the Institute would, in other than exceptional circumstances, act as a publishing body; but that it was to be concerned rather with the publication of summaries of papers read before the co-operating academies. We regard it as somewhat unfortunate that there should be an increase in the large number of journals already published in India. Of greater interest than the specialist papers is the account of the symposium on "Problems of the Ionosphere". The holding of these general discussions on varied subjects of scientific importance will, we think, prove to be one of the most notable activities of the National Institute, and if they maintain the high standard of the first symposium, original work in India will receive a marked stimulus.

#### Recent Acquisitions at the Natural History Museum

AMONG recent additions to the zoological collections are specimens of Ungulate mammals from the Sudan presented by Major P. H. G. Powell-Cotton and Miss Diana Powell-Cotton. A fine specimen of adult beaver from Norway has been purchased, and an interesting series of Crustacea from the Bering Sea and the Sea of Okhotsk, regions previously very poorly represented in the Museum collection, have been received by exchange. A specimen of a rare mollusc, *Halicardia flexuosa*, from the Atlantic Ocean off Cape Point, South Africa, has been presented by the director of the South African Museum, Cape Town. The Department of Geology has recently acquired, through the generosity of the Committee of the Torquay Natural History Society, more than 160 Devonian invertebrates from Devon, all of which are type or figured specimens; and has received from

Mr. M. H. Donald a large collection of fossil invertebrates, formed by the late Mrs. J. Longstaff, chiefly from the Carboniferous of Great Britain, and including more than 20 figured specimens. The Mineral Department has received by gift from Prof. E. D. Mountain a specimen of bokspuutite, a species new to the collection; from Dr. E. S. Simpson distorted crystals of cassiterite from Pilbara goldfield; and from Mr. R. Murray-Hughes a series of rocks collected by him on the Aberdare Range, Kenya Colony, in 1933. A piece, weighing 99 gm., of the meteoric stone which fell on May 26, 1932, at Kuznetzovo, Tatarsk district, Siberia, has been acquired by exchange.

AMONG recent acquisitions of the Department of Botany is a complete collection of the observed phanerogamic flora of Etah (Inglefield Land, north-west Greenland) made by Dr. G. N. Humphreys on the Oxford University Ellesmere Land Expedition. A few gatherings from the Disco area of west Greenland are included, but none from Ellesmere Land, as the Expedition left there before the collecting season. The material, of about three hundred numbers, is well collected and dried, and is a valuable addition to those already in the Museum from these high altitudes in Greenland. Another addition comprises 122 sheets of Finnish plants collected by Mr. H. Krogerus, who accompanied Mr. G. J. Kerrich on his recent expedition. The plants are all critical species, and correspond to a list supplied by the Department. They were named in Finland, and thus have an additional value. Collections from Mozambique, Angola and Tanganyika have also been received. Miss G. Lister has presented the simple microscope and stand of her grandfather (Joseph Jackson Lister) to the Department. This he used "when he was in the full swing of work". It was constructed before or about 1820. J. J. Lister (1786-1869) was "the discoverer of the principle upon which the modern microscope is constructed" ("Dictionary of National Biography").

#### New Meteorological Observatory at Brisbane

THE formal opening of Crohamhurst Observatory, situated in lat.  $26^{\circ} 50' S.$ , long.  $152^{\circ} 55' E.$ , by H. E. the Governor of Queensland took place on August 13, 1935. The observatory will be concerned with meteorological and solar work, and will in particular attempt seasonal forecasting on the basis of the sunspot cycle. The City of Brisbane is visited by disastrous floods about every twenty years, and the rainfall which is received in the valley in which the new Observatory is situated is the sole cause of these floods; in fact, the record rainfall of Australia, 35.7 inches in 24 hours, was recorded at Crohamhurst in 1893. The director of the new observatory is Mr. Inigo Jones, who has been engaged on meteorological work in this part of Australia for forty years, and claims an accuracy of more than eighty per cent in forecasting weather conditions. His views on the relation of weather to the sunspot cycle and to the movements of the planets have been referred to from time to

time in our columns (see NATURE, July 2, 1932, p. 31, and Sept. 2, 1933, p. 345). Brisbane is to be congratulated on the possession of its new observatory.

#### Geological Survey and Museum

FROM the opening of the Geological Museum at South Kensington on July 3 until December 31, 159,000 visitors passed through its doors. This compares with an average total of 18,000-20,000 a year at the old museum in Jermyn Street. Recent additions and presentations to the Museum include a fine collection of cut zircons, one royal blue stone of 44 carats, being unique in size and colour; a collection of multi-coloured doubly-terminated tourmaline crystals from Mesa Grande, California; a large composite photograph of the moon from the Mount Wilson Observatory, and other series of enlarged photographs of earthquakes and other geological phenomena; more than two thousand British building stones and other collections illustrating economic geology, bequeathed by Mr. B. E. Laine-Pearson; and some 250 rocks recently collected for the Museum from southern Norway.

#### Sunspots during 1935

A PROVISIONAL value of the mean daily area of sunspots for 1935 is 550 millionths of the sun's hemisphere. This may be compared with 119 millionths for the year 1934 and 88 millionths for 1933, the date of the last minimum of the 11-year cycle being 1933.8. During 1935, solar activity—as shown by the occurrence of sunspots, disk markings in hydrogen and calcium light, and prominences at the limb—increased to a marked degree, especially during the latter half of the year. The maximum of the cycle, which normally occurs about four years after the preceding minimum, may be expected in 1937-38, but the epochs of the cycle are not amenable, as is well known, to exact prediction.

#### Recent Large Sunspots

SINCE the beginning of last December, when a very large group of sunspots crossed the sun's disk, there have been other groups of lesser magnitude but nevertheless of considerable extent, especially the group most recently visible. These groups are summarised as follows, the area being expressed in millionths of the sun's hemisphere. It may be noted that a single spot of area 500 units, when near the centre of the disk so as to escape foreshortening, is usually visible to the naked eye. Times are in U.T.

Date on Disk	Central Meridian Passage	Latitude	Maximum Area
Dec. 6-19	Dec. 12.5	$23^{\circ} S.$	900
Dec. 28-Jan. 9	Jan. 3.4	$12^{\circ} S.$	900
Jan. 1-14	Jan. 7.8	$27^{\circ} N.$	1100
Jan. 14-26	Jan. 19.9	$32^{\circ} S.$	1800

No magnetic storms were recorded at Greenwich (Abinger Station) on or about the time of central meridian passage of any of the above spots, but from Jan. 8<sup>h</sup> 4<sup>d</sup>. for three or four days the traces appear distinctly unsteady. On Jan. 24<sup>d</sup>. 17<sup>h</sup>., however, another disturbance commenced; but this

can scarcely be taken as being related to the group of spots that crossed the central meridian on Jan. 19.9. There were, however, several smaller groups following in longitude from which the solar disturbance, presumably responsible, might have originated.

#### The Quadrantids, 1936

MR. G. E. D. Alcock, of Peterborough, observed this shower on the early morning of January 4. The sky cleared at January 3, 13h. 45m. (G.M.A.T.) and clouded over at 15h. 55m. The moonlight was a big hindrance, but 17 meteors were mapped. Two radiant points of Quadrantids were determined: (a)  $229\frac{3}{4}^{\circ} + 53^{\circ}$ ; diameter  $1.1^{\circ}$ ; 5 meteors; (b)  $229\frac{1}{4}^{\circ} + 49^{\circ}$ ; diameter  $1.4^{\circ}$ ; 6 meteors.

#### Announcements

SIR ARTHUR SMITH WOODWARD has been elected a member in the Section of Zoology, and Dr. Ulrich Wilcken (Berlin) a member in the Section of Historical and Philological Sciences, of the Royal Swedish Academy of Sciences.

THE Council of the Institution of Naval Architects has awarded the premium of the Institution for the year 1935 to Mr. J. L. Scott, of Armstrong College (University of Durham), for his paper "A Simplified Form of Direct Flooding Calculations", and the Wakeham prize for the year 1935 to Mr. W. H. C. Nicholas, of Hull, for his paper "The Evolution of the Modern Steam Trawler with Superheating".

DR. FRITZ LEJEUNE, professor of the history of medicine at Cologne, has been elected a member of the Lisbon Academy of Sciences.

THE sixth International Congress of Physical Medicine will be held in London on May 12-16 under the presidency of Lord Horder. Further information can be obtained from the Honorary Secretary, Dr. Albert Eidinow, 4 Upper Wimpole Street, W.1.

THE opening meeting of the Photometric Section of the Illuminating Engineering Society, which was to have taken place on January 28, will take place at the Westminster Technical Institution, Vincent Square, S.W.1, at 7.0 p.m. on February 4, when Dr. J. W. T. Walsh will deliver his opening address.

WE have received from Messrs. Charles Baker, 244 High Holborn, London, W.C.1, a copy of their latest catalogue of microscopes and accessories, which has just been published. Several new pieces of apparatus have been introduced since the publication of the last issue; these include a Greenough binocular dissecting microscope, a low-voltage research microscope lamp, a school micro-projection outfit of moderate price, and a low-priced detachable universal mechanical stage for the microscope.

IN order to meet a demand for a vitamin preparation for medical practice, and particularly for hospital

out-patients, British Drug Houses, Ltd., Graham Street, City Road, London, N.1, have introduced "Multivite Pellets". The preparation consists of chocolate-coated tablets, each tablet or 'pellet' containing vitamins A (3,000 international units), C (100 I.U.), and D (600 I.U.), together with vitamin B complex equivalent to 2 gm. of yeast. The dosage is, for adults 2-4, for children 1-2, pellets daily, which may be swallowed or eaten as a sweetmeat. Literature and sample will be forwarded on application.

THE spring programme of the Electrical Association for Women has recently been issued. The London branch has arranged an interesting series of lectures, papers and visits. Special lectures and demonstrations for teacher members have also been arranged in connexion with a Teachers' Circle which is open to members of the Association who are in the teaching profession. A special programme for a Demonstrators' Circle has also been arranged. The eleventh Annual Conference of the Association will be held at Park Lane Hotel, London, W.1, on March 13-15. Further particulars can be obtained from the Secretary of the Association, 20 Regent Street, London, S.W.1.

DR. C. E. K. MEES, vice-president in charge of research and development at the Eastman Kodak Co., who has just delivered a course of Christmas lectures on "Photography" at the Royal Institution, is to embody the substance of them in a book which will be published in the autumn by Messrs. G. Bell and Sons, Ltd. Among the topics with which Dr. Mees will deal are the methods used in the manufacture of photographic films; colour photography; the making of motion pictures, cartoons and sound recording; the application of photography in many fields of science and industry; and the photography of coloured objects in black and white.

ERRATUM.—In a paragraph entitled "Transpiration and Stomata in Desert Plants" in NATURE of December 21, 1935 (p. 993), the authors of the paper under notice are wrongly given as A. H. Nontasir and A. M. Nigaleid; the authors are A. H. Montasir and A. H. Migahid.

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

A lecturer in geography (woman) in Whitelands College, Putney, London, S.W.15—The Secretary (Feb. 14).

An official fellow in chemistry in Queen's College, Oxford—The Provost (Feb. 15).

Professors of economics, politics, pure chemistry and applied chemistry in Andhra University, Waltair, India—The Secretary, The Universities Bureau, 88a, Gower Street, London, W.C.1 (March 1).

A professor of physics in the University of Birmingham—The Secretary (March 2).

A head of the Department of Mechanical and Structural Engineering and Building of the Borough Polytechnic, Borough Road, London, S.E.1—The Principal.

## Letters to the Editor

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

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 192.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

### Action of Slow Neutrons on Rare Earth Elements

IN view of the discrepancy between the values obtained by different workers for the periods and the intensity of radiation emitted by the radio rare earth elements<sup>1-5</sup> after neutron bombardment, we carried out a detailed investigation on this subject and also on the absorption of slow neutrons in rare earth elements. The latter measurements were carried out chiefly to ascertain the possible presence of strongly capturing isotopes but leading to the formation of a stable instead of an active isotope, as was actually found to be the case for europium. Our investigations lead to the result that the

periods of decay of the radio rare earth elements secured by different workers and also absorption data obtained by us. A detailed account of our work will be published in the *Proceedings of the Royal Society*.

G. HEVESY.

Institute of Theoretical Physics, HILDE LEVI.  
Copenhagen.

<sup>1</sup> E. Amaldi, E. Fermi and others, *Proc. Roy. Soc., A*, **149**, 522 (1935).

<sup>2</sup> S. Sugden, *NATURE*, **135**, 469 (1935).

<sup>3</sup> I. K. March and S. Sugden, *NATURE*, **136**, 102 (1935).

<sup>4</sup> G. Hevesy and H. Levi, *NATURE*, **136**, 103 (1935).

<sup>5</sup> Amaldi, Fermi l.c.; according to Sugden l.c. not active; while McLennan finds a period of 6.4 hours (*NATURE*, **136**, 831 (1935)).

Artificial Radioactivity of Rare Earth Elements

Element Bombarded	Half-life Value	Relative Intensity
Yttrium	70 h.	0.5
Lanthanum	1.9 d. <sup>3</sup>	—
Cerium	—	—
Praseodymium	19 h. <sup>2</sup> 5 m. <sup>1</sup>	4.5
Neodymium	1 h. <sup>1</sup>	0.04
Samarium	40 m. <sup>1</sup> ; long <sup>2</sup>	0.6
Europium	9.2 h. <sup>2</sup>	80
Gadolinium	8 h. <sup>5</sup>	very low
Terbium	3.9 h. <sup>2</sup>	2.5
Dysprosium	2.5 h. <sup>3,4</sup>	100
Holmium	35 h. <sup>4</sup>	20
Erbium	12 h. <sup>4</sup> ; 7 m. <sup>3</sup>	0.35
Ytterbium	3.5 h. <sup>3,4</sup>	0.25
Lutecium	6 d. <sup>4</sup> ; 4 h. <sup>3</sup>	1.4; 1

Absorption of Slow Neutrons in Rare Earth Elements  
(Amount necessary to reduce the activity of the indicator by ten per cent)

Element	Indicator	mgm./cm. <sup>2</sup>
Europium	Europium	13
Dysprosium	Dysprosium	40
Holmium	Holmium	120
Europium	Rhodium	16
Dysprosium	"	43
Holmium	"	160
Gadolinium	Rhodium	2
Samarium	"	12
Yttrium	"	500
Scandium	"	300
Cadmium	Rhodium	18

discrepancies can in most cases be explained through the presence of small amounts of impurities showing a very strong activity, like dysprosium in the sample investigated, while some of the very high absorption data found by different workers are due to the presence of highly absorbing substances like gadolinium, samarium or dysprosium in the samples used.

In the accompanying tables we give a list of the

### Effect of Scattering Neutrons on Induced Radioactivity

M. DANYSZ, J. Rotblat, L. Wertenstein and M. Zyw<sup>1</sup> have found that iodine and silver exposed to neutrons acquire a stronger radioactivity if the neutrons are allowed to pass through lead or gold. We have investigated further this effect using different substances as scatterers, in the form of cylinders of 55 mm. height and 24.5 mm. diameter, with a coaxial cylindrical hole of 7 mm. diameter for the source of neutrons consisting of 35 millicuries of radon mixed with beryllium. Silver tubes of 25 mm. inside diameter were placed around the cylinders for activation. In this arrangement, practically all primary and scattered neutrons pass through the receiver. For comparison, source and receiver were placed in exactly the same positions but without any scatterer. With all substances we have found that the activity is increased, the effects ranging from a few per cent to about 18 per cent.

We have worked out our results in order to establish separately the increase produced in the amount of the two radioactive isotopes of silver by neutrons scattered in different elements. In the table below this increase is presented for each element as a percentage of the value obtained when no scatterer was used; in the second line of the table are products of the radial path of the neutrons in a given scatterer by its density.

The two isotopes behave in a different way. The product of 140 sec. half-period is enhanced in the case of all scatterers investigated with the exception of carbon and aluminium. If this effect is due to inelastic collisions of neutrons, as was assumed in the paper quoted above and also by Ehrenberg<sup>2</sup>, then it should not occur when neutrons before passing through the scatterer are slowed down in the usual way by collisions with protons. The experiment must be restricted to elements which do not absorb slow neutrons. We have found, in fact, that the slow

neutrons scattered in lead do not enhance the 140 sec. isotope. It seems probable that the inelastic collisions of fast neutrons are relatively frequent in many elements. Fleischmann<sup>3</sup> has found that  $\gamma$ -rays are produced not only by 'slow' but also by 'primary' neutrons in copper, iron, cadmium and lead. We may assume that the same effect takes place also in silicon, zinc, silver, tin and mercury.

TABLE 1.

Scatterer	C	Al	Si	Fe	Cu	Zn	Ag	Cd	Sn	Hg	Pb
Thickness of scatterer (gm./cm. <sup>2</sup> )	1.33	2.25	1.27	6.72	7.75	6.21	9.10	7.39	6.37	10.06	9.78
Percentage increase of 22 sec. product	32	32	2	0	28	2	-5	17	20	-10	3
Percentage increase of 140 sec. product	1	-7	7	9	14	14	12	9	6	8	9

The 22 sec. product is strongly enhanced by neutrons scattered in carbon, aluminium, copper and tin, and its quantity is diminished in the case of silver and mercury. The different behaviour of this isotope may be related to the selective absorption of silver for neutrons producing the 22 sec. activity<sup>4</sup>. We have found that if a silver foil 0.05 mm. thick or a sheet of boron of 0.036 gm./cm.<sup>2</sup> is placed between the copper scatterer and the silver receiver, then there is no increase of the short period product. This shows that neutrons scattered in copper are strongly absorbed in silver and in boron. The scattering in silver and mercury is interesting in showing also that primary neutrons responsible for the 22 sec. products are strongly absorbed in some elements.

The facts are complicated, and it seems that in addition to the inelastic collisions connected with the emission of  $\gamma$ -rays, some other mechanisms may also be involved.

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Warsaw Society of Sciences.  
Dec. 31.

<sup>1</sup> NATURE, 134, 970 (1934).

<sup>2</sup> NATURE, 136, 870 (1935).

<sup>3</sup> Z. Phys., 97, 265 (1935).

<sup>4</sup> Amaldi and Fermi, Ric. Sci., 6, Nr. 11-12. Szilard, NATURE 136, 950 (1935).

### Energy of $\gamma$ -Rays excited by Slow Neutrons

In a previous letter [NATURE, Jan. 4, p. 30] we have reported briefly the result of experiments determining the mean cross-section for the recombination of the proton with a 'slow neutron' to form a deuteron. As the continuation of it, we have recently measured the energy of a quantum of  $\gamma$ -rays accompanying the above process, by determining the maximum energy of the secondary electron by the usual method of coincidence of two counters. The result is shown in Fig. 1, together with the results of similar measurements on other  $\gamma$ -rays. The abscissa indicates the thickness of the aluminium absorber inserted between the two counters.

We see that the number of simultaneous discharges (less the number of accidental coincidences) falls to zero fairly abruptly at the absorber thickness of 2.8 mm. As the wall of the counter was made of aluminium plate of 0.1 mm. in thickness, we obtain 3.0 mm. for the maximum range in aluminium of a secondary electron ejected by the  $\gamma$ -rays. According

to Varder<sup>1</sup> and Madgwick<sup>2</sup>, this corresponds to an electron of  $2.0 \times 10^6$  e.v. energy, which, in its turn, gives the energy of a quantum of  $\gamma$ -rays as  $2.2 \times 10^6$  e.v. This value agrees quite well with the value  $2.1 \times 10^6$  e.v. obtained by Chadwick and Goldhaber<sup>3</sup> for the energy of dissociation of a deuteron into a proton and a neutron, but does not agree with the value of Fleischmann<sup>4</sup>,  $1.5 \times 10^6$  e.v. obtained from the measurement on the absorption of  $\gamma$ -rays.

We have also measured the energy of  $\gamma$ -rays excited in cadmium, chlorine, copper and iron by slow neutrons. It is interesting to note that  $\gamma$ -rays from cadmium have at least two components. The energy of the softer component is about  $2 \times 10^6$  e.v., while that of the harder one seems to be of the order of  $1.0 \times 10^7$  e.v., though we could not determine the maximum range of the secondary electron accurately. In the case of chlorine, the  $\gamma$ -rays seem to be homogeneous and the energy of a quantum corresponds to  $5.0 \times 10^6$  e.v. In the case of iron and copper, we have again observed secondary particles of high energy comparable with those produced with cadmium. These components of high energy may correspond to those observed by Joliot and Kowarski<sup>5</sup>. Lately, Rasetti<sup>6</sup> has reported the

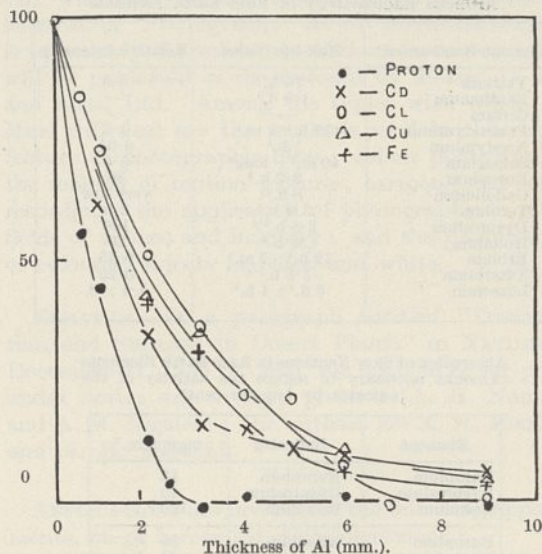


FIG. 1.

results of experiments very similar to those described here. The elements examined by both Rasetti and ourselves are cadmium and chlorine. As to cadmium, it seems that he has overlooked the presence of the harder component, while in the case of chlorine, our value is somewhat lower than that given by him.

A fuller account of the investigation will appear shortly in *Proc. Phys.-Math. Soc. Jap.*

Physical Institute,  
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Nov. 24.

S. KIKUCHI.  
H. AOKI.  
K. HUSIMI.

<sup>1</sup> Varder, *Phil. Mag.*, 29, 726 (1915).

<sup>2</sup> Madgwick, *Proc. Camb. Phil. Soc.*, 23, 970 (1927).

<sup>3</sup> Chadwick and Goldhaber, *Proc. Roy. Soc.*, 151, 479 (1935).

<sup>4</sup> Fleischmann, *Z. Phys.*, 97, 242 (1935).

<sup>5</sup> Joliot and Kowarski, *C.R.*, 200, 824 (1935).

<sup>6</sup> Rasetti, *Z. Phys.*, 97, 64 (1935).

Interrelationships of  $e$ ,  $h/e$  and  $e/m$ 

IN a report<sup>1</sup> presented some twenty months ago on the values of  $e$ ,  $h$  and  $e/m$ , attention was directed to the numerous inconsistencies shown by the experimental data. More recent developments have resolved a number of these inconsistencies, and it now seems possible to reduce all the really precise experimental data in such a way that only one fundamental discrepancy remains. Because of the great amount of experimental material here involved, it is necessary to omit all details in the present brief letter. I wish merely to remark that I am now using for  $c$  the value<sup>2</sup>  $2.99776 \times 10^{10}$  cm./sec., in place of the former 2.99796.

As a result of several recent investigations, it seems practically certain that the wave-lengths of X-rays derived from ruled gratings ( $\lambda_g$ ) are correct. The summary of this work given by Bearden<sup>3</sup> leads to the result that such wave-lengths are 0.2034 per cent larger than wave-lengths on the conventional Siegbahn scale ( $\lambda_s$ ). As is well known, one can calculate the wave-lengths of X-rays, if one knows the value of  $e$ , and if, in addition, one assumes that calcite is a geometrically perfect crystal of known density, molecular weight, etc. In my previous work<sup>4</sup>, I made this assumption, and X-ray wave-lengths then appeared in all theoretical expressions merely as a certain known function of  $e$ , which in turn was one of the quantities to be evaluated.

With the new assumption that such wave-lengths are known and are equal to  $\lambda_g$ , several of the theoretical relations are much simplified. If we discard the evaluation of certain constants such as the Bohr magneton and the fine structure constant, which are not yet sufficiently precise for our purpose, there remain experiments that lead respectively to an evaluation of (1)  $e$ , (2)  $e/m$ , (3)  $h/e$ , (4)  $(h/e)(e/m)$ , (5)  $(e/h)(e/m)$ . The last two experiments are respectively the measurement of the Compton shift and the measurement of the energy of photoelectrically ejected electrons by means of their deflection in a magnetic field<sup>5</sup>.

The direct determinations of  $e/m$  are now very consistent, and the weighted average of the five latest results, based on four distinctly different methods, is  $(1.75762 \pm 0.00026) \times 10^7$  E.M.U. Because of the apparent correctness of this result, I have inserted it in functions (4) and (5), to get thus two additional determinations of  $h/e$ . The latest results for methods (4) and (5), when treated in this way, give almost identical values of  $h/e$ , and this agreement is significant, since there would be a disagreement of 1.5 per cent in the two values if one should adopt Bond's suggestion<sup>6</sup> that the 'true' value of  $e/m$  is 137/136 of the observed value.

With the addition of the two indirect methods for obtaining  $h/e$  just mentioned, there are six distinctly different methods for evaluating this important ratio, of which by far the most precise is the determination of the Duane-Hunt limit of the continuous X-ray spectrum<sup>7</sup>, and it is gratifying to find that the present best results for each of the six methods are mutually consistent. For the final weighted average, I obtain  $h/e = (1.37588 \pm 0.00027) \times 10^{-17}$  E.S.U. If now one assumes the truth of the Bohr formula for the Rydberg constant, and substitutes in this formula the values of  $e/m$  and  $h/e$  just given, one

obtains  $e = (4.7824 \pm 0.0015) \times 10^{-10}$  E.S.U. It is this value that cannot now be reconciled with the direct measurement of  $e$ , and this constitutes the outstanding discrepancy mentioned earlier.

If one assumes that  $\lambda_g/\lambda_s = 1.002034 \pm 0.000016$  (the probable error is due to Bearden<sup>3</sup>) and if one assumes also that calcite is a geometrically perfect crystal, then, using the best constants for calcite, one obtains  $e = (4.8029 \pm 0.0005) \times 10^{-10}$  E.S.U., which may be called the grating value of  $e$ . Until recently this result was supposed to be in serious disagreement with the oil-drop value, but Kellström's recent work on the viscosity of air<sup>7</sup> indicates otherwise. Since the resulting oil-drop value,  $4.816 \pm 0.013$ , is far less accurate than the grating value, one may adopt  $4.8029 \pm 0.0005$  as the best direct determination of  $e$ , and the discrepancy with the indirect value  $4.7824 \pm 0.0015$  is then seen to be more than ten times the sum of the stated probable errors.

Because of the variety of methods now available for the measurement of  $e/m$  and of  $h/e$ , and the consistency of all results, it seems reasonable to assume that the adopted average values of these two quantities are essentially correct. With this assumption there remains, so far as I can now see, only two possible explanations of the major discrepancy in  $e$ : (1) the Bohr formula for the Rydberg constant is not correct, (2) the method of calculating  $e$  on the assumption of a geometrically perfect calcite crystal is not correct.

There still remains the third possibility that all measured values of  $h/e$  are too low due to systematic errors of one sort or another (including possible errors of theory), but since almost any such error that can be imagined would affect a portion of the experimental results in one sense, and another portion in the opposite sense, and since all of the present results are in fact quite consistent, this last possibility seems to be ruled out.

RAYMOND T. BIRGE.

University of California,  
Dec. 5.

<sup>1</sup> R. T. Birge, *Science*, **79**, 438 (1934).

<sup>2</sup> R. T. Birge, *NATURE*, **134**, 771 (1934).

<sup>3</sup> J. A. Bearden, *Phys. Rev.*, **48**, 385 (1935).

<sup>4</sup> R. T. Birge, *Phys. Rev.*, **40**, 228 (1932) and reference 1.

<sup>5</sup> H. R. Robinson, *Phil. Mag.*, **18**, 1086 (1934).

<sup>6</sup> W. N. Bond, *NATURE*, **133**, 327 (1934).

<sup>7</sup> G. Kellström, *NATURE*, **136**, 682 (1935). See also R. T. Birge, *Phys. Rev.*, Dec. 15, 1935.

## Pressure Effect on Predissociation

THE absorption spectrum of  $S_2$  vapour shows two regions of predissociation (marked by the diffuseness of the bands) which are known to extend over a considerable spectral range, including several bands belonging to different vibrational states. Using, however, an extremely low vapour pressure of sulphur—this may be obtained experimentally by heating carbon disulphide vapour in the absorbing cell up to about 500°C.—the previously diffuse bands appear sharp, with the exception of one band ( $v'' = 0$ ,  $v' = 16$ ) which is situated nearest to the predissociation limit and remains quite diffuse. (The spectrum extends only over a limited range; for this reason the first predissociation limit could not be observed.) The next following band ( $v'' = 0$ ,  $v' = 17$ ) shows a broad but well developed rotational fine structure.

A similar observation has been made previously<sup>1</sup> in the absorption spectrum of  $SO_2$ . This spectrum contains diffuse bands situated between 2764 Å. and

\* In fact, if one uses only this result and the best determinations of  $e/m$ , the final conclusions of this letter are unchanged.

2367 A. If, however, the pressure of the absorbing vapour is made very small, then the rotational fine structure of the previously diffuse bands will reappear.

All bands which are usually found to be diffuse in absorption are entirely missing in the emission spectrum because the excited molecule dissociates before the radiation is emitted. In a letter to NATURE, Asundi<sup>2</sup> has reported experiments on the emission spectrum of S<sub>2</sub> vapour in the presence of a large amount of a rare gas. In this case, most of the otherwise missing bands reappear, not diffuse but sharp, in the spectrum.

An interpretation of the experiments referred to above may be given as follows: sulphur is strongly inclined to polymerise to form complex molecules such as S<sub>6</sub> or S<sub>8</sub>. If therefore an S<sub>2</sub> molecule is approached by another sulphur atom or molecule, the potential field surrounding the molecule is strongly affected, and this will lead to a deformation of the potential curves representing the nuclear vibration. The phenomenon of predissociation is theoretically interpreted by the intersection of two potential curves of the same molecule, one of these leading to repulsion of the nuclei. In the case of sulphur, the influence of collisions with sulphur leads to a deformation of the potential curves in such a way that the transition to the 'repulsion' curve is made more easy. This explains why so many bands of S<sub>2</sub>, obtained from heated sulphur, are diffuse in absorption. In emission, the S<sub>2</sub> molecule will predissociate out of its excited state, perturbed as it is by its neighbours, unless it is screened from sulphur by a rare gas. In the latter case the bands will reappear and may be found sharp if the energy difference to the intersection point of the potential curves is sufficiently large.

It may be mentioned that the pressure effect on the predissociation spectrum of S<sub>2</sub> is closely related to the phenomenon of induced predissociation which has been found in the spectra of I<sub>2</sub>, Br<sub>2</sub>, N<sub>2</sub> and NO.

W. LOCHTE-HOLTGREVEN.

Physikalisches Institut,  
Kiel.  
Dec. 6.

<sup>1</sup> Kornfeld and Weegmann, *Z. Electrochem.*, **36**, 789 (1930).

<sup>2</sup> Asundi, NATURE, **127**, 93 (1931).

### Cultivation of the Unfit

E. W. M. SAYS that the minimum size of family required to maintain a population constant is four children; but, happily for women, at least one eminent statistician (Dr. Louis I. Dublin) has indicated that an average of three children per fertile couple will be sufficient. Next he raises a bogey when he declares that "sterilisation is a mutilation to which few will consent"; because, in males, it is merely a ligaturing of two superficial ducts and may become the commonest contraceptive method. Next he says that the only remedy for the over-production of children by the least fit is "compulsory sterilisation as a *punishment* for parents who have to resort to public assistance in order to support their children", although this would be an injustice until the popular remedy of abortion were legalised.

My population idea is that, whatever the social system may be, the women in the poorest classes should, so far as possible, have less than three children per family and most of the others not less, and that

sterilisation and abortion should at least be available to any person with two children.

In one of the book reviews in NATURE of January 18 (p. 88) the suggestion is made that "there is no general law of population—certainly no Malthusian law". I submit that Malthus's doctrine, that an unrestricted birth rate in a long-settled country must cause food shortage, constitutes a law of population.

B. DUNLOP.

Manor Fields,  
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It is impossible to let the article "Cultivation of the Unfit", signed by E. W. M. in NATURE of January 11, pass without comment. With remarkable inconsistency, the author felicitates Sir Arthur Keith's apology for war as being "the result of increasing population and race pressure" and "the means by which Nature decides which race shall 'inherit the earth'"; yet admits in an adjacent paragraph that the spread of birth-control will bring to an end the "cultivation of the unfit". If birth-control can be made to do this, why can it not also be made to bring to an end the existence of War, with all its horrors? Population-control by a world authority is the obvious goal towards which all our efforts should be tending.

E. W. M. then describes the weeding out of the (physically) unfit in animal communities, and goes on to refer to the "elaborate and costly social services" which keep alive the "morally, mentally, and physically" human unfit. This apparently guileless transition seems to involve several non sequiturs. Thus we are given no evidence that the deformed specimens of chamois or red deer were also morally and mentally unfit, or if so, unfit for what? The application of purely biological concepts to sociological phenomena is surely inadmissible.

Finally, the compulsory and *punitive* sterilisation of parents who "have to resort to public assistance in order to support their children" is offered as a remedy. Are we to assume that E. W. M. includes shipowners, beet-sugar shareholders, and other persons receiving financial benefit other than wages from industries subsidised by the State, though privately owned, in this category? And can he even be serious in suggesting biological "punishment" for the two million unemployed?

It is difficult to express the dismay experienced in seeing these doctrines, so dangerous for humanity, receiving the imprimatur of what is perhaps the most famous scientific weekly in the world.

JOSEPH NEEDHAM.

Caius College,  
Cambridge.

MY article on "The Cultivation of the Unfit", published in NATURE of January 11, has drawn several criticisms including those from Dr. B. Dunlop and Dr. Needham printed above. Dr. Dunlop criticises me because I have estimated the number of children necessary to maintain the population constant as four instead of three. All I can say is that I derived my information from Major Leonard Darwin, who had looked thoroughly into the matter. It may be that subsequent research has proved Major Darwin to be mistaken, but in such matters a policy of caution is essential. It is rash to base a sweeping statement on the results of one worker—it is better to wait and see.



Dr. Dunlop then goes on to say that I have raised a "bogy" in asserting that sterilisation is mutilation. I adhere to my statement. I was perfectly well aware that in males sterilisation is now effected by severing the vasa deferentia and not by castration, but that is none the less a mutilation. I assert that in every normal male there is a deep-seated subconscious desire to perpetuate himself by producing offspring. If this is rendered impossible, however slight and painless the operation may be, it leaves a psychic wound which will never heal.

Dr. Dunlop desires to have abortion legalised in order to prevent unwanted births. This is a matter for medical opinion; I am inclined to think that safe and simple methods of contraception (including common cleanliness) will be found, which would be on all grounds infinitely preferable. I fully agree with Dr. Dunlop, however, that some method of contraception must be taught before resorting to compulsory sterilisation.

Dr. Needham's letter includes several fallacies and suggests that a man may be a good biochemist but a poor biologist. It is elementary biological teaching that 'fitness' and 'unfitness' in men or animals mean ability or inability respectively to maintain themselves in their normal environments. Fitness, both in animals and men, is correlated with vigour of growth and movement. This vigour shows itself in the growth of antlers in deer and in the growth of the brain in civilised man, and in both cases the vigour is inherited. It is because the 'high grade' defectives are incapable of maintaining themselves (including in 'maintaining', providing for a family) that we object to their adding to the population.

There is no inconsistency in my praising Sir Arthur Keith for his clarity of vision and his honesty in pointing out that the ultimate cause of war is race-pressure, and advocating birth-control as a means of reducing race-pressure. For, as every anthropologist and zoologist knows, there is an innate urge in every virile race to spread, and no race will resort to birth-control until it realises that this spread is impossible.

Dr. Needham then resorts to socialistic arguments and denounces capitalists (shipowners, shareholders, industrialists, etc.) as unemployed and therefore unworthy to perpetuate their race. This fallacy has also been exposed times without number, but I may specially mention the work of another distinguished anthropologist, Sir Grafton Elliot Smith. He has shown that capitalism is the parent of all civilisation, and began when primitive man stumbled into the Nile valley, where cultivation could be continuously carried on and the surplus of one year can be carried over to the next.

No one will take the trouble to hoard supplies of any kind if their fate is to be raided by his greedy comrades. Dr. Needham then asks what is to become of our two million unemployed. In the Middle Ages they would have perished of disease and famine; and biologically this is the natural fate for superfluous mouths. But because our morality is founded not on biology but on Christian ethic, we cannot let our fellow citizens, however unfit, starve to death. Whether this ethic is well founded or not cannot be discussed in the pages of NATURE, but Christian ethic does not impose on us the duty of allowing the workless and also the worthless to produce enormous families which have to be supported by their neighbours.

E. W. M.

## Fundamental Characteristics of Electronic Oscillations

THE precise nature of the electronic oscillations produced by thermionic valves is still, fifteen years after their discovery in the three-electrode valve by Barkhausen and Kurz, imperfectly understood. The characteristic feature of these oscillations is that their period bears some more or less definite relation to a time of electron transit in the valve. It has often been suggested that such oscillations can be maintained without the co-operation of a resonant circuit external to the cloud of moving electrons, but a recent survey of the literature<sup>1</sup> led me to conclude that this view was not supported by unambiguous experimental evidence. While many workers have tacitly assumed that only a single frequency, or a harmonically related series of frequencies, is present when electronic oscillations are generated, the conclusion<sup>2</sup> that the Maxwellian distribution of initial electron velocities, apart from other causes of variation in transit time, leads necessarily to the production of a band of frequencies, has recently found wide acceptance. Experimental evidence has now been obtained which shows quite definitely that electronic oscillations can be produced without any external resonant circuit and that they can have a single frequency.

Oscillations were generated in a cylindrical diode (anode 5 mm. diameter, 15 mm. long, filament 0.17 mm. tungsten) placed in a magnetic field so that the electrode axis was nearly parallel to the lines of force. They were obtained over a wide range of magnetic field strength above the critical value and were clearly different from the well-known type of electronic oscillation of which the oscillation period is always close to the rotation period of the electrons about the lines of magnetic force. In this case the period was of the order of 10 times longer. The wave-length varied rather more rapidly than  $V_a^{-1/2}$  but showed only slight variations with magnetic field strength and angle of tilt of the electrodes relative to the field. A slow increase with emission current was observed.

It is very probable that this mode of oscillation is the same as that reported by Slutzkin and Leljakov<sup>3</sup> and that it is of the same nature as the original Barkhausen oscillation but with axial instead of radial motion of the electrons. The wave-lengths obtained (2-5 metres) are consistent with the supposition that the electron period is determined by the axial potential gradient inside and just outside the anode, and that electrons are oscillating about the central potential maximum through a distance rather greater than the anode length. It was observed several years ago in these Laboratories that electrons with axial velocities considerably greater than the value corresponding to the anode voltage could be obtained in similar circumstances.

The oscillations were detected by means of a heterodyne wave-meter. With proper precautions regarding constancy of supplies and absence of mechanical vibration, a single steady beat note could be obtained. In one case it was followed continuously while the wave-length was varied (by reducing the anode voltage) from 2.9 to 4.8 metres. In part of this range the 'radial' type of electronic oscillation was also being maintained, and the modulation of an externally generated 25 cm. signal could then be superimposed on the beat note. The 'axial' oscillation was substantially unaltered by making a short high-frequency connexion between anode and filament in

such a way that *no resonant circuit could have been formed with a natural wave-length greater than about 1 metre at most*. There were no high-frequency choke coils in the circuit which might have led to uncertainty in this respect. Bridging or earthing the filament leads through condensers gave the same result, although the energy picked up by the wavemeter appeared to be radiated mainly from this part of the circuit.

While it remains open to question whether the conclusions stated at the end of the first paragraph are necessarily true of all modes of electronic oscillation, it is at least clear that there is no fundamental reason to doubt their general validity.

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Dec. 12.

<sup>1</sup> *J. Inst. Elec. Eng.*, 72, 313 (1933).

<sup>2</sup> M. v. Ardenne, *Naturwiss.*, 22, 561 (1934).

<sup>3</sup> *Phys. Z. Sowjetunion*, 1, 768 (1932).

### Limits of Inflammability of Hydrogen and Deuterium in Oxygen and in Air

IN the course of a study of the propagation of flame in mixtures of hydrogen with air and with oxygen, a comparison has been made between the limits of inflammability of deuterium and of hydrogen at atmospheric pressure. The determinations were made in a small vessel, 22 mm. in diameter and 45 cm. long. The deuterium used contained more than 99 per cent D<sub>2</sub>.

(a) *Lower Limits*. The lower limit of inflammability of each gas in air and in oxygen was the same under the same conditions, but the limits for H<sub>2</sub> were about 1 per cent lower than for D<sub>2</sub>; they were for H<sub>2</sub>, 3.9 per cent upward and 9.1 per cent downward; and for D<sub>2</sub>, 4.9 per cent upward and 10.2 per cent downward. The values differ from those obtained by Clusius and Gutschmidt<sup>1</sup> with air mixtures (4.1 and 9.6 per cent for H<sub>2</sub>, 5.65 and 11.0 per cent for D<sub>2</sub>), but these authors used a larger vessel with mixtures at a lower initial pressure (400 mm.).

(b) *Upper Limits*. From the values of the lower limits it would be anticipated that the upper limits of D<sub>2</sub> would be lower than those of H<sub>2</sub>; actually they are slightly higher. The values obtained were, for H<sub>2</sub>, 94.2 per cent in O<sub>2</sub>, 73.0 per cent in air; for D<sub>2</sub>, 94.7 per cent in O<sub>2</sub>, 75.0 per cent in air. The values for upward and downward propagation were the same in each instance.

It can readily be shown that, when oxygen is not in excess (that is, except at the lower limit), the limit of inflammability is determined mainly by the thermal balance (heat produced against heat absorbed by diluting gas<sup>2</sup>). This can best be understood by regarding each such limit mixture as a mixture of the heat-producing 'basic mixture', 2H<sub>2</sub> + O<sub>2</sub>, with excess gas as diluent. By adding H<sub>2</sub>, N<sub>2</sub>, H<sub>2</sub> and N<sub>2</sub>, or CO to the mixture 2H<sub>2</sub> + O<sub>2</sub>, we should finally attain approximately the same limit mixture. In other words, all limit mixtures should contain the same concentration of basic mixture, 2H<sub>2</sub> + O<sub>2</sub>, since the specific heats of these diluting gases are approximately the same. The following are the results obtained for downward propagation:

2H <sub>2</sub> + O <sub>2</sub>	(a) + H <sub>2</sub> (upper limit H <sub>2</sub> in O <sub>2</sub> )	17.4 per cent
	(b) + H <sub>2</sub> and N <sub>2</sub> (upper limit H <sub>2</sub> in air)	16.8 "
	(c) + N <sub>2</sub>	16.8 "
	(d) + CO	17.1 "

The agreement is not quite so good for D<sub>2</sub>:

2D <sub>2</sub> + O <sub>2</sub>	(e) + D <sub>2</sub> (upper limit D <sub>2</sub> in O <sub>2</sub> )	15.9 per cent
	(f) + D <sub>2</sub> and N <sub>2</sub> (upper limit D <sub>2</sub> in air)	15.6 "
	(g) + N <sub>2</sub>	16.8 "

At the lower limit (that is, dilution of basic mixture with oxygen or air), the concentration of 2D<sub>2</sub> + O<sub>2</sub> is 15.3 per cent and is in good agreement with the values (e) and (f); for 2H<sub>2</sub> + O<sub>2</sub> the value is appreciably less than in (a) and (b), namely, 13.6 per cent. Certain other effects come into play when limits for upward propagation are considered.

W. PAYMAN.

H. TITMAN.

Safety in Mines Research Station,  
Buxton.  
Jan. 9.

<sup>1</sup> Clusius and Gutschmidt, *Naturwiss.*, 22, 693 (1934).

<sup>2</sup> Payman, *J. Chem. Soc.*, 115, 1436 (1919).

### Paramagnetic Relaxation

WHEN a paramagnetic substance, which follows Curie's law, is subjected to an alternating magnetic field, a certain amount of heat has been found to be developed per second in the substance. At room temperature only a very feeble effect could be observed for various paramagnetic substances. But at low temperatures, on account of the increased susceptibilities and the decreased specific heats, better conditions for the study of this phenomenon might be expected. Prof. W. J. de Haas kindly put the facilities of the Kamerlingh Onnes Laboratory at my disposal. The effect proved to be very large indeed at low temperatures. At 14°, for example, in a field of amplitude 8 gauss and frequency  $2 \times 10^7$ , the increase in temperature of the calorimeter filled with ferric alum amounted to 0.04° per second.

So far, experiments have been carried out with chromic alum, ferric alum and, as a control, with the non-magnetic aluminium alum. The amount of heat developed in the paramagnetic substances proved approximately to be: (a) proportional to the square of the amplitude of the magnetic field; (b) proportional to the square of its frequency; (c) inversely proportional to the absolute temperature. So the effect can be described by a relaxation time of the magnetic vector, which is independent of field strength, frequency and temperature. This time is about  $10^{-10}$  sec. for ferric alum.

The experiments are being continued. Details as well as a theoretical discussion will appear in *Physica*.

C. J. GORTER.

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Laboratorium Teyler's Stichting,  
Haarlem.  
Dec. 16.

### Effect of Time and Intensity of Radium Radiation upon the Inverting Capacity of Yeast

ALTHOUGH the view has often been expressed that the radiation of living cells must modify the action of some of their contained enzymes, experiments upon the enzymes *in vitro* have given either negative results or produced only a slight inhibition, even when very heavy doses of X- or  $\gamma$ -radiation have been applied. For this reason, Havard<sup>1</sup> considers that the

inhibition by X-rays of the respiration of surviving cells is probably not due to their effect upon the enzymes employed in respiration, but to some other cause, possibly to some effect upon the properties of the interphase surfaces surrounding and within the cell.

Recently in our laboratory, yeast cells have been subjected to radiation from radium, and the biological effect has been measured by determining the change produced in the inverting power of the yeast. Flat-bottomed cylindrical glass tubes, about 2.5 cm. in diameter, were used, into each of which was placed 10 c.c. of a sucrose solution containing a definite amount of pressed yeast suspension. The radiation was supplied by 30 mgm. and 10 mgm. radium plaques which were covered with thin sheets of monel metal. The plaques were placed, flat surface upward, at the bottom of cylindrical brass tubes and were held in position by small brass rings. The glass tubes to be radiated were disposed directly on top of the plaques, and the radiation received by their contents consisted therefore of some penetrating  $\beta$ -radiation in addition to the  $\gamma$ -rays. The yeast cells settled slowly to the bottom of the glass tubes; but this was not of consequence, since the inversion taking place in the radiated tubes was always compared with that in control tubes kept under identical conditions. All tubes were placed in a water-bath maintained at 30° C. The amount of invert sugar produced was determined by Fehling's solution.

Experiment showed that a negligible portion of the inversion (considerably less than one per cent) was due to invertase passing from the cells into the solution, consequently the action of the radiation must be referred to the inverting capacity of the yeast cells themselves, as brought about by the intracellular invertase. This capacity was found to be considerably reduced by radiation. Thus with the 30 mgm. plaque and 10 per cent sucrose solutions containing in every 100 c.c. respectively 2 c.c., 1 c.c., and 0.5 c.c. of a one per cent pressed yeast suspension, the inversion in the radiated tubes, when left over the plaques for eighteen hours and compared with that in the respective controls, showed diminutions of approximately 11, 18 and 32 per cent. With the 10 mgm. plaque the percentage diminutions were just about half these values.

Killing the cells with toluene produced generally a greater inversion than was obtained with the fresh yeast controls, but the application of radiation had scarcely any effect on the inversion produced by yeast treated with toluene; the inference being that the action of the radiation is due to some effect upon the living cells rather than upon the enzyme itself. The action of the radiation on the fresh cells, with the 30 mgm. plaque and 2 c.c. of the yeast suspension, reached about 50-60 per cent of its maximum in two hours, and about 70-80 per cent in three hours, and had nearly arrived at its saturation value in five hours.

The change produced in the inverting capacity of the yeast was permanent in character. If a plaque were applied for three hours and then withdrawn, and the radiated and control solutions maintained at 30° C. for another fifteen hours, the percentage diminution found at three hours showed little change at the end of the additional period. It is generally held in therapeutic practice that the biological effect of radiation is given by the product of the intensity of the applied radiation and the time of application. This relationship between time and intensity was not found in the experiments just described. In these

the biological effect reached a saturation value which depended upon the intensity of the radiation, the value for the 30 mgm. plaque being about double that for the 10 mgm. plaque. Further experiments are in progress.

GEORGE HARKER.

Cancer Research Committee,  
University,  
Sydney.  
Dec. 19.

<sup>1</sup> *Chem. and Ind.*, 54, 507 (1935).

#### Validity of Concentric Rings of *Mya arenaria*, L. for Determining Age

CERTAIN students of molluscan growth, among whom may be mentioned Weymouth<sup>1</sup>, have succeeded in demonstrating the annual character of particular concentric rings on the valves of several pelecypod molluscs.

With respect to *Mya arenaria*, Mead and Barnes<sup>2</sup> definitely state that their specimens collected from the coast of Rhode Island, U.S.A., do not possess 'annual rings' suitable for age determination. On a basis of field experiments, I have been able to prove the existence of 'annual rings' in *Mya arenaria* of the Bay of Fundy region, Canada. The results of this study constitute the subject of the following discussion.

The annual ring method described by Weymouth<sup>1</sup> and the field experimental method (Newcombe<sup>3</sup>) were employed. The former is based on the principle that yearly rings are formed resulting from the alternation of rapid and slow rates of growth depending on the favourability of environmental conditions, for example, those of the winter and summer seasons.

With certain reservations, it may be stated that *Mya arenaria* of the Bay of Fundy possess certain concentric rings more conspicuous than others, which may be quite easily recognised by the experienced observer. Several thousand ring measurements were made, and representative mean length values obtained for the first, second, third, fourth, fifth, sixth, seventh and eighth rings are respectively, 4.4 mm., 19.6 mm., 31.3 mm., 41.7 mm., 49.8 mm., 57.0 mm., 63.0 mm. and 69.4 mm. In older specimens, the first ring is often obscure due to a wearing away of the shell in the umbo region, and rings beyond the eighth are not always clearly defined on account of the relatively slow growth rate at this age.

To verify the annual growth increments pointed out above, controlled experiments, conducted in Nature by planting specimens carefully selected with respect to size, were continued for nearly three years. The standard error of the differences between mean annual increments obtained by 'annual ring' measurements and those based on field growth experiments was found to be insignificant.

The explanation for the statement of Mead and Barnes on the validity of concentric rings for age determination seems to lie in the fact that significant shell variations occur in *Mya arenaria* from different latitudes of the Atlantic coast of North America (Newcombe<sup>4</sup>). No specimens have been examined from the Rhode Island coast, but it is worthy of note that a study of Chesapeake Bay forms has failed to reveal rings that might be considered 'annual' in character. It seems probable, therefore, that regional shell differences may be the explanation for the conclusion reached by Mead and Barnes.

The establishment of the validity of concentric rings for age determination opens up a new field of possibilities for growth analysis of this widely distributed bivalve and constitutes a fundamental contribution to the solution of problems that are basic for the formulation of constructive conservation policies.

CURTIS L. NEWCOMBE.

Chesapeake Biological Laboratory  
and  
University of Maryland.  
Dec. 30.

<sup>1</sup>Weymouth, F. W., "The Life History and Growth of the Pismo Clam, *Trochus stultorum*", *Cal. Fish Game Comm., Fish Bull.*, 7, Contr. 1-120 (1923).

<sup>2</sup>Mead, A. D., and Barnes, E. W., "Observations on the Soft-Shelled Clam", 34th Rep. Comm. Island Fish., Rhode Island, 1904.

<sup>3</sup>Newcombe, Curtis L., "Growth of *Mya arenaria*, L., in the Bay of Fundy Region", *Can. J. Res.*, December 1935.

<sup>4</sup>Newcombe, Curtis L., "Variations in the Growth Indices of *Mya arenaria*, L., from Different Latitudes of the Atlantic Coast of North America", *Ecology* (in press).

### Greenland Seal in British Waters

ON page 258 of "A History of British Quadrupeds" (1837), Thomas Bell states that "... it is a matter of great satisfaction to me that I am enabled to increase the catalogue of British Seals by the addition of two species, one of which, probably the Long-bodied Seal of Dr. Parsons, has been discovered on the coast of Ireland by Mr. Ball; the other has been taken in the Severn, the remains of two specimens of which are now in the Museum of the Bristol Institution". Later, on page 270, he states that Dr. Riley exhibited two crania at the meeting of the British Association at Bristol in August 1836, and

that they were afterwards identified as *Phoca groenlandica*. Doubt was later cast on the identification by Robert Ball in a paper "On the Seals of Ireland (Phocidae)", *Proc. Royal Irish Academy* 1836-7, Part 1, pp. 18, 19 (1837) and he "expressed his belief that the species was still to be determined".

Thomas Southwell, in "Seals and Whales of the British Seas" (1881), mentions the two skulls and says (p. 22): "These specimens are unfortunately lost". And in his "Mammals of Great Britain and Ireland", vol. 1, p. 345 (1904), J. G. Millais, after mentioning the occurrence of these two specimens of the harp (or Greenland) seal, proceeds: "The skulls have been mislaid and doubt has been cast upon the identification but Bell maintained his point, and the matter will remain in doubt unless the skulls are subsequently recovered".

Recently, on going through the osteological collections in the Bristol Museum and Art Gallery, I find that there are two skulls labelled *Phoca groenlandica* which are mentioned in an old catalogue and are the only ones in the collections. There can be no doubt that these are the two mentioned above, and Mr. M. A. C. Hinton, to whom the skulls have been submitted, has confirmed the identification on the skulls.

It can, therefore, be stated that the first record of the Greenland or harp seal (*Phoca groenlandica*, Fabr.) from British waters was from the Severn in 1836, and that the skulls of these two animals are in the collections of the Bristol Museum and Art Gallery.

Bristol Museum and Art Gallery. H. TETLEY.  
Jan. 7.

### Points from Foregoing Letters

PROF. G. HEVESY and Hilde Levi submit two tables, one showing the power of absorption, determined by them, of some rare earth elements for neutrons and another giving the periods of decay and relative intensity of the resulting radioactive elements, as determined by various investigators. Discrepancies in the published data appear to be due to the presence of small amounts of impurities.

The effect of 'screens' of various elements upon the amount of radioactivity induced in silver by neutrons has been investigated by J. Rotblat and M. Zyw. Of the two radioactive substances produced, the amount of the longer-lived component (half-period 140 sec.) is increased when the neutrons are scattered by any of the metals studied, with the exception of aluminium. The shorter-lived component (44 sec.) is strengthened by carbon, aluminium, copper and zinc, and weakened by mercury and by silver itself.

Graphs showing the energy of the gamma radiation excited in various elements (hydrogen, cadmium, chlorine, copper, iron) by bombardment with slow neutrons are given by S. Kikuchi, H. Aoki and K. Husimi. The  $\gamma$ -rays from protons (hydrogen nuclei) which combine with slow neutrons to form deuterons (heavy hydrogen nuclei) are found by the authors to have an energy of 2.2 million electron volts. The  $\gamma$ -rays from cadmium appear to have at least two components.

There exists a major discrepancy between  $e$  (the charge of an electron) obtained from X-ray diffraction

methods ( $4.8029 \times 10^{-10}$ ) and that obtained by various methods involving  $e/m$  and  $h/e$  ( $4.7824 \times 10^{-10}$ ). A critical survey leads Prof. R. T. Birge to the view that either the Bohr formula for the Rydberg constant or the method of calculating  $e$  on the assumption of a geometrically perfect calcite crystal, is not correct.

A sudden rearrangement of the electronic configuration of an excited molecule may lead to dissociation, the effect being known as predissociation. Dr. Lochte-Holtgreven finds in the case of sulphur a marked dependence upon pressure. The pressure effect is interpreted by the strong mutual forces between the sulphur molecule considered and its neighbours. The interpretation holds for both absorption and emission.

Experiments by E. C. S. Megaw answer affirmatively the question whether it is possible for an oscillating cloud of electrons in a thermionic valve to give rise to a stable monochromatic radiation without the co-operation of a resonant electrical circuit external to the electron cloud.

Mixtures of heavy hydrogen gas with air or oxygen are found by Dr. W. Payman and H. Titman to have inflammability limits slightly different from those of corresponding mixtures with ordinary hydrogen.

Yeast which has been exposed to radium radiation has its sugar-reducing power permanently reduced, according to Dr. G. Harker. The effect apparently reaches a saturation value depending upon the intensity of the radiation.

## Research Items

### Art in China and on the North-West Coast of America

ATTENTION was first directed to the resemblances between the style of Chinese decorative art of the Chou period (1122-256 B.C.) and that of ancient Central America by Prof. Perceval Yetts. Dr. Leonhard Adam, who also had already discerned similarities between the Chou and Huai styles and that of the marble vessels from the valley of the Rio Ulua (Honduras) of about the twelfth or thirteenth centuries A.D., now asks for the consideration of anthropologists of his theory that both the Chinese Chou style and the north-west American style in decorative art developed under identical rules (*Man*, 3; 1936). This comparison, it is thought, may lead to a solution of the problem of the Tao Tieh mask, which is obviously a key to an understanding of the typical Chou decoration. It is evident that the Tao Tieh mask does not always represent the same being, while the decorative elements surrounding it are not identical, but vary considerably. It is suggested that originally it was not a mask at all, but was the head of an animal; and the decorative details around it are not independent, but originally formed part of its structure. In the course of a long development, these details were separated from the body of the animal, and were distorted in the same way as occurred in north-west America, for example, in the Chilcat blankets, which show the final stage of degeneration. The fact that geometric forms are far fewer in north-west America than in Chou art confirms the view that the American art represents a more recent stage of development. The chronological gap of three thousand years between the two styles precludes the suggestion of a historical connexion between them, but the application of the principles, stylisation, symbolism, etc., to be deduced from studies of the art of the north-west to the art of the Chou dynasty provides an important and very elucidating auxiliary for a reasonable analysis of the Chou style, though it does not solve all problems.

### Begging as Woman's Function among Serbian Gypsies

THE latest of the "Contributions to the Study of the Serbian Gypsies" by Dr. Alexander Petrovič (*J. Gypsy Lore Soc.*, Ser. 3, 15, Pt. 1) deals with the begging activities of the women, which have a definite place in gypsy economy. There exists in Serbia a certain group, whose families would starve if their women did not go round to the villages to beg. They have no employment, except occasionally and unsatisfactorily as casual labourers. In them is firmly implanted the idea that so long as there is a woman in the house none will starve. Others have a certain craftsmanship, such as tinsmithery or fiddling, and may even own a house or cattle. The activity of the woman appears to create a special mentality in the man, who is always hungry and has an uncontrollable desire for everything he sees. When a gypsy woman goes begging, she invariably has with her her bag and her stick. To both a recognised ritual attaches. When a girl accompanies her mother to beg, an old bag is given her to carry; but as soon as she is betrothed, a new bag is prepared.

It is made by an older woman, and she herself must not help. The sewing is begun before dawn, "when the day increases", but no sewing is done on a Saturday, which is 'the day of death', or on a Tuesday, which is a day of ill-omen. When the bag is finished, it is hung on a hook and must not be used until the girl is married. On the bridal night the bride puts in the bag a shirt and socks for her husband, as it must be full, and in Bosnia, where it is presented with the rest of the wedding gifts, it contains in addition bread, chicken, sugar and salt, and these form the first supper eaten by the bridal pair when they enter their tent. The stick, usually the hazel because of its fecundity, is presented to the bride by her mother-in-law, three days after her arrival. A fruitful source of the gypsy woman's income is by the extraction of the worms, which are thought to cause pains in ear, nose or eye, so much being paid for each worm which the gypsy pretends to extract by suction through a rush.

### Chemical Protection against Infantile Paralysis

INFANTILE paralysis is a virus disease the infection of which travels by the nasal passages to the central nervous system. Monkeys can be infected by instillation of an emulsion containing the virus into the nose, some seventy-five per cent of animals so treated developing the disease. According to Science Service of Washington, D.C., Drs. Sabin, Olitsky and Cox, of the Rockefeller Institute for Medical Research, find that if a four per cent solution of sodium alum or of tannic acid is dropped into the nose daily for a few days before instillation of the virus, only five per cent of the animals become infected. They therefore suggest that these agents might be similarly employed as preventives of human infection. The method is simple and harmless, the chemicals presumably acting as a shield against the disease by preventing the causative virus from entering the body and reaching the nerve cells in brain and spinal cord.

### Larval Euphausiids from the South-West Coast of Ireland

MISS WINIFRED FROST has continued her studies on larval euphausiids (*Nematoscelis megalops*, G. O. Sars, and *Stylocheiron longicorne*, G. O. Sars, taken off the south-west coast of Ireland. *Proc. Roy. Irish Acad.*, 42, B, No. 16, September 1935). These two species are both taken in the oceanic waters of considerable depths and the larvæ came from similar localities. The descriptions add to our previous knowledge of the development in the Euphausiidae, for the larvæ of *Nematoscelis megalops* and *Stylocheiron longicorne* were not previously known, and it is shown that they respectively resemble closely those of other species belonging to the two genera. It is interesting that only certain furcilia stages are present, indicating that several stages are normally omitted, and in *Nematoscelis megalops* these do not correspond with those previously found in *N. microps* from the Mediterranean. Similarly, in *Stylocheiron longicorne* only a few furcilia stages are represented, these agreeing with *S. submii* and *S. abbreviatum* from the Mediterranean, except for the fact that one extra

stage was found in *S. submii*. It is emphasised that all euphausiid larvae so far known from waters where oceanic conditions prevail (with temperature and salinity relatively high) have fewer furcilia stages than those from neritic waters (*Nyctiphanes*, *Meganyctiphanes* and *Thysanoessa*).

#### Polyporaceous Fungi of Bengal

DR. S. R. BOSE, president of the Section of Botany at the Indian Science Congress held on January 2-8 at Indore, addressed his audience on "Bengal Polyporaceæ", a subject to which he has devoted twenty years of critical and productive research. Certain territorial limits are implied by the title; but the discourse also reviewed work prosecuted in many parts of the world. The sections on the origin of fungi, fossil records of Polyporaceæ, morphology and systematics, and physiology of polypores, would be directly useful to a teacher of mycology in any land, and form a concise digest of modern research findings. Species of Polyporaceæ found in Bengal show an affinity with the fungus flora of Malaya, and conditions for their development are determined largely by the monsoon climate of these lands. Methods of adaptation to the extremes of wet and dry weather are described, and the influences which control the discharge of spores are discussed. The cytology of reproduction has been investigated, and is quite similar to that established for other higher Basidiomycetes. Heterothallism has been demonstrated for fifteen species, eight of which are bisexual, and the others quadrisexual. The problem of sex in fungi receives critical review, and cultural characters of several species in monosporous culture are outlined. Chemical analyses of the organic matter and ash of polypores have been made, and the enzyme actions of some species have also received attention. *Fomes pectinatus* is used to cure weeping eczema, and *Polyporus anthelminticus* is, as its name implies, a control for worms. The language of the address was simple, even picturesque in the general parts, and the subject matter a striking portrayal of the useful results to be obtained from a limited field of research.

#### Analysis of Cereal Products

THE assessing of the quality of a foodstuff is often a matter of great difficulty, if possible at all, without resort to the ultimate practical test of utilisation. No better example of the difficulties of evaluation of quality can be given than the case of flour and cereal products generally. Despite the efforts of many workers, the only certain test of quality in flour is still the baking test, though with a knowledge of composition and source something approaching a satisfactory prediction can be made. The American Association of Cereal Chemists has produced a revised book of standard methods for use in the analysis of cereal products (*Cereal Laboratory Methods: with Reference Tables*. Compiled by Committee on Methods of Analysis. Third Edition. Pp. viii+204. (Omaha, Neb.: American Association of Cereal Chemists, 1935.) 3.00 dollars). Many of the methods, of course, are well known and in common use; others of recent origin are not so familiar. Full descriptions of practical tests such as baking tests, the determination of shortening values of fats, wheat-meal fermentation time tests, etc., are given. No reference is made to the Chopin 'extensimeter' which has found wide use in France and certain other European countries for assessing the quality of flour by means

of the physical characteristics of the dough. This publication covers the whole range of cereals, flours, and cereal products, shortening materials, baking powders and flour improvers, and should prove of value to many food chemists.

#### Bog-flow in County Clare

A RECENT bog-flow in the Slieve Aughty Mountains in County Clare is described by Mr. G. F. Mitchell in a recent paper (*Sci. Proc. Roy. Dublin Soc.*, 21, No. 27, November 1935). The burst occurred for a width of 50 yards over the edge of an escarpment at a height of 1,020 feet. Above the line of the burst, the hill slopes upwards at about 3°: below the line the gradient is much steeper. The bog moved forward and covered several acres, though its flow was checked by escarpments at lower levels. A more or less solid raft of crust about three feet in thickness was carried forward on a completely humified semi-fluid layer about two feet in thickness. Lower down, the movement of the more solid rafts of crust were checked, and the fluid underlayer flowed on into a small river channel. Mr. Mitchell suggests that a burst on such a terrain was inevitable sooner or later. What actually started it was probably an increase in weight of the peaty crust due to heavy rainfall, causing a pressure on the humified underlayer, which was thus pushed down the slope and moved under the influence of gravity. The flow was quiet and lasted for several days.

#### Recent Earthquakes in California

MESSRS. P. BYERLY and J. T. Wilson have made two interesting studies of recent earthquakes in California (*Bull. Seis. Soc. America*, 25, 223-246, 269-273 (1935)). In the first paper, they describe the Niles earthquake of May 16, 1933, and the two Parkfield earthquakes of June 7, 1934, all of destructive strength. The intensity of the former earthquake was greatest near Niles on the Hayward fault, but the inner isoseismals follow the Sunol fault. There was no surface faulting in connexion with this earthquake. The epicentre, as determined from seismograms at neighbouring observatories, lay in lat. 37° 38' N., long. 121° 57' W., and the focal depth cannot have exceeded 6 miles. The Parkfield earthquakes occurred at about 8.30 and 8.48 p.m. (Pacific standard time). The epicentre of the second earthquake was in lat. 35° 56' N., long. 120° 29' W., on the San Andreas fault, that of the earlier being about 2½ miles farther north. From the evidence of the seismograms, it seems that the thickness of the surface granite layer in this region is about 19 miles. In the second paper, they determine the epicentres of 70 earthquakes in northern California during the year April 1, 1933-March 31, 1934. The map shows that the epicentres were thickly clustered in the districts lying to the east of Monterey Bay and around Niles. The coastal region between Humboldt County and San Francisco was remarkably free from earthquakes, while the San Andreas fault—the great fracture with which the earthquake of 1906 was connected—was inactive northwards from Loma Prieta.

#### Conditions in Cumulus Cloud

"SOME Observations on the Thermal Structure of Cumuliform Cloud", by Flight-Lieut. R. O. Veryard (*Scientific Notes*, 6, No. 64, India Meteorological Department), is a paper describing meteorological

observations specially undertaken by pilots of aeroplanes of five squadrons of the R.A.F. in the neighbourhood of Peshawar, Kohat and Risalpur in the North-West Frontier Province of India. W. Kopp and others had observed a fall of temperature on entering cumulus clouds, the fall being greatest near the top. To account for the buoyancy of the cloud, which appears to require that the air within it shall have a lower density than has the surrounding air, Kopp suggested a high degree of supersaturation within the cloud, for the presence of a large amount of water-vapour would lower the density and might more than counteract the greater density arising from the relatively low temperature. These observations were made with the view of testing the validity of Kopp's observations and conclusions, and included readings of both the dry and wet bulb thermometers inside and outside cumulus clouds. Although it could not be claimed that the readings were accurate to within less than 1° F., on the whole they confirmed the lower temperature within the cloud. The internal temperature was the lower on no fewer than thirteen out of the fourteen occasions when the cloud was dissolving; out of twenty occasions of growing cloud, the internal temperature was lower on six and higher on ten occasions, and higher near the base while cooler or equal in temperature to the outside air at the top on three occasions, the remaining case showing no difference from the environment. The author of the paper evidently looked for evidence of supersaturation to be furnished by the wet bulb reading higher than the dry, but within the limits of accuracy of the readings such differences were not found; the wet bulb reading was sometimes entered as  $\frac{1}{2}$ ° higher than the dry; but even this was rare, the normal condition within the cloud being equality in the readings, implying a humidity of 100 per cent.

#### Radiation from Aerials

PROGRESS is being rapidly made in the design of aerials for broadcasting and radio transmission. Many of the problems that have to be solved in practice possess considerable mathematical difficulty, and so the paper by E. B. Moullin on the radio resistance of aerials, read to the Institution of Electrical Engineers on January 8, will be welcomed by radio experts. The function of an aerial is to transmit or receive communication to or from a point at a considerable distance away. The author examines the action of the aerial from both points of view. In transmission he examines it to see whether its geometrical shape is such that it performs its functions with the least expenditure of power, and in reception he examines the aerial from a very distant point of view to see what field strength it produces at the point of reception. The broadcasting engineer has to build not only an aerial which produces the requisite direct-ray communication with the minimum expenditure of power, but also one which radiates little at high angles. The power radiated at high angles is not merely wasted but it is also definitely harmful. It is liable to be reflected by the ionosphere and so make the station audible at a radius far in excess of that occupied by the listeners it is meant to serve and who contribute to its cost. As the number of channels available for broadcasting is very limited, the possibility of having a large number of stations providing satisfactory services in different regions of the world depends on these stations having a limited range of action. The problem of designing an aerial

affects both the initial cost of the station and the comfort of distant neighbours. It is proved that for a straight aerial of given length the necessary power is a minimum when it is vertical. It is also proved that the current distribution in the aerial is not the same in reception and transmission.

#### Testing Electric Cables

Two papers were read to the Institution of Electrical Engineers on January 15 discussing methods of testing the insulating wrappings of cables, and of eliminating defective or weak parts of the covering, which otherwise might develop into breakdowns in practice. The first paper, by Mr. A. N. Arnam and Dr. A. T. Starr, discusses the various types of breakdown which occur with high-voltage cables. There is first breakdown by disruption or puncture, which occurs immediately the voltage is greater than a certain definite value. This type rarely occurs in cables, and takes place generally with a large impulsive rush of current. The second type is due to thermal instability of the current. It occurs when the rate of increase with temperature produced by the losses at a part of the dielectric is greater than the heat conducted away, and so the temperature at this spot rises. In the third method, there is a breakdown due to a slowly progressive 'treeing' and 'coring' of the dielectric caused by ionisation by collision. This leads eventually to thermal instability at the thermal centre of the coring. The second paper discussed was by Mr. C. Kibblewhite, who suggested a method of routine high-voltage testing with direct current. He shows that this method locates weaknesses in the insulation of high-voltage cables which, unless eliminated, will develop into breakdowns in service. A series of tests carried out on a cable network operating at 11 kilovolts is described, and conclusions are drawn as to the best way of carrying out tests, and the extent to which this increases their factor of safety.

#### A New Essential Amino Acid

ATTEMPTS have repeatedly been made to study the physiological significance of individual amino acids by feeding experiments in which a known mixture of amino acids has been supplied in place of proteins. Such attempts have failed, and the existence of a protein growth-promoting component other than the twenty known amino acids was proved. The addition of a crude concentrate of the mono-amino acids to such a synthetic diet provided for satisfactory growth. The inference was that the missing growth essential was of a simple nature. This missing component has now been isolated and found to be, in fact, two acids (M. Womack and W. C. Rose, *J. Biol. Chem.*, 112, 275 (1935); R. H. McCoy, C. E. Meyer and W. C. Rose, *ibid.*, 112, 283 (1935)). These have been separated by their solubility difference in aqueous butyl alcohol. The more soluble has been identified as isoleucine and the less soluble as one of the four optically active  $\alpha$ -amino- $\beta$ -hydroxy *n*-butyric acids. This acid has been isolated in a pure crystalline form, and several derivatives obtained. The importance of isoleucine had been recognised previously, but the amount present in the leucine of the amino acid mixture was insufficient for growth. Hydroxyamino-butyric acid has been described before as a hydrolytic product of proteins, but its essential character was not hitherto known. About 0.6 per cent of this acid is the minimum amount for satisfactory growth of rats with an otherwise adequate diet.

## Wood Anatomy and Resistance to Shipworm Attack

A FASCINATING discussion of this important subject appears as a paper included in the *Proceedings of the Fifth Pacific Science Congress, 1933* (University of Toronto Press, 1934) by Prof. G. van Iterson, jun., of Delft. A statement by Klitarchus in 325 B.C. to the effect that the Romans conducted a successful expedition to the Island of Tylos in the Red Sea in search of some species of wood that could resist the attacks of the teredo is made the keynote of the address.

In these days we are still suffering from the attacks of this shipworm; the damage to piling in the Bay of San Francisco alone in the years 1920 and 1921 being estimated at 15 million dollars. Science has so far been able to help but little, though the best remedy, creosote impregnation, was the result of scientific research. Even this is not, however, completely effective, as cases are reported where molluscs have pierced the creosoted timber, even the holes smelling of creosote.

What, then, remains of the knowledge of the Romans of a timber that resists the teredo? Nothing apparently, as a committee appointed by the Royal Academy of Amsterdam in 1869 came to the conclusion that such a timber could not be found.

Later, however, the great resisting powers of certain woods were recognised, notably of Demerara greenheart (originating from *Nectandra rodioei*, Schomb.), the wood of which both the polar ships, the *Fram* and the *Discovery*, were built, and the wood which Colonel Goethals preferred during the early years of the construction of the Panama Canal.

A second wood, 'manbarklak', from *Eschweilera longipes*, Miers, from Dutch Guiana later became famous as still more resistant, though sometimes rapidly destroyed by fungi when stored on land.

The reasons for the resistance of these timbers to the teredo was not known. Demerara greenheart contains certain poisonous alkaloids, but manbarklak does not, and Prof. van Iterson suggested that its resistance might be due in part to inclusions of silica in the ray cells, which makes the wood very difficult to work and may impede the boring activities of the teredo. In the museum at Balboa are piles of Demerara greenheart (from the Panama Canal) riddled by teredo, a disappointment due to the appearance in these busy waters of a new species of teredo. A Dutch forester, Mr. J. W. Gonggrijp, followed up this observation of Prof. van Iterson, when he found manbarklak resisting much better than Demerara greenheart in canal sluice-gates of Dutch Guiana. The result of his extensive studies has been to indicate five or six species of woods from the Netherlands East Indies as promising for marine construction because of their silica inclusions, notably two related species of *Metrosideros*, whilst two or three species containing poisonous substances are also recommended.

The investigation of woods from other wood-producing regions from the same point of view is obviously a next step, and in this connexion Prof. van Iterson describes in this paper a new and rapid method for the microscopic recognition of the silica inclusions.

## A Grid System for Ordnance Survey Maps

A PAPER by Brigadier M. N. MacLeod, Director General of the Ordnance Survey, on "A Grid System for the Maps of Great Britain" was read at a recent meeting of the Royal Geographical Society. Brigadier MacLeod explained that the 1/2,500 survey is not published as a continuous series for the whole country but consists of more than forty separate series, each comprising a single county or a small group of counties. This lack of continuity has proved a source of much inconvenience, and no little extra expense in revision. Since the War, the revision has fallen seriously into arrears, but if, as a result of the recommendations of the Departmental Committee now considering the matter, drastic action for overtaking these arrears is approved, the Director General thinks it would be a good opportunity for recasting the 1/2,500 sheets on national instead of county lines and on a single projection.

Such a step would enable all the maps of Great Britain to be brought on to the same projection, to which a grid could be applied. A map grid is formed by lines parallel to the co-ordinate axes of the projection at fixed distances therefrom. These lines appear on the maps as a network of squares. They

form a framework upon which the map is compiled, and which enables one scale of map to be easily compared with another, besides being a complete index to maps of all scales. Above all, they form a simple, convenient and precise system of reference enabling the position of any point to be identified or defined, by the same co-ordinates on all scales.

For most uses of the grid, it is essential that the lines should be at intervals of 10 units; though the actual unit is immaterial. This 'decimal' arrangement of the grid lines at once suggests the use of metric units for the grid. There are, however, other considerations—the most important of which is that the grid square should be of a suitable size. It was suggested that a square of about 5 cm., or 1½–2 inches, is a suitable size. If much larger than this, measurements within the square would be affected by expansion or contraction of paper, and if much smaller, the squares would tend to obscure the map.

The size of the grid square is a function of the scale of the map as well as of the grid unit, and whatever unit is selected it is not possible to have a grid square of the ideal size on every scale of map. The two most important British maps are the 1/2,500 and



the one-inch but, as there are nearly 52,000 1/2,500 maps and only about 300 one-inch maps, Brigadier MacLeod thinks that the former should be regarded as the basic scale for grid purposes.

From a discussion of the various possible units, it is concluded that the choice lies between the yard and the metre. On the 1/2,500 scale, the 100 metre grid square is 4 cm.—a little on the small side though moderately suitable. The 100 yard square is 10 per cent smaller and therefore 10 per cent less suitable. An objection to the yard is that its decimal multiples (1,000 and 10,000 yards) are not named.

The metre has therefore intrinsic advantages over the yard, but the decisive consideration is the question of permanence. So long as there is any possibility of metric measures being adopted in Great Britain, a metre grid is preferable to a yard grid—for once the grid is introduced a change in grid unit would not be practicable. The introduction of metric measures has often been attempted, but has always failed, though sometimes only by narrow margins. Some industries already use metric units, and others will probably have to follow. Everyone is agreed that the metric system has advantages over our native systems; the difficulty of introducing it is the obstacle. Anything which will help to overcome this difficulty should be encouraged. Brigadier MacLeod believes that a metre grid would do this without causing inconvenience; it would not compel anyone to alter present survey practice or to alter units of area now in use.

As to the unit of height, if a metre grid is adopted, it might be desirable to adopt the metre for heights also. This is not essential, but would be especially desirable if it is decided to contour the six-inch map at a closer interval than the present 100 feet.

With regard to map scales, if a grid system is adopted, there are great advantages in having map scales exact multiples of one another. If the 1/2,500 scale is taken as basic—a 1/10,000 or 1/12,500 would be preferable to a scale of six-inches to one mile. Similarly, 1/250,000 would be more suitable than four miles to one inch (1/253,440).

The present would be a favourable opportunity for making any such changes, as the one-inch map is now being redrawn—less than one-fifth has been completed—while the other small-scale maps would in any event have to be redrawn before long.

In the discussion which followed the reading of the paper, most of the speakers confined their remarks to comments on the difficulty of getting the British public to use metric units. Few of them kept strictly to the point at issue, which was not the adoption of the metric system by the public, but the adoption of metric units for the proposed grid—not yet in existence. The substitution of 'decimal' map scales for the present scales of inches to a mile was criticised on the same grounds, but this has nothing to do with metric units being equally desirable whether yards, metres, or miles are adopted for the grid.

Prof. C. B. Fawcett, who spoke last, said that the use of metric measures is now taught in all secondary schools, and suggested that the difficulties of getting the public to use metric measures might not be as great as some people suppose.

Brigadier MacLeod concluded the discussion by reminding the audience of the merits of the metric system. Care should in any event be taken to do nothing to make its adoption more difficult. The adoption of the metre for the grid would cause no inconvenience, nor would it compel the public to adopt metric units for purposes unconnected with the grid.

## Hudson Strait Survey

THE sixty-eighth annual report of the Canadian Department of Marine for the fiscal year 1934-35 contains some interesting information respecting the charting operations which have been continued in Hudson Strait along the south-eastern coast of Baffin Island for a distance of seventy-five miles eastwards of Pritzler Harbour. The following is a description of the coast from Pritzler Harbour to Gabriel Strait.

The Lower Savage Islands, which are separated from Baffin Island by four miles of turbulent water, is a distinct group of three main and several smaller islands characterised by the same rugged topography as south-eastern Baffin Island and Resolution Island. Bare, rocky hills in great disorder rise to a height of 720 ft. above the sea. Due to the exceptionally exposed position, the islands are almost destitute of vegetation even in the declivities, and present a most desolate and chaotic appearance. With the exception of the low south-western end of the group, the islands possess a formidable sea-face, composed of a succession of lofty cliffs rising sheer out of the water. The strong tidal streams of Gabriel Strait striking heavily against the Savage Islands are sheered abruptly from their course and the accelerated swirling currents cause a confused sea with whirlpools and remarkable tide-rips. Even on fairly calm days, there occur areas

of sharp uprisings of the sea, like a great boiling-up. In Gabriel Strait there was observed a most unusual difference between the spring and neap ranges of tide. This variation was found to be 28-80 ft. at springs and only 10 ft. at neaps.

An imposing promontory, East Bluff, stands at the south-eastern extremity of Baffin Island. It is the southern termination of a great high wall of solid rock extending for 3½ miles along Gabriel Strait. Severe in aspect, it rises precipitously out of very deep water to a height of several hundred feet. From this great headland the ragged coast of Meta Incognita trends abruptly to the north and to the west. The shore is pierced by many small incursions of the sea and is fringed by many skerries. Outside these rocky islets, the water is deep and apparently free from obstructions. In Gabriel Strait, the echo-sounding instrument recorded the great depth of 234 fathoms only 1½ miles off the land. The Grinnel glacier, which overlies most of the peninsula, approaches to within six miles of Hudson Strait and nowhere does it discharge any icebergs. The bare strip of country between the edge of the glacial ice cap and the sea is very hilly and deeply scored by glacial action. In summer, the melting glacier gives rise to numerous swift rivulets; they abound in sea-trout, upon which the natives are much dependent for food.

## Skidding of Motor-Cars

IN a paper in *Roads and Streets* of December, Prof. R. A. Moyer gives some interesting results of experiments on skidding tests at various speeds obtained under all kinds of weather conditions. He finds that all surfaces, except gravel and cinders, increase in slipperiness with an increase in speed. The great majority of skidding accidents occur with wet or icy or snow-covered roads. He says that in no circumstances should a driver with chains go at more than 30 miles an hour on icy rural highways, or at more than fifteen miles an hour on city streets. To prevent skids, the roads should be sprinkled with sand or cinders treated with calcium chloride. The salt hastens the process of embedding the gritty material into the ice. Snow is not nearly so dangerous as ice from the point of view of skidding, but mud-covered pavements can be as dangerous as ice-covered pavements.

At speeds greater than 15 miles an hour, tyres with treads worn smooth are more slippery on wet surfaces than tyres with a non-skid tread design. An overload on lorry tyres lessens the resistance to skidding. Tyres should be kept at a pressure slightly above the recommended minimum. From the point of view of skidding, over and under inflation are equally bad; but faulty brakes and the improper use of brakes are the cause of more skidding accidents than any other driving operation.

If brakes produce a greater retarding effect on one side of a car than on the other, the tendency

to skid is very great. Of 2,134 cars tested for unequalised brakes, 31 per cent had brakes which produced not less than 40 per cent more braking effect on one side than the other, and practically half the cars tested had faulty and inadequate brakes.

In driving round curves there is only one speed at which the centrifugal is exactly balanced by the gravity force. A car going slower than this tends to slide down the banked section, and going faster it tends to move upwards. When a certain critical speed is exceeded, the necessary friction to keep the car on the curve suddenly vanishes, with the result that the car starts to skid. Many drivers from force of habit put on the brakes when the car starts to skid, the usual effect being to make it worse. The majority of accidents on curves are caused by entering the curve at an excessive speed.

Rough spots or waviness on road surfaces greatly reduce the available friction as the speed is increased. Sir Malcolm Campbell proved that a variation of only two inches in 100 feet, which could not be detected by the eye, was sufficient to lift his six ton car off the surface at speeds of about 250 miles per hour. Campbell is the only man who has driven at a speed of more than 200 miles per hour on a straight track, 500 feet wide, without losing control of his car. Prof. Moyer says that the high-speed runs of Campbell, although the factor of safety was low, are important, since they represent the ultimate possibilities in speed under ideal conditions.

## Systematic Anatomy of Timber-Producing Trees

A REPORT of the committee for the investigation of the systematic anatomy of timber-producing trees (Prof. H. S. Holden, chairman; Dr. Helen Bancroft, secretary; Prof. J. H. Priestley) was presented to Section K (Botany) at the recent meeting at Norwich of the British Association. Four papers dealing with the Monotoideæ and with British elms have been published, whilst three others on the Monotoideæ, *Marquesia acuminata* from Northern Rhodesia, and the Dipterocarps in Africa will appear shortly. A brief summary of the report shows the value of the investigation work being carried out from both the scientific and economic points of view. It is stated that continued work on the Monotoideæ supports the view, expressed in last year's report, that the members of the group are closely related to one another and, as a whole, to the Dipterocarpaceæ rather than to the Tiliaceæ; and that the timbers can be of little value economically outside the areas where they occur naturally.

New material from Nigeria, regarded in conjunction with the fossil Dipterocarps from Mount Elgon (described in detail in *Amer. J. Bot.*, 22, 164; 1935), indicates very interesting possibilities with

regard to the previous history of the Dipterocarps in Africa.

In connexion with research in Great Britain, the work on the vexed question of the elms has indicated that the genus is in a highly variable and plastic condition, and that hybridisation has taken place freely among the British species. A considerable amount of field-work outside the British area has also been carried out in this connexion. The timbers of the different species and hybrids vary greatly in their value from the utilisation point of view; and a thorough systematic investigation of those types which produce easily worked timber is desirable.

The papers to which the report refers have appeared, or are to appear, in such varied publications as the *Kew Bulletin*, *American Journal of Botany*, *Gardeners' Chronicle*, *Quarterly Journal of Forestry* and the *Empire Forestry Journal*.

Valuable as this report may be, regarded from its purely botanical aspects, to those interested in the economic side of forestry the practical nature of the potential possibilities of this line of investigation into the systematic anatomy of timber-producing trees will be obvious.

## Educational Topics and Events

CAMBRIDGE.—The Adams Smith prize (£40) offered annually for an essay upon some unsettled question in economic science or in some branch of economic history or statistics subsequent to the year 1800 has been awarded to V. K. R. V. Rao, Gonville and Caius College.

D. J. Bell has been appointed University lecturer and Dr. E. H. F. Baldwin, of St. John's College, University demonstrator in the Department of Biochemistry.

The Faculty Board of Mathematics has appointed Prof. J. W. Alexander, of the Institute of Advanced Study, Princeton, to be Rouse Ball lecturer for the year 1935-36.

Dr. T. S. Hele, Master of Emmanuel College, has been appointed assessor to the regius professor of physics.

Lord Rutherford has been appointed director of the Royal Society Mond Laboratory.

DR. H. LOWERY, head of the Department of Pure and Applied Physics in the College of Technology, University of Manchester, and secretary of the Manchester and District Local Section of the Institute of Physics, has been appointed principal of the North-Western Polytechnic, London.

SIR MARTIN O. FORSTER, formerly director of the Indian Institute of Science, Bangalore, gave the presidential address at the Education Week held recently in Bangalore. He quoted the Principal of the Muhammadan College, Madras, as saying that in nine-tenths of life only elementary knowledge is required, therefore for nine-tenths of the population elementary education is sufficient. That is true in England as in India, and considerable time and money would be saved if secondary and university training was reserved for those only who could benefit by it. Sir Martin is not in favour of making Hindi the common language of India, instead of English. By not learning English, Indians would cut themselves off from communicating with 200 million English-speaking inhabitants of the globe. Only ten per cent of the population of India is literate; until that percentage can be doubled or trebled, natives of the country must remain poor in purse and in intellect.

RHODES scholars in residence at Oxford in 1934-35 numbered 191, namely, 99 from the British Empire, 88 from the United States and 4 from Germany. They were distributed among the various fields of study as follows: natural science and medicine 57, philosophy, politics and economics ('Modern Greats') 46, law 33, English 14, modern history 13, mathematics 7, *Litt. Hum.* 6, modern languages 5, economics 5, geography 3, theology 1, forestry and rural economy 1. A list of degrees, honours and distinctions won includes the names of 65 scholars from the British Empire (Canada and Newfoundland 20, South Africa 21, Australia and New Zealand 21, West Indies 3), 53 from the United States and 3 from Germany (2 B.Litt. degrees in social sciences and one diploma in economics and political science). Of the seventeen who obtained distinctions in law studies, all except two were from America.

## Science News a Century Ago

### Polarisation of Heat

WRITING to Whewell on February 2, 1836, J. D. Forbes said: "I cannot help writing two lines in a hurry to tell you that I succeeded yesterday in making the most curious discovery respecting heat, it seems to me, that I have yet arrived at, and one quite decisive of the identity of its character with that of light. I found that dark heat is copiously reflected within rock salt at an angle too great for its emergence. This I had foreseen last summer before I was aware that Melloni had actually tried it, and at the same time I conceived the possibility of trying whether two total reflections would produce the same effect in the case of heat as in that of light. I have had a Fresnel's rhomb made of rock salt with angles of  $45^\circ$ —one of the critical ones, nearly, calculated by this formula, giving  $\mu$  its proper value for light. I placed it between polarizing and analysing plates of mica, as described in my last. When the plane of total reflection coincided with that of primitive polarization, or rather was perpendicular to it, the heat was as much polarized as before the rhomb was interposed; when it was inclined  $45^\circ$  it was wholly unpolarized, apparently, or even the longer axis of the ellipse turned a little the other way corresponding to  $\mu$  for heat. This I made out even with a very imperfect rhomb, and with heat wholly unaccompanied by light. . . ."

### Challis becomes Plumian Professor at Cambridge

ON February 2, 1836, the Rev. James Challis succeeded Airy as Plumian professor of astronomy and experimental philosophy and as director of the observatory at Cambridge. The fourth son of John Challis, he was born at Braintree, Essex, on December 12, 1803, and educated at Mill Hill School. In 1821 he entered Trinity College, Cambridge, as a sizar and in 1825 was senior wrangler and Smith's prizeman. Ordained in 1830, he was made rector of Papworth Everard, Cambridgeshire, the living of which he held until 1852, though from 1836 onward for many years he resided at the Observatory, Cambridge. His earliest astronomical paper was one on the extension of Bode's law to the case of the satellites of the planets, read to the Cambridge Philosophical Society in 1828. He resigned the directorship of the Observatory in 1861, while retaining his professorship, and died at Cambridge on December 6, 1882.

### Progress of Colonel Chesney's Expedition

ON February 2, 1836, *The Times* said: "We have intelligence of Colonel Chesney up to the 10th December. The hopes that were entertained of the speedy equipment of the expedition and the sailing has not been realized, and matters are represented as beginning to wear rather a gloomy aspect. One boat has been launched, but the heavy materials of the others, on the passage from Aleppo to Bir, had got grounded, and great difficulty was experienced in procuring other means of transport. One of the officers had been despatched to Ibrahim Pascha's headquarters, to ask his assistance in this difficulty, and had met with a most friendly reception. . . ."

## Murchison on Erratic Blocks

At a meeting of the Geological Society held on February 3, 1836, presided over by Lyell, Murchison read a memoir on the gravel and other ancient detritus of the eastern and southern counties of Wales and the border counties of England. The detritus of Herefordshire, the southern part of Shropshire and the Welsh counties, he said, was of local origin, the whole of its materials being referable to the formation of which the district consists. On the other hand, the detritus spread over a considerable portion of Lancashire, Cheshire and the north of Shropshire contained large blocks of granite, porphyry and greenstone, not referable to any rocks *in situ* in those counties, but which had been traced to the mountains of Cumberland. He entered into an examination of the condition of the surface at the time when the boulders were transported, the agents by which the transport was effected, and the means by which the blocks attained their relative altitudes.

## A Character Sketch of Sir Humphry Davy

WHEN the "Memoirs of the Life of Sir Humphry Davy, Bart." by his brother John Davy appeared, a reviewer in the *Athenæum* of February 6, 1836, said: "We knew Sir Humphry Davy: he was one of the most various and accomplished men of his time. In science he stood nearly without a rival; he was an elegant and observing writer; a poet of some powers, and his manners were graceful and winning. . . . He differed from most of his scientific brethren in breadth of character, and also in the easy and courteous way of communicating the results of his experiments, and the fruits of his studies. He was indeed, in almost all things, the opposite of those scientific bores, who, proud of some trivial discovery, seem giants in their own esteem, and talk contemptuously of all other pursuits. It was even more pleasant to go astray in speculation with him, than to go right with some others of his brethren. . . . Poetry brightened his science, and enabled him to soften her severities, and render her acceptable to lovers of beauty as well as the followers of truth."

## Societies and Academies

## LONDON

Royal Society, January 23. H. CARMICHAEL: The nature of large cosmic-ray bursts. Cosmic-ray bursts have been investigated at sea-level with a large (175 litre) ionisation chamber. The results of 1,500 hours observation are given. A new sensitive quickly responding electrometer was used, and also a new method of recording, such that bursts of all sizes above the lower limit set by the normal fluctuations of the ionisation current were measurable. Experiments were made with different gases in the ionisation chamber and with several thicknesses of lead from 0 cm. to 8 cm. above the chamber. The result of the former experiments was used to complete the experimental evidence necessary to establish that the bursts are produced by thinly ionising particles such as are found in cosmic-ray showers in the Wilson chamber, and the result of the latter experiments shows that the large bursts of 160 to several thousand ionising rays are almost certainly complex examples of the

shower-phenomenon. H. LONDON: An experimental examination of the electrostatic behaviour of supra-conductors. The question, whether in a supra-conductor the lines of electric induction terminate discontinuously in surface charges or whether they penetrate a thin layer of the supra-conductor, was undecided. It has now been decided experimentally in favour of the surface charges by the measurement of the capacity of a supra-conducting condenser. Accordingly  $E=0$  is valid in stationary conditions even in surface regions of the order of magnitude of  $10^{-7}$  cm. The measurements were carried out with a very low measuring voltage in order to exclude disturbances due to a possible electric threshold value.

## DUBLIN

Royal Irish Academy, November 30. H. G. LEASK and LIAM PRICE: The excavation and survey of a megalith at Labbacallee, Co. Cork. The excavation of a long wedge-shaped cist with two chambers is described. Skeleton remains and fragments of pottery of two types were found. The monument is unlike any other known in Ireland or Great Britain, but resembles in some points the long galleries found in France in the basin of the Seine and Oise.

December 9. A. W. CONWAY: Integrals of MacCullagh's equations. The equations of propagation of light through a biaxial crystal were given by MacCullagh in 1839 (*Trans. Roy. Irish Acad.*, 21.) The same equations were given by Maxwell in 1865. The integrals for plane waves were given by MacCullagh and no other particular integrals seem to have been found. In this paper, various special types of integrals are given.

## PARIS

Academy of Sciences, December 23 (*C.R.*, 201, 1301-1444)\*. JOSEPH MALETTE: The use of coloured reagents for the microscopical observation of carbon steels. The etching solution proposed contains nitric acid, ammonium molybdate (or vanadate or uranate) and alcohol. Each constituent of the steel, except carbon, takes on a distinctive colour. MME. PAULINE RAMART-LUCAS and JOSEPH HOCH: The structure and absorption of the benzo-cyclanone oximes. MME. ZINA SOUBAREW-CHÂTELAIN: Mannito-dimolybdic acid and the variations of pH determined in molybdic solutions by the addition of sugar. The formation of the mannito-dimolybdic acid, described by the author in an earlier communication, is shown to account for the changes in pH described by Pierre Thomas and Mlle. Kalman. JEAN DESMAROUX, ROBERT VANDONI and Mlle. THÉRÈSE PETITPAS: The absorption of cyclopentanone by nitrocellulose. CHARLES DUFRAISSE and LÉON VELLUZ: The dissociable organic oxides. The naphthacenic formula of the rubenes. Synthesis of 9.10.11.12-tetraphenyl-naphthacene: its identity with tetraphenylrubene (formerly known as rubrene). HENRY GAULT: The flameless combustion of liquid combustibles with low vapour pressures. Description and diagram of an apparatus capable of burning completely heavy oils or tars. JOSEPH WIEMANN: A new methylhexite. Vinylpropenylglycol, oxidised with a solution of silver chlorate in the presence of osmic acid, gives a new methylhexite, the properties of which are given.

\* Continued from p. 162.

PAUL WOOG and N. YANNAQUIS : The orientation of the molecules of beeswax. Results of an X-ray examination of beeswax. ANDRÉ VATAN : Spongolites and silicified gypsum in the upper Eocene of Berry. ERNEST CHAPUT : The Tertiary folds of Central Anatolia. GEORGES EMELIANOFF : The bauxites of Lika (Yugoslavia). LOUIS LONGCHAMBON : The bitumenous schists of Saulx-de-Vesoul. A map is given showing the position of the borings. The thickness varies from 2.5 to 33 metres, the yield of oil from 4.6 to 6.3 per cent with an average of 4.9 per cent. Mlle. BERTHE DELAPORTE : Researches on the cytology of the intestinal bacilli of the tadpole. ALBERT MAIGE : The amylogen capacity and organic mass of plants. HENRI COLIN : Inulogenesis in the Compositæ. DENIS BACH and JEAN FOURNIER : The absorption of oxalic acid by *Aspergillus repens*. Oxalic acid, in spite of its high toxic power for fungi, can be absorbed in considerable quantities by *A. repens*, provided that the acid is in the ionic form. Oxalic acid in non-ionised form gave negative results. JOSEPH BOUGET : The potato reproducing itself spontaneously without cultivation. PIERRE JOLIBOIS, H. BURGEVIN, G. GUYON and ANDRÉ BOULLÉ : The fertilising value of the different forms of phosphoric acid. PIERRE CHEVEY : The presence of the genus *Anguilla* in French Indo-China. PIERRE DRACH : The phenomena of resorption in the endoskeleton of the short-tailed decapods in the course of the period preceding casting the skin. MME. LUCIE RANDOIN and FRED MILHAUD : The utilisation of sugars: the B vitamins and food equilibrium. The utilisation of certain sugars (glucose, saccharose, lévulose) depends on the presence of B vitamins in sufficient quantity in the food ration. ANTOINE MAGNAN and CLAUDE MAGNAN : Contribution to the study of the propulsion of fishes. J. ANDRÉ THOMAS : Biochemical attempts at the experimental transformation *in vitro* of cells into histiocytes. G. BARAC : The spectrometric determination of phenol (C<sub>6</sub>H<sub>5</sub>OH) added to urine. The ultra-violet spectrographic method, previously shown to be applicable to ordinary phenol in aqueous solution, in plasma and blood, is now shown to be capable of giving accurate results with urine. ANGEL H. ROFFO and A. E. ROFFO : The radiations emitted by cholesterol after irradiation by the sun or by ultra-violet rays. Irradiated cholesterol emits a radiation, a spectrogram of which is reproduced. A blank experiment with non-irradiated cholesterol gave no radiation. ALBERT GORIS and HENRI CANAL : On a 2'.6'-dioxy-4'-methoxy-β-phenyl-propionophenone extracted from the essence of *Populus balsamifera*. MAURICE LEMOIGNE, PIERRE MONGUILLON and ROBERT DESVEAUX : The presence of compounds of hydroxylamine in the fresh leaves of the higher plants. Evidence in favour of the existence of various compounds of hydroxylamine in green leaves. It is suggested that this substance takes part in the nitrogen metabolism of the higher plants. MAURICE DOLADILLE : Contribution to the study of the dispersing property of the blood serum in relation with its alexic power. MME. HELENE SPARROW : Attempts at immunisation with Tunis *virus murin* I, introduced by the nasal passage. JEAN CUILLE, PAUL LOUIS CHELE and FRANCIS BERTUREAU : The identity of the French and Algerian bovine anaplasmosis. Cattle after recovery from French anaplasmosis are immune from the Algerian virus. The two parasites are identical, *Anaplasma marginale*.

## AMSTERDAM

Royal Academy (*Proc.*, 38, No. 9, November 1935). W. H. KEESOM and B. G. DAMMERS : Construction of platinum thermometers and the determination of their basic points. (2) Comparison of some platinum thermometers with the helium thermometer between 0° and -183° C. Experiments to relate the international temperature scale to that of the helium thermometer. J. DE GIER and P. ZEEMAN : Isotopic constitution of iron. There are four isotopes, 54, 56, 57 and 58, with percentage abundance 6.5, 90.2, 2.8 and 0.5 respectively. D. COSTER and F. BRONS : Dissociation energy of CO. A value 8.41 volts is deduced for the dissociation energy of CO from an investigation of the rotational structure of the fourth positive group and the general energy level system. A. A. NIJLAND : Mean light curves of long-period variables. (25) V20=ST Cygni. The light of this star varies with a period of 334 days and an amplitude of 3.64 magnitudes. F. M. JAEGER and J. A. VAN DIJK : Some complex dipyrindyl salts of nickel and copper. Crystallographic data. E. COHEN and J. J. A. BLEKKINGH, jun. : The influence of the degree of dispersion on physico-chemical constants (5). The density of crystals of salicylic acid is the same within 1 in 5,000 whether they are 0.01 mm. or 1.0 mm. in diameter. F. A. H. SCHREINEMAKERS and J. P. WERRE : An osmotic complex with two stationary liquids. C. U. ARIËNS KAPPERS : The degree of the changes in the cephalic index correlated with age and environment. P. J. HARINGHUIZEN and D. A. WAS : Research on thin layers of tin and other metals (1). The influence of thin metal layers on the deterioration of technical insulating oils. V. HLAVATY : Conformal geometry. (3) Application to the theory of curves. J. BENTEMA : Crystal structure of cerium tungstate. (2) Crystal structure and the composition of sodium dihydropyrostibiate. W. KLEIN : The degree of the developmental changes in the length-breadth index of the head of Dutch Askenasim Jews. G. STIASMY : The tornaria of the Snellius Expedition. Description of the finds of this expedition to the waters of the Dutch East Indies. N. POSTMA : Tonus phenomena in the foot of the snail (*Helix pomatia*). S. M. BERGGREN : Anatomical study of a case of unilateral section of the *Brachium conjunctivum cerebelli* in the dog, with remarks concerning the existence of cerebellopetal fibres in this brachium.

## CRACOW

Polish Academy of Science and Letters, December 2. L. MALIS and W. JACYNA : The law of action and thermodynamic reaction. K. SMOLENSKI : The acid saponin of the beetroot. This saponin from the juice of the sugar beet on hydrolysis gives a glycuronic acid and the resin acid of beet, C<sub>22</sub>H<sub>36</sub>O<sub>2</sub>. K. SMOLENSKI and W. ZERO : The solubility of lime in water and in sugar solutions. J. NOWAK and J. ZERNDT : The tectonic of the eastern portion of the Polish coal basin. T. DOMINIK : Contribution to the study of the microscopic fungi of western Poland. Mlle. O. SEIDL : (1) The prehistoric species of charcoals and fruits detected in the tumulus east of Radziejow, near Pinczow. The charcoal, probably from ritual fires, arose from oak, pine and birch; the fruits were from *Lithospermum officinalis*. (2) The different species of charcoal and of wood found in some prehistoric remains. Z. GRODZINSKI and J. MARCHLEWSKI : Mobility of the spermatozooids of the cock outside the organism. T. GARBOWSKI : Contributions to the ethnology and to the psychology of certain Hemiptera.

## Forthcoming Events

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

## Monday, February 3

VICTORIA INSTITUTE, at 4.30.—Colonel A. Kenney-Herbert: "The Problem of the Great Pyramid".

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Bradford Washburn: "The Harvard-Dartmouth Alaskan Expedition, 1932-34".

SOCIETY OF ENGINEERS, at 6.—(at the Geological Society, Burlington House, W.1).—Inaugural Meeting. N. Hoskins: Presidential Address.

## Wednesday, February 5

IMPERIAL COLLEGE—ROYAL SCHOOL OF MINES, at 5.30.—S. J. Wright: "The Engineer's Contribution to Agricultural Engineering" (succeeding lectures on February 12 and 19).\*

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION), at 6.—Dr. V. K. Zworykin: "Electron Optical Systems and their Applications".

## Friday, February 7

GEOLOGISTS' ASSOCIATION, at 7.30.—(at University College, Gower Street, W.C.1).—Dr. G. B. Barbour: "The Peking Man Discoveries".

ROYAL INSTITUTION, at 9.—Prof. A. S. Eve, F.R.S.: "Northern Lights".

## Official Publications Received

## Great Britain and Ireland

- Board of Education: Science Museum. Catalogue of the Watt Bicentenary Exhibition (December 1935-April 1936). Compiled by A. Stowers. Pp. 40. (London: H.M. Stationery Office.) 9d. net. [71]
- Board of Trade. Statistical Abstract for the British Empire for each of the Ten Years 1925 to 1934 (Trade and Commerce Section). (Cmd. 5016.) Pp. xv+217. (London: H.M. Stationery Office.) 3s. 6d. net. [71]
- Imperial Bureau of Plant Genetics. Vernalization and Phasic Developments of Plants. (Bulletin No. 17 of the Imperial Bureau of Plant Genetics: Herbage Plants and Occasional Publication of the Imperial Bureau of Plant Genetics, for Crops other than Herbage.) Pp. 152. (Aberystwyth: Imperial Bureau of Plant Genetics; Cambridge: School of Agriculture.) 10s. [91]
- British Industries Fair, 1936, Olympia and White City, London, February 17th to 28th. Organised by the Department of Overseas Trade. Special Overseas Advance Edition. Pp. xvi+496+Ad. 164+Ad. xlii. (London: Department of Overseas Trade.) 1s. [101]
- Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1659 (T. 3569): Split Flaps and other Devices for facilitating Landing. By S. B. Gates. Pp. 12+13 plates. 1s. 3d. net. No. 1665 (T. 3560): Rolling and Yawing Moments on Half Wings with various Modifications of Wing Tips. By D. H. Williams. Pp. 6+14 plates. 1s. net. No. 1664 (T. 3634): Note on Boundary Layer Flow. By H. B. Squire. Pp. 12+4 plates. 9d. net. No. 1667 (Strut 242): A Distribution Method of Stress Analysis. By Prof. J. F. Baker and A. J. Ockleston. Pp. 75. 3s. 6d. net. (London: H.M. Stationery Office.) [131]
- University of London Council for Psychological Investigation. Bulletin 2: A Report on Two Experimental Fire-Walks. By Harry Price. Pp. 15+20 plates. (London: University of London Council for Psychological Investigation.) 5s. net. [141]
- University of Birmingham: Executive Board of Mining Research. Report on the Work of the Mining Research Laboratory during the Fifteen Months ended 31st March 1935. Pp. 21. (Birmingham: The University.) [151]
- The University of Leeds: Department of Coal Gas and Fuel Industries (with Metallurgy). Report of the Livesey Professor (John W. Cobb) for the Session 1934-35. Pp. 11. (Leeds: The University.) [161]
- The British Electrical and Allied Industries Research Association. Fifteenth Annual Report, October 1, 1934, to September 30, 1935. Pp. 129. (London: British Electrical and Allied Industries Research Association.) [231]
- London Health Services. An Extract from the Sixteenth Annual Report of the Ministry of Health, 1934-35. Pp. 58. (London: H.M. Stationery Office.) 1s. net. [231]
- ULAWS (The University of London Animal Welfare Society). Ninth Annual Report, 1st July 1934 to 30th September 1935. Pp. 32. (London: University of London Animal Welfare Society.) [231]

## Other Countries

- Lac and the Indian Lac Research Institute. By Dorothy Norris, P. M. Glover and Dr. R. W. Aldis. Second edition. Pp. vi+66+15 plates. (Nankum: Indian Lac Research Institute.) 2.8 rupees. [71]
- Year Book, American Amaryllis Society, 1935. Vol. 2. Dedicated to Theodore L. Mead. Pp. 162. (Winter, Fla.: Wyndham Hayward, Secretary, American Amaryllis Society.) [71]
- U.S. Department of the Interior: Geological Survey. Professional Paper 178: Geology and Ore Deposits of the Montezuma Quadrangle, Colorado. By T. S. Lovering. Pp. ix+119+40 plates. 1.25 dollars. Water-Supply Paper 676: Geology and Ground-Water Resources of Atascosa and Frio Counties, Texas. By John T. Lonsdale. Pp. v+90+8 plates. 35 cents. (Washington, D.C.: Government Printing Office.) [71]
- Spisy vydávané přírodovědeckou fakultou, Masarykovy University. Čís. 206: A Climatic Map of Czechoslovakia according to Köppen's Classification. By Bohuslav Hrudíčka. Pp. 5+1 map. Čís. 207: Fallacies of Anthropological Identifications and Reconstructions; a Critique based on Anatomical Dissection. By Prof. V. Suk. Pp. 18. Čís. 208: K otázce baltského jara (Les remarques sur le printemps baltique). Napsal Fr. Kolářek. Pp. 25. Čís. 209: Über Moravioidrilus pygmaeus n.g.n. sp., Rhyacodrilus falciformis Br., Hydrolilus bavaricus Oschm. und Bothrioneurum vejvodskyanum St. Von Sergej Hrabě. Pp. 19. Čís. 210: Über die Beziehung zwischen den physikalischen Eigenschaften der Hydrate und ihrem Wassergehalt. Von V. Rosický and J. Kokta. Pp. 17. Čís. 211: Příspěvky ku krystalografii Moravského barvty (Beiträge zur Kristallographie des mährischen Barytes). Napsala Božena Bobková. Pp. 15. Čís. 212: Recherches sur la courbure des surfaces dans les espaces à  $n$  dimensions à courbure constante, II. Par O. Borůvka. Pp. 20. Čís. 213: Endokrine hautdrüsen von *Syndiamesa braniczi* Now (Chironomidae). Von J. Zavřel. Pp. 18+1 plate. Čís. 214: Recherches sur la courbure des surfaces dans les espaces à  $n$  dimensions à courbure constante, III. Par O. Borůvka. Pp. 25. Čís. 215: Spongilitové horniny české křfdy, Díl 1 (Die Spongilitischen Gesteine der böhmischen Kreide, Teil 1). Napsal Břetislav Zahálka. Pp. 22+6 plates. Čís. 216: Dynamická metoda pro měření gravitačního pole zemského (Dynamische Messmethode des gravitationsfeldes). Napsal Josef Zahradníček. Pp. 19. Čís. 217: Spongilitové horniny české křfdy, Díl 2 (Die spongilitischen Gesteine der böhmischen Kreide, Teil 2). Napsal Břetislav Zahálka. Pp. 17+2 plates. Čís. 218: Akustiká měření na píšťalách metodou interferenční (Akustische Messungen an Lippenpfeifen Mittels der Interferenzmethode), napsal Tadeáš Gajdoš; Měření na jazýčkových píšťalách (Einige Messungen an den Zungenpfeifen), napsal Josef Žák. Pp. 24. (Brno: A. Piša.) [71]
- Spisy lékařské fakulty Masarykovy University. Svazek 14, Spisy 132-138. Pp. 9+12+31+15+41+28+72. (Brno: A. Piša.) 30 Kč. [71]
- Zprávy komise na Přírodovědecký výzkum Moravy a Slezska, Oddělení mineralogické, Č. 6: Moravská síra, její původ a nerosty s ní sdružené. Napsal Dr. Jos. Sekanina. Pp. 29. (Brno: A. Piša.) [71]
- Cold Spring Harbor Symposia on Quantitative Biology. Vol. 3. Pp. xv+359. (Cold Spring Harbor, L.I.: Biological Laboratory.) [81]
- Field Museum of Natural History. Geological Series, Vol. 6. No. 14: The Question of Living Bacteria in Stony Meteorites. By Sharat Kumar Roy. Pp. 179-198. (Chicago: Field Museum of Natural History.) 20 cents. [101]
- Dominion of Canada: Department of Marine: Meteorological Service of Canada. Canadian Meteorological Memoirs, No. 1: The Climate of the Gulf of St. Lawrence and surrounding Regions in Canada and Newfoundland, as it affects Aviation. By W. E. Knowles Middleton. Pp. 40. (Ottawa: King's Printer.) [131]
- Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 87. An Annotated List of Two Collections of Guatemalan Birds in the Academy of Natural Sciences of Philadelphia. By M. A. Carriker, Jr., and Rodolphe Meyer de Schauensee. Pp. 411-455. (Philadelphia: Academy of Natural Sciences.) [131]
- Proceedings of the American Academy of Arts and Sciences. Vol. 70, No. 5: Studies in the Bromeliaceae, 6-1, Preliminary Records; 2, Synopsis of the Tribe *Tillandsieae*, Part 2. By Lyman B. Smith. Pp. 147-220+4 plates. 1.35 dollars. Vol. 70, No. 6: An Ancient Chinese Alchemical Classic—Ko Hung on the Gold Medicine and on the Yellow and the White. The Fourth and Sixteenth Chapters of Pao-p'u-tzú translated from the Chinese by Lu-Ch'iang Wu. With an Introduction, etc., by Tenney L. Davis. Pp. 221-284. 1.25 dollars. (Boston, Mass.: American Academy of Arts and Sciences.) [131]
- Zoologica. Vol. 19, No. 6: The Fishes of Union Island, Grenadines, British West Indies, with the Description of a New Species of Star-gazer. By William Beebe and Gloria Hollister. Pp. 209-224. (New York: New York Zoological Society.) [131]
- New Zealand: Department of Lands and Survey. Annual Report on Public Domains and National Parks of New Zealand. Pp. 12. (Wellington: Government Printer.) 6d. [141]
- Ministère de l'Éducation nationale. Enquêtes et documents relatifs à l'enseignement supérieur. 128: Rapports sur les Observatoires astronomiques de Province et les Observatoires et Instituts de Physique du Globe, Année 1932. Pp. 123. (Paris: Imprimerie Nationale.) [151]
- Republique Française: Présidence du Conseil: Statistique générale de la France. Statistique du mouvement de la population. Nouvelle Série, Tome 12, Année 1932. Partie 2: Les causes de décès. Pp. xlii+287. Annuaire statistique. Vol. 50, 1934. Pp. xi+360+512. Enquêtes annexes du recensement de 1931. Enquête industrielle. Pp. 87. (Paris: Imprimerie Nationale.) [151]
- Proceedings of the California Academy of Sciences, Fourth Series. Vol. 23, No. 1: Cretaceous Geology of Lower California. By Frank M. Anderson and G. Dallas Hanna. Pp. 34+11 plates. (San Francisco: California Academy of Sciences.) [171]
- Publications of the Astronomical Observatory of the Warsaw University. Vol. 10: Determination of Latitude by the Method of Equal Altitudes of different Stars (Piewzowski's Method) and the corresponding Star-pairs for Northern Latitudes 20°-40° and for the Epoch 1930-0. Vol. 2: Northern Latitudes 25°-30°. By Prof. M. Kamiński, with the collaboration of T. Karpowicz and L. Zeidler. Pp. 44. (Warsaw: Astronomical Observatory.) [221]