

Editorial & Publishing Offices :

MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2



Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

No. 3512

SATURDAY, FEBRUARY 20, 1937

Vol. 139

Oxford and Present Needs in Science

FOR some time, the University of Oxford has been faced with the task of finding £500,000 for pressing needs, largely connected with the extension of Bodley's library and prospective science and other buildings. It recently launched an appeal for help to its friends in Great Britain, in the Dominions and in the United States. The sum it is hoped to collect is about £1,000,000. Great trouble has been taken privately to make the need known to those capable of helping, and there is good hope that industry (now flourishing as rarely before), the surtax-payer, and the ordinary individual, between them, will find this large amount.

While it is true that those who contribute jointly the last £50,000 are most blessed of all, it is good that already the first three hundred thousand pounds have been given or are in sight. It is hoped that as much as £150,000 will come from North America, despite the damage due to the Mississippi floods, which rightly makes a first claim on much of American generosity. The needs for this appeal are, of course, quite independent of those so handsomely met by Lord Nuffield last year for the school of clinical research. They are very different needs and needs of long standing; they cannot even indirectly be met out of the £2,000,000 provided by him. Lord Nuffield has recognized this point by generously subscribing a separate £100,000 to the present appeal.

The money received is to be administered by a trust, so that it will be guarded from inroads for 'general purposes', and devoted to the needs set out in the appeal. The extension of the Bodleian library will be the first charge on the fund; the alteration or erection of buildings, mainly science buildings, will be the second. The rest of the

money is to be used as capital or interest for developing research in any subject at all that looks promising, except such part of it as may have been earmarked at the wish of contributors. Oxford, while still highly cherished in our affections, is a changed place from the old days. It is now largely a University for the hard-working, middle-class student. Higher study and research have never been more ardently pursued over a wide field. In pure science for many years Oxford has done a large quantity of excellent work. With increased endowments for material in the physical sciences, and for men in the biological sciences, it could do much more without attempting to become a second Cambridge.

The most urgent of the scientific needs is a new physics building for Prof. F. A. Lindemann. His department has grown rapidly of recent years and latterly has become almost intolerable in the Clarendon Laboratory, now more than seventy years old. Within the next three or four years it is proposed to erect nearby in the Parks a new physics institute, equipped for the studies now being prosecuted there, and to adapt the vacated building for the Department of Geology. That department has had to exist in cramped quarters within the University Museum, which dates from 1860, and has suffered in recent years from the lack of leadership of its late head, who was in office until he was nearly ninety years of age. In the ampler space of the Clarendon Laboratory, with increased endowment, and with a new professor to be elected this term, this department should again take its rightful place in the University.

The second great need is for a University Institute of Physical Chemistry. There is at present no such place. For years the whole of the

teaching and most of the research in this subject has been done in the college laboratories and cellars of Balliol, Trinity and Jesus Colleges. A fine spirit has been shown there and excellent work done—more, perhaps, than in many a university department with proper staff and ungrudged grants for material. But college laboratories are now at best makeshifts, rich only in improvisation. They are neither well endowed nor well equipped. They are small; not everyone is free to enter them and work there.

A new University building properly equipped and endowed is imperative, and it is fitting that Prof. C. N. Hinshelwood, who has succeeded Prof. Frederick Soddy as Dr. Lee's professor of inorganic and physical chemistry and is a leader of physical chemistry, should have as his place a proper official laboratory in which scattered researchers in this subject, collected from various parts of college and University buildings, may find a home. It is proposed to put up the building in the next four or five years in the Parks next to the Organic Chemistry Laboratory, if funds earmarked for it are forthcoming.

These are the immediate needs. Next comes that of the Physiology Laboratory, which some day

must be rebuilt. It was originally put up in 1884, and the recent growth of the medical school must soon make change in it very desirable. Something also should be done to endow the Museum of the History of Science. A donor who might jib at seeing his comparatively modest contribution swallowed up in the general total might like to individualize it by helping this institution, which does good work on an exiguous income. It saves for the studies of future generations apparatus and other objects of historical value which might easily be lost in the midst of change.

Mention must also be made of the need for an extension of the Ashmolean Museum and for funds for archaeological research, and, what is likely to be of far-reaching significance in the future, for research in the study of human society, social studies and allied subjects such as anthropology.

It is announced that the appeal has already produced a response averaging £2,000 a day. The promotion of the welfare and influence of the University of Oxford is worthy of the support of all who are concerned for the progress of learning in the present somewhat distracted state of world affairs.

Inter-Imperial Co-operation in Scientific Research

AS already pointed out in the leading article in *NATURE* of November 7 last (p. 777), the proceedings of the British Commonwealth Scientific Conference were mainly concerned with inter-Imperial co-operation in supplying bibliographical information on the sciences relating to agriculture. Co-operative research in certain subjects was, however, suggested by various delegations from the countries represented. Sections of the report of the proceedings recently issued (Cmd. 5341. London: H.M. Stationery Office, 1937. 1s. 3d. net) deal briefly with such subjects of wide Empire interest as the transport and storage of foodstuffs, the control of insect infestation of stored products, the properties and utilization of wool, the collection and maintenance of plant material for crop improvement, and the control of damage by termites.

The Conference recommends that the contributions of overseas Governments to the Food Investigation Board of the United Kingdom should continue to be a matter for arrangement

between the individual Governments interested in the transport and storage of foodstuffs, and that Governments should continue, pending further consideration, the payments they are making for work on wool at the Wool Industries Research Association's station at Torridon, Leeds. It also recommends that the Farnham House Laboratory of the Imperial Institute of Entomology be continued on an inter-Imperial basis by the countries interested in the control of insect pests by the use of parasites of these pests (so-called 'biologic control'), so as to maintain a small nucleus staff. Additional staff to deal with specific problems will be paid for by fees as occasion arises. Though stating that this method of controlling insect pests is still in its infancy, no reference is made to the need for research into it; the aim is to bring the cost of maintaining the Laboratory into close relation to the specific (applied) services demanded of it.

Similarly, in considering the work—largely pioneer work—on the control of insect infestation

of stored produce carried out at Slough at the Stored Products Research Laboratory of the Imperial College of Science and Technology, the Conference, while recording its appreciation of the work, notes that in future the contributions from Empire countries towards general expenses will cease, and special inquiries will be paid for by fees; no inter-Imperial finance for research on this subject is suggested. No recommendations for financial co-operation on the various other subjects

of wide interest discussed were made, beyond those included in the provision of bibliographical services and in the identification work of the Institutes of Entomology and Mycology.

Co-operation in scientific research, jointly financed on an inter-Imperial scale is, at the moment, in abeyance. It seems likely to remain so until its scope can be more clearly defined by the men of science concerned, and its planning entrusted to them.

Birds of the Greek Classics

A Glossary of Greek Birds

By D'Arcy Wentworth Thompson. (St. Andrews University Publications, No. 39.) New edition. Pp. viii + 342. (London: Oxford University Press, 1936.) 12s. 6d. net.

THE first edition of this book was published forty years ago, and the author tells us that it is fully fifty since he began to write it. It is the work of a Greek scholar of wide knowledge and immense reading, as well as an expert naturalist. More, much more, than fifty years ago, he says in his preface, his father taught him that many a Greek word or name of a hero was foreign to Aryan speech. The merchant and the mariner had brought strange words home from overseas, and many a beast and bird and hill and river had kept its pre-hellenic name. Many old names of birds and fish are recorded by Italian scholars from the rich dialects of Italy, and new light is thrown hereby on obscure Greek and Latin words.

The author quotes in his preface a series of names of birds with strange non-Greek (probably Phœnician) names which, save one exception, it is difficult to identify with their present modern Greek names, or even to prove by their actual existence. What is, for example, *σελευκίς*, *τίτυγξ*, *σοῦσφα* or *τάνταλος*? *ὄρνυξ* however, and *πέρδιξ*, differ very little from their present names and the foreign traveller who would designate them, as many of the other Greek birds, by their ancient name to a Greek peasant would be easily understood by him—unless the pronunciation was the Erasmian one or his accent too foreign.

So far as I can judge, the glossary of the names of birds in the book seems to be very complete, and the reader is amazed by the profusion of quotations from ancient authors—naturalists, historians, or poets, representing the reading and

filing of a whole lifetime indeed. The mention of the corresponding names in the modern Greek language is extremely accurate, except in a few cases, where Prof. D'Arcy Thompson has been led into error by foreign observers describing Greek birds. For example, the neutral in modern Greek does not use the terminal syllable *ον* of earlier forms (ancient Greek or Byzantine), so that the modern name cannot be *ὄρνυκιον* or *παγώνιον* but is *ὄρνυκι* and *παγώνι*. Heldreich, from whom the author quotes, was a naturalized German, and was influenced by the ancient grammatical forms, or he heard the names from Greek purists who thought it probably more elegant to use classical forms instead of the popular ones, especially when informing foreigners. Such lapses, however, are rare and unimportant, and the correct forms are also mentioned by the author.

Ancient Greek literature, descriptive as well as imaginative, is luxuriously rich in its references to birds. Prof. D'Arcy Thompson borrowed lavishly from it, and I think that no quotation worthy of being referred to has been missed. Thus we have in the book a real treasure of quotations, which can be enjoyed by the naturalist as well as the scholar or the ordinary reader. Since the first edition of the book, the author has been able even to enlarge and to complete them. The whole romance of the life of Greek birds is displayed here in the etymology of their names (sometimes unknown, disputed or obscure), in epithets and phrases from authors or poets, in their description, nesting and migration, or with reference to mythical and legendary traditions connected with them. Some of the latter are really fascinating, and it is interesting to see them sometimes perpetuated to-day among the Greek people.

One of the most captivating chapters of the book is the long one devoted to the swallow, the bird of the returning spring, or as Sappho sings,

"who brings again the new beauty". Superstitions are still connected with the bird. Modern Greeks are not reputed as bird-loving people, and it is probable that some of the species mentioned in the glossary have disappeared from the country. The swallow, however, remains the favourite bird. Lucky is the house chosen by it for nesting when the spring comes! It is a good omen. A daughter will marry during the year, or the mother will give birth to a male child—female ones being not generally welcome in Greek families, owing, I suppose, to the dowry to be paid when they are of age to be married. It would be curious to verify whether the swallow ever stays, as recorded by Pausanias, to nest in Daulis (now Davlia), the country of Tereus.

The hoopoe or hoope-bird, which persecutes the swallows (the Ἑπόψ of ancient Greeks), plays an important part in the Aristophanean play and boasts there that he and his companions live "by grazing in the gardens on the white sesame, the myrtle, the poppy, and the mint". There are in the very obscure Tereus myth, as Prof. Thompson remarks, frequent indications of confusion between hoopoe and cuckoo, and the 'metamorphosis' is in part connected with the resemblance between the cuckoo and the hawk. In spite of confusions, the modern Greek τσαλαπετεινός is to be identified with Ἑπόψ and is too the ἀγριοκόκορας, found on Mount Taygetus.

To revert to the swallow, as I mentioned in an article on "Classical Aspects in Modern Greece" in the October issue of the *Quarterly Review*, I cannot affirm from personal experience that the charming and ever-young song of the swallow, preserved by Athenæus, survives until to-day, but reliable witnesses report that children in villages still sing it, scarcely altered, as they carry round a wooden swallow to announce the coming of spring.

Modern Greeks are not at all respectful of the sacred bird of the goddess patron of Athens, symbolizing her wisdom. Not only has the beautiful ancient word γλαυξ, so strikingly reminiscent of the blue-eyed daughter of Zeus, been succeeded by the cacophonous κουκουβάγια, evidently derived from the resemblance of the ululations of the owl to the call of the cuckoo (Md. Gr. κοῦκος), but also they consider a visit from the Athenian bird to the roof of a house, flying there from its usual haunts on the slopes of the Acropolis, as a definite ill-omen. Somebody will die in the house so visited, and the superstition, more widespread in Athens than elsewhere, is confirmed by striking coincidences.

The nightingale, on the contrary, is most welcome and much cherished among Greek birds. Nightingales delight by their melodious concerts the tardy walkers wandering around the Royal

Gardens during the summer in Athens, seeking some relief from the canicular heat of the day. As a matter of fact, nightingales amply justify the ancient epithet "deprived of sleep" attributed to them.

As people believe firmly that nightingales once captured and locked in a cage cannot survive but for a short time, the bird is generally respected and free, among trees and groves; and it charms with its harmonious modulations the life of humble folk in the country as well as that of the opulent citizen enjoying the blessing of a private garden.

The

τιὸ, τιὸ, τιὸ, τιὸ, τιὸ, τιὸ, τιὸ, τιὸ, τιὸ,
τριοτὸ, τριοτὸ, τοτοβριξ

of the nightingale is really spread over all in the most democratic way.

Colonus alas! is no more the beautiful wooded hill, where according to the immortal Sophoclean song

" . . . the clear voiced Nightingale

Who hid in her bower, among

The wine-dark ivy that wreathes the vale,

Trilleth her ceaseless song";

but nightingales may be heard now even there.

It is interesting to note that in spite of the popularity of the nightingale, sweethearts are never referred in Greek folk-songs as ἀηδὼν μου. This appellation applies, in a satirical mood, to prolix orators in the Agora or elsewhere. As for terms of endearment, comparisons used in the Greek folk-songs and even in daily life, are confined to partridges (=περδικά μου), pigeons (=περιστέρα or περιστέρι μου) and turtle-doves (=τρυγὼνα μου). I must say, however, that the names of these birds in Greek have a poetical flavour unknown in the corresponding names in Western languages. Or am I influenced in this belief by the frequent use of the words in Greek folk-poetry?

The production of the new edition of "Greek Birds" by the Oxford University Press enhances the reputation of this famous printing-house—although I should prefer for the Greek text the new beautiful Greek type designed some time ago by Mr. Victor Scholderer and freely used now by the University Press. The author acknowledges gratefully the contributions made by the Carnegie Trust for the Universities of Scotland and his own University of St. Andrews for the production of the book, published by Mr. Humphrey Milford for the latter. To make easier for laymen the identification of birds mentioned in the glossary, the drawings of many of them figure in the text, and the innovation is most welcome.

DEMETRIUS CACLAMANOS.

Natural History of Glamorgan

Glamorgan County History

Vol. 1: Natural History. Edited by Prof. W. M. Tattersall. Pp. xix + 444 + 39 plates. (Cardiff: William Lewis (Printers), Ltd., 1936). 25s. net.

THIS handsome and well-produced volume is the first instalment of a projected history of the county of Glamorgan which was initiated in 1930 by the Lord Lieutenant of the County, the Earl of Plymouth. It is intended to cover the scientific interest of the county, and includes sections on the geology, climate and meteorology, soils, botany and zoology, written by voluntary workers, the whole being edited by Prof. W. M. Tattersall, professor of zoology and comparative anatomy in University College, Cardiff. This volume is to be followed by five others covering the industries, archaeology, and ecclesiastical, political, economic and parochial history of Glamorgan. The scheme adopted is more or less that of the "Victoria County History", but the material of future volumes will be treated chronologically as a whole, and not as separate sections.

The first volume now published deals with the "natural environment of the county as a background to the history of man", and Prof. Tattersall is to be complimented upon setting a standard which, if followed in subsequent volumes, and in neighbouring counties, will result in an imposing contribution to the topographical history of Wales. In Glamorgan, the geological history has an important economic aspect owing to the material resources of the county, and this practical side is not forgotten in the biological sections, which

include chapters on ornamental trees and shrubs under cultivation, and an account of the parasitic diseases to which cultivated plants and domesticated animals are subject.

In this connexion, attention may be specially directed to the section which discusses liver-rot in sheep. The distribution of four species of the primary host, *Lymnæa*, has been plotted during a period of ten years, and also the areas in which *L. truncatula*, the only important species economically, does not occur. The conditions favourable and unfavourable to this species, and its methods of migration, have been investigated. Ecological research of this character has significant bearings on the incidence of an important epizootic disease. Similarly, the survey of the soils of the area, accompanied by soil maps, is a useful contribution to the solution of the problem of soil classification. The greater part of the history, however, is devoted to the fauna and flora of the district—the work of various specialists. Besides the usual lists of species, ecological and historical notes are included, which add considerably to the usefulness of the records. This section of the work is valuable as a first attempt to assemble in print the fauna and flora of the county, but an inspection of the lists suggests that considerable additions have still to be made to them.

The volume is beautifully printed and illustrated, and there is a good index. It is to be hoped that the reasonable price which the Committee has wisely decided to adopt will ensure a wide circulation for the series.

F. J. C.

Another Dimension in Films

Colour Cinematography

By Major Adrian Bernard Klein. Pp. xi + 350 + 29 plates. (London: Chapman and Hall, Ltd., 1936.) 25s. net.

NOT all books are written by experts, in the sense that their authors know not only their special corner of their field but also what everyone else has done in that field and over a historical period of time. The present author complies with this definition for he gives valuable data respecting the system of colour cinematography in which he is most interested, and also

collects and criticizes the entire range of systems and processes tried and developed up to date.

Major Klein is right in his contention that the release colour print must be used in standard projectors without any modification of the latter, beyond the obvious necessity of using specific carbons. It may never be assumed that the projectionist will carry out arbitrary instructions, precisely and time without number; such procedure will always break down and discredit the colour system. The remarkable freedom from breakdown in cinemas has been won by adhering to the limit of standardization. It follows that

additive systems of colour cinematography are thereby ruled out, likewise two-colour systems, since not all shades can be objectively realized with a primary omission. We are left with Technicolor, Kodachrome, and Gasparcolor, the second being in use for 16 mm. film only, but has possibilities in simplifying the others for 35 mm.

The history of colour films is remarkable for the millions of pounds which has been expended on development; much of it, according to the author's contention, uselessly because of disregard of fundamental engineering limitations. The exquisite Technicolor, with its elegant, though yet secret, methods of imbibition printing, is criticized for using a key print and so causing some desaturation. The author's analysis of the complete problem, from the original lighting,

colour, design, emulsions, processing, to final projection and the reproducing light, is clear and balanced, while his knowledge of patents and other people's work is impressive.

As an extension from technicalities, the author has wisdom to offer film directors in their use of mobile colours in their work, and some pungent ideas in cutting down existing production expenses to balance the greatly increased cost of film, lighting and the colour experts which are to come. His æsthetic pronouncements are derived from years of experience with colour-music, which did not fascinate the public. In the world of art, he suggests that Rembrandt was colour-blind and that the colour-film will be perfected when the colour is so natural as not to be noticed.

L. E. C. H.

Humanistic History

A History of English Life, Political and Social
By Amabel Williams-Ellis and F. J. Fisher. Pp. xvii + 120 + 132 + 163 + 160 + xviii + xxxii + 5 plates. (London: Methuen and Co., Ltd., 1936.) 8s. 6d. net.

WE have so often in these pages deplored the absence of the scientific, popular and progressive spirit in the presentation of history, especially for educational purposes, that we hasten to welcome a new and most successful effort in the right direction. The book by Mrs. Williams-Ellis and F. J. Fisher has everything to commend it. The publishers' account on its 'jacket' does not exaggerate in the least.

The book is delightful and racily written; it gives the necessary outline of political development—all the kings and their dates are there—with a really good account of the progress of science and of the arts of living. It is most admirably and suggestively illustrated by all sorts of coloured sketches and diagrams, as well as prints and photographs. But it has more than all this, and something of still greater moment. It is inspired throughout by an intense sympathy for the life of the common people—the poor who have been at all times in history the vast majority of the population. The authors constantly insist on this, but they do it in no sense of despondency or of a desire for violent revolt. They see quite truly that the lot of the masses, which must be the main criterion of human progress, has improved immeasurably in the time and country which they review, mainly through science. They estimate England kindly but not excessively, and

introduce at every suitable place the European or world-connexions and contrasts.

It is only practised writers who can do all this so deftly. Mrs. Williams-Ellis is a novelist, and the success of the present book is another proof of what has so often been proved before, namely, that the mere possession of a mass of knowledge is not in itself any guarantee of the power of presenting it effectively to others; and that for this particular purpose—and many others—a woman has special qualities not generally possessed by men—sympathy, tact and a knack of story-telling which in this case is combined with a very unusual and truly philosophic grasp of the hang of all the parts of the great theme. The authors thus show government, industry, science and social life bound together as they really are, and they do not entirely neglect—though this is undoubtedly the minor interest—the arts of beautiful expression. It is not too much to say that the authors have done in this book for English history much the same service which Arabella Buckley did in the last generation for science, in her "Fairy Land of Science".

It would be an interesting task to pick out a few specimens of the happy sayings and picturesque figures with which the book is full. The changes which 'Old Parr' would have witnessed in his life of more than a hundred and fifty years are a good example. But we have only space to deal with the one overwhelming question which will face teachers and scholars who will turn over its pages with delight. Will it enable the pupil to pass the School Certificate Examination? The answer must be, "Probably not". But could any interesting

all-round presentation of the subject, in reasonable compass, ever hope to make its way through that barbed-wire entanglement in which our education is now confined? The final answer must be some drastic change in the system.

Everyone should know the things which are here set out with so much charm, clarity of expression, humane tendency and fair balance of interest. That might well be required from all

completing a course of general education by the age of sixteen years. For the rest, encouragement should be given to scholars with special interest to pursue further the study of special branches of history. This is the sphere to which diplomatic relations, constitutional details, plans of campaign and colonization properly belong. There also the progress of science and of technical inventions should find a leading place. F. S. MARVIN.

Absorption from the Intestine

Absorption from the Intestine

By Prof. F. Verzář, assisted by Dr. E. J. McDougall. (Monographs on Physiology.) Pp. xii + 294 + 12 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 21s. net.

THE Monographs on Physiology, published by Messrs. Longmans, Green and Co., Ltd., have performed a useful service in providing competent reviews of different aspects of a rapidly advancing subject. It is good to see that the series is to be continued under the editorship of Prof. Lovatt Evans, and it is hoped that these monographs will now appear more frequently.

Prof. F. Verzář of Basle has made many important contributions, during the last ten years, to our knowledge of absorption from the intestine. He writes with the authority of experience on nearly all aspects of this subject, and his book is fascinating to read. The first five chapters are devoted to a general discussion of the anatomy of the intestine, methods of research, and the physical and chemical forces involved. The remaining seventeen chapters are each devoted to a discussion of the absorption of one class of substance.

The author has tried to explain all the facts in terms of physico-chemical laws. In many cases he has been successful in finding plausible explanations; and in all cases he has made it clear that there is no necessity at present to invoke vitalism. The water in the intestine is in free communication with the body water; if heavy water is placed in the intestine it becomes diluted, within an hour, by an amount corresponding with the total water content of the body. The membrane is also freely permeable to crystalloids. It is practically impermeable to colloids, although minute quantities of unsplit proteins, or even visible particles, may occasionally be absorbed, probably through an accidental fault in the membrane. Absorption is controlled by diffusion and osmosis, and in the large intestine the hydrostatic

pressure may be such that filtration is also an effective factor. The pumping movements of the intestinal villi may help to mix the intestinal contents, but it is probable that their main function is to pump absorbed fat into the large lymphatic vessels.

Hydrotropy plays an important part in the absorption of water-insoluble substances such as fat and calcium salts. This is defined as the property of some asymmetric, strongly surface-active, water-soluble organic substances of disintegrating water-insoluble substances to molecular complexes in which the hydrotropic molecules surround the insoluble molecule, and render it soluble and diffusible. Bile acids have this effect.

The rapid absorption of substances, such as glucose, which are useful foodstuffs, compared with similar substances, such as xylose, which are not, has seemed in the past to suggest that the intestinal mucous membrane is endowed with intelligence, and has provided a prop for vitalism. When the cells are killed they lose their power of discrimination. Prof. Verzář attributes these observations to the fact that glucose is rapidly phosphorylated in the cells of the living mucous membrane, while xylose is not. The diffusion gradient is therefore greater in the case of glucose than in the case of xylose. When phosphorylation is inhibited by monoiodoacetic acid, the cells lose their power of discrimination. Similar explanations can be applied to the absorption of fats and other substances. This work has led to interesting experiments with the suprarenal cortex, which is known to affect the phosphorylation of sugars. Adrenalectomy destroys the selective absorption of glucose and fats; the injection of eucortone restores it. These facts are easily explained on the theory discussed above.

The theoretical and practical importance of this work is obvious. Prof. Verzář and Dr. McDougall have performed an important service to physiology in writing an authoritative account of work that is not so well known as it deserves to be.

Change of Life in Men and Women

By Dr. Marie Carmichael Stopes. Pp. xv+282. (London: Putnam and Co., Ltd., 1936.) 6s. net.

THIS book, like most others of the author, is popular in style and easy to understand. Moreover, it contains much common sense and a great deal of the advice given is thoroughly sound. For example, no physician would quarrel with the recommendation to avoid constipation. There are many other practical suggestions, and Dr. Stopes has done good service in directing attention to the help to be obtained from the work of the distinguished Spanish gynaecologist, Prof. Gregorio Marañón.

It is in dealing with the male climacteric that Dr. Stopes claims most originality, and though every medical man will agree with her as to the importance of studying this subject, serious doubts will be expressed as to the value of some of her advice and the accuracy of some of her statements. It is surely an extreme view to hold that "in the general physiology of man the testicles share their pre-eminent place with the prostate gland", and it is by no means certain that "the spermatozoa are stimulated to activity" by the alkalinity of the prostatic secretion. Again, it is doubtful what action the prostatic hormone possesses, or indeed whether there is a true hormone secreted by the prostate at all. Yet Dr. Stopes recommends the use of prostatic extracts to reduce the enlargement to which the prostate is subject. It is stated, further, that these and other extracts should be taken orally and not injected, the fact being ignored that most hormones (but not thyroid) are destroyed in the alimentary canal and never enter the circulation of the patient. In view of recent researches on the testicular hormones, it may confidently be predicted that in course of time, and probably in the near future, prostatic enlargement will be successfully treated, but Dr. Stopes does not allude to testicular extracts; and in any event further experimental data are required before definite recommendations can be safely made in a book addressed to the general public.

Isles of the Seven Seas

By Collingwood Ingram. Pp. 283+31 plates. (London: Hutchinson and Co (Publishers), Ltd., 1936.) 18s. net.

THE author is well known among horticulturists as an enthusiastic collector of cherries, and one who has also contributed to our knowledge of the genus *Gladiolus*. Furthermore, all his life he has been an observer of birds. Equipped with the twin lore of botany and ornithology, he has travelled widely, collecting and noting. For the purpose of this book, he has made a selection from his copious material, confining himself to islands he has visited. We leap from Tahiti to Coll and back to Sumatra, to Corsica, New Zealand, Ushant, and not least to Little Tobago; and if we have a feeling that Mr. Ingram is rather self-consciously trying to avoid the too smooth day-to-day narrative of orthodox travel literature, the device has its charm. Wisely he rivets our interest at the start by taking us to the South Seas.

Where the author has, if not quite beaten out the track himself, at least helped to widen it—and nowhere does he follow the crowd—he writes interestingly, and with real insight. His account of his father's experiment in introducing a very rare bird of paradise from the Aru Islands into Little Tobago is fascinating. Occasionally he imports scientific words into narrative in a slightly pretentious way; it would indeed be surprising if the moonlight even in Tahiti, where we expect everything to be glamorous, is really 'glaucous'! Such mannerism is the only blemish in an otherwise pleasant style.

The book is a record of personal impressions by a man of considerable feeling and knowledge, trained to observe accurately; a scholarly but not technical book for the lover of Nature.

Eisen- und Stahllegierungen: Patentsammlung

Ergänzungsheft 1. Von A. Grützner. Zugleich Anhang zur Metallurgie des Eisens in "Gmelins Handbuch der anorganischen Chemie", achte völlig neu bearbeitete Auflage herausgegeben von der Deutschen Chemischen Gesellschaft. Pp. v+425. (Berlin: Verlag Chemie G.m.b.H., 1935.) 44 gold marks.

THE publication in 1932 of a special volume containing in tabular form a list of patent specifications relating to iron and steel has proved to be so useful to research workers engaged in this industry that it has been necessary to prepare supplements of this collection on similar lines. The comprehensive nature of these tables, which cover the patent specifications of Germany, England, France, Austria, Switzerland and the United States, will be gathered from the fact that the present issue deals only with the interval between March 1932 and December 1934, and furthermore another special supplement to Part A of the volume on iron is being devoted to "Mechanical Properties of Steels", and will contain a complete bibliography extending over a very considerable period of time.

Epitome de Culturologia

Por el Dr. Imbelloni. (Humanior: Biblioteca del Americanista Moderno, Serie A, Tomo 1.) Pp. 320+8 plates. (Buenos Aires: José Anesi, 1936.) n.p.

THE series, of which this is the first volume, might well be symbolized by an inverted cone. The volumes of which it will be composed are classified into sections, beginning with general surveys of the various branches of the study of man, and narrowing and intensifying with each successive section, until in the sixth and last, attention is focused on the cultural history and ethnology of Argentina. This conception of a gradual intensification of interest as a basis of regional study, if execution does not fall behind, is wholly admirable. Dr. Imbelloni has given the series a good send-off in his survey of the study of culture and the methods of investigation by cultural distributions. Several examples of the study of areas of cultural distribution in relation to specific cultural traits are given in appendixes.

Geography and Economic Theory*

By Sir Josiah Stamp, G.C.B., G.B.E., F.B.A.

THOSE who are interested in geography as a subject to be expounded educationally must welcome every approach to it which may add to its effective rationalization and bond it into the main structure of knowledge. This is not a mere teaching device, for it may make teaching more difficult, if it is to make it more effective. It makes teaching more difficult if we have to go beyond the immediate neighbour in causation, to reach basic causation and fundamental reasons. To explain a geographical condition by an economic condition is immediate, but not fundamental. Some theory of economic action is implied, though it may be conveniently left unexamined and unexpressed—taken for granted. All such single economico-geographic couplets of facts taken together must ultimately conform to some theoretic principle, and have some common thread. If they do *not*, then there is no uniformity of causation, and no economic, still less geographical science. An economic explanation of a geographic fact is then no 'explanation' at all. The kind of theory which geography may involve, or which may aid geographic understanding, and help to make geography, already culturally basic to so many mental disciplines, a fully rounded science, is therefore the subject of this address.

Geography in recent decades has multiplied its descriptive classification or titles in a rather opportunist manner. No one bothers much about keeping or making the boundaries—they seem to be sufficiently well understood. Yet at the outset I find some uncertainty as to the true scope and purpose of 'economic geography'. Economic history is certainly not the history of economics, but quite clearly the selection of those facts in history which are of economic importance, or which can be accounted for only by economic tendencies and principles. But I am not sure whether economic geography is confined to describing the geographical aspects of physical and spatial facts which are of interest to the economist, providing him, so to speak, the bricks to build with, but quite indifferent to the use he makes of them. If so, how far does the economist really use them? To what extent in constructing an edifice of economic principle does he rely on geographical material? To what extent does he overhaul and recast principles to cover the wealth

of material, with differences and similarities, which the economic geographer continually presents to him? How far does he merely use this material by selection, to illustrate his point, or does he feel a responsibility for subsuming and accounting for the whole of it? Is a geographical fact *ever* the awkward fact that kills the happy economic theory? But perhaps the economic geographer thinks it is his own task to account for facts, for the presence or absence of features, for similarities and differences, by applying economic principles and tests. Perhaps he learns what facts to register and elaborate, by economic theories and differentials. Or am I again an idealist? What, in fact, is the functional relationship between the two disciplines? Whose task is it to do the work of establishing causation, in either direction?

Economic geography must *begin* with physical environment, because these natural controls are dominant. So its first contributor is pure geography. But this is only the first of three classes. Variations of labour and capital are also important and these are covered by economic history and economics proper, not by geography. Thus complementary productions, in seasons or in female labour, are not factors derived from geography. The persistence of a factor through an early start comes from economic history. The data provided by Nature have to be handled by man, and therefore human motives are involved; so the balance of marginal cost to himself of the effort and of marginal utility to himself of the product, or its market equivalent, must be made. Utility and value and psychic considerations have entered.

Geographers have been as active in adopting the term 'economic' without doing much distinctive with it, as economists have been inactive in using the term 'geography' for their basic data. In the composite volume, "The Trend of Economics", Prof. Weld has a section on "Regional Comparison and Economic Progress", in which he refers to the three trends now becoming clear: first, realistic studies as opposed to abstract analysis; secondly, statistical presentation; and thirdly, regional comparison. In elaborating the last, he details Mill's five canons of method applied to inter-regional data. "The economist of today finds himself face to face with the problem of the inequalities of standards of living in different regions. For example, India and China have not

* Abstract of the presidential address to the Geographical Association, delivered at the London School of Economics on January 6.

participated in the economic progress which has become conspicuous in some of the Western countries. Many explanations have been offered for the economic backwardness of regions in Asia, Africa and South America. Which explanation is nearest the truth? We do not know. It is time we were finding out. Scientific comparison seems the most obvious method. What is required is a thoroughgoing search for the *causes* of the differences in the separate regions." Surely this is economic geography in the truest sense, yet he never once uses the term 'geography'. The word geography does not appear in the indexes to the first forty years of the *Economic Journal*. The "Encyclopædia Britannica", 14th edition, has no mention of economic geography in its index. Palgrave's "Dictionary of Political Economy" (1896) includes an article on "Commercial Geography", which is for a large part economic history, but contains no reference to *causal* geography in the economic sense, except the conventional reference to England's natural advantages. It is very much the same story when we look in geography literature for economic theory. The index to the *Geographical Review* over a long period of years contains scarcely any reference to economics in its analytical or theoretical sense. Probably the nearest that it gets to it is in an article by Chisholm on "World Unity", where he postulates the tendency towards the equalization of economic development throughout the world in capital, in population density and in skill—an important economic generalization akin to the second law of thermodynamics and fraught with vital consequences in the field of foreign trade and also in the extent to which natural resources will be fully developed. But it is a generalization of his own which does not base itself on any recognized economic field. Modern works on realistic economics contain much geographical matter, and those on commercial geography, important summaries of economic factors. Thus a chapter in Seligman's "Principles of Economics" and one in Dr. Dudley Stamp's "Commercial Geography", dealing with the localization of industry, might even be changed over, without doing any real violence to the balance or trend of either work.

We may classify geographical explanations of economic facts, which are thus also quite often reversible as economic explanations of geographic facts, first as the simple static; second, as the simple dynamic; third, as the inductive static and fourth, as the inductive dynamic; and fifth, beings the most rare, as theory inductive and illustrative. The first, the simple or direct static, is the type best known to us, filling our commercial geographies and our realistic economic text-books. Its method is to account for one fact or set of

facts by another set, not indeed in a connexion obvious until it is pointed out, but when stated, requiring or securing no supporting argument, no discrimination from other possible causes or connexions, and certainly involving no analytic and theoretic body of economic principles either to verify it or in itself to form an illustration. These often involve a certain element of history. In general, this class includes such statements as that a given port owes its prosperity to the fact that it lies on the trade routes between two wealthy or populous areas. "The completion of the Erie Canal in 1815 gave to New York, then a city of secondary importance, a position of undisputed pre-eminence" (Chisholm).

The second, or simple dynamic, class accounts for a *changing* set of facts by another set *changing* with it. Accounting for an important part of the grain trade of St. Louis, Chisholm says: "Here reside the merchants who handle a large part of the grain grown in the region to the west, including eastern Kansas and Nebraska. The nearest ports for that grain are Galveston and Houston. If the railways to these ports become congested, and are consequently disposed to charge too high rates, the merchants can apply for rates by rail or river to New Orleans, by rail to Baltimore or some other eastern port, or partly by water by the route here spoken of to New York" (p. 631). This is economic geography, but not economic theory. To provide economics with a problem for analysis, details of the change in traffic passing in different directions at different levels of freight rates and their fluctuations would be necessary. Or perhaps lessons in equilibrium between two types of transport, with different ratios of working costs to total costs, might be obtained therefrom. Chisholm provides a factual dwelling, but the economist is not yet dwelling therein.

The third, or inductive static class, draws lessons from a *number* of instances of the first class—for example, cases in which transport is involved. "With the increase of facilities and lowering of costs, geographical situation is yielding to the facts of artificially created location" (Seligman, p. 45). Similarly, population densities provide material for comparable generalizations.

The fourth, or inductive dynamic class, draws lessons from a number of instances of *changing* facts in sets or pairs with their correlations. This obviously is getting nearer to help for economic theory than any of the foregoing.

The fifth class goes further than the fourth if it brings the general principle that emerges into relation with analytic work, and perhaps produces generalizations which will 'work' as prophecies or further explanations. But I cannot find many clear examples in recent work. J. E. Orchard advanced

along this line when he claimed that the geographic study of minerals is certain to involve economic theory and to make contributions to it. He illustrated by a geographic explanation of the agitation for the nationalization of mineral resources. Pressure comes through a demand for higher wages or lower prices. The emergence of a period of abundance in particular countries has the basis of different economic conceptions of property rights, and the threat of future scarcity in particular places has a like differential in the property concept. The period of abundance lay behind the *laissez faire* theory, and the current concept of property right is differentially distributed with scarce or abundant minerals.

Now, in the present state of economic geography, it seems to me that most progress is naturally being made in the third class. The photographs, so to speak, being taken in the first class, are being brought together for induction under the third. But as time goes on, new photographs will be taken of the same physical locations under the first class, and the endeavour to relate the old and the new will call for measurement and explanation of the change, and bring them under the second class. The accumulation of instances under the second class will then provide masses of material for induction under the fourth class. Here economic theory fully emerges, but not before. The economic theory is not based on static conditions—it is essentially related to incremental changes of cause and effect, or related effects; and only as geography registers changes over time can it be of full advantage to economic theory.

Turning to the geographical ideas of well-known economists, Adam Smith's "Wealth of Nations" was not so much a piece of abstract reasoning, as a systematic induction from history and geography, in what was really a piece of political propaganda of high wisdom. It was a great protest against nationalism, and therefore it was cosmopolitanism. But no man can be a cosmopolitan without being a geographer. It has more geographical references in proportion to its bulk than any later important work.

A famous example of the inductive method is John Stuart Mill's discussion of peasant proprietors. He does not elaborate from first principles the economic results of the whole produce of land going to the owner worker without a tripartite division into rent, profits and wages, for he calls it one of the most disputed questions in the range of political economy. But instead he examines conditions in Ireland, Switzerland, Norway, the Palatinate, Saxony, Prussia, Holland, Flanders, Channel Islands, France and Lorraine, takes the common factors and then makes generalizations. He declares, first, there is no necessary connexion

between the form of landed property and an imperfect state of the arts of production; secondly, that the most effective use of the soil is not endangered; thirdly, that it is supreme in developing industry, intelligence, and frugality; and last, that it raises the standard of life, and does not unduly increase the numbers of the population.

We find no such rich geographic texture in the abstract reasoning of Ricardo, which was "unfavourable to any regional treatment". The German historical school introduced again ideas of relativity in time and space, but as we get down to modern times the text-books of "principles" are rather bare of geographic illustration. Seligman's "Principles" is well based on such facts, but even so objective a writer as Taussig in his "Principles" provokes the criticism of a geographic reviewer that he has very little geography. The latest highly analytical works of Pigou and Keynes are nearly bare of *geographic* facts.

Let us now lay out the field of economic theory on broad lines, and indicate in which quarters there lies most opportunity for geographic illustration or induction. It will be obvious at once that geography has no lot or part in a considerable range of it. Material objects need to have an appeal to human psychology before they are wealth. At least one half of the theory of value is psychological. A good part of invested capital is not geographical. Political and social institutions are of this order and, therefore, in the fields where these matters predominate geographic generalization is at a minimum. Where, however, we come to land, we should expect to find that if the theory, for example, of no rent land, and marginal land of various types, has any validity, we ought to be able to see these things objectively, and it is in relation to land and minerals, that induction from geographic facts should be most productive of theory or illustrative of it.

All questions of location and their effect upon production are capable of geographic illustration. Here is a generalization which is capable of economic analysis and certainly of illustration: "The geographic location of a manufacturing plant assumes an importance now that did not obtain when competition was less keen and almost any site would do. All the geographic factors have to be considered and a mistake in only one of them may offset good judgment in all the rest." Again, the geographer finds various methods of land utilization and describes them. The economist asks the question, why and wherefore—the causes. He finds certain uses bring misfortune; he seeks to impose conditions and so considers values.

When we get to the theory of demand and value, geography is quiescent. It is not, however, out of the question to see some possibilities. Anyone

illustrating the principles of inelastic and elastic demand respectively, and taking salt and margarine as examples, might extend the study into the relative stability of employment in geographical areas supplying one as compared with those dependent on the other, to account for their differences. This would be an excellent geographic verification or illustration of the theory. The principle of substitution might well be illustrated by the rise to popularity of particular commodities supplanting others the costs of which had become dearer, relatively, if not absolutely. This change means a change in the economic statistics of geographical areas, which can be examined and stated.

International trade proceeds on the theory of comparative costs (with certain important modifications) and it shows that it is quite possible for *a* to export to *b* commodities in which *b* has the greater natural advantage, provided that *b*'s natural advantages in another commodity are even greater. This ought to be susceptible of verification by reference to geographic facts.

Geography has little concern with money, banks or the technique of trade, and productive methods, but I would not conclude that the economist can make no use of geography at all in these fields. Atkinson says: "But if the metric system gives Germany an advantage over Great Britain in South American markets, it becomes to that extent a factor in the Geographic division of labour—that is, it tends to locate the economic complement of the wheat fields, and cattle ranches of Argentina in Germany rather than England."

Then again, banking systems may affect geographic facts: if the bank reserve system in America draws money from country to cities and

gives them a lower interest rate, then it becomes a factor in concentrating industries, and determining the geographic division of labour.

Technical production is not economic geography. But if the Bessemer process causes migration of the steel industry to areas where the ores are free from certain impurities, it is part of economic geography.

A few years ago the American Economic Association had a round table discussion on the various relations between economics and geography¹. It covered the geographic basis of agricultural production, land economics, economic concept of property in minerals, the study of pioneer belts, and geography in foreign trade prospects.

This probably expresses fairly the field of geography which actually lies within the field of economic theory, but the range of the latter is extensive and may—to reverse the metaphor—throw valuable side-lights at unexpected points of geography. But economics, though now highly specialized, is really one and indivisible. The geographer who aims at strengthening his grasp of causality, especially for expository purposes, by learning economics, would do well to cover the whole field first, in a preliminary way, and then specialize on the particular applications to which our analysis has led us. The economist who would keep his feet on the ground, even if his head is in the clouds, by realistic treatment, will get no such mitigations of his task from the geographer—like John Wesley, he will take the whole world for his parish.

¹ *Proceedings of the American Economic Association*, March, 1926, p. 112.

Constitution of the Earth*

By J. H. Reynolds

THE behaviour of materials such as granite and basalt can be tested in the laboratory up to a pressure of 30,000 atmospheres, or, as engineers would say, about 200 tons to the square inch. This corresponds to a depth of 120 km. in the earth's crust, but what are the conditions of matter at pressures of 10,000 tons to the square inch or thereabouts, which presumably must obtain near the centre of the earth? Then with regard to temperature, we know that near the surface of the earth in Europe this increases generally with depth by about 30° C. per km. The rate of increase

differs considerably from one point of the earth's surface to another. In North America it is three quarters of this amount, and in South Africa only about one half. In regions where volcanic activity has taken place in recent geological times, the rates of increase are abnormally high. In a boring almost a kilometre deep at Budapest a temperature of 69° C. was reached at the bottom. In Tuscany and other places in Italy a similar rate of increase has been found. If we take an average and extrapolate from this, we find that at a depth of something like 50 km. we reach a temperature of 1,400° C.,—enough to fuse all but the most refractory substances.

* Extract from the presidential address to the Royal Astronomical Society delivered on the presentation of the Gold Medal to Dr. Harold Jeffreys on February 12.

But is it safe to extrapolate, and would not the increase in pressure alter the fusing point and also the rigidity? This undoubtedly takes place, for earthquake foci as deep down as 400–500 km. have been inferred from the various types of seismic waves and their times of travel to different stations. An earthquake focus at such a depth presupposes that the material there is strong enough to fracture, so we must assume that notwithstanding the probability of a temperature certainly equal to, and probably much more than, the free fusing point, the material, whatever it is, has still considerable strength.

Then we have the complication introduced by radioactivity. A certain proportion of the earth's internal heat, at any rate in the outer crust, is due to the presence in igneous rocks of radioactive metals such as uranium and potassium. What proportion of the earth's internal heat is due to this cause, and how much to primeval heat still remaining from the time when the whole earth was a molten globe?

The deductions which geophysicists can make as to the internal structure and composition of the earth, below such an insignificant fraction of the earth's radius as a few kilometres, must therefore be in the nature of extrapolations, and the validity of the conclusions reached depends entirely on the assumptions made as to the behaviour of various substances under conditions of heat and pressure which are for the most part far beyond the limit of verification in the laboratory.

Notwithstanding these formidable difficulties, Dr. Harold Jeffreys has boldly grappled with the many problems involved, and has presented us with a conception of the earth's interior which fits in remarkably well with the known data. He first of all postulates a shell which behaves mechanically as a solid, reaching down as far perhaps as 3,000 km. This shell is of a density which increases from the surface downwards, the surface density being about 2.7 and the lowest layer about 5. It is worth noting at this point that Jeffreys' work is quite inconsistent with Wegener's hypothesis of the continents floating on a viscous magma comparatively near the surface, and it is equally opposed to the tetrahedral theory of the formation of the continents. There is a discontinuity between the central core and the shell in the way of transmitting earthquake waves, and as the core is apparently incapable of transmitting distortional waves at all, it is concluded that the central core is still in a molten condition. Its density is only consistent with the heavier metals, and iron is probably its principal constituent.

From a detailed study of the times and rates of travel of the two main types of earthquake waves, the primary and the secondary, with their

associated surface waves, it is suggested that the principal constituent of the earth's solid shell is olivine, as this mineral is of about the right density required. But this does not extend to the surface, where there is a layer of granite under the accumulated sedimentary rocks of the continents, and a layer of denser rocks, presumably basic, lies under the oceans. The granitic or continental layer is estimated to be about 10 km. thick, and two other layers of about the same thickness, but discontinuous in their density, may lie between it and the lower shell of olivine or its equivalent.

Stoneley has also made an estimate of two discontinuous surface layers, and he finds a thickness of 12 km. for the granitic layer and 24 km. for the intermediate layer. There seems to be another discontinuity of density at something like 400 km. down.

In substances that contract on solidifying, the fusing point is raised by pressure, so that at great depths materials must be still solid at temperatures much higher than the fusing points at the surface. This rise in the melting point due to pressure at low pressures is about 3° per kilometre, at greater depths probably somewhat less than this. While the earth was molten, the temperature would increase downwards, but the fusing point would increase faster, and as the whole cooled at a uniform rate, so solidification must have taken place from the bottom upwards. If the core is of metals, which have a lower fusion temperature than the basic silicates of which the outer shell probably consists, then the core would remain liquid, while the outer shell, still liquid at the surface, would be solid at great depths. The core, therefore, got trapped under a layer of badly conducting silicates, and its temperature has not dropped greatly since it was originally formed. On this hypothesis the whole process of solidification did not take more than some tens of thousands of years.

It is now established that the earth's surface temperature is practically controlled by solar radiation alone, and it has been so during the greater part of geological time. If we find evidence of variation in surface temperatures in past geological epochs, we must attribute the variation either to changes in the sun's radiation or to altered meteorological conditions. I find it difficult to imagine altered general meteorological conditions without a corresponding cause in solar radiation.

The small amount of heat still leaving the earth by conduction from the interior is partly a relic of the primeval heat from great depths, and partly heat generated more recently by radioactivity. The radioactive metals, uranium, thorium and potassium are found in all surface rocks in minute

but measurable amounts. Granite contains a greater proportion of these radioactive metals than the basic rocks. In average granite the rate of generation of heat is found to be 1.3×10^{-12} calories per cubic centimetre per second, while for basalt it is only 0.50×10^{-12} calories. Small as these amounts are, it is found that the total heat now being lost from the earth by conduction can be supplied by a layer of granite 20 km. thick over the whole surface. This leaves nothing to be supplied from greater depths, and fixes an upper limit for the thickness of the granite layer. But it has been found from the study of near earth-

quakes and surface waves that the granitic layer is only 10 ± 3 km. thick. There must be, therefore, as large a proportion of radioactive elements in the upper 10 km. as in all the rest of the solid shell beneath it. This leads to the conclusion that radioactivity decreases rapidly with depth, and further that the radioactive metals became concentrated in the surface rocks in the early history of the earth. In any event, volcanoes and subterranean igneous phenomena such as intruded masses of granite and basalt must have some source of heat not a great distance down to explain them, and radioactivity in the earth's crust does this.

Obituary Notices

Dr. F. S. Macaulay, F.R.S.

FRANCIS SOWERBY MACAULAY, who died at Cambridge on February 9, aged seventy-four years, was for many years mathematical master at St. Paul's School and will be remembered by generations of pupils, not a few of whom became distinguished mathematicians; he also produced original mathematical work of high quality, in a field little cultivated in England, the general theory of algebraic polynomials.

Macaulay was the son of the Rev. Samuel Macaulay, and was born at Witney, Oxfordshire, on February 11, 1862. From Kingswood School, Bath, he went up to St. John's College, Cambridge, in 1879, and was bracketed eighth wrangler in Parts I and II of the Mathematical Tripos in June 1882, the first year of the divided tripos. In the January following he was placed in the third division of the new Part III, to which only wranglers were admitted. After two years at his old school, he was in 1885 appointed to a mastership at St. Paul's, where he remained until his retirement in 1911. Before going to Cambridge he had passed the London Matriculation with honours; he took the London B.Sc. in 1891, and the D.Sc. in 1897. He published, in 1895, a text-book on "Geometrical Conics". He was an active member of the Mathematical Association, being for many years an associate editor of the *Mathematical Gazette*. After the Great War he went to live in Cambridge, where, in 1923, he married Norah, widow of Mr. G. A. Matthew.

Macaulay approached his algebraic research from the geometrical side, the theory of algebraic curves. His first paper, of fifty pages, published in the *Proceedings of the London Mathematical Society* (26; 1895), is concerned with the number of conditions presented by a finite set of points in a plane, grouped in 'clusters' of any degree of complication, in the determination of algebraic curves of given order. This led on to an algebraic investigation of the intersections of curves at multiple points and to a thorough reinvestigation of the well-known theorem of Noether

on the form of the equation of a curve which passes through the intersections of two curves, with the generalizations of Lasker. So his interest was aroused in the general theory of modular systems, that is, of polynomials, in any number of variables, expressible in the form $A_1F_1 + \dots + A_rF_r$, where the F 's are given polynomials and the A 's are arbitrary polynomials. A series of papers in the *Proceedings of the London Mathematical Society*, the *Transactions of the American Mathematical Society*, and the *Mathematische Annalen* was followed in 1916 by his Cambridge Tract, "The Algebraic Theory of Modular Systems", in which he gave an account of the whole subject, filling in many gaps in the proofs of his predecessors, and adding considerably to the theory.

Macaulay's work attracted more attention in Germany than in Great Britain, and it was not until 1928 that its first-rate quality was recognized by his election to the Royal Society. In his later years, in Cambridge, he lived a retired life, and was not often seen in College or in society, but he always showed a keen interest in the work of the younger mathematicians on the algebraical and geometrical side, and was a frequent and welcome visitor at seminars in these subjects.

We regret to announce the following deaths:

Dr. Frederick V. Coville, botanist of the U.S. Department of Agriculture, known for his work on the relation of plant growth to soil conditions, on January 9, aged sixty-nine years.

Sir Reginald Craddock, member of Parliament for the Combined English Universities since 1931, on February 10, aged seventy-two years.

Dr. Alfred Daniell, author of the well-known "Text-book of the Principles of Physics", on January 12, aged eighty-three years.

Prof. Max C. W. Weber, For. Mem. R.S., formerly professor of zoology and comparative anatomy in the University of Amsterdam, on February 7, aged eighty-four years.

News and Views

British Industries Fair

THE 1937 British Industries Fair opened in London and Birmingham on February 15 and will remain open until February 26. The organizers tell us, as they have been able to tell us each successive year for many years past, that it is the biggest and most impressive fair that has yet taken place. There is no reason to doubt the claim; the record area occupied by the exhibitors' stands last year has been exceeded by more than 10,000 square feet. No doubt, over and above the increased number of exhibits due to the natural growth of industry and to the recent improvement in trade generally, the fact that this is Coronation year has had a considerable influence upon the record figures. There are more than 1,500 exhibitors detailed in the catalogue, of whom the largest number (78) are from London and the two smallest groups are from Glasgow (12) and from Edinburgh (7). No less than sixty countries are represented by their trade buyers. Holland heads the list, and other countries well represented are Germany, Belgium, France, Denmark, the United States, Sweden and Poland. Italy also is well represented, but Spain, which last year sent a strong contingent of buyers, is this year a notable absentee, for reasons which will be obvious. As before, the hardware and heavy industries section of the fair is held at Castle Bromwich, Birmingham.

OLYMPIA accommodates exhibits of what may perhaps be called the lighter industries, such as chemicals, glassware, leather, scientific instruments, foodstuffs, paper, toys and games, and musical instruments. The textile, furniture and allied industries have their exhibits at the White City. It should be noted that only goods manufactured or produced within the British Empire are permitted to be displayed, and no exhibitor may exhibit articles other than those of his own manufacture. We hope to publish in our next issue an article directing attention to the prominent features of the exhibits that can be regarded as being predominantly scientific. Meanwhile, it is of interest to note that the printers of NATURE, Messrs. Fisher, Knight and Co., Ltd., have installed at Olympia a complete printing works demonstrating block-making, type setting, machining and binding, and volumes of NATURE are being exhibited.

New Equipment for the Royal Air Force

THE publicity recently given in Parliament to the delay in the aircraft building programme scarcely gave due importance to one of its fundamental causes. This expansion in quantity required comes at a time when a radical change is taking place in aircraft constructional methods, made necessary by recent research having caused aerodynamic design to

demand a somewhat different exterior form. A continued increase in engine-power available, added to improvements in design reducing resistance and giving greater speed ranges, have enabled the speed of flight to increase so that up to 300 miles per hour can be contemplated for certain types of aircraft which constitute the quite normal equipment of the R.A.F. At such speeds as this, the air friction at the surfaces of the various component parts of the machine becomes a much greater proportion of the total resistance than at the lower speeds used hitherto. It now becomes vital to have both correct aerodynamic shape and smooth surfaces if reasonable efficiency is to be attained. In the past, most aircraft has consisted of girder frameworks taking the loads, covered by linen fabric the function of which was to give an airtight surface to react to the air pressure. It is not possible to avoid this cover sagging between its points of support to a certain extent, thus spoiling the correct aerodynamic form. Also the method of attachment, usually sewing, set up excrescences on the surface the roughness of which was appreciable. Thin metal sheeting, with flush riveting, is the obvious improvement upon this, but its weight is intolerable unless it can be made to take some of the induced loads, and allow the interior structure to be correspondingly lighter.

THE development of this conception has led to the use of 'stressed skin' construction in modern machines, in which both the wings, control surfaces, and the body are formed of strong and hard sheet metal, withstanding the majority of, and in some cases all, the loading. Although the theory of the design of such structures is now becoming fairly well known, the workshop practice of building them in quantities is by no means well advanced. The adoption of these new designs has necessitated the development of new workshop technique and the design and production of new tools and equipment, which has obviously been especially difficult for those firms that are still working on the older type of construction, which is by no means obsolete or even incorrect for certain types of slower-speed machines. It is probably not unfair to say that the speed-up in aircraft production that has taken place in some countries during the last few years began too soon, and has resulted in a large equipment of machines that are already obsolescent.

Dr. Thomas Midgley

THE Perkin Medal of the American Section of the Society of Chemical Industry has this year been awarded to Dr. Thomas Midgley, who has achieved world-wide fame for his discovery of tetra-ethyl lead as an anti-knock agent. This, it should be emphasized, was no chance discovery but the result of systematic

trial following a study of the periodic system, the final finding that the lead derivative would solve the problem being predicted beforehand. To-day 'ethyl' is added to seventy per cent of all the petrol used in America, and the increased horse-power thereby generated amounts to a very large figure. In a characteristic address given at the time of receiving the medal, Dr. Midgley told the story of his more recent discovery of a compound of carbon, chlorine and fluorine, CHCl_2F , to be used as a refrigerant, which is non-toxic and non-inflammable. Apparently he was told of the need for a new refrigerant over the telephone, and with the aid of two colleagues, the use of a chemical library and some deductions from the periodic table, arrived at the probability that the above fluorine compound might prove non-toxic and suitable. Small quantities were prepared from various samples of available starting material. The first batch was pure and proved non-toxic; in the others the raw material proved to be contaminated and gave toxic products, which, however, could be purified when this fact was realized, and became non-toxic. Three days' work sufficed to solve the problem and to give the refrigerating industry a new material which is expected will prove of outstanding importance in its development.

Gottfried Treviranus (1776-1837)

GOTTFRIED REINHOLD TREVIRANUS, the eminent physiologist, the centenary of whose death occurred on February 16, was born at Bremen on February 4, 1776. He studied medicine at Göttingen, and while an undergraduate wrote an essay on nerve power and its method of action. He qualified in 1796 with a Latin thesis on the reform of physiology, and settled in his native town where he was made professor of mathematics and medicine in 1797. The rest of his life was divided between the practice of medicine and scientific research, though the latter claimed most of his attention. His medical publications were of little significance, being chiefly concerned with the prevention of salivation in the mercurial treatment of syphilis and animal magnetism in Bremen. On the other hand, his biological work was of considerable importance, his principal publications of this kind being entitled "Biology or the Philosophy of Living for Natural Philosophers and Doctors" (6 vols., 1802-22) and "Manifestations and Laws of Organic Life" (2 vols., 1831-33). In addition to physiological research, he devoted special attention to microscopical anatomy of invertebrate animals, especially molluscs and insects. In collaboration with his brother, Ludwig Christian Treviranus, a well-known botanist and medical man of Bonn (1779-1804), he published four volumes of miscellaneous work on anatomical and physiological subjects (1816-20).

Auroral Display and Radio Disturbance

THE probable occurrence of an aurora on January 7, twenty-seven days earlier than the notable display on February 3, as recorded in last week's issue of NATURE (p. 277), is confirmed by Mr. W. N. Craig, of The Manse, Fortrose, Ross-shire. On January 7,

between 16 $\frac{1}{2}$ ^h and 19^h U.T., Mr. Craig, who was listening on the 14 Mc. amateur band, found that reception from long-distance stations in South Africa and on the west coast of America, which was good at first, suddenly deteriorated at 18^h 40^m so as to render the signals practically unintelligible by "a very rapid flutter". At 19^h 30^m, Mr. Craig, on looking outside, found that a conspicuous auroral display was in progress. An arch extending from north-east through north to west was beginning to break up into a series of streamers, and at 19^h 45^m, after an apparent increase in auroral activity, a corona formed for a few minutes a little to the north-west of the zenith. The display then decreased rapidly, but was partially renewed as a quiescent arch extending from east-north-east to west-north-west from 22^h until after 23 $\frac{1}{2}$ ^h. As mentioned in the previous note, the magnetic traces on January 7 recorded at the Greenwich magnetic station at Abinger show distinctive movements between 19^h and 20^h U.T. The extreme ranges, occurring at about 19^h 32^m, indicate a local increase in the intensity of the earth's magnetic field of about 130 γ accompanied by an easterly swing in declination of about 20'.

Science and Building Exhibition

THE Science and Building Exhibition which is to be held on March 1-25 at the Building Centre, 158 New Bond Street, London, W.1, is being arranged at the invitation of the Building Centre, by the Department of Scientific and Industrial Research. The object of the Exhibition is to illustrate the work being carried out by the various organizations controlled by the Department, or associated with it, of interest to the building industry. The exhibit provided by the Building Research Station will deal with such subjects as concrete, plastering materials, fire resistance, bituminous materials and building units for walls and roofs, an exhibit by the Fuel Research Station illustrates work on domestic heating. The Forest Products Research Laboratory is dealing with wood preservation, dry rot, resistance of timber to abrasion, timber seasoning and insect damage. Interesting exhibits are being shown by the National Physical Laboratory on illumination in buildings, acoustics and engineering investigations such as wind pressure on structures and mechanical tests on structural steels, etc. The exhibit by the Water Pollution Research Board and the Department's Chemical Research Laboratory deals with water softening, the removal of dissolved salts from water and contamination of water by lead. British marbles will be dealt with in an exhibit provided by the Geological Survey of Great Britain. The Industrial Research Council of the British Iron and Steel Federation will show models of steel-frame buildings intended for working-class flats, and the applications of foamed slag as an aggregate for lightweight concrete. An exhibit by the Non-Ferrous Metals Research Association deals with galvanizing and zinc coatings, and recent investigations on the frost-bursting of water pipes. The Cast Iron Research

Association, the Paint Research Association and the Rubber Research Association will also be represented. Lectures have also been arranged to take place at 8 p.m. on March 3, 10, 17 and 24.

Palaeobiology and Biostratigraphy

DR. H. G. SCHENCK has published an exhaustive monograph of "Nuculid Bivalves of the genus *Acila*" (Geological Society of America, Special Papers No. 4; 1936). A critical descriptive catalogue of the twenty-five known species and varieties is arranged in the order of their age, from Cretaceous to Recent, and is illustrated by eighteen admirable plates which give a complete iconography of the genus. The systematic part of the work is preceded by the morphology of the shell and by an account of the anatomy, habits and habitats of the living animal. The terms 'paleobiology' and 'biostratigraphy' are used hopefully, but no radically new methods are apparent to correspond with them. Ever since palaeontology has been rationally studied, its best workers have used the anatomy, the habits and habitats of living creatures to explain the debris of their precursors. The method requires caution, for some animal genera have changed their mode of life. The marine mollusc *Pholadomya*, for example, is now abyssal; in Jurassic times it lived in shallow water and, so late as the Eocene, it is found in sediments which give no indication of very deep seas. Dr. Schenck was led to this study by the problems of the Oligocene in the United States Pacific coastal areas. His results help to solve these problems, not by any *a priori* palaeobiology, but by the accurate delimitation of fossil species and by showing that they are associated with distinct faunas in a sequence of strata. This is not a new method, but it is the only sound one, for all our knowledge of the succession of forms of life is from stratigraphy, which, somewhere or other, must be based upon visible superposition. Terms like 'zone', 'age', 'epoch' are discussed. Palaeontologists did not invent these words, which are still current in ordinary speech, so that we can doubt the wisdom of restricting their meaning, for their common, vague sense is sure to lodge in runaway minds and cause confusion.

Investigation into Brood Diseases of Bees

IN May 1934, an investigation into the brood diseases of bees was commenced at Rothamsted Experimental Station, the British Bee-Keepers' Association undertaking to supply half the annual cost of the work (£250 per annum) and the Agricultural Research Council the remainder. As a result, Dr. H. L. A. Tarr was appointed, and has worked continuously on the problem since that time. He has confirmed the fact that American foul brood is caused by a spore-forming organism, *Bacillus larvæ*, and that its incidence is independent of the strength of the bee colony. European foul brood, on the other hand, is a disease which usually affects weak colonies of bees early in the brood-rearing season, and is probably caused by *Bacillus pluton*, a curious organism which has so far resisted all attempts made

to cultivate it, in association with other organisms. He has also shown that a third condition known as addled brood is very prevalent in Great Britain, and has constituted almost one third of the cases of brood disease sent in for examination. The Bee Research Committee at Rothamsted and the British Bee-Keepers' Association are unanimously of the opinion that the investigation should be continued, particularly in connexion with methods of treatment, but the latter have asked that Rothamsted should collect the contributions directly. The Agricultural Research Council has sanctioned an increased grant of £300 for the current year on condition that a sum of not less than £250 is collected from other sources. In the circumstances, Rothamsted Experimental Station is making an appeal for contributions from interested individuals in order that this important investigation may be continued.

Sperm Whale at the Natural History Museum

THE skeleton of the sperm whale stranded at Bridlington on January 25 has now reached the British Museum (Natural History). The animal from which the skeleton was taken was a male 59 feet in length. In the sperm whale, the male is fully grown at about 65 feet, whereas females have not been recorded exceeding 40 feet in length. The sperm whale or cachalot belongs to the division of the Cetacea known as toothed whales or Odontoceti. The Bridlington animal had thirty pairs of teeth in the lower jaw (all unfortunately removed by souvenir hunters) and three small tooth vestiges on one side of the upper jaw. The whole skeleton weighed between four and five tons, of which weight the skull accounted for more than three tons. The sperm whale is not a common animal in British waters, only about six strandings having occurred in the last twenty-five years. It prefers the warmer tropical and sub-tropical seas. Sperm whales stranded on British shores are almost invariably large old males, and it has been suggested that they are animals which have been driven out from the main herd by younger and more vigorous bulls. The present stranding is therefore rather remarkable. The Museum is informed by coastguards of all Cetacea stranded on the British coasts, and specimens are obtained whenever desirable and practicable. On an average, there are about sixty such strandings in the year. Stranded whales, being "Fishes Royal," are the property of the Crown, and are handed over to the Museum by the authorities concerned.

Botany in China

IN a paper presented at the annual conference of the International Faculty of Sciences, held in London on January 29-30, Prof. H. H. Hu described the progress of botanical sciences in China. Botany in China is a very modern study, having a history of only a quarter of a century, though, of course, the medicinal study of herbs in ancient China is well known. At present, taxonomy takes pride of place, which is natural in a country so rich in botanical

resources. During the past fifteen years, six institutes have been established which are carrying out important exploration work; and this has resulted in a rich harvest, including many rare specimens. Prof. Hu himself is attached to the Fan Memorial Institute of Biology which was established in 1928, and is wholly devoted to the taxonomic study of the flora and fauna of China. The botanical section carries out exploration in Yunnan, during which many new genera have been discovered. Monographic studies of ferns and flowering plant families are also being made, which are published in the bulletins of the Institute. In connexion with systematic botany in China, three botanic gardens have been established. The other branches of botany are still at the pioneer stage. Valuable work is being done on freshwater and marine algæ, mycology and morphology. We would, however, like to see further recruits to the small band of Chinese botanists studying plant physiology, ecology and genetics, in order that the whole subject may become more balanced, since all the subdivisions of the science are so interrelated that satisfactory progress in the whole is not easy without equal progress in each part.

Plastics for Use in Electrical Engineering

In a recent paper (*J. Inst. Elec. Eng.*, Oct.), A. R. Dunton gives an account of recent advances in the technique of producing plastics. This word is now used for describing 'moulded compounds' which produce intricately shaped articles in a suitably constructed mould under the influence of heat and pressure. The accuracy obtainable by this method has aroused great interest in both mechanical and electrical engineers. There are many fabricated articles still being sold which could be replaced conveniently and economically by suitable mouldings. In Germany, many plastics are employed, and the technical specifications made ensure that they are suitable for the purpose for which they are to be used. The articles supplied are stamped with an identification mark and the maker's number. The national laboratory in Berlin has the right to take samples at any time without warning, and if the test results are not satisfactory, the maker's name is deleted from the approved list published periodically by the laboratory. The British Standard Specification was published by the B.S.I. in 1933; but unfortunately it makes no attempt to define the characteristics of arc-resisting or high-temperature materials. The performance of nearly all plastics is coupled in practice with high temperatures. A method of making rapid tests advocated by Prof. Marten of Berlin is described. It determines without difficulty the softening point of plastics. In a paper in the same issue by A. Caress, an attempt is made to classify typical plastics into those for 'hot service' and those for use at moderate temperatures. The author says that if the electrical industry will specify clearly what it requires, the plastics industry will rapidly develop suitable materials. He states that there is a very large range of new plastic materials to be discovered and examined.

Sterilized Catgut for Surgical Use

In a Circular (No. 1563. Price 1*d.* net) and accompanying Memorandum (Memo. 199. Med. Price 2*d.* net. London: H.M. Stationery Office) issued to county, and county borough, councils, the Minister of Health directs attention to the responsibility and risk attached to the use of imperfectly sterilized, or unsterile, catgut for surgical purposes. Several groups of cases of tetanus infection have recently occurred following surgical operations in which catgut had been employed, in some of which the infection was definitely traced to the catgut. Under the Therapeutic Substances Act, 1925, and Regulations, 1931, the manufacture for sale and the importation of sterilized surgical ligatures and sutures is prohibited except under licence from the Minister of Health, and the granting of such licence is conditional upon routine testing of samples of the product for sterility, and upon control and inspection of the process of manufacture. When 'sterilized surgical catgut' is employed, the patient may be regarded as adequately safeguarded from tetanus infection, but in many hospitals 'raw' unsterile catgut is bought for use. Such catgut is not controlled under the Therapeutic Substances Act, and is 'sterilized' in the hospital itself by a process which may or may not be satisfactory. The Memorandum describes the method of preparation and of sterilization of catgut. Respecting the sterilization process, heat is sometimes employed, but needs great care, and an aqueous solution of iodine, with or without preliminary treatment with hydrogen peroxide, is efficient and widely used. Most other sterilizing agents are inefficient, or damage the gut.

Yale University Publications in Anthropology

THE second issue of collected papers in anthropology, published by Yale University (London: Oxford University Press. 11*s.* 6*d.* net) under the editorship of Dr. E. Sapir and Dr. Leslie Spier, contains six papers, of which five deal with various aspects of the ethnography of North America. Students of primitive music will welcome an attempt to produce order in a subject to which no little attention has been given in the field, but to which comparative study has still to be applied systematically. This is a regional survey of the music and musical instruments of the indigenous inhabitants of North America by Helen H. Roberts. A contribution by Mr. William Morgan on "Human Wolves among the Navahos" will be found of considerable interest to students of European witchcraft and demonology. Not only do the Navaho beliefs relating to the werewolf bear a strong resemblance to certain of the European beliefs, but also the all-pervasive Navaho belief in witchcraft suggests something of the atmosphere in which the European witchcraft superstition and consequent persecutions became rife. Mr. George P. Murdock studies "Rank and Potlatch among the Haida", providing something of a rational setting for a custom which, as usually described, is beyond the range of normal reasoning, and thereby affording a valuable object lesson for the student of social

anthropology. In this connexion, however, Prof. R. C. Thurnwald's account of the profane literature of Buin, Solomon Islands, is even a more valuable pointer towards a method of gauging social values, while affording an index of change under contact with external influences. The songs which he collected, at first in 1908-9 and then in 1934, deal with topics of everyday life, and by their difference in manner and matter show unconsciously but infallibly how times have changed.

Sodium Lamps for Lighting Tennis Courts

FOR the lighting of tennis courts it is essential that there should be complete freedom from glare and that the light should have a high speed of discrimination. In *Philips Technical Review* (Eindhoven) of August last, it is pointed out that both these requirements are exceptionally well fulfilled by a lighting system employing sodium lamps. Although no satisfactory method has yet been found for making quantitative measurements of the disturbing effect produced with different types of light, experience has shown that the presence of a source of light in the field of vision is less disturbing with sodium lamps than with other lamp sources of equivalent total candle power. This is due to the comparatively low luminous intensity of sodium lamps. Several experimenters have also proved that the speed of discriminating objects is quicker with sodium light than with other types of light. The illumination of tennis courts is particularly important in regions with a tropical climate where the heat renders play during the day impossible, and where during the evening, when the atmosphere is cooler, darkness sets in very quickly. Three open-air tennis courts in the Netherlands East Indies were recently equipped with sodium lamps. Good results have been obtained with an arrangement of eight 150 watt sodium lamps arranged in two rows, containing four each, on the sides of the court and situated 20 feet above the ground.

Phenology of 1935

THE Phenological Report for 1935 by I. D. Margary (*Quart. J. Met. Soc.*, 62, No. 265) covers the period December 1934–November 1935 inclusive. That period was of unusual interest on account of two spells of exceptional weather—the very wet December of 1934, and the bitterly cold period of May 1935 when a strong flow of air from polar regions brought severe frosts and snowstorms down even to the coastal regions of the south of England. The early months of 1935 were, on the whole, mild, with the result that in most counties flowers appeared early. The wintry weather in May therefore caused damage to plants and trees on a scale that luckily can probably be seen only once or twice in an average lifetime. Insects reacted eccentrically to this topsy-turvy weather that preceded the setting in of true summer weather, and showed very variable dates for their first appearance. Migrant birds behaved likewise; the species that normally arrive early were in the south mostly much in advance of their average first appearance; those that usually arrive late, for

example, the garden warbler and the spotted flycatcher, were nearly all abnormally late. The spotted flycatcher was, however, exceptionally early in reaching the northern parts of Scotland and Ireland.

Soviet Arctic Exploration

IN continuance of its plans of Arctic exploration, the Soviet Government, according to the Soviet Union Year Book Press Service, is planning to dispatch ninety-five Arctic expeditions this year. Besides new geological prospecting work, topographical surveys in high latitudes will be combined with hydrographical work in the Kara and Laptev Seas. The northern rivers will also be studied with the view of improving transport. Research is also in hand on the problem of the northward extension of agriculture. Last year's work led to the discovery of coal deposits in the Chukchee peninsula, and these are now being worked.

New Coastline of Antarctica

THE Norwegian expedition to the Antarctic under Mr. L. Christensen which aims at mapping from the air the partially known coast-line of Antarctica between long. 100° W. and 10° E. is reported by *The Times* to have discovered one of the missing stretches of the coast. Mr. Wideroe, flying from the *Thorshavn*, found land between Queen Maud Land to the east and Princess Ragnhild Land to the west in about lat. 69° 30' S. and long. 38° E. Even more interesting than this completion of the coast-line south of the Indian Ocean was the discovery by another flight of a mountain range extending westward for at least two hundred miles from lat. 71° 30' S. and long. 26° E., with peaks rising to 6,000 ft. and 10,000 ft. This range would appear to lie in Princess Ragnhild Land and to extend into the new land. Farther east, it may be remembered that in 1930 Sir Douglas Mawson found mountain ranges in the interior of Enderby Land. In all probability, these ranges will prove to be fault ranges along the edge of the plateau of the eastern Antarctic.

Presentation to Dr. E. J. Butler, F.R.S.

FOR many years, mycologists throughout the world have reaped the benefits of the great work carried out by Dr. E. J. Butler, the first director of the Imperial Mycological Institute, Kew. Following upon his resignation, workers in all parts of Australia contributed to a presentation fund organized by Dr. W. L. Waterhouse of the University of Sydney. Acting on their behalf, the High Commissioner for the Commonwealth in London, Mr. S. M. Bruce, kindly consented to make the presentation, which took place at the Institute on February 8 in the presence of the members of the staff, most of whom had been with Dr. Butler throughout his term of office. One of the gifts was an inscribed table clock made of Australian woods.

Biological Equipment

MESSRS. GRIFFIN AND TATLOCK, LTD., Kemble Street, Kingsway, London, W.C.2, have issued a catalogue, No. 30 K, of biological and general

apparatus and laboratory equipment for bacteriology, pathology, public health, chemistry and cognate sciences. In addition to laboratory fittings, and the ordinary chemical and physical glass-ware and apparatus and reagents, microscopes by various makers, microtomes, incubators, and blood and milk testing instruments are included. An extensive series of anatomical diagrams and models, osteological preparations, and mounted microscopic objects are also listed. Practically all laboratory requirements appear in this catalogue, which is well produced and illustrated, and strongly bound.

Sir Warren Fisher, Permanent Secretary of H.M. Treasury since 1919; Prof. R. H. Fowler, Plummer professor of applied mathematics in the University of Cambridge since 1932; Dr. W. B. Yeats, author of poetic and dramatic works, have been elected members of the Athenæum under the provisions of Rule II of the Club, which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service.

THE Council of the Institute of Metals has elected Dr. Harold Moore and Mr. W. Murray Morrison to the short list of fellows of the Institute, limited in number to twelve, who have "rendered eminent service to the Institute". Dr. Moore is a past-president of the Institute and director of the British Non-Ferrous Metals Research Association. Mr. W. Murray Morrison is an original member of the Institute, having assisted in its formation in 1908. He is vice-chairman and managing director of the British Aluminium Company, Ltd.

At the annual general meeting of the Royal Astronomical Society, held on February 12, the following officers were elected: *President*, Dr. H. Spencer Jones; *Vice-Presidents*, Sir Frank Dyson, Prof. E. A. Milne, Prof. H. C. Plummer, and Prof. W. M. Smart; *Treasurer*, J. H. Reynolds; *Secretaries*, W. M. H. Greaves, and Prof. H. H. Plaskett; *Foreign Secretary*, Sir Arthur Eddington.

PROF. E. J. SALISBURY will deliver the Masters Memorial Lectures of the Royal Horticultural Society in the lecture room of the Society's New Hall in Greycoat Street, Westminster, on March 9 and March 23 at 3.30 p.m. The subject of the lectures will be "The Plant and its Water Supply".

MR. L. B. TANSLEY has been appointed assistant director of the Testing House and Laboratory of the Manchester Chamber of Commerce, Royal Exchange, Manchester. At present, Mr. Tansley is assistant to the Director of the British Cotton Industry Research Association.

THE second Conference on Industrial Physics arranged by the Institute of Physics will be held in Birmingham on March 18-20. The subject of the Conference will be "Optical Devices in Research and

Industry". The president of the Institute, Prof. A. Fowler, will deliver his presidential address, entitled "Spectroscopy in Industry", on March 18. Further information can be obtained from the Secretary, Institute of Physics, 1 Lowther Gardens, Exhibition Road, South Kensington, S.W.7.

IN order to encourage original medical research, the Grocers' Company offers three scholarships, each of £300 a year, with an allowance to meet the cost of apparatus, tenable for one year but renewable for a second or third year. The next election will take place in May. Applications must be made before the end of April to the Clerk, Grocers' Hall, E.C.2, from whom further information can be obtained.

To commemorate the services of the late Sir Grafton Elliot Smith to University College, London, and to the advancement of anatomical and anthropological teaching and research, it is proposed that a bust of him should be modelled in bronze by Mr. A. H. Gerrard of the Slade School, and placed in the Thane Library of the College. Contributions towards the cost of the bust, made payable to "The Elliot Smith Memorial Fund", should be sent to Prof. J. P. Hill, University College, Gower Street, London, W.C.1.

THE Silver Jubilee Commemoration (1934) award of five guineas is granted annually by the Illuminating Engineering Society, which is open to members of the Society less than twenty-six years of age. The award may be made (1) for a suitable paper dealing with illuminating engineering, (2) the design or construction of a novel instrument or appliance for use in researches on illumination, or (3) the carrying out of any investigation beneficial to illuminating engineering. Further information can be obtained from the Secretary, Illuminating Engineering Society, 32 Victoria Street, London, S.W.1.

PROF. GEORGES BOULIGAND, professor of differential and integral calculus in the University of Poitiers, has been elected *correspondant* of the Section of Mechanics of the Paris Academy of Sciences in succession to the late Dr. Joseph Auclair.

PROF. HANS MOLISCH, vice-president of the Vienna Academy of Sciences, Dr. Julius Wagner-Jauregg, emeritus professor of psychiatry at Vienna, Dr. Hans Horst Meyer, emeritus professor of pharmacology at Vienna, Dr. Otto Loisi, professor of pharmacology at Graz, and Dr. Victor Hess, professor of experimental physics at Innsbrück, have been awarded the Austrian insignia for science and art.

A PHARMACOLOGICAL department is being organized in the Gorky Institute of Experimental Medicine at Moscow under the direction of Prof. Nikolayev to study the reactions of various medicines on the sick and healthy. Special attention will be paid to the effectiveness of traditional home remedies of various nationalities and of Eastern medicines in particular.

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. 332.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Cosmological Constants

THE fundamental constants of physics, such as c the velocity of light, h Planck's constant, e the charge and m mass of the electron, and so on, provide for us a set of absolute units for measurement of distance, time, mass, etc. There are, however, more of these constants than are necessary for this purpose, with the result that certain dimensionless numbers can be constructed from them. The significance of these numbers has excited much interest in recent times, and Eddington has set up a theory for calculating each of them purely deductively. Eddington's arguments are not always rigorous, and, while they give one the feeling that they are probably substantially correct in the case of the smaller numbers (the reciprocal fine-structure constant hc/e^2 and the ratio of the mass of the proton to that of the electron), the larger numbers, namely the ratio of the electric to the gravitational force between electron and proton, which is about 10^{39} , and the ratio of the mass of the universe to the mass of the proton, which is about 10^{78} , are so enormous as to make one think that some entirely different type of explanation is needed for them.

According to current cosmological theories, the universe had a beginning about 2×10^9 years ago, when all the spiral nebulae were shot out from a small region of space, or perhaps from a point. If we express this time, 2×10^9 years, in units provided by the atomic constants, say the unit e^2/mc^3 , we obtain a number about 10^{39} . This suggests that the above-mentioned large numbers are to be regarded, not as constants, but as simple functions of our present epoch, expressed in atomic units. We may take it as a general principle that all large numbers of the order 10^{39} , 10^{78} ... turning up in general physical theory are, apart from simple numerical coefficients, just equal to t , t^2 ..., where t is the present epoch expressed in atomic units. The simple numerical coefficients occurring here should be determinable theoretically when we have a comprehensive theory of cosmology and atomicity. In this way we avoid the need of a theory to determine numbers of the order 10^{39} .

Let us examine some of the elementary consequences of our general principle. In the first place, we see that the number of protons and neutrons in the universe must be increasing proportionally to t^2 . Present-day physics, both theoretically and experimentally, provides no evidence in favour of such an increase, but is much too imperfect to be able to assert that such an increase cannot occur, as it is so small; so there is no need to condemn our theory on this account. Whether the increase is a general property of matter or occurs only in the interior of stars is a subject for future speculation.

A second consequence of our principle is that, if we adopt a scheme of units determined by atomic

constants, the gravitational 'constant' must decrease with time, proportionally to t^{-1} . Let us define the gravitational power of a piece of matter to be its mass multiplied by the gravitational constant. We then have that the gravitational power of the universe, and presumably of each spiral nebula, is increasing proportionally to t . This is to some extent equivalent to Milne's cosmology¹, in which the mass remains constant and the gravitational constant increases proportionally to t . Following Milne, we may introduce a new time variable, $\tau = \log t$, and arrange for the laws of mechanics to take their usual form referred to this new time.

To understand the present theory from the point of view of general relativity, we must suppose the element of distance defined by $ds^2 = g_{\mu\nu} dx_\mu dx_\nu$ in the Riemannian geometry to be, not the same as the element of distance in terms of atomic units, but to differ from this by a certain factor. (The former corresponds to Milne's $d\tau$ and the latter to Milne's dt .) This factor must be a scalar function of position, and its gradient must determine the direction of average motion of the matter at any point.

P. A. M. DIRAC.

St. John's College,
Cambridge.
Feb. 5.

¹ Milne, *Proc. Roy. Soc., A*, **158**, 324 (1937).

Gamma Rays excited by Capture of Neutrons

LEA's observations and Fermi's pioneer work has shown that many elements may capture a neutron, and emit gamma rays in the process. This phenomenon has been further investigated especially by Rasetti¹, and more recently by Kikuchi² and Fleischmann³, who used polonium-beryllium, deuterium-deuterium and radon-beryllium sources respectively.

We have used radon-beryllium sources, with an experimental arrangement designed to reduce the high background effects of the Geiger counter due to the gamma rays emitted by this type of neutron source, and also to concentrate slow neutrons on the counter. As indicated in the diagram (Fig. 1), a cylindrical block of lead 18 cm. in diameter and 44 cm. in length is sunk into a thick-walled paraffin wax tube closed at the bottom. The radon-beryllium neutron source is placed on the axis of the lead block at a distance of 29 cm. from the top. The neutrons emitted are slowed down by the paraffin wax, diffuse through the lead core, and slow neutrons emerge at the top of the lead block. The efficiency of this arrangement is based on the fact that the mean free path for scattering of slow neutrons is much larger in lead than in paraffin. Gamma ray effects were measured by a thin-walled magnesium counter covered by a thick-walled lead tube and placed in

the neutron stream; beta rays and secondary electrons were measured with the same counter uncovered.

The capture radiation from a thick sheet of cadmium (0.4 gm./cm.^2) placed below the counter produced 1,700 impulses per minute above the background; the background amounted to 440 impulses per minute with a radon-beryllium source of about 500 mc. The capture radiation of cadmium (and other strongly absorbing elements) is thus a sensitive, and in many respects a very convenient, indicator for slow neutron intensities in our arrangement.

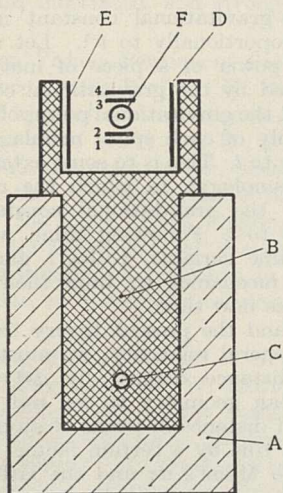


Fig. 1.

A, PARAFFIN WAX TUBE;
B, LEAD CORE; C, RADON-BERYLLIUM SOURCE; D AND E, BORON SCREENS; F, GEIGER-MÜLLER COUNTER;
1, 2, 3, 4, POSITIONS OF THE SAMPLES.

We have used it as an indicator to determine the absorption of slow neutrons in a number of elements. A sample of the element was placed below the counter, a sheet of cadmium inserted between this sample and the counter, and the gamma ray effect measured. This, compared with the gamma ray effects obtained in the absence of the cadmium, and in the absence of the sample, gives the absorption of the sample. The results are shown in Table 1. Our values are not corrected for a slight divergence of the neutron stream, which may account for the fact that most of them are slightly above those of Dunning and Pegram⁴, who used the disintegration of lithium as an indicator.

TABLE 1.

Element	Compound	gm./cm. ²	Per cent transmitted	Cross-section ($\times 10^{-24} \text{ cm.}^2$)
Cl	CCl ₄	1.30	34	52
Co	Co ₂ O ₃	2.87	44	39
Rh	Rh	0.68	51	170
Ag	Ag	1.07	56	97
Cd	Cd	0.0285	50	4,500
Ir	Ir	0.61	46	410
Au	Au	3.14	37	103
Hg	HgO	0.70	50	355

Further, we have compared the gamma ray effect per captured neutron as measured by the counter for a number of strong absorbers of slow neutrons, and the

results are given in Table 2. The value for cadmium is arbitrarily fixed at 100.

TABLE 2.

Cl	Co	Rh	Ag	Cd	In	Sm	Gd	Ir	Au	Hg
95	86	82	75	100	94	94	94	74	80	105

The same samples of elements were used to measure both the absorption cross-section and the gamma ray effect, and the values given in column four of Table 1 were then used to compute the relative gamma ray effect per captured neutron. The value for indium includes gamma rays from the induced activity of the 54-minute period. Otherwise the figures include only gamma rays from induced activities of periods shorter than half-hour; longer periods were not appreciably excited in our experiments.

The eleven elements investigated give almost equal effects although their atomic weights range from 35 to 200.

A similar comparison of the gamma rays emitted by elements which are weak absorbers of slow neutrons would, in our opinion, require better data on the elastic scattering of such elements than is at present available. So far, with no element heavier than chlorine have we found evidence to show that the gamma ray effect is appreciably different from 'normal'.

About equal effects might be expected if each element emitted one gamma ray quantum per captured neutron, but other observations do not support this simple interpretation of our result, since they seem to indicate that a larger number of quanta are emitted from the investigated elements.

We obtained some indication of this number by comparing the number of fast electrons ejected backwards from lead by the gamma rays from cadmium which were excited by a slow neutron beam, with the number of beta rays from a very thin silver foil made radioactive by the same neutron beam. Half-value thicknesses in lead were determined for the electrons from lead and for the gamma rays from cadmium. The values obtained indicate that more than seven quanta are emitted from cadmium per captured neutron, but this result requires confirmation by an independent method which is now being attempted.

The fact that chlorine shows a 'normal' gamma ray value indicates that its intense neutron absorption is due to radiative capture that leads to a chlorine isotope of long half-life period which has not yet been detected. Samples of yttrium prepared free from gadolinium by Dr. J. K. Marsh, Old Chemistry Laboratory, Oxford, showed only very weak capture radiation and, in agreement with a measurement of Hevesy⁵, a small absorbing cross-section. Thus the widespread view⁶, based on earlier measurements, that yttrium has a large capture cross-section for slow neutrons and therefore must transform into an undetected radioactive isotope, does not seem to be justified. Barium also shows a much smaller capture cross-section ($< 10 \times 10^{-24} \text{ cm.}^2$) than given by earlier measurements⁴. In agreement with Kikuchi², we find that boron shows a gamma ray effect of about a twentieth of that of cadmium.

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LEO SZILARD.

Clarendon Laboratory,
University Museum,
Oxford.
Jan. 20.

¹ Rasetti, *Z. Phys.*, **97**, C4 (1935).

² Kikuchi, Husimi and Aoki, *Proc. Phys.-Math. Soc. Japan*, **18**, 188 (1936).

³ Fleischmann, *Z. Phys.*, **100**, 307 (1936).

⁴ Dunning, Pegram, Fink and Mitchell, *Phys. Rev.*, **48**, 265 (1935).

⁵ Hevesy and Levi, *NATURE*, **137**, 185 (1936).

⁶ Cf. Feather, "Nuclear Physics", p. 183 (1936).

Resonance Levels of Neutrons in Silver Nuclei

THE resonance absorption of neutrons by silver nuclei has been studied with a photo-neutron source by Kurtschatow and Schepkin¹ and by us². Continuing this work, we have now estimated the total width of the resonance levels effective for neutron capture which have their energy values lying in the continuous spectrum of the neutrons scattered in a thin paraffin layer. Using the formula of Breit and Wigner³ for the capture cross-section as a function of energy, and making some simplifying assumptions, we can evaluate the average spacing between adjacent levels in the energy region concerned, by giving a plausible value to the width of a single level.

In our experiment, the neutron source consists of 50 mgm. of radium surrounded with 12 gm. of beryllium powder. It gives 1.0×10^4 neutrons per second, as deduced from the work of Chadwick and Goldhaber⁴. In order to produce a continuous spectrum of neutrons, the source is surrounded with a spherical paraffin shell of 0.5 cm. thickness. Two silver detectors of 0.4 mm. thickness are used. Each is screened with cadmium, and subtends a solid angle 0.71 at the source during exposure. According to a formula of Wigner⁵, the neutron-proton scattering cross-section is 11×10^{-24} cm.² for neutrons of 2×10^5 volts. The total number of scattered neutrons received by the detectors is then 450 per second. By means of a Geiger-Müller counter, the number of β -rays emerging from the surfaces of the silver detectors in the saturation state is found to be 1.4 per second for the activity of half-period 22 sec. We had measured also the apparent absorption coefficient of the resonance neutrons in a thin silver absorber of 0.020 gm./cm.² and get the value 12.5×10^{-22} cm.² per silver nucleus. For the absorption coefficient of the β -rays emitted from silver, we find 10×10^{-22} cm.² per silver atom.

Let us assume that the photo-neutrons consist of one homogeneous group of energy $E_0 = 2 \times 10^5$ e.v.; let n_1 be the density of the effective resonance levels per volt and 2Γ be their half-value width, assumed to be equal for all levels. Then it can be shown by a calculation which will appear elsewhere that the total half-value width summed over the effective resonance levels from zero to 2×10^5 e.v. can be evaluated from our experimental results. We find $2\Gamma n_1 E_0 = 520$ e.v. If Γ be given the value 0.1–1.0 volt⁶, the average spacing between adjacent effective resonance levels is then of the order 80–800 volts. This result is in good accord with a recent theoretical estimate given by Bethe⁷, namely, of the order 50–500 volts. It is also in conformity with the frequency of occurrence of the resonance groups in the low energy region.

Details of this work will be published in the *Chinese Journal of Physics*.

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C. Y. FU.

Physics Department,
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Peiping.
Nov. 30.

¹ Kurtschatow and Schepkin, *Phys. Z. Sowjet.*, **9**, 102 (1936).

² Chao and Fu, *Tsing Hua Science Rep.*, **A**, **3**, 451 (1936).

³ Breit and Wigner, *Phys. Rev.*, **49**, 519 (1936).

⁴ Chadwick and Goldhaber, *Proc. Roy. Soc., A*, **151**, 479 (1935).

⁵ See Bethe and Bacher, *Rev. Mod. Phys.*, **8**, 117 (1936).

⁶ Frish and Placzek, *NATURE*, **137**, 357 (1936); Preiswerk and Halban, *NATURE*, **138**, 163 (1936).

⁷ Bethe, *Phys. Rev.*, **50**, 332 (1936).

A New Phenomenon in the Supraconducting Transition of Tantalum and of Tin

THE transition from the supraconducting to the normal resisting state under certain conditions is found not to be continuous but to include a hitherto unsuspected spontaneous increase in resistance followed by a slower decrease. The spontaneous decrease in resistance usually proceeds for several minutes in a succession of steps, until only a fraction of its crest value remains. This crest value of the transient resistance is sometimes 75 per cent of the normal. After such an effect has occurred, it will not occur again when the same conditions are re-established, unless in the meantime the temperature has been lowered or else a time interval of at least half an hour has elapsed.

These spontaneous changes in resistance can be initiated by a step upward in temperature, in current or in magnetic field, and proceed thereafter as described above while all three external conditions are maintained constant. The combination of temperature, field and current at which this phenomenon appears has been studied and the progress of the resistance change under various conditions noted. The effect is pronounced only when the current is relatively large (about 2 amperes in the tin wire, diameter 0.022 cm.).

A more complete report of this work will appear in the March issue of the *Journal of Research of the National Bureau of Standards*.

F. B. SILSBEE.

R. B. SCOTT.

F. G. BRICKWEDDE.

National Bureau of Standards,

Washington, D.C.

Jan. 8.

Influence of Magnetic Fields on Persistent Currents in Supraconducting Single Crystals of Tin

UP to the present, the determination of the effect of a magnetic field in restoring the resistance in a metal conductor which is in the supraconducting state has depended on the direct measurement of the resistance of the conductor, and consequently it has been difficult to find the exact point at which the first traces of resistance return.

In the McLennan Laboratory at Toronto there have been in use supraconducting galvanometers¹ by means of which it is possible to measure directly, under various conditions, the value of the persistent current in a completely supraconducting circuit. With such an instrument, it is easy to find the magnetic field under which resistance begins to appear, for the smallest resistance causes rapid cessation of the persistent current. These measurements have been carried out for a cylindrical single crystal of tin, in both transverse and longitudinal external fields, at a temperature of 3.22° K. (0.5° below the normal transition point).

According to the theory of von Laue², F. London³, and R. Peierls⁴, the penetration of a transverse magnetic field into a cylindrical superconductor should commence when the external field has reached one half of the critical field strength, H_c , and the body should then pass into the so-called 'intermediate state', and show resistance. In a longitudinal field, the resistance should return abruptly when the external field is equal to H_c .

In Fig. 1 the observed persistent current is plotted against the external magnetic field, in Curve I for

transverse fields, and in Curve II for longitudinal fields. With a transverse magnetic field, no persistent current flows in a field greater than 41 gauss, while with a longitudinal field the limiting value is 71 gauss. The ratio of the transverse to the longitudinal field for the first appearance of resistance is therefore 0.58 instead of 1/2. This result agrees with the work of de Haas, Voogt and Jonker⁶, who also found this ratio to be 0.58 in the case of direct resistance measurements. Along the descending

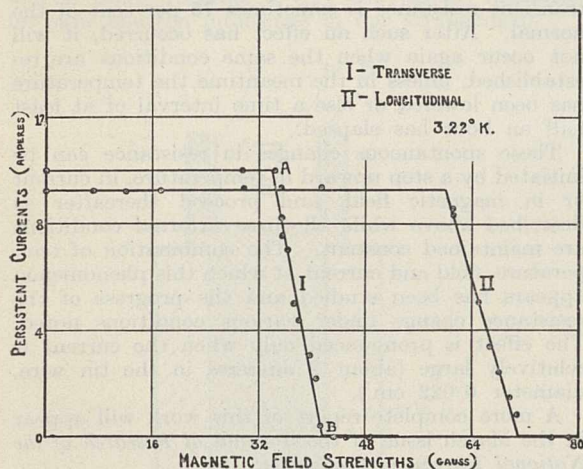


Fig. 1.

portion AB of Curve I, the persistent current decreases as the external field is increased, in such a way that the relation $\frac{H}{0.58} + H_i = H_c$ is obeyed, where $H_i = \frac{2i}{r}$ is the field at the surface of the wire due to the current itself.

Complete results will be published shortly.

E. F. BURTON.
K. C. MANN.

McLennan Laboratory,
University of Toronto.
Jan. 7.

¹ Smith, H. Grayson, and Tarr, F. G. A., *Trans. Roy. Soc. Can.*, (3), **29**, Sec. III (1935). Smith, H. Grayson, Mann, K. C., and Wilhelm, J. O., *Trans. Roy. Soc. Can.*, **30**, Sec. III (1936).

² Laue, M. von, *Phys. Z.*, **33**, 793 (1932).

³ London, F., *Physica*, **3**, No. 6 (June 1936).

⁴ Peierls, R., *Proc. Roy. Soc., A*, **155**, 886 (1936).

⁵ de Haas, W. J., Voogt, J., and Jonker, J. M., *Leiden Comm.*, 229c (1934).

The Sterckfontein Ape

THE letter from Dr. E. Schwarz which appeared in NATURE of December 5 shows, I think, the necessity for some hesitation before coming to any definite conclusion as to the affinities of *Australopithecus*. Dr. Schwarz considers it "very probable that *Australopithecus* was a pigmy gorilla"; and he has compared it with the dwarf chimpanzee of the Congo (*Pan satyrus panicus*). It is unnecessary at this stage to criticize in detail Dr. Schwarz's views, but the fact that other prominent anatomists have come to quite different opinions shows that we are not yet able finally to place it.

Dr. Adloff, who has made a special study of the dentition of *Australopithecus*, says, "Das Gebiss von *Australopithecus* ist aber rein menschlich und lässt den Schluss zu, dass *Australopithecus* kein Anthro-

pode, sondern ein Hominide ist". Dr. Gregory, of New York, who is probably the greatest living authority on mammalian teeth, has pointed out that of twenty-six dental characters in *Australopithecus*, not one is nearer to the chimpanzee, two are nearer to the gorilla, one is nearer to the chimpanzee and gorilla, three are common to the chimpanzee, gorilla and primitive man, and twenty are transitional to or nearer to primitive man; and he adds: "if *Australopithecus* is not literally a missing link between the older dryopithecoid group and primitive man, what conceivable combination of ape and human characters would ever be admitted as such?" Romer, of Harvard, the eminent American palaeontologist who made a careful study of the Taungs ape in 1929, while not definitely deciding as to the affinities, says it is "clearly not a chimpanzee or a gorilla".

All this seems to show that *Australopithecus* is a form of considerable interest whose affinities are difficult to determine; but I think it likely that the whole question will be quite definitely settled within two years. In the meantime, I may mention that the brain of the Sterckfontein ape was considerably smaller than was at first believed. The contact of the occipital fragment has been found, and the restored brain appears to have been only about 435 c.c. It is thus an ape fairly comparable in size with the chimpanzee, but with teeth which in my opinion resemble those of man much more than they do those of any of the living anthropoids.

R. BROOM.

Transvaal Museum,
Pretoria. Jan. 18.

Vitamin P

WE reported in our previous notes¹ on the vitamin nature of phenyl-benzo-γ-pyrone dyes, and have described a method for the experimental demonstration of this activity. Using this method, we tested the following substances for their vitamin activity: hesperidine (m.p. 261°), an impure sample of demethylo-hesperidine (mother liquor of 'citrin') and quercitrine, 1 mgm. being given daily.

The experiment consisted of seven groups of 20 guinea pigs each. One of these groups received the basal diet only. The other groups received in addition: hesperidine, demethylo-hesperidine, quercitrine, ascorbic acid (2 mgm.), ascorbic acid plus hesperidine, ascorbic acid plus demethylo-hesperidine.

All three groups receiving ascorbic acid equally showed normal growth. The animals receiving hesperidine, or demethylo-hesperidine only, behaved in the same way as the animals of our previous experiments receiving 'citrin'. The animals receiving the basal diet only or this diet and quercitrine showed severe scurvy and died after a sharp fall in weight on about the twenty-eighth day.

These results admit of the following conclusions: experimental scurvy, as commonly known, is the symptom of a mixed C and P avitaminosis. Pure C avitaminosis can be observed, if in addition to the basal diet vitamin P is administered. The pure P avitaminosis has no clinical symptoms. If, however, vitamins C and P are simultaneously withheld, the lack of P will greatly modify the pathological condition.

There is a great difference in the activity of different phenyl-benzo-γ-pyrones. Since the only essential difference in the formula of quercitrine and hesperidine is found on the C² and C³ atoms, it can be concluded that these atoms are of special importance

for the activity. Changing the flavanone hesperidine into the corresponding flavonole entails inactivation.

The therapeutic effects observed after the administration of 'citrin' in man in septic conditions, also accompanied by polyarthrititis and endocarditis, suggest that the age-old beneficial effect of fruit juice is partly due to its vitamin P content.

This research is being sponsored by the Josiah Macy Jr. Foundation, New York.

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Institute for Medical Chemistry
and Medical Clinic,
Szeged. Dec. 23.

¹ NATURE, 138, 798 (Nov. 7, 1936).

Plant Collecting on the Pribilof and Aleutian Islands, 1936

THE Aleutian Islands stretch from the tip of the Kenai Peninsula of Alaska for 1,200 miles westwards to Kamchatka. They comprise some fifteen larger islands and hundreds of smaller ones, and owing to their inaccessibility have been very little explored botanically.

The Swedish botanist of Kamchatka, Dr. Erik Hulten, of the University of Lund, made important observations on the Aleutian isles in 1932. I visited them last summer, through the courtesy of the United States Government (to which they belong), and was also allowed to spend some days and make a botanical collection for the British Museum (Natural History) on the prohibited fur-seal islands of the Pribilofs, about 150 miles north of the Aleutians.

Unalaska village, near Dutch Harbour, was my base for botanical work in the Aleutians. I reached it from Seward, in Alaska, in mid-July by a small monthly steamer, the *Starr*. Owing to delay *en route* I was able to spend some time collecting at Seward, and two weeks on the very interesting and fertile island of Kodiak, off the Kenai Peninsula. During the eruption of Katmai in 1913, the north-east portion of Kodiak lay for long under a thick covering of ash which killed all vegetation for a year or two.

At Unalaska I collected during part of July and early August, and made a collection of about 318 specimens. The island is very fertile, vegetation growing up to the summits of many of the mountains of several thousand feet, but owing to the dense vegetation and entire lack of roads it is very difficult in summer to get far afield, as there is no means of transport. Finding the further islands quite inaccessible without the aid of the United States coast-guard vessels (which were in 1936 the only ones calling there once or occasionally twice in the season), I applied to the Department of the Interior at Washington, and was granted permission to make the last trip of the season, in August (unfortunately late for botanical work) so far west as Attu, the last of the islands, on the United States Coastguard Cutter *Chelan*, which was doing hydrographic survey work in these uncharted waters. Unfortunately, landings were usually brief, but on Attu (where a precarious landing of a few hours was all that was possible owing to bad weather conditions) I was granted the help of two sailors of the *Chelan* in collecting the plants, and obtained some seventy specimens, including a few Asiatic species not gathered on the other islands. Landings of two days were made at

Kiska (where some fifty to sixty species were gathered), an interesting volcanic island, now a prohibited shore to aliens as it is a U.S. naval reserve, and at Amchitka and Atka.

In all, some 2,000 specimens were gathered on the Kenai Peninsula and the Aleutians, including about 160 species from the Pribilof Islands. Many thanks are due to the personnel of the U.S.S. *Chelan* and the coastguard authorities at Unalaska for their kind assistance, and to the agent of the U.S. Government and the Bureau of Fisheries on the Pribilof Isles, for much valuable assistance in transport and collecting.

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An Amphipod, *Eucrangonyx gracilis* S. I. Smith, new to Britain

RECENT exhaustive investigations into the fauna of filtration plants, which are being conducted by the Water Examination Department of the Metropolitan Water Board, under the direction of Colonel C. H. H. Harold, have resulted in the discovery at the Lea Bridge Waterworks of *Eucrangonyx gracilis* S. I. Smith. This species has been recorded only from Canada and the United States. It was collected in October and November 1936 by Mr. A. C. Gardiner, from whom I obtained the following notes on its distribution in the filters and its appearance in life. Specimens were submitted for identification to Prof. A. Schellenberg, of Berlin, to whom my thanks are due.

The majority of specimens were found in culverts below the filter beds at the Lea Bridge Works: these culverts are in complete darkness, and specimens from them were whitish in colour, though with well-developed black eyes. A few were found among weeds on the grating of the intake to these filters, together with *Asellus aquaticus* (which was also found in the subterranean culverts) and *Gammarus pulex*. These specimens were of a quite dark slaty-blue colour. It was not ascertained whether this species was present in the River Lea, from which these filter beds are supplied with water. It is even possible that it is widely distributed in England. In Canada and the United States it has been recorded from a large number of loci, chiefly in surface waters. A list of these can be found in Shoemaker¹.

Eucrangonyx can be distinguished from *Gammarus* by the absence of spines on the dorsal surface of the urosome: from *Niphargus* by the presence of well-developed black eyes and from *Crangonyx* by the presence of a small inner ramus to uropod III. *E. gracilis* can usually be distinguished in life from *Gammarus pulex* by its smaller size. Stebbing² gives a detailed description of this species. The only published figure of the whole animal is that of Kunkel³, which is crude and in some respects incorrect. Various features are figured by Weckel⁴, Huntsman⁵ and Shoemaker¹. Weckel's figures are inferior to those of Huntsman and Shoemaker.

Department of Zoology, G. I. CRAWFORD.
British Museum (Natural History).
Jan. 15.

¹ Shoemaker, C. R., *Amer. Mus. Novitates*, 598, 15, fig. 9, a and b (1933).

² Stebbing, T. R. R., "Amphipoda Gammaridea" in "Das Tierreich", 21, 390 (1906).

³ Kunkel, B. W., *Bull. Conn. State Geol. and Nat. Hist. Survey*, 26, 94, Fig. 20 (1918).

⁴ Weckel, A. L., *Proc. U.S. Nat. Mus.*, 32, No. 1507, 32, Fig. 3 (1907).

⁵ Huntsman, A. G., "Contrib. Canad. Biol. 1911-14", part 2, 152, Fig. 4c (1915).

Origin of Cross-Cousin Marriage in Assam

CROSS-COUSIN marriage is widely prevalent among the primitive peoples of Assam. Of the two types, the marriage with the daughter of the mother's brother is more frequent. Different theories have been put forward by ethnologists as to the origin of this custom, but none of them seems to be tenable in Assam area.

Though most of the tribes of Assam are now patrilineal, yet an earlier stratum of matriliney should not be overlooked. Even among some of the tribes, matrilineal traits are still dominant. These matrilineal people probably came in contact with later patrilineal immigrants of superior culture, and marriages between them were frequent. During this period, the immigrant people, in order to give their sister's family better economic status, introduced the marriage of their sister's son to their own daughters. The contact in some cases led to the formation of dual groups, and there both types of cross-cousin marriage were permitted. But after a time, when the domination of the patrilineal people was complete, the avoidance of the father's sister's daughter came from the idea that father and father's sister inherited the same blood, so her daughter, who also inherited a part of the blood through her mother, was not marriageable. This idea is still common among the Chothe Kukis, Mantak Koms and other tribes of Assam. In some cases, the patrilineal dominance is so strong that, in the absence of the mother's brother, the bride-price accrues to his son, that is, the mother's brother's son will get the payment for his father's sister's daughter, as is found among the Choches.

This rule, on the face of it, seems to be absurd, but if we go into details we can easily understand the underlying principle. In the early matrilineal stage referred to, the marriage between the children of brothers and sisters was not looked upon with favour by the earliest group as it would break the 'household exogamy'. But the later group would not observe this rule, as it would be against their interest, and they might have no reason for observing 'household exogamy'. The husband in such a group, finding property to descend matrilineally, would try to provide for his portionless sister's family by marrying his sister's son to his daughter. The wife who owns the property and observes the rules of the earlier people would not object as 'household exogamy' on her side of the family would not be violated. In this way marriage with the daughter of the mother's brother would come into vogue. But she would be opposed to her children marrying her own brother's children. Hence the other cross-cousin marriage (father's sister's daughter) would not be permissible. In some cases also, marriage with the daughter of the mother's brother would not be allowable. But if the three groups (two older and the one later) were linked up in a tri-clan system, this problem would disappear.

If later on, through the dominance of the patrilineal people of this group or other groups, the whole social and economic structure passes on to father-right, only the tradition of such preferential mating, with occasional actual marriages, would persist. This seems to be the present position in Assam.

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Dec. 31.

Annual Variation of the Critical Frequencies of the *E*- and *F*₂-Layers

THE successive accumulation of data on the critical frequencies, that is, the limiting penetrating frequencies, of the *E*- and *F*-layers determined from noon observations show the following main features¹: the critical frequencies of the *E*-layer show a regular annual variation depending on the height of the sun, whereas the critical frequencies of the *F*₂-layer show an inverse annual variation, with high values during winter and lower values in summer. Appleton² has explained this as a temperature effect, the density of the air at 200–400 km. in winter being higher on account of the lower temperature. According to the simple theory of photo-ionization, the maximum electron density, that is, the critical frequency, will depend on the pressure.

From a geophysical point of view, it is difficult to understand why an annual temperature variation should be restricted to the *F*₂-layer alone. Studies of the variation of the auroral heights in the border region between the dark and sunlit atmosphere have shown³ that there is a marked diurnal variation of temperature at a height of 100 km., that is, in the region of the *E*-layer. It is therefore probable that the annual variation of temperature in the *F*₂-layer also must include the *E*-layer.

A hypothesis explaining the dependence of the critical frequencies of the *F*₂-layer on, and the independence of the critical frequencies of the *E*-layer of, the annual temperature (and therefore, pressure) variations will be put forward in the following, based on noon observations of the critical frequencies recorded at Tromsø ($\phi = 69.7^\circ$ N., $\lambda = 18.9^\circ$ E.) during the last two years.

The observations from Tromsø show the same inverse annual variation of the critical frequencies of the *F*₂-layer with high values in winter and low values in summer previously observed. During the dark period in winter, when the sun's height at noon is negative, the sun's rays when producing the dense *F*₂-ionization in the zenith have to enter the layer from below after first having passed once through the layer. During the same period one does not obtain *E*-echoes on undisturbed days. This means that the part of the solar spectrum producing the *F*₂-ionization is only slightly absorbed when passing through the *F*₂-layer, whereas the rays producing the *E*-ionization are completely absorbed when entering the *E*-layer. From this it follows that a variation in the pressure of the air in the *F*₂-layer will strongly influence the ion-production of the rays, as the spectral energy producing the ionization is in excess. For the *E*-layer, where the ionizing rays are completely absorbed when entering the layer, a variation of pressure (and therefore temperature) will be of minor importance, as the maximum ionization there will be determined by the limited energy of the ionizing rays.

Chapman⁴ has developed a theory according to which there is a stratification in the ionosphere; at heights above 200 km. the oxygen molecules are dissociated and occur as atomic oxygen. There will therefore be different parts of the solar spectrum which produce the ionization in different levels, according to the different ionization potentials of the constituents. The ionization potentials of N₂, O₂ and O correspond to the bands from 766 Å., 730 Å. and 910 Å., and according to Chapman⁵ the energy available in the solar spectrum from 910 Å.

for ionizing the oxygen atoms is more than a hundred times greater than the energy available for ionizing O_2 and N_2 . This fits in with the point of view developed above that the energy of the part of the solar spectrum producing the F_2 -ionization is in excess when passing through the layer.

LEIV HARANG.

Auroral Observatory,
Tromsø.
Jan. 1.

¹ Appleton and Naismith, *Proc. Roy. Soc., A*, **150**, 635 (1935).
Schafer and Goodall, *Proc. Inst. Rad. Eng.*, **23**, 670 (1934). Kirby,
Berkner and Stuart, *Bur. Stand. J. Res.*, **12**, 15 (1934). Harang,
Gerl. Beitr. Geophysik, **46**, 438 (1936).

² NATURE, **136**, 52 (1935).

³ Harang, *Terr. Mag.*, **41**, 143 (1936).

⁴ *Proc. Roy. Soc., A*, **131**, 353 (1931).

⁵ loc. cit.

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

PROSAD and Bhattacharya have reported¹ the 'optical catalysis' of the Raman effect. That this phenomenon should exist is in accordance with the theory of the Raman effect along classical lines which we have presented elsewhere². Moreover, it is possible from that theory to predict the circumstances in which the catalysis should be most pronounced.

According to this theory, the emission of the Raman lines is facilitated by the close proximity of a system resonant at the frequency of the difference line or anti-resonant at that of the sum line. It is hindered by the reverse of these conditions. If the observed effect is due to such a resonance in the 'catalyser', we should expect the following experimental results: (1) The effectiveness of a particular 'catalyser' should vary with the frequency of the incident light, being a maximum for some one frequency. (2) Two substances having different infra-red frequencies should be 'catalysed' by the same added substance, provided the incident frequencies are so adjusted as to make the difference, or sum, frequencies the same for both. (3) It should be possible to find substances the addition of which reduces the Raman effect. In particular, if the effect of a 'catalyser' is found to show a maximum for a particular incident frequency, a shift of the incident frequency, such that the new sum frequency coincides with the old difference, should reduce the effect below normal.

The above considerations apply particularly to experiments at low temperatures, and the effects described might easily be masked at higher temperatures.

R. V. L. HARTLEY.

Bell Telephone Laboratories,
New York.
Jan. 11.

¹ NATURE, **138**, 510 (Sept. 19, 1936).

² *Bell System Tech. J.*, **424** (July 1936).

Fluorescence of the Bivalent Rare Earths

IN a letter in NATURE of January 19, 1935¹, I stated that the blue fluorescence shown by fluorites is due to bivalent europium produced through reduction of traces of trivalent europium by radium rays. In the same way a yellow-green band shown by some fluorites at low temperatures can be ascribed to bivalent ytterbium. Later², it was shown that a red fluorescence band that had puzzled us a good deal is due to bivalent samarium.

From the investigations of G. Jantsch and W. Klemm³, it appears that these three rare earths, europium, ytterbium and samarium, are the only ones that can be obtained definitely as bivalent ions; whilst for thulium there are at least distinct indications of the formation of traces of bivalent compounds, for the other rare earths there are scarcely any. Taking the hypothetical connexion between the formation of bivalent ions and the appearance of radio-photo-fluorescence bands as a guiding hypothesis, one might hope to get such a fluorescence also with suitable substances containing traces of thulium.

Through the courtesy of Dr. P. Hoernes, I got from the Degea (Auergesellschaft) in Berlin a sample said to contain 93 per cent Tu_2O_3 , 3 per cent Yb_2O_3 and 4 per cent Cp_2O_3 , for which my best thanks are due. A small amount of this substance was added to calcium sulphate (concentration 10^{-3}). After exposure to radium rays, the preparation was tested with filtered ultra-violet light. At room temperature, nothing was observed, but on lowering the temperature a red fluorescence appeared that became very brilliant at the temperature of liquid air. Calcium sulphate preparations with 10^{-3} erbium or 10^{-3} ytterbium, the neighbouring elements, showed under the same conditions a much weaker fluorescence, evidently due to inevitable traces of thulium. The maximum of the thulium band has nearly the same wavelength as that of samarium in calcium sulphate, about 620 m μ , but it is—at the same temperature—distinctly narrower and reacts quite differently towards changes of temperature, increasing in brightness with decreasing temperature, whilst the samarium band gradually disappears on nearing liquid air temperature. At the latter, the thulium band shows a structure which needs further investigation.

I have to thank Miss E. Rona for preparing the synthetic material, and Miss B. Karlik for photographing the spectra. A detailed report will be presented to the Vienna Academy of Sciences.

K. PRZIBRAM.

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Jan. 20.

¹ See also *Wien Ber.*, **IIa**, **144**, 141 (1935); *Z. Phys.*, **102**, 331 (1936).

² *Wien. Anzeiger*, Dec. 3, 1936.

³ Jantsch, G., and Klemm, W., *Z. anorgan. Chem.*, **216**, 80 (1933).

Claims of Geology in School Courses of General Science

PROF. TRUEMAN's letter in NATURE of February 6, as to the parlous state of geology in relation to teaching in schools, leads one to inquire further into the causes of this state of things.

Considering first the cultural aspect of the question, it is abundantly clear that the purely cultural value of geology is insufficiently realized by teachers in secondary schools. This is all the more puzzling in view of the rapid hold which it exercises on the imagination when properly taught, and the extreme value of its field side to adolescents.

My experience during the last twenty years has led to the conclusion that geologists lost a valuable chance of introducing their subject into schools when they allowed geographers to seize a branch (physical geology) in the great expansion which took place in geographical studies just after the Great War.

Turning to the utilitarian side of the problem, it is found that apart from mining and oil geology,

geologists as a body are little interested in applications of their science, in this respect forming a marked contrast to chemists and physicists. At the present time, the posts open to graduates in geology fall roughly into four main classes: (1) appointments with mining and oil companies; (2) geological survey posts; (3) museum posts; (4) university appointments; and it is clear that the numbers and prospects of such posts are not such as to attract an increasing number of graduates in the near future. One of the chief factors militating against a change in this position is the present overweening importance attached in most quarters to the purely stratigraphical side of the science, to the exclusion of a linking up with other sciences such as chemistry, physics and engineering.

I think it is correct to state that there is not a single trained full-time geologist on the staffs of Government departments, such as the Road Research and Building Research Laboratories, and I find it difficult to believe that there is not an outlet or opportunity for a suitably trained geologist in work of that kind. I have found that the possible applications of the science in civil engineering and building problems are many, but that men who are suited to the study of these problems are not being produced by our schools of geology to-day.

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Application of the Polarographic Effect of Proteins in Cancer Diagnosis

THE investigations of E. Waldschmidt-Leitz¹ have shown that blood serum, similarly to blood itself², activates deactivated papain. Prof. E. Waldschmidt-Leitz¹ has also shown that normal blood serum induces in these ferments or in methylglyoxalase a greater activity than serum from carcinomatous blood. This activity is ascribed to the sulphydryl groups of the proteins of serum.

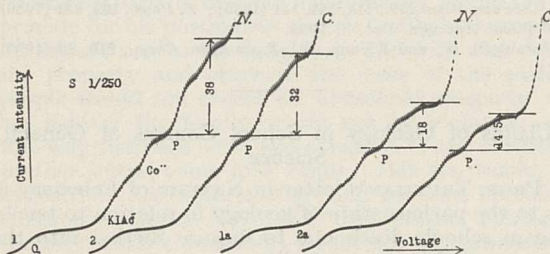


Fig. 1.

CURVE 1, NORMAL SERUM, 'WAVE' P 38 MM. HIGH. CURVE 2, CARCINOMATOUS SERUM, 'WAVE' P 32 MM. HIGH. BOTH SERA WERE TREATED WITH ALKALINE IODOACETATE FOR 70 MIN. CURVES 1a AND 2a WERE OBTAINED WITH THE SAME SERA AFTER 250 MIN. TREATMENT.

Some years ago, I found a sensitive polarographic protein effect, conspicuously exhibited by serum, which I explained as due to the catalytic activity of the sulphydryl groups of proteins³. It seemed thus important to investigate the differences between carcinomatous and normal sera polarographically, by electrolysis with the dropping mercury cathode. In this way a method has been worked out, in which

the sulphydryl groups of serum proteins are acted upon by iodoacetate in alkaline solution, and after a certain time the denatured serum is subjected to the polarographic investigation. In these experiments, 0.3 c.c. of serum, 0.15 c.c. of *N* potassium hydroxide and 0.3 c.c. of 0.2 *N* potassium mono-iodoacetate are mixed and kept at room temperature; after a certain time (about one hour) 0.1 c.c. is taken out and added to 5 c.c. of a solution consisting of 8×10^{-4} *M* cobalt chloride, 10^{-1} *N* ammonium chloride, 10^{-1} *N* ammonia. The polarographic curve of this solution is then recorded. The 'protein effect', consisting in the appearance of a characteristic 'wave' on the current voltage curve, is always found larger with normal serum than if in the same procedure carcinomatous serum is used (Fig. 1. Curves 1 and 2).

Another way which also leads to polarographic differences between carcinomatous and normal serum is to mix 0.3 c.c. of serum, 0.3 c.c. of water and 0.15 c.c. of *N* potassium hydroxide. After 5, 10 or 20 min., 0.1 c.c. of this mixture is added to 20 c.c. of the above cobalt solution, to be investigated polarographically. 67 different samples of various individuals were thus examined without knowledge of the clinical (histological) investigations, which were carried out by Prof. H. Knaus. 32 of these gave an abnormally low polarographic protein effect, and thus were reported as carcinomatous, in perfect agreement with the results of the medical examination and with the biochemical examination of Prof. Waldschmidt-Leitz.

Whilst the details of this investigation will be found elsewhere⁴, it is mentioned here that the polarograms were obtained with Prof. J. Heyrovský's authentic polarograph, made by Messrs. Dr. V. and J. Nejedlý, Prague. A simple 'micropolarograph' suitable for medical routine work of this sort of research is under construction.

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Jan. 17.

¹ Waldschmidt-Leitz, E., Conrath, O., and Gloeditsch, J., *Naturwiss.* [Jan. 22]. Waldschmidt-Leitz, E., *Z. Angew. Chem.* (in the press).

² Purr, A., and Russel, M., *Z. physiol. Chem.*, **228**, 198 (1934).

³ Brdička, R., *Collection*, **5**, 112, 238 (1933).

⁴ Brdička, R., *Rozpr. Ces. Akad.*, II. tř (in the press). *Bull. intern. de l'Académie des Sciences de Bohême* (in the press).

Time Lag in the Vacuum Photo-Cell

IN a recent letter¹ Dr. R. A. Houston treats equally as vacuum photo-cells the KMV6 and the KV6, both of which are made in these laboratories. The KMV6 is highly evacuated, but the KV6 always contains an appreciable quantity of hydrogen evolved from the sensitized potassium; it should not be regarded as a true vacuum cell.

No experiments made in these laboratories throw any light on the question whether the difference between the two cells discovered by Dr. Houston is actually due to this difference in gas content. My object is merely to point out that this possibility should not be excluded from consideration.

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¹ NATURE, **139**, 29 (Jan. 2, 1937).

Genetics in Madrid

DURING a recent visit to Madrid for another purpose, I was able to visit some of my colleagues there, and was delighted to find that research work in genetics was continuing. Prof. I. de Zulueta, in the intervals of hiding the more precious contents of the biological museum in cellars, was continuing his work on the polymorphic beetle *Phytodecta variabilis*. Prof. Galan, of Salamanca, was very appropriately breeding the 'explosive cucumber', *Ecballium elaterium*. This plant is hermaphrodite in one half of Spain, dioecious in the other. Crosses between a dioecious plant and hermaphrodites from different areas seemed to reveal the existence of 'strong' and 'weak' local races, differing, like those of *Lymantria*, in respect of sex-determining factors.

Our discussion of these topics was interrupted by an air raid considerably more severe than any of those on London in 1914-18. However, no bombs fell very near us, and at the time I left, the Museo de Ciencias had not yet shared the fate of the University City, the Prado and the Museum of Anthropology. I think that the persistence of de Zulueta and Galan under conditions which are, to say the least, uncongenial for research, deserves to be recorded, and augurs well for the future of biology in Spain.

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Neutrino Theory of Light

PROF. V. FOCK¹ has stated recently in these columns that he has found that the photon operator defined in the Jordan neutrino theory of light is commutable with its conjugate, and has thus claimed an inconsistency in the theory. It may be remarked that Fock's arguments in this connexion are not quite clear. Indeed, if we follow the notation in his note, we get:

$$\sqrt{|\nu\nu'|} (b_\nu b_{\nu'} - b_{\nu'} b_\nu) = \int_{-\infty}^{\infty} (\gamma_a^\dagger \gamma_a + \nu + \nu' - \gamma_a^\dagger \nu' \gamma_a + \nu) dx \dots (1)$$

It must not be thought that (1) is zero just because it can be split up into two integrals and the second integral can be transformed to the first by changing α to $\alpha + \nu'$ in it. The splitting of the integral appears to be not justified; when $\nu + \nu'$ is zero, each of the split integrals is divergent, for each of them represents the number of particles both in the positive states and the negative states. This is in fact the argument which implies $\infty - \infty$.

A careful application of the convergence criteria regarding the finiteness of the number of particles in the positive states and the number of holes in the negative states, presented in a report by Prof. Max Born and myself², will lead to the result that (1) has the value ν if b_ν and $b_{\nu'}$ are conjugate, and has the value zero if it is otherwise. Jordan³ has also deduced this result by writing the photon operator in a form that does not involve negative indices.

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¹ NATURE, 138, 1011 (1936).

² Proc. Ind. Acad. Sci., 3, 318 (1936).

³ Z. Phys., 99, 109 (1936).

Breeding Tests and Variations

IN NATURE of January 30, p. 197, Prof. T. F. Dreyer draws certain sweeping conclusions as to genetics and its limitations, from an experiment in which he produced visible abnormality and constitutional defect in 11 locusts by means of environmental treatment during development. He did not breed even an *F*₁ generation.

Prof. Dreyer naïvely remarks that the abnormalities "remind one strongly of similarly localized (and similarly produced?) abnormalities in *Drosophila*, and we may legitimately assume the abnormality will be hereditary".

Such a statement, in the present state of biology, can only rest on unfamiliarity with the facts. For it is a commonplace of genetics that only breeding tests can distinguish between hereditary and non-hereditary variation; and numerous workers, notably Goldschmidt, have directed attention to the frequent phenomenon of the complete identity of visible effect, in *Drosophila* and other organisms, of mutations due to genetic change and modifications due to environmental change and not inherited.

Prof. Dreyer's conclusions are thus founded on an elementary but basic methodological error.

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Activity of Corticosteron in the Glucose Test in Rats

EIGHT days after extirpation of both adrenals, adult rats die in about 5 hours if fed with 2.5 gm. glucose (5 c.c. of 50 per cent solution)¹. This test can be used to titrate adrenal cortical hormone both quickly and accurately.

By this method, the great activity of corticosteron, the active crystalline fraction of cortical extracts, can be clearly shown². If 0.2 mgm. or more of corticosteron be injected subcutaneously one hour before the glucose is given, the adrenalectomized rats remain alive. With doses of 0.1-0.15 mgm., about 50 per cent of the rats lived, and with 0.05 mgm. or less all the rats died in 3-6 hours (with severe diarrhoea, as in the case of the uninjected rats). The active dose of corticosteron in this test is 0.2 mgm. (per rat of 150 gm.).

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L. LASZT.

¹ Verzár, F., and Laszt, L., NATURE, 138, 844 (Nov. 14, 1936).

² Fremery, Laqueur, Rechstein, et al., NATURE, 139, 26 (Jan. 2, 1937).

Scientific Worthies and Events commemorated on Postage Stamps

SOME time ago¹, reference was made in these pages to the fact that Ecuador had celebrated the centenary of Darwin's visit on September 16, 1835, by a special issue of postage stamps. These are not the first stamps of scientific interest. In 1923 France issued stamps bearing the head of Louis Pasteur, in 1927 Berthollet and later Pilâtre de Rozier. Louis Blériot and his pioneer flight across the Channel were commemorated in 1934. A recent issue also shows Pasteur at work.

Other countries, too, have issued stamps commemorative of scientific events or famous men of

science. In Germany, last year, there appeared stamps showing portraits of Otto Von Guericke, Daimler and Benz; Italy has Volta, and a stamp which shows a portrait of Galvani, commemorating the Radio-Biology Congress in 1934; the United States a stamp issued in 1929 showing Edison's electric lamp. Special stamps were issued in Germany for the mails carried on the Graf Zeppelin's flight to Spain-Brazil-America in 1930, and again in 1936 on the flight to North America.

Mendeléeff appears on a stamp of the U.S.S.R., which also celebrated the bicentenary of the Academy

of Sciences by a special issue in 1925. Hungary has two stamps for the tercentenary of the University of Sciences, whilst Yugoslavia remembers Nikola Tesla. So recently as last December, a set of Austrian stamps was issued showing six inventors—Weisbach, Schrauben, Von Ghega, Werndl, Lieben and Kaplan.

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¹ NATURE, 133, 15 (July 4, 1936).

Points from Foregoing Letters

By expressing the age of the universe as derived from cosmological theories (2×10^9 years) in units provided by the atomic constants (e^2/mc^3), Prof. P. A. M. Dirac obtains a number comparable with the ratio of the electric to the gravitational force between the electron and the proton (10^{39}). He suggests that this ratio, and also that between the mass of the universe and the mass of the proton (10^{78}) are functions of the age of the universe. This leads him to the supposition that the amount of matter in the universe is constantly increasing while the gravitational 'constant' decreases. He introduces a new time variable ($\tau = \log t$) similar to Milne's distinction between 'dynamic' time as measured by pendulums, etc., and 'kinematic' time measured by radioactive and atomic phenomena.

A method is described by J. H. E. Griffiths and Dr. Leo Szilard for observing the capture radiation emitted by slow neutron absorbers. Using the capture radiation of cadmium as an indicator of the neutron intensity, the absorbing cross-section for slow neutrons is determined for a number of elements. The effect on the Geiger counter of the capture radiation from the eleven strongest slow neutron absorbers is observed. Though the atomic weight of these elements varies from 35 to 200, the effect per captured neutron is about the same for all of them. The number of quanta emitted per captured neutron is estimated for cadmium.

From the number and absorption coefficient of the 'resonance' neutrons and of the electrons which they liberate in a silver detector, C. Y. Chao and C. Y. Fu have estimated at 80–800 volts the average spacing between adjacent resonant levels effective for neutron capture.

A spontaneous increase in the resistance of supraconducting tin and tantalum, followed by a slower decrease, has been observed by Dr. F. B. Silsbee, R. B. Scott and Dr. F. G. Brickwedde, when the current is relatively high (about 2 amperes in a tin wire, diameter 0.0222 cm.).

By measuring the value of the persistent current in a single crystal of tin, by means of a supraconducting galvanometer, Prof. E. F. Burton and K. C. Mann show that the magnetic field necessary to initiate the restoration of resistance when the field is transverse is 0.58 of the value for longitudinal fields.

Commenting on the uncertainty concerning the affinities of the Sterckfontein ape, Dr. R. Broom mentions that the contact of the occipital fragment has now been found. The restored brain appears to

be fairly comparable in size with that of the chimpanzee, but the teeth "resemble those of man".

A. Bentsáth, St. Rusznyák and Prof. A. Szent-Györgyi report that hesperidin and also the mother liquor of 'citrin' show properties which have been ascribed to vitamin P; quercetin, though nearly related in constitution to hesperidin, has no vitamin P activity. (The absence of vitamin P does not in itself affect the animals, but modifies the pathological condition produced by the lack of vitamin C.)

G. I. Crawford records the presence of *Eucrangonyx gracilis* S. I. Smith from the Lea Bridge Works of the Metropolitan Water Board. This amphipod has been previously found only in Canada and the United States.

The reasons why certain types of cross-cousin marriage are favoured and other types are not allowed in Assam is ascribed by Prof. J. K. Bose to economic factors arising during the intermingling of patrilineal and matrilineal clans.

L. Harang explains the regular annual variation of the critical frequencies of the *E*-layer and the inverse annual variation of the *F*₂-layer as due to different absorption of the solar radiation producing ionization in the layer. In the *F*₂-layer the ionizing agency is only slightly absorbed when passing through the layer; a variation of pressure will therefore strongly influence the production of ions. In the *E*-layer the ionizing rays are completely absorbed and the maximum electron production is fixed by the limited spectral energy and is independent of pressure variations.

Assuming that a connexion exists between the bivalent ions of the rare earths and the radio-photo-fluorescence bands, Prof. K. Przibram has tested calcium sulphate containing 10^{-3} thulium after exposure to radium rays with ultra-violet light, and has obtained actually a brilliant red fluorescence at low temperatures.

A criticism of the excessive attention paid to the stratigraphical side in the teaching of geology, at the expense of the chemical, physical and engineering aspects, a knowledge of which would be valuable in building and road research, is made by Dr. B. H. Knight.

The behaviour of serum of a number of cancer patients has been compared by Dr. R. Brdička with the behaviour of 'normal' serum, in its effect upon the current-voltage curve of a dropping mercury cathode, after suitable treatment devised to bring about the 'protein effect'.

Research Items

Buddhism in China

A CLUE to the essential quality, often mis-called materialism, in Chinese culture is afforded in a lecture by Prof. Hu Shih, of Peiping, on "Chinese Culture before and after Indianization", which was delivered on September 11, 1936, at the Harvard Tercentenary Conference on Arts and Sciences (*Science and Culture*, Calcutta, 2, 6). As was then pointed out, the Indianization of China affords material for the study of cultural borrowing on a grand scale such as is without comparable parallel anywhere, except perhaps in the Christianization of Europe. The contrasting elements in the culture of China and India stressed by Prof. Hu Shih were the factual outlook of early Chinese religion, a religion of a hard-working and plain-thinking people, and the imaginative and speculative elements in Buddhism, in which Chinese thought, as it became more sophisticated, found a much-needed and long-sought outlet. The rapid spread of Buddhism in the Yangtze valley suggests, it was maintained, that Buddhism had made considerable advances among the people at large, and especially the lowly, long before it was adopted officially in A.D. 68; while the readiness and completeness with which it was assimilated is shown by the fact that the great persecutions of Buddhism, of which the first took place in A.D. 446 and the last in A.D. 955, were none of them of lasting effect. At the same time, in adopting Buddhist concepts of divinity, the Chinese mentality did not fail to mould them to its own categories and needs. The god Avolokita, for example, changed his sex and became the goddess of mercy, while Maitreya becomes the familiar figure of a jovial monk. Nevertheless, the spread of Buddhism in China is not the least remarkable event in the history of that religion, for, as Prof. Hu Shih pointed out, there was an essential opposition in the two modes of thought, as is shown, for example, in the institution of monasticism, which made such great inroads on the population and wealth of China, though entirely opposed to Chinese economic ideas, while asceticism and disregard of family ties contradicted the whole of China's conception of the family and the obligations of, and to, posterity.

Dominance of Genes in Man

IN a paper on the problem of dominance in man (*J. Genetics*, 33, No. 3), Dr. S. G. Levit has made a careful study of a number of pathological genes in man, and concludes that a large majority are 'conditionally dominant', showing weak penetrance and hence frequently skipping a generation. Thirty-eight genes are classed in this category against 14 recessives and 3 indeterminates. It is recognized that some of the recessives, such as epilepsy and schizophrenia, are not always expressed even in the homozygous condition. The 'indeterminates' are sex-linked genes, which are limited to the male sex so that it is impossible to distinguish them as dominant or recessive. Hæmophilia and night-blindness, usually classed as male sex-linked, are placed here, while colour-blindness, another sex-linked condition, is regarded as intermediate, since female heterozygotes

have recently been shown to exhibit a partial expression of the condition. It is pointed out that genes which are conditionally dominant in the heterozygote tend to express themselves at a late age, while genes which are recessive (in the homozygote) tend to appear earlier. The evolution of dominance is discussed, and it is concluded that, as natural selection has played a decreasing role in civilized man, the mutant genes of more recent origin have retained some of their original dominance while the less numerous recessive genes are older in origin. This encounters the difficulty that many genes may be expected to have occurred repeatedly at different periods.

Yolk of the Egg of Salmon

THE egg of the salmon, *Salmo salar*, contains a large quantity of yolk, and F. R. Hayes and D. M. Ross (*Proc. Roy. Soc.*, B, Dec. 1936) have studied the manner in which this is utilized during development. During this process fat is used up (burnt) and stored in the embryo, and the total of these two amounts is defined as the fat absorbed by the embryo from the yolk. The rate at which these processes take place is estimated by taking samples of a hundred eggs at a time at various intervals from a few hours after fertilization until the absorption of the yolk sac, and the results are given in graphical form. These curves are compared with the well-known curves for the chick, and when the necessary corrections for the difference in time are made, the resulting curves show considerable similarity. Thus it appears probable that the sequence of energy sources, that is, carbohydrate-protein-fat, is the same in these two widely differing forms.

Metopa Grænlandica in a Lamellibranch

K. STEPHENSEN and G. THORSON describe an interesting case of commensalism (*Meddelelser om Grønland*, 118. No. 4. 1936). *Metopa grænlandica* has been recorded from inside ascidians both in north and west Greenland and in the Mount Desert region, Maine, U.S.A., whilst other species of the genus were found in *Actiloba* and in association with the medusoid *Phialidium* from Millport, Scotland; but apparently this is the first time it has been seen in a bivalve (*Pandora glacialis*). This bivalve is a high arctic circumpolar species, the southern limits of which are east Canada and the Murman coast, but it does not occur in west Greenland and Iceland. Its mantle lobes are united almost entirely, and are only free at the anterior end to allow the foot to pass out. Thus the habitat must be a natural one for the *Metopa*, although peculiar and with little available space as the shell has one valve quite flat and the other only slightly convex. The *Metopa* adheres to the gills of the mollusc by sticking its antennæ between the lamellæ, or it lies free, back downwards, head pointing towards the caudal end of the host. Quite young specimens of the amphipods and also adults were found, which probably indicates that breeding takes place within the mantle cavity of the shell. Out of twenty-three *Pandora*, eight contained *Metopa*.

Effects of Cyclone on Coral Reef

In the Reports of the Great Barrier Reef Committee, vol. IV, Part II, 1936, Mr. F. W. Moorhouse records the effects of a cyclone in 1934 on Low Isles, North Queensland. This was the island on which the Great Barrier Reef Expedition had its headquarters in 1928-29. At that time, the island and reef were surveyed in great detail and Mr. Moorhouse, who was himself a member of the expedition, has been able to give valuable information on the destructive effects of the cyclone and the changes that it wrought in the formation of the reef. The effects of lowering of the waters of the moats on the perforate coral *Porites* are dealt with in some detail. The polyps of the newly exposed zones of the coral appear to become stimulated and an increase in lime deposition follows. This deposition takes the form of sharp pointed spines. As a result of the constant expansion and retraction of the polyps over these spines, the tissue becomes penetrated and the spines are exposed to the exterior. The bared spines become settling points for filamentous algae. As the algal growth increases, sediment is held by it, which can no longer be removed by the polyps. As a result they become smothered. The whole process takes several months.

Cytology of *Agave*

THE century plants of the genus *Agave* include *A. sisalana* and various other species native to Mexico and Central America but now widely grown in the eastern tropics as a source of fibre. In connexion with breeding experiments at the Amani Agricultural Research Station in Tanganyika, Mr. L. R. Doughty has examined the chromosomes of various species (*J. Gen.*, 33, No. 3). He finds that *A. amaniensis*, a new species of unknown origin found growing in the plantations, is diploid, having $2n=60$ chromosomes, 10 long and 50 short. In addition to two other diploid species, *A. cantala* is found to be triploid, *A. Zapupe* tetraploid, *A. fourcroydes* and *A. sisalana* approximately pentaploid ($2n = c. 140$). That these species are autopolyploids is shown by the behaviour of the chromosomes, which frequently form trivalents, quadrivalents and pentavalents in meiosis. The species are of limited natural distribution and nearly related. Breeding experiments indicate that they are heterozygous. The diploid species will cross with one another and with polyploid species. The diploid species fail to set fruits at Amani, and even with artificial pollination the setting of seed is low. *A. sisalana* becomes partially fertile under certain conditions which appear to be connected with the formation of the abscission layer at the base of the ovary.

Phytopathology in India

A SECTION of "Biochemical and Allied Research in India, 1935" (pp. 100-112) summarizes the investigations into Indian plant diseases during 1935 and previous years. A reprint of the section has been received from the author, Dr. B. B. Mundkur, and shows a gratifying amount of research work in progress. Cereal diseases are mainly represented by the smuts and *Helminthosporium* troubles. A new disease of gram (*Cicer arietinum*), caused by a species of *Mystrosporium*, was reported by Mitra during the year, and a new virus disease of til (*Sesamum indicum*) made its appearance (Pal and Nath). The immunity of Indo-American strains of cotton to the Indian strain of the fungus *Fusarium vasinfectum* has been

compared with the susceptibility of Indian cottons. Diseases of the sugar-cane, of fruit trees, and other crops, are further considered. Dr. Mundkur has also two recent articles in the *Indian Journal of Science*, on the "Systematic Position of the Smut causing Malformation of *Vitis quadrangularis*" (6, Pt. 3; June 1936) and "A Rhizoctonia on Sweet Potatoes in Bombay" (6, Pt. 4; Aug. 1936).

The Geological Time Scale

FOLLOWING up his important work on the determination of the age of the Keweenaw basalt (510-560 million years) by the helium method, W. D. Urry has now applied the latter to small groups of basic igneous rocks representative of many of the geological horizons above the Keweenaw (*Bull. Geol. Soc. Amer.*, 47, 1217). The results include the following:

		Millions of years
<i>Pliocene</i>	Basalt, Steens Mt., Oregon	13 ± 1
<i>Miocene</i>	Basalt, Douglas Creek, Washington	17 ± 1.5
<i>Oligocene</i>	Basalt, Lower Silesia, Germany	36 ± 2
<i>Early Cretaceous</i>	Little Hatchet Mts., N. Mexico	85 ± 3
	Dykes cutting the Nevadan	90 ± 4
	Granodiorite	110 ± 7
<i>Late Jurassic</i>	Nevadan Granodiorite	110 ± 5
<i>Triassic</i>	Palisade Sill, New Jersey	165 ± 8
	West Rock Sill, New Haven, Conn.	170 ± 12
	First Flow, Watchung Mt., N. Jersey	180 ± 11
	Basalt, Brighton, Mass.	230 ± 15
<i>Permian</i>	Newbury volcanic rock, Mass.	300 ± 10
<i>Devonian</i>	Diabase in Martinsburg Shales,	355 ± 15
<i>Ordovician</i>	Pa.	375 ± 15
	Basalt, Unicoi formation, Tenn.	440 ± 30
		465 ± 30

Brief descriptions are given of the analysed specimens, and it is shown that the ages found are consistent with those obtained from strongly radioactive minerals by the lead method.

Nature of Atmospherics

E. V. APPLETON and F. W. Chapman (*Proc. Roy. Soc.*, A, 158, 1) have published the latest stage of their investigation of atmospherics, which appears to mark a distinct advance in the study of atmospherics and of thunderstorms. An aperiodic elevated aerial was used as in the classical experiments of C. T. R. Wilson, but the potential changes were recorded by a cathode ray tube with a screen which gave a persistent image. This was photographed automatically, the camera shutter being itself tripped by the transient discharge. As is to be expected, the field change produced by a lightning flash nearby is mainly due to the electrostatic effect of the change in charge distribution, while the field at a great distance is that due to electromagnetic radiation. This results in a progressive change in the wave form of the atmospheric at increasing distance from the source. The picture obtained from a near discharge shows a change of field taking place usually in a series of steps, as may be expected from moving-plate photographs of lightning flashes. The first part of the discharge is often comparatively slow, corresponding to the 'leader stroke' of the flash photographs. During the period of maximum current, there are often superposed pulsations with quasi-periods down to 10 micro-seconds. The atmospherics observed at great distances commonly show several quasi-periodic half-cycles, and sometimes a tail with much slower cycles. These changes in shape as the disturbance is propagated are possibly caused by dispersion in the ionosphere.

Automatic Regulation of the Temperature of a Room

PERHAPS the most difficult problem in connexion with the automatic control of the temperature of a room is to find the most suitable spot at which to fix the thermostat. In an article in the *Electrical Contractor and Retailer* of January, it is stated that the British Thermostat Co., Ltd., has been able to show that for the vertical walls of the room there is a cushion of air extending about $1\frac{1}{2}$ in. from the wall surface in which, owing to the existence of convection currents and other causes, the temperature varies considerably. Further, owing to heat exchange between the outside and inside of a wall, its temperature is continually changing. To avoid these sources of error, the British Thermostat Co. has recently introduced a new design of room thermostat. The main features of the design are, first, that the sensitive element is spaced sufficiently far from the wall to avoid the abnormally heated air cushion; and secondly that the contact area between the back-plate and the wall is small and the conductive heat path between the back-plate and the main body of the instrument 'housing' is at the top of the instrument, so that conducted heat, already reduced to a minimum, has little effect on the sensitive element. The thermostat is contained in a vertical bakelite tube open at the top and bottom to permit free circulation of air, and thus assists rapid operation. The instrument has an adjustable setting scale, the standard range being from 45° to 75° F., and operates on a differential of 3° F. If required, a locking device can be fitted to the setting scale so as to prevent unauthorized interference.

Iron-Nickel Alloys of High Permeability

IN a paper read by W. F. Randall before the Institution of Electrical Engineers on January 8, a most interesting summary is given of the metallurgy and magnetic properties of the remarkable group of iron-nickel alloys of high permeability. Difficulties experienced with the first 'permalloy' containing 78.5 per cent of nickel have led to its substitution by iron-nickel alloys containing other metals, and in this paper the copper alloy known as 'Mumetal' is specifically considered. Details of the manufacture of the strip and of its practical heat treatment are given, together with a fairly detailed treatment of the factors which determine its magnetic characteristics. The paper ends with a short account of the testing methods employed and of the practical applications of this material for loading cables, for the cores of instrument transformers, transformers and chokes for radio apparatus, magnetic screening, magnetic relays and the armatures for moving-iron instruments.

Solubilities in Deuterium Water

PUBLISHED measurements of solubilities of salts in deuterium water have been limited to a few determinations near room temperature. R. W. Shearman and A. W. C. Menzies (*J. Amer. Chem. Soc.*, **59**, 185; 1937) have now measured the solubility of potassium chloride in 98.2 per cent deuterium water from 0° to 180° , the total weight of deuterium water used being 1.39 gm. By comparing the solubilities with those in ordinary water, a short linear extrapolation gave the solubility in pure deuterium water. The solubility was lower than in ordinary water, but increased

faster with temperature. From about 60° to 180° the solubility difference is approximately a linear function of temperature; the more rapid increase with temperature below 60° may be connected with changes of the average configurations in liquid water. The authors emphasize that, contrary to a prevalent belief, deuterium water is not always a poorer solvent for salts than ordinary water (cf. *NATURE*, **138**, 121; 1936).

Inorganic Chromatographic Analysis

THE adsorption method of analysis known as chromatography, which has been used with such marked success in the investigation of the carotenoid field of organic chemistry, and in the examination of many other complicated organic molecules, has now been applied by Schwab and Joekers (*Naturwiss.*, **25**, 44; 1937) to the problem of the separation of inorganic cations. The method depends upon the fact that the different cations are adsorbed to different extents by aluminium oxide. The solution containing the cations to be separated is poured over a column of alumina. As it runs through, the cations are adsorbed at different positions in the column. The column is then washed and 'developed' by passing through it a reagent, usually ammonium sulphide, which forms coloured compounds with the adsorbed cations. Coloured rings are thus produced in different parts of the column, by means of which the different cations present in the mixture can be detected. From neutral aqueous solutions of nitrates of the metals the cations are adsorbed by alumina in the following series: antimony, bismuth, chromium, ferric, uranyl, lead, mercuric, cupric, silver, zinc, cobalt, cadmium, nickel and manganese. In some parts of the series, however, the adsorption rings are very close, and separation is difficult. Hydrogen ions are themselves adsorbed rather more strongly than most cations. The adsorption series is different when solutions of the cations in ammonia or alkaline tartrate solutions are used. A practical use of the method lies in the detection of traces of elements lying high up in the adsorption series in those adsorbed further down. Thus, a trace of iron in copper or cobalt solutions, or a trace of copper in cadmium or cobalt solutions, is readily detected.

The Stellar Problem of Three Bodies

PROF. E. W. BROWN has recently published two papers on this subject (*Mon. Not. Roy. Astro. Soc.*, **97**, 1; November 1936). He limits the solution to those terms which may be capable of being detected by observation at present and in the immediate future. In the first paper, "Application of Satellite Theory", where he shows how a literal satellite theory could be adapted to the stellar problem, the results are useful only when the eccentricities and inclinations are small. This restriction is removed in the second paper, "The Equations of Motion With a Simplified Solution", where nearly all eccentricities and inclinations can be included. In both cases, however, there is one important limitation; no periodic term which has the square or products of the ratio of the periods and that of the mean distances as a factor of its coefficient can be detected by observation. After dealing with the satellite problem a simple rule for deducing the stellar problem is given, and it is shown that this rule holds good for the second, and hence for all higher approximations.

Optical Lenses moulded from Plastic Material

AN interesting exhibition of optical lenses moulded from plastic materials was held on February 9 at the Waldorf Hotel, London, under the auspices of the Combined Optical Industries, Ltd. Those responsible for the production of the material and for the process of moulding it are Mr. A. Kingston, the inventor, and Mr. Peter Koch de Gooreynd, chairman of the company, who has been associated with the development of the process.

It is claimed that this invention, which is British in origin and development, offers an opportunity for the increase of an industry in which Great Britain has hitherto taken a comparatively small share. The optical medium is produced from various plastic and transparent materials of a resinous character. It is originally prepared in sheets, which are guillotined into strips and then into small squares. These are subjected to a special treatment in which compression and the maintenance of temperatures of varying degrees play an essential part. The refracting surfaces are produced by moulding, and lenses polished and ready for mounting are delivered from specially designed machines. The long and difficult process of grinding at present necessary in the manufacture of optical systems is thus avoided, and it is evident that the cost of the production of the essential parts of optical instruments can be very greatly reduced.

The lenses shown at the exhibition were made of a particular form of the plastic material known by the trade name of 'Perspex'. It is a substance of high transparency, very light, being about half the density of glass, and practically unbreakable. It is possible to throw one of the lenses with great force on to a marble table without damaging the surfaces so far as can be seen by eye. It appears that the

material can recover from a considerable degree of strain without apparent permanent set.

The refractive index of the material has been determined by the method of apparent depth and was found to be approximately the same as that of crown glass. It is extremely transparent in the ultra-violet region extending to 2700 Å. but is more absorbent in the infra-red.

These properties of the material suffice to show that it has the right to be regarded as a valuable optical medium, which may well exercise a revolutionary influence in the optical industry. Cameras, spectacles, range-finders and similar apparatus can be produced more quickly and cheaply and in a more robust form in this material than in glass. A striking exhibit was a photograph enlarged about twenty times showing excellent detail. Small opera glasses exhibited very little colour effect, although it is true that the magnification was not more than three diameters.

Certain questions naturally arise as to the possibility of the development for the manufacture of accurate scientific apparatus, where it is essential to eliminate the effects of aberrations. It appears that a number of different kinds of plastic materials is available, and, if they can be produced with the right dispersive powers and refractive indices, there is obviously a great future for the material in the field of research.

It appears that surfaces can be silvered. Can they be produced optically flat, and is the medium so optically perfect that it can form a Lummer plate? We do not know if information on such points is available yet, but enough was shown at the exhibition to supply convincing proof that, in the wide and extending field where optical instruments come into contact with modern life, this medium will play an important role.

The British Electrical and Allied Industries Research Association

THE sixteenth annual report, covering the period from October 1935 to September 1936, of the British Electrical and Allied Industries Research Association, now usually called E.R.A., has been published. It shows that its research work is rapidly increasing in magnitude and importance. When the formation of research associations in Great Britain was first considered some twenty years ago, their value to industry was considered highly problematical by many. This distrust is now completely dispelled. It can be proved that their work has resulted in the saving of millions of pounds every year to the consumers. In the electrical industry alone it has resulted in a great increase in the continuity of the supply and the length of life of the cables and the efficiency of the lamps.

Knowledge cannot be gained without expense. The funds contributed by the manufacturers and the equal contributions from the Government are converted into 'knowledge stock' which the chairman

of the council of E.R.A. calls a priceless national asset which repays the investor by ever increasing dividends of prosperity and progress. There are 450 voluntary workers, some of them well-known experts, serving on the various committees of E.R.A. The electrical industry is one of the best organized in the country and now fully recognizes the commercial value of research. Within its present field there are many problems still to be solved by E.R.A. When solutions are obtained, some of them will doubtless lead to the active development of profitable branches of the industry.

A very happy state of affairs is disclosed in the report by the way this Association co-operates with the leading engineering institutions, with numerous international committees, with the Electricity Commission, with the G.P.O., the B.B.C. and the Radio Manufacturers' Association. Its financial position is very sound. It has built up its laboratory at a cost of £26,000 out of its own reserve fund. Out of

a total income of £68,000 last year, the Department of Scientific and Industrial Research contributed £19,000.

Of individual researches, we may mention the research on the electric strength of thin dielectrics and varnish films. The electric strength of mica has been found to be constant up to 300° C. This value agrees with certain calculations based on recent theories. The oscillographic studies of the current and voltages which occur during a breakdown have led to valuable practical results. A research is proceeding on the deleterious effects of ionization products and coronæ (brush discharges). Two papers were presented on behalf of E.R.A. to the British Association, by Dr. S. Whitehead and Prof. W. M. Thornton respectively. The latter is also revising the tables for spark-gap calibration.

Important tests were carried out with the co-operation of the Central Electricity Board, on the Portsmouth-Reading line, on the interference produced by high harmonics in neighbouring circuits, and a

report will also be issued. A number of reports on interference were presented to the Commission Mixte Internationale, and some of the conclusions put forward were incorporated in the final recommendations. The issue of a report by the Institution of Electrical Engineers on electrical interference with broadcasting brought the large-scale co-operative researches co-ordinated by E.R.A. to a close. They have been superseded by a series of investigations which aim at (1) obtaining accurate data and limits for standard specifications and (2) compiling reports upon specific matters of interest to manufacturers of electrical plant. In railway engineering research, it has been found that cadmium-copper wire shows considerably less wear than pure copper as a trolley wire material; the small quantity of cadmium present only reduces the conductivity of the wire by a small amount. Its freedom from stretching makes this alloy of copper very suitable for use as a trolley wire.

The report is published by E.R.A., 15 Savoy Street, W.C.2.

International Fisheries Research*

THE twenty-ninth reunion of the Conseil Permanent International pour l'Exploration de la Mer was held in Copenhagen in May 1936 under the presidency of Mr. Henry B. Maurice. The present position being unchanged, all the States now participating will continue for another five years as from July 22 of last year. Latvia is now desirous of becoming a full member.

Among the many subjects involved was the position of the various countries as regards size limits and mesh regulations (Point 7 of the agenda), the president having circulated a memorandum previously prepared by himself summarizing, so far as was possible, the present position with regard to mesh regulations and size limits.

Three special scientific meetings were held during the Council meeting of 1936, the first to discuss the physiological problems of interest to the marine biologist in his studies of the most important species of fish, the second to compare stocks of fish in the several areas in respect of age composition, the third on the measurement of submarine light and its relationship to biological phenomena. The programmes and reports of the different area committees are included in Part 1 of the *Rapports et Procès-verbaux*.

Part 2 includes the Administration Report, which was passed without amendment. A large part of this has to do with the herring. A special meeting of herring experts was held at Lowestoft on October 16-17, 1935. Besides the report with recommendations, there are papers on the herring from the Skagerak, Kattegat and Baltic, Fladen Ground, Western European waters, the Southern Bight, the southern part of the Transition Area, Faroes, Iceland and Greenland, and from Scotland, also others on race questions, populations and larvæ. M. le Gall's paper on the present state of knowledge

concerning the origin and distribution of herring populations in western European waters was specially discussed.

The following recommendations were made. Any group of herring spawning in a given area at a given season from year to year should be defined as the natural 'Biological Group', and morphological characters should be used as a practical aid in the identification of these biological groups outside the area and season of spawning. Work on biological groups and other local and seasonal population should be continued. Vertebral counts of selected material should be continued, additional characters such as the number of keel scales being also studied when necessary. A co-operative study should be undertaken on the practicability of utilizing a count of separate portions of the vertebral series in such a way as to draw distinctions between morphologically distinguishable groups with a minimum of labour and material. Spawning times should be defined by stating the actual month, and in the northern area group, characters of the autumn and spring spawning populations on the north-west coast of Iceland should be investigated and compared. All countries working in one way or another in the waters of the Faroes, Iceland and Greenland should arrange for material of herring to be collected for age determinations and distribution of larval stages; fishing experiments should be carried out in the open sea between Norway, Faroe Isles and eastern Iceland to collect material in order to get information as to the exchange of population between different parts of this region; and the collecting work concerning age composition, population-characters, exact determination of maturity and distribution of larvæ should be carried out in all important areas systematically and continuously for a period of years. Samples of spawning herring from the Viking Bank should be collected and investigated as opportunity occurs; samples from western Greenland and from Labrador should be collected with the view of comparing the population characters, age composition, spawning time and

* Conseil Permanent International pour l'Exploration de la Mer. *Rapports et Procès-verbaux des Réunions*. Vol. C. 1^{ère} partie: Procès-verbaux (Mai 1936). Pp. 62. 3.00 kr. 2^{ème} partie: Rapport administratif (1935-36). 3^{ème} partie: Appendices. Pp. 111 + 25. 4.00 kr. (Copenhagen: Andr. Fred. Høst et fils.)

growth. It is of importance for the international work that contact be maintained with the herring investigations in Russian northern waters by the U.S.S.R. Further, it was recommended that in the North Sea and Channel Area the following problems be investigated: the three subgroups of 'autumn' spawning herring of the North Sea, the degree of mixing, if any, in the winter spawning herrings of the southern North Sea and Straits of Dover, the herring of the Smalls, the mixing on the Fladen Grounds and the herring population in general in the Irish Sea; that further investigations be carried out in the Skagerak, Kattegat and Baltic as regards the 'autumn' spawning population of the Kattegat, co-operation being necessary between Denmark and Sweden, and that population investigations be carried out on the eastern coast of the Baltic, on a co-operative basis between the countries concerned.

A second special meeting of experts from the Baltic countries met at Copenhagen on December 4-5,

1935, to examine more closely the question of further measures to protect the stocks of fishes in the Baltic. The meeting dealt mainly with the flounder and salmon, and recommended further protective measures.

The third part of the Report (Appendices) contains several papers, including one by F. S. Russell on "The Importance of Certain Plankton Animals as Indicators of Water Movements in the Western End of the English Channel" and "Handliste zur Sicherung der Bestimmung nordischen Plankton" by H. H. Gran, E. Hentschel and F. S. Russell. The latter paper is an attempt to list the more important plankton organisms, both micro- and macro-plankton, plant and animal, in order that it may be seen at a glance which to record in any preliminary plankton investigations. Only those species which can be identified easily are included, and if two or more important species of a genus are easily confused the genus only is given.

The Natural History of Barra, Outer Hebrides*

EDINBURGH has been enterprising and has adopted the island of Barra in the Outer Hebrides as a centre of its natural history activities. The Biological Society of its University produced eight zoologists, seven botanists and four geographers and geologists who invaded the island, camping there for the first fortnight of July.

The island is a useful size for this purpose, about $8\frac{1}{2}$ miles long by $5\frac{1}{2}$ miles broad. This gives only about twenty-five square miles of land, as it has a much indented coast, with many sandy bays between rocky headlands. Its central parts are about 700 ft. high with hills to the south of 1,260 ft. and 1,092 ft. The geology was already known, the surface being peat moor with rocky knolls and ridges of gneiss with intervening boggy hollows. The character of the coastal scenery is said to suggest recent subsidence, some of the inlets appearing to have been originally freshwater lochs. Heavy south-west winds dominate one side, carrying the shell-sand over the peaty soil and producing excellent grazing grounds (machair). Once completely afforested, there are now only three patches of woodland. Lastly, there are nine freshwater lochs, these containing about 0.2 per cent calcium, 0.02 per cent chlorine and pH 5.6-7.4.

Clearly, in this diversified island of Barra there was plenty of room for the botanists. To commence with, one party had to collect and determine all the species of plants dwelling there, while another set to work to see how far the vegetation had been segregated into communities. Coastal areas, moorland, loch, woodland and cultivation were recognized, and lists are given of the higher plants found in each; these are obviously incomplete, being collected in a restricted season, but serve to indicate the associations. The layman would remark that this section consists largely of Latin names, whereas the botanist would see a necessary start. The lochs are particularly interesting, one set with a rich lacustrine and a poor marshland flora and a second set with opposite characters—it is not clear how far these are due to topographical conditions. Of the lower plants there is a particularly rich moss and liverwort

flora, 85 and 21 species respectively. To these must be added 27 species of pteridophytes, 42 fungi and 30 lichens—while evidently one botanist was interested in marine algae, of which 78 species were named, here an evident correlation with the relatively warm, oceanic waters.

Inasmuch as the fauna is a consequent of the flora, it cannot be collected in any completeness without a knowledge of the latter—and in any event there are many forms which are seasonal. All we can say is that an excellent start has been made on the land fauna. At this stage it is a mere list of the species, for as the authors say, "it would be premature to discuss the animal ecology". The lists vary in value; thus Waterston's section on land and freshwater Mollusca records 51 species in Barra as compared to 64 species known from the whole Outer Hebrides and contains excellent notes on their distribution. There is an element of completeness here, as indeed there is in respect to the whole freshwater fauna. In contrast, the insect fauna probably does not record a third of Barra's species—and lists of the marine fauna are obviously out of place and of little value.

Now is there to be a sequel of a further expedition by the Edinburgh Biological Society to Barra? The preliminary work has been done and upon this the plan for a serious attack on the ecology can be based. The island must be so mapped as to show the distribution of the plant communities and the proportions of the various species in these determined. Then the animals associated with each plant community must be collected and such species as are of general distribution or are chance visitors eliminated. This will entail a study of the physiological connexions of the animals with their environments and of their numbers of individuals. The island is small enough and its parts so clearly defined that valuable ecological results seem certain. Lists of the species of animals and plants in any locality cannot form a natural history; for this science is one of life, not of death. Edinburgh has a great University and it may perhaps be invited to bring its work to full fruition, even if it means student-expeditions at different seasons extending over several years.

**Proc. R. Phys. Soc., Edin.*, 22, 241-96 (1936).

East African Rift Valleys*

J. W. GREGORY'S classical work on the rift valley in Kenya focused attention on the rift valleys of Central Africa, and the historical retrospect given by Bailey Willis at the beginning of the recent Carnegie Institution volume on the subject provides a summary of the views of the pioneers, though there are some notable omissions both in this and in the bibliography.

The work consists of two principal parts: the first giving the 'general picture' with a hypothesis of rift valley formation, and the second detailed characters of the several areas, which include the coastal region of Tanganyika and the Tanganyika plateau, Lake Victoria and the central plateau, and also the rift valleys, Lake Albert with the Ruwenzori range at its southern end, Lake Tanganyika, the Rukwa trough, Lake Nyasa, the Ruaha trough, the classical rift valley (called Gregory Rift Valley throughout the work), and Lake Rudolf. A chapter on the volcanoes is given, and shorter chapters on earthquake conditions and on gravity tests. So little space is devoted to seismology that it might be wondered why this volume is one of the series in the studies of that science until it is realized that the work forms a very suggestive basis for a seismological study, and it is probable that the seismologist will be best qualified, when more data are available, to decide whether the general hypothesis will stand. It is likely that the physicist will object to some of the theories put forward, where conceptions such as anti-gravity or levity, downdraft and suction, are given the status of scientifically defined forces acting in the crust of the earth and capable of forming the structures under consideration.

A brief outline of the main thesis is here attempted. An area of uplift where the high plateaux of Central Africa are developed is situated over an asthenosphere consisting of "relatively incompetent but solid elastic rock". By gradual heating, probably by radioactive processes, this asthenosphere becomes a molten body, or asthenolith, which is covered by the competent shell about twenty-five miles (40 km.)

* Studies in Comparative Seismology: East African Plateaus and Rift Valleys. By Bailey Willis. (Publication No. 470.) Pp. x+358+73 plates. (Washington: Carnegie Institution, 1936.)

thick. The melting of the magma causes an expansion in volume and hence a forcing up of the central area, while various forces at the margins, which are rather convincingly described, cause the edges to sink down. The author points out that the great plateaux "exhibit a tendency to a circular form" and shows (p. 72) that "this is strikingly the fact in the case of that plateau which is most completely surrounded by rift valleys of East Africa, the Tanganyika plateau and its northern extension beyond Lake Victoria".

We are to suppose that the large central plateau is the raised cover of the asthenolith of molten magma twenty-five miles below, and that the rift valleys and troughs, and the upraised masses of Ruwenzori and Elgon(?) are round the edges, and that any escapes of magma to give volcanic eruptions also lie round the margins. This roughly fits the facts, and it must be noted that the central cover is thick enough to have prevented any eruptive or intrusive activity since Karroo times.

The details of structures which form the second part of the volume constitute a mass of information very usefully assembled together. Bailey Willis is to be congratulated on having reached the top of the rim of the great Ngorongoro hollow and found that it is not a giant crater as stated by Jaeger. He warns the reader who visits Lake Tanganyika not to be disappointed, as he was, on first seeing that mighty trough which is almost filled with water (p. 185). There is very little evidence for a central core of greenstone to the Ruwenzori range, as postulated by the author, and the basic intrusive rocks known on the mountains are far older than the uplift of the mass. There is some confusion between Mgahinga, a volcano almost as large as Muhavura and Sabinyo, and Gihinga, a small cone to the north-east.

This important and stimulating work is beautifully printed, with few misprints, while the plates (many of which appear to be from infra-red photographs and most of which are by the author) much enhance the value of the volume. It will be read by all geographers and geologists, as well as by seismologists, who are interested in rift valleys in Central Africa, and will be referred to by those who are now working in, or studying, that most impressive part of the globe.

WILLIAM C. SIMMONS.

Breeze and Clinker Aggregates

THE Department of Scientific and Industrial Research has issued a revised edition of a bulletin published some years ago on "The Properties of Breeze and Clinker Aggregates and Methods of Testing their Soundness" (Building Research Bulletin No. 5. London: H.M. Stationery Office. 6d. net). Since the original publication, investigations carried out at the Building Research Station have established the cause of the occasional failures of these materials and have enabled tests to be devised which are suitable for application under ordinary working conditions.

'Clinker', or well-burnt furnace residue, and 'breeze'—the name applied to the smaller and less definite residues—usually contain a proportion of unburnt fuel, which has been proved to be the cause, when these materials are used as aggregates, of cracking which develops and becomes visible in the set concrete at various periods after pouring, by reason of the swelling movements which these unconsumed coals undergo in the mass. Certain types of coal are more likely to give trouble of this kind than others and, it is stated, the extent of the action can be

predicted from the physical properties of the coal from which these aggregates were originally derived. For laboratory purposes, samples of coal are distinguished by their power of removing the colour from an aqueous solution of methylene blue and by their relative moisture absorption properties, and it is suggested that the presence in the aggregate of as little as 4 per cent of a coal of the most dangerous class may be sufficient to cause failure.

Investigations made on the setting and maturing movements in breeze and clinker concretes, and on the influence of sulphur and of water content, are described, while it is also explained why these aggregates may not be used in reinforced concrete construction owing to the rapid corrosion resulting from their permeability. Of the two tests recommended, the 'pat test' is said to be reliable in the majority of cases. A standard pat is made by mixing a sample of the material under test with fine white plaster of Paris, and a normal Portland cement; if in a period of 1-4 days this exhibits certain defined symptoms of movement, the material is to be judged unsound and must be rejected.

Fossil Algae in Boghead Deposits

BOGHEAD coal is a comparatively rare and valuable material yielding gas and paraffin on distillation. It is characterized structurally by the presence of minute 'yellow bodies', the nature of which has been a subject of discussion. An algal nature was suggested for these in 1889 by Edgeworth David, but their peculiar properties in resisting decay and compression prevented any general acceptance of this view. Since that time, reports of C. E. Bertrand and Renault, Zalesky, and Thiessen have supported the algal view, and finally P. Bertrand in 1930 came to the conclusion that the *Pila* of C. E. Bertrand and Renault was *Botryococcus* and their *Reinschia* a member of the Volvocales.

The subject has now been placed on a much surer basis by a detailed study of living *Botryococcus Braunii* and material from the muds of glacial lakes and more recent peat deposits by Dr. K. B. Blackburn, and a re-examination of the 'yellow bodies' of boghead deposits by Dr. B. N. Temperley (*Trans. Roy. Soc. Edin.*, 58, 1935-36). Dr. Blackburn has followed the alga through its many variations in form; she shows that the inner membranes of the cells are cellulose, but external to this each cell has, towards the periphery of the colony, a cellulose and pectin cap, which contributes to the general mucilage surrounding the colony, whilst towards the centre of the colony, a thick fatty thimble forms around each cell, and these constitute the general matrix of the colony. The cuticular nature of these thimbles would explain their resistance to decay. The cells are rich in oil and also contain appreciable quantities of starch.

Dr. Temperley finds that the 'yellow bodies' described as *Pila* show extremely close agreement with *Botryococcus Braunii*, the various polymorphic forms of which are recognizable in the deposits. The form *Reinschia*, formerly ascribed to the Volvocales, differs from *Pila* in the hollow form of the colonies, but the details of structure correspond so closely with those of *Botryococcus* that Dr. Temperley concludes that "there is no doubt that the various forms of *Reinschia* and *Pila* are fossil colonies of the same type of alga".

Science News a Century Ago

Medicine in Chili

"THE science of medicine has hitherto made but small advances in Chili. . . . Twenty years ago medicine was practised by men of colour and the most ignorant quacks, the hospitals were entirely under the control of the monks, and the few well informed physicians, those, namely, who had received an European education found in Lima a more lucrative field for their exertions than was offered to them anywhere in Chili. This state of things, however, no longer obtains, for the number of physicians is now even greater than necessity requires, and there is a college at Santiago at which medicine is taught, although on a somewhat compendious plan. Still there is a scarcity of educated practitioners in the country, where the healing art is chiefly exercised by matrons and old Indian women. The country people are tolerably familiar with the virtues of the rather numerous indigenous plants, but to many of them properties are attributed which the individuals in question do not really possess, and many other remedies supposed to be of great efficacy are solely indebted for the estimation in which they are held to a credulous superstition. When any particular part of the body is the seat of disease, the remedy is sought for in the corresponding part of some animal, variously prepared; thus for ophthalmic disorders the carbonized eyes of birds of prey are administered, the claws of the condor are given for gouty pains of the hands, and the flesh of the smooth-skinned lizard for scurfy affections of the skin." (*London Medical and Physical Journal*, February 18, 1837.)

The Colony of Western Australia

At a meeting of the Statistical Society held on February 20, 1837, Lord Glenelg, then Colonial Secretary under Lord Melbourne, communicated "A Report of the Committee of Correspondence of the Colony of Western Australia". Known first as Swan River Settlement, Western Australia was formed into a province in 1829, and the towns of Perth, Fremantle and Guildford were founded the same year. The development of the colony, however, had been slow. The report consisted of nine sections written by different individuals and dealt with agriculture, live stock, shipping, commerce, population, crime, religion and other matters. The total population of the Swan River Settlements west and east of the Darling Mountains was but 1,550. Sheep farming was the principal industry, there being in the York district east of the Darling Hills about 5,000 sheep in excellent condition. The original flocks were imported from "Van Diemen's Land". The animals were a large-framed and very coarse-wooled breed, but being crossed with Merino rams, the quality of the wool was constantly improving. The merino flock consisted of about 900 pure descendants of the choice Spanish flock presented in 1791 to George III by the King of Spain. This breed had much improved since imported into the colony. The amount of wool shipped for England and the Cape of Good Hope in 1836 was 12,500 lb.

The East India Company's S.S. *Berenice*

ACCORDING to *The Times*, on February 22, 1837, the East India directors gave a dinner at the West

India Dock Tavern, Blackwall, to Captain Grant and the officers of the S.S. *Berenice*, which was being prepared to leave for India. This vessel was the first steamship for the East India Company contracted for by the famous engineer and shipbuilder Robert Napier (1791-1876), and her success had much to do with Napier being entrusted with the contracts for the earliest ships of the Cunard Company. The *Berenice* was 170 ft. long by 28.8 ft. broad and of 646 tons with engines of 250 nominal horse power. She was a wooden paddle vessel; her boilers working at a very low pressure were of copper and her engines were of the ordinary side-lever type. Leaving Falmouth on March 16, 1837, she reached Bombay on June 13, having called at Santa Cruz, Mayo, Fernando Po, Table Bay and Port Louis. Her average speed was about 8 knots.

Therapeutic Use of Odours

At a meeting of the Medico-Botanical Society on February 22, 1837, reported in the *Lancet* of March 4, Dr. George G. Sigmond read a paper on odours. Though not now used therapeutically, the older physicians employed them, and, according to Dr. Sigmond, they might once again be found of service in medicine. Travellers, he remarked, who sleep in houses made of cinchona wood, escape intermittent fever, probably from the odour of sulphate of quinine. A similar odour has also relieved tic douloureux. In a work published by a pupil of Linnæus after the death of that eminent botanist, who, however, superintended the construction of the volume, plants were divided into seven classes according to their smells as the *aromatica*, the *fragrantia*, etc., each odour having an action peculiar to itself, and some suggestions were made for imparting odours to scentless flowers through the roots, etc.

Davenport's Invention of an Electric Motor

ON February 25, 1837, Thomas Davenport (1802-51) secured a patent for an electric motor, the first of its kind taken out in the United States. Davenport was a blacksmith of Brandon, Vermont, who about 1833, with his friend Orange Smalley, began experimenting with magneto machines, unaware of what Henry had already accomplished. By December 1834 they had made a machine having twelve permanent magnets and two electromagnets connected through a form of commutator consisting of wires dipping into mercury cups to an electric battery. By May 1835 he had substituted for the mercury cups insulated segments on the lower part of the wheel shaft, which were rubbed by contact springs made of flattened wire. His new machine he showed to Henry at Princeton, and there saw Henry's own electromagnetic engine.

On Henry's advice, Davenport showed his machine to Alexander Bache and to a group of men at the Franklin Institute, but being short of money, sold it to the Rensselaer Polytechnic Institute for 30 dollars. Encouraged by Prof. Eaton, he made a new machine adapted for traction purposes, and this was exhibited at Troy on October 14, 1835. He was joined by Ransom Cook, and new models were built and exhibited, and Davenport lodged a model and applied for a patent, but at the Patent Office fire of December 15, 1836, both model and papers were destroyed. Soon after this, however, he secured his patent of February 28, 1837, and his model is

now preserved in the National Museum at Washington. The inventor, however, reaped no reward for his ingenuity and died on July 6, 1851, on a small farm in Salisbury, Vermont.

Faraday on Marshall Hall

THE *Lancet* of February 25 contains the following note on a lecture delivered at the Royal Institution by Prof. Faraday on "Dr. Marshall Hall's Discoveries in the Nervous System": "The principal feature in these discoveries appears to be the fact that in the medulla oblongata and the spinal marrow resides a function which is distinct from sensation and volition, and termed by Dr. Hall the *reflex excito-motory function*, from its generally proceeding along the nerves from the point of excitement to the spinal marrow, and being reflected from thence to some muscular organ. For this reason the seat of this class of action is called by him the excito-motory system. Müller, of Berlin, Mr. Faraday stated, has in a remarkable manner confirmed the truth of Dr. Hall's discoveries by a recent and separate investigation, although the former still confounds the nature of the function with sensation. . . . Mr. Faraday concluded by observing that Dr. Hall's views are original, all preceding physiologists having confounded the phenomena alluded to with sensation. The subject appears to have interested Mr. Faraday, as not improbably preparing the way for some future discovery relating to electricity as connected with the nervous system; for, as he said, the division of the nervous system into distinct portions was somewhat simplifying any investigation with regard to electricity, considered as a nervous agent."

University Events

CAMBRIDGE.—G. E. Briggs, of St. John's College, has been appointed reader in plant physiology.

The Raymond Horton-Smith Prize awarded to that candidate for the degree of doctor of medicine who presents the best thesis for the degree during the year has been divided between Dr. F. Goldby, of Queens' College, and Dr. J. Gray.

Mr. Thomas Dalling has been elected to the professorship of animal pathology, in succession to Prof. J. B. Buxton, Queens' College, who resigned last term on being appointed principal of the Royal Veterinary College.

Dr. R. G. W. Norrish, formerly fellow of Emmanuel College, H. O. Jones lecturer in physical chemistry, has been elected to the professorship of physical chemistry vacant by the death of Prof. T. M. Lowry.

OXFORD.—The Herbert Spencer Lecture for 1937 will be given by Dr. Joseph Needham on May 27 at 5 p.m. in the Examination Schools. The subject is: "Integrative Levels, a Revaluation of the Idea of Progress".

Prof. The Svedberg, of Uppsala, will give two public lectures in English in the Museum, Oxford, at 5 p.m. on February 26 and 11.15 a.m. on February 27. The subject is: "Sedimentation, Diffusion and Electrophoresis Technique for the Study of High-Molecular Compounds".

Societies and Academies

London

Royal Society, February 11.

N. G. HEATLEY and P. E. LINDAHL: Studies on the nature of the amphibian organization centre. (5) The distribution and nature of glycogen in the amphibian embryo. N. G. HEATLEY, C. H. WADDINGTON and J. NEEDHAM: (6) Inductions by the evocator-glycogen complex in intact embryos and in ectoderm removed from the individuation-field. Total glycogen, lyo-glycogen and desmo-glycogen have been estimated by quantitative micro-chemical methods in the amphibian embryo around the gastrulation period. Prior to gastrulation, the glycogen concentration is highest at the animal, lowest at the vegetal, pole. During gastrulation, the total glycogen decreases in amount all over the embryo, but especially markedly (30 per cent) in the material which invaginates through the dorsal lip of the blastopore. Desmo-glycogen also decreases in all regions. It is thought unlikely that desmo-glycogen can be identical with that fraction of glycogen to which the evocator may be attached in the cells. The finding that both lyo-glycogen and desmo-glycogen preparations produce successful neural inductions in the chick embryo makes this still more unlikely. The distinction between evocation and individuation has been studied by implanting desmo-glycogen preparations (containing the adsorbed evocator) into isolated pieces of competent ectoderm. Massive neural inductions are produced, but these have not the character either of recognizable parts of the nervous system or of sections of a normal neural tube. On the other hand, the cells are not oriented entirely at random. This is believed to demonstrate the effect of the homogeneous stimulus of the primary evocator. Following on the induction of neural tissue in these explants, the repulsion of overlying ectoderm and the formation of melanophores were observed. These two effects are interpreted as dependent differentiations brought about by the presence of neural tissue as such.

A. HADDOW and A. M. ROBINSON: The influence of various polycyclic hydrocarbons on the growth-rate of transplantable tumours. A. HADDOW, C. M. SCOTT and J. D. SCOTT: The influence of certain carcinogenic and other hydrocarbons on body-growth of the rat. While intra-peritoneal administration of a number of carcinogenic hydrocarbons produced considerable inhibition in the rate of growth of the Jensen and Walker tumours, a series of related non-carcinogenic compounds gave no such inhibition. One synthetic oestrogen was moderately inhibitory and another quite inactive. Inhibitory activity was also shown to a variable extent by chrysene and by 1:2-benzanthracene and certain of its derivatives (3-, 4- and 7-methyl-), the carcinogenicity of which is either very feeble or nil. In comparative experiments on body-growth, X-radiation, lead, and colchicine were found to produce a temporary interference which was followed by recovery to the normal growth-rate, with or without compensation. Although the carcinogenic hydrocarbons must be regarded as toxic substances, their growth-inhibiting action is apparently independent of toxicity in any non-specific sense. The inhibition produced by the carcinogenic compounds was extremely prolonged, even after a single injection.

There is thus a correlation in compounds of this type between carcinogenicity and growth-inhibitory power. The mode of action of these substances seems to be indirect; they operate by producing a prolonged retardation of the growth of normal cells, which eventually react by a process of discontinuous variation to give a new cell race with a greatly increased fission rate.

Paris

Academy of Sciences, January 18 (*C.R.*, 204, 161-200).

LÉON LECORNU: Obituary notice of Joseph Auclair.

GABRIEL BERTRAND and GEORGES BROOKS: The composition of the wood of the trunks and branches of the principal French trees. Determinations of xylose, mannose and cellulose.

SERGE FINIKOFF: (T) Configurations admitting an infinity of Calapso transformations.

DOUCHAN AVSEC: The wave forms of vortices in longitudinal bands.

JEAN HÉLY: A synthetic theory of gravitation and of electromagnetism.

MAURICE COTTE: The convergence and achromatism of centred systems of electronic optics.

PIERRE JACQUET: The application of electrolytic polishing to the study of metallic deposits. The crystalline nature of the supporting metal is destroyed by the usual mechanical polishing methods; but the electrolytic method recently suggested by the author gives smooth, brilliant surfaces without altering the structure of the underlying metal. Some experimental results with copper are described.

SALOMON ROSENBLUM, MARCEL GUILLOT and Mlle. MARGUERITE PEREY: The α magnetic spectra in the actinium family.

PAUL BAYARD. The infra-red absorption spectrum and molecular structure of pyruvic acid. From the data given, it appears that pure pyruvic acid exists almost entirely in the ketonic form, but the presence of a band attributable to the (OH) vibration proves the existence of a certain proportion of the enolic form.

PAUL LAFFITE and ANDRÉ PARISOT: The influence of the velocity of detonation of an explosive on the velocity of the shock wave. The results of experiments proving that the velocity of the explosive wave and that of the shock wave increase at first with the density of the charge. This disagrees with the results of Gawthrop, and possible causes for the difference are discussed.

FERNAND GALLAIS: The constitution of solutions of potassium iodobismuthates. These solutions possess an exceptionally high magnetic rotatory power, and utilizing this property it was found that the chief complex ion in solutions of potassium iodobismuthate was either $(\text{BiI}_6)^{3-}$ or $(\text{BiI}_7)^{4-}$, and it was not possible to decide between the two formulæ. Compounds of both types have already been isolated.

EMILE THELLIER: The magnetization of baked clay: application to the study of the intensity of the earth's magnetic field in the past. A method is described for deducing the intensity of the earth's magnetic field at the time the brick was baked.

JEAN FELDMANN and ROBERT LAMI: The marine vegetation of Guadeloupe.

JULIEN DE SAINT-LAURENT: The formation of resiniferous canals in the ligneous tissue of the seedlings in *Pinus halepensis* and *Pinus Pinaster*.

JEAN MICHEL GUILCHER: The comparative respiratory intensity of the androecium and gynæcium in flowers.

ROGER DUFFAU: The influence of *B* avitaminosis on the composition of the muscle of the pigeon.

MME. VÉRA DANTCHAKOFF: The experimental production of free-martins in the guinea pig, and the nature of the factor conditioning their sexual histogenesis.

YVES RAOUL: The estimation of tyrosine in raw material from plants.

Copenhagen

Royal Danish Academy of Sciences and Letters,
October 16.

HARALD BOHR: Contributions to the theory of almost periodic functions (7, 8).

TH. MORTENSEN: Studies on the development of echinoderms: from the Biological Station, Ghardaqa (Red Sea).

November 13.

THORVALD MADSEN: The negative phase of the immunity curve.

November 27

A. LANGSETH: Constitution of the benzole molecule.

December 11.

ELIS STRÖMGREN and H. Q. RASMUSEN: The origin of Comet 1863 VI.

ELIS STRÖMGREN: Description of Ole Römer's micrometer after Horrebow's "Basis Astronomiae".

C. M. STEENBERG: A morphological and biological investigation of the larva and pupa of *Delopsis aterrima* Zett.

GEORGE HEVESY, O. CHIEWITZ and G. HEVESY: Studies on the metabolism of phosphorus in animals. Radioactive phosphorus (phosphate) prepared from sulphur is added to the diet of animals and the path of the phosphorus in the body followed up by radioactive measurements.

Moscow

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

M. KELDÝŠ: A class of extreme polynomes.

M. SUBBOTIN: A new anomaly which comprises, as particular cases, the eccentric, true and tangential anomalies.

M. A. ROSENBERG and K. E. AVALIANI: Dissolution of the 'vacuum films' of metals in acids (2). Dissolution of iron and nickel in sulphuric acid.

I. I. ČERAJAJEV and A. D. GELMAN: Isomerism of ethylene compounds of platinum.

B. N. FORSCH: The problem of a field of thermal waters.

M. V. KLENOVA: Sediments of the Kara Sea.

O. S. VJALOV and V. I. SOLUN: Palæogenic Turritellidæ of Ferghana.

J. A. BIRSTEIN: Growth and propagation of *Cardium edule* in Uertvy Kultuk and Kaidak in the Caspian Sea, in connexion with salinity.

A. N. DRUŽININ: Contribution to the knowledge of the anatomy of the yak (*Poephagus grunniens* L.).

G. U. LINDBERG and D. I. OCHRJAMKIN: The flat-fishes of the Japan Sea, *Liopsetta obscura* Lichtenstein and *Limanda schrenki* Schmidt.

(*C.R.*, 4, No. 5; 1936.)

G. V. PFEIFFER: The expression of functions by functions.

M. LAVRENTIEV: The continuity of univalent functions.

L. KANTOROVICH: A class of functional equations.

G. FICHTENHOLZ: Linear functions continued in generalized direction.

V. FOCK: The impossibility of a neutrino theory of light (1). Contradictions between the neutrino theory of light and the principle of superposition (see *NATURE*, Dec. 12, 1936, p. 1011).

F. N. KIRILOV: The sand-eel of Novaya Zemlya (*Ammodytes marinus* Raitt).

D. M. FEDOTOV: The late post-embryonic development of *Operophtera Crumata* L.

Rome

Royal National Academy of the Lincei
(*Atti*, 23, 643-713; 1936).

L. PUCCIANI: Inductances and fields of force.

S. CHERUBINO: Reduction of matrices to canonical form (2).

B. SEGRE: Oblique ovals, and the extension of the theorem of Cavalieri-Lagrange to functions of two variables.

M. MANARINI: Vectorial homographies with kinematic applications in S_n spaces (3). General formula for the velocity and composition of the instantaneous motions of rotation.

E. VOLTERRA: Plane elastic arches (3).

C. AGOSTINELLI: The helicoidal vortex.

B. FINZI: Plastic rotations.

C. JODI: Procedures for experimental researches on elastic floors.

R. BRUSCAGLIONI: Investigation of the resolving power of sensitive photographic materials by means of a new type of interferometer.

P. GUARESCHI: Viscosity of liquids (2).

A. C. BLANC: Submarine deposit of *Cyprina islandica* L. in the gulf of Terranova Pausania (Sardinia).

A. GALAMINI and E. SERIANNI: Survival of *Bufo vulgaris* after bilateral pneumectomy.

V. ZAGAMI: Further observations on the behaviour of creatin bodies and of urinary sulphur, phosphorus and chlorine during fasting and subsequent feeding.

V. FIGURA: Alimentary and nutritive value of the acorn and the possibility of utilizing it in human nutrition.

C. RIZZO: Movements of teleosts in relation to experimental lesions of the peripheral apparatus of movement and of sensation (4). Labyrinthine lesions.

Sydney

Royal Society of New South Wales, October 7.

M. D. GARRETTY: Some notes on the physiography of the Lake George region, with special reference to the origin of Lake George.

G. J. BURROWS and A. LENCH: (1) The action of lead tetrachloride on primary and secondary halogenated arsines and on tertiary arsines. (2) Note on diphenyl dihydroxy arsonium chloride, $\text{Ph}_2\text{As}(\text{OH})_2\text{Cl}$.

O. U. VONWILLER: Interference by reflection from a concave spherical mirror. Interference bands may be observed when light is reflected at large angles

of incidence from a spherical concave mirror, the result of the superposition of beams which have undergone different numbers of reflections. Two, three or more beams may contribute. An examination is made of the conditions for the occurrence of the bands and of the ranges over which those due to particular pairs of beams are observed. The band interval for a given system is λ/θ^2 , θ being the deviation of the light and λ depending on the numbers of reflections of the two beams concerned. The factors controlling intensity are investigated. A convenient and reasonably accurate method for the determination of wave-length is based on the effect.

J. C. EARL and N. G. HILLS: The action of nitrous acid on amines. A comparison has been made of the behaviour of aniline and methyl aniline, respectively, with nitrous acid. The possibilities of interference by secondary reactions in the case of aniline has to be kept in view. Allowing for this the experimental results recorded indicate that the reactions are essentially similar. Dilatometric and conductimetric methods were used in making the comparison.

Forthcoming Events

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

Monday, February 22

VICTORIA INSTITUTE, at 4.30.—Alan Stuart: "Science and the Interpretation of Scripture".

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Dr. Friedrich Zeuner: "Some Aspects of Evolution revealed by the Study of Fossils".*

UNIVERSITY OF LEEDS, at 5.15.—Prof. F. A. Lindemann, F.R.S.: "Low Temperature Research".*

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Eric Shipton: "More Explorations round Nanda Devi".

Tuesday, February 23

WARBURG INSTITUTE, at 5.30.—Prof. J. Huizinga: "The Play Element in Culture".*

Wednesday, February 24

SOCIETY FOR THE STUDY OF ALCHEMY AND EARLY CHEMISTRY, at 8—(at University College, Gower Street, W.C.1).—Discussion on "Alchemical and Chemical Symbols".

ROYAL SOCIETY OF ARTS, at 8.15.—Prof. W. L. Bragg, F.R.S.: "Alloys".

Friday, February 26

INSTITUTION OF CHEMICAL ENGINEERS, at 11 a.m.—Fifteenth Annual Corporate Meeting to be held at the Hotel Victoria, Northumberland Avenue, London, W.C.2.

GEOPHYSICAL DISCUSSION, at 4.30—(at the Royal Astronomical Society).—Discussion on "Radio Observations in High Latitudes" to be opened by Prof. E. V. Appleton, F.R.S.

UNIVERSITY OF OXFORD, at 5—(in the Museum).—Prof. The Svedberg: "Sedimentation, Diffusion and Electrophoresis Technique for the Study of High-Molecular Compounds" (succeeding lecture on February 27 at 11.15 a.m.).*

BRITISH PSYCHOLOGICAL SOCIETY, at 8.30—(at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1).—Prof. T. H. Pear: "Psychological Problems of Television".

ROYAL INSTITUTION, at 9.—Lord Horder: "Old Diseases and New".

ASSOCIATION OF TECHNICAL INSTITUTIONS, February 26–27.—Annual General Meeting to be held in the Carpenters' Hall, Throgmorton Avenue, London, E.C.2.

February 26, at 10.45.—The Right Hon. Lord Kennet: Presidential Address.

Appointments Vacant

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

ASSISTANT IN MATHEMATICS AND ENGINEERING SCIENCE AND ASSISTANT IN ELECTRICAL ENGINEERING in the Willesden Technical College—The Secretary, Willesden Local Higher Education Committee, Education Offices, Dyne Road, Kilburn, N.W.6 (February 26).

SCIENTIFIC OFFICER (BALLISTIC PROBLEMS) in the Air Ministry—The Secretary, Air Ministry S.2.D., Adastral House, Kingsway, W.C.2. Quote No. B348.) (February 26).

LECTURER IN CHEMISTRY in the Wigan and District Mining Technical College—The Principal (February 27).

INSPECTOR OF MINES, BURMA—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (February 27).

SENIOR AGRICULTURAL ADVISORY OFFICER for West Norfolk—The Director of Agricultural Education, Agricultural Station Offices, Sprowston, Norwich (February 27).

PHARMACIST in Runwell Hospital, near Wickford, Essex—The Clerk to the Visiting Committee (February 27).

GOVERNMENT CHEMIST, CYPRUS—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, London, S.W.1 (March 6).

ASSISTANT LECTURER IN MATHEMATICS AND ASSISTANT LECTURER IN ZOOLOGY in University College, Exeter—The Registrar (March 6).

X-RAY AND RADIUM PHYSICIST in the National Research Council of Canada—The Secretary, National Research Council, Ottawa (March 15).

PROFESSOR OF PHYSIOLOGY in the Lady Hardinge Medical College, New Delhi, India—The Principal (April 15).

LECTURER IN DOMESTIC SCIENCE in the Gloucestershire Training College of Domestic Science, Barrack Square, Gloucester—The Secretary.

Official Publications Received

Great Britain and Ireland

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1687 (1792): Performance and Longitudinal Stability of a Single-Engine High Wing Monoplane; Experiments on a Quarter Scale Model with Aircrew Running. By L. W. Bryant, D. H. Williams and A. F. Brown. Pp. 31+41 plates. 3s. 6d. net. No. 1691 (2238): Comparison of Drag of Trousered and Retractable Undercarriages. By Dr. R. Jones, A. H. Bell and A. F. Brown. Pp. 6. 1s. net. No. 1701 (2004): The Effect of Central Cutaway in Split Flaps on the Trim of a Low Wing Monoplane. By D. W. Bottle, C. Callen and K. W. Kirkby. Pp. 17. 3s. net. No. 1704 (2212): Structure of Turbulence in a Natural Wind, with a Description of a Sensitive Pressure Gauge. By A. Graham. Pp. 16. 2s. 6d. net. No. 1707 (1939): Trailing Edge Flaps in relation to Take-off and Landing of Landplanes. By S. B. Gates. Pp. 31. 4s. 6d. net. No. 1711 (2072): A Successive Approximation Process for Solving Simultaneous Linear Equations. By J. Morris. Pp. 12. 2s. net. No. 1712 (2107): Full Scale and Model Porpoising Tests of the Singapore IIc. By W. G. A. Perring and J. L. Hutchinson. Pp. 26. 3s. 6d. net. No. 1713 (2087): Full Scale Tests of Slots and Flaps on a Heinkel He.64, with Special Reference to Landing. By J. E. Serby and H. B. Squire. Pp. 15. 2s. 6d. net. No. 1718 (2186): The Use of Dynamically Similar Models for Determining the Porpoising Characteristics of Seaplanes. By L. P. Coombes, W. G. A. Perring and L. Johnston. Pp. 14. 2s. 6d. net. No. 1719 (2146): Full Scale Tests of the Hendy Heck (with an Appendix giving Pilot's Notes). By A. E. Woodward Nutt and P. A. Hufton. Pp. 18+2 plates. 3s. net. No. 1722 (2038): The Effect of a Reduction of Aileron Torsional Stiffness on the Flutter of a Model Wing. By V. M. Falkner, W. P. Jones and C. Scruton. Pp. 8. 1s. 3d. net. (London: H.M. Stationery Office.) [281]

Other Countries

Commonwealth of Australia: Council for Scientific and Industrial Research. C.S.I.R.: Ten Years of Progress, 1926–1936. Pp. 67. (Melbourne: Government Printer.) [251]

Mikrochemie: Internationale Zeitschrift für deren Gesamtgebiet. Festschrift zum 80 Geburtstag von Prof. Dr. Hans Molesch. Pp. viii+454+1 plate. (Wien und Leipzig: Emil Halm und Co.) 28 gold marks. [261]

U.S. Department of the Interior: Office of Education. Leaflet No. 37: Physique of School Children. By Dr. James Frederick Rogers. Pp. 17. 5 cents. Bulletin, 1936, No. 9: Testing Practices of High School Teachers. By J. Murray Lee and David Segel. Pp. v+42. 10 cents. (Washington, D.C.: Government Printing Office.) [271]