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A Threat to Zululand Game Reserves.

A CONTROVERSY of some moment in the history of game preservation in South Africa has been raging in interested circles and in the press of the Union. The heads of two of the State departments—the Minister of Agriculture, General Kemp, and the Minister of Lands, Mr. Grobler—have decreed that two of the three game reserves in Zululand must be blotted out and their game exterminated. One of the threatened reserves is of particular interest, in that it harbours the last dwindling remnant of the southern race of the white rhinoceros, the largest of land animals next to the elephant.

Two considerations seem to have weighed with the ministers who have reached this fateful decision. In general, game reserves are unpopular with the farmers in their neighbourhood, since they restrict what has long been regarded as a legitimate source of sport and of food supply. The throwing open of a reserve is therefore an easy step to political popularity. A more specific plea is that since big game undoubtedly carries nagana, domestic stock runs a serious risk of infection from this source through the agency of tsetse flies. Upon this premise is founded the conclusion that the only method of freeing stock from nagana infection is the total extermination of big game throughout the area. This policy has long been favoured by General Kemp, and his present decision is consistent with his firm opinion.

It has still to be shown, however, that the policy of extermination is needful or even desirable from the stock-breeder's point of view. Indeed, many competent observers hold that extermination of big game but aggravates the trouble so far as domestic animals are concerned. In the first place, it is impossible to bring about the total extermination of all wild carriers of nagana, which the policy demands if it is to be effective ; in the second place, it is believed that the segregation of game in reserves tends to keep the tsetse fly restricted to definite areas ; in the third place, as was recently pointed out in an article in the *Journal of the Society for the Preservation of the Fauna of the Empire*, experience has shown that the slaughter of big game has caused the tsetse to range farther into new territories, and has not succeeded, and cannot succeed, in reducing the numbers of tsetse. On the other hand, satisfactory and unobjectionable methods of extirpating the tsetse fly and reducing the incidence of nagana in domestic stock are known, as has been shown

by experiments carried out in Southern Rhodesia, where the bush itself, the winter retreat of the tsetse fly, has been attacked.

In view of these facts, the decision to exterminate the game in the Zululand reserves appears to be premature. Fortunately, the decree of the Ministers of Agriculture and of Lands requires endorsement by Parliament and by the Natal administration before it can become effective. The necessary delay has given Dr. Leonard Gill, the Director of the South African Museum in Cape Town, an opportunity of voicing in the *Cape Times* a strong and reasoned protest against the abolition of the sanctuaries, and a leading article in the same journal, supporting his views, shows how great pride is taken in the unique heritage which South Africa retains in her wild animals, and how needful for her own credit in the eyes of a Nature-loving world is the preservation of the remnant of a fauna which has already suffered much at the hands of civilised man.

The controversy still continues. We can only hope that by expressing the enlightened will of the people it will succeed in turning aside the danger which threatens the Zululand reserves.

Rhodesian Man.

British Museum (Natural History). Rhodesian Man and Associated Remains. By William Plane Pycraft, G. Elliot Smith, Macleod Yearsley, J. Thornton Carter, Reginald A. Smith, A. Tindell Hopwood, Dorothea M. A. Bate, and W. E. Swinton. With an Introduction by Dr. F. A. Bather. Pp. xiii + 76 + 5 plates. (London: British Museum (Natural History), 1928.) 12*s.* 6*d.*

THE official account of the Rhodesian skull has now been published, and it will doubtless be read with interest by anthropologists all over the world. In his introduction, Dr. F. A. Bather, until lately head of the geological department of the Natural History Museum at South Kensington, reviews the somewhat contradictory records of the finding of the skull in 1921, and thinks that the evidence shows that, when it was found, the entire skeleton was with it, covered by a stalagmitic deposit; but that the greater part of the skeleton has since been destroyed, and that now it is quite uncertain whether any, and, if any, which of the human bones preserved, belonged to the skull. Since parts of at least three individuals are said to have been found, this is a most important admission.

A description of the skull and other human remains from Broken Hill, by Mr. Pycraft, Assistant Keeper in the Department of Zoology at the Museum, follows, and is greatly helped by a series of plates showing beautiful photographs of the skull from five points of view, as well as of some of the other bones. These probably are by far the most valuable part of the whole publication, and would have been more valuable still had they been full size instead of approximately three-quarters. If this were impracticable, a scale, photographed beside them, would have shown the reader what he should understand by 'approximate.'

To a craniologist it is clear that, before it was photographed, the skull was carefully orientated on the Frankfurt plane, though this is not stated: and it will be noticed that in taking the norma verticalis the vertex was tilted a little to the left. These, however, are comparatively trivial criticisms of some very fine and artistic reproductions.

Mr. Pycraft's description is painstaking and directs attention to many points which otherwise might be missed. It is well that the Museum authorities should have sought the help of a member of their zoological staff, because he is able to make many useful comparisons with the skulls of anthropoids, and his opinion that the Rhodesian skull is definitely human is valuable.

At the same time, in giving Mr. Pycraft the sole responsibility for writing an official account of this important skull, an account which may really be helpful to anatomists and physical anthropologists in other lands who have no opportunity of checking it with the remains, we cannot help thinking that the authorities have put him in a rather false position, through no fault of his own.

No one who has not worked in a dissecting room, as well as in a museum, can be expected to understand how largely the skull and bones are moulded by the muscles, ligaments, and nervous structures in relation with them; and though it is true that Mr. Pycraft writes familiarly about the semispinalis capitis and the rectus capitis posticus major, his deductions from them are quite unconvincing to an anatomist, especially since he fails to notice the influence which huge muscles like the trapezius and sternocleido mastoid have exerted.

On p. 7 we are told that "the foramen spinosum is not present," but on p. 27 we find "the sphenoid being produced beyond and behind the foramen ovale into the usual outstanding foramen spinosum." Owing to the ponderous style which is used, it is often difficult to know what the author really means; for example, he tells us that "the apertura

pyriformis is of the orygmoscrapid type," but this and the dissertation which follows fail to make clear whether the nasal opening has a subnasal fossa or not. Indeed, the whole description is so loaded with rarely used technical terms and turgid sentences about unessential things, that it would be difficult for an ordinary anthropologist to grasp were it not for the excellent photographs.

All this no doubt would have been pointed out and put right had Mr. Pycraft been granted the help of a colleague trained in human anatomy; nor should we emphasise them here were it not that we are dealing with the official account of our national museum, which will be accepted by our colleagues abroad as the best that British anthropology can do. It must clearly be understood that for this description of Rhodesian man, with the exception of the endocranial casts, British anatomists can claim no praise or share any blame.

Then, again, in considering the affinities of the skull, Mr. Pycraft admits, as every physical anthropologist who has seen it admits, its close likeness to the Neanderthal group, yet he seldom compares it carefully with other skulls of this series, but usually with Bantu, Australian, and modern English skulls; and this, we cannot help feeling, is a regrettable omission.

When we come to the description of the axial and appendicular skeletons, we find Mr. Pycraft more in need of expert help than ever. First he produces a sacrum which he says he is justified in regarding as a part of the skeleton which furnished the skull, because "its salient features agree completely with the evidence furnished by the hip girdle and limb." We may take it, therefore, that he sees nothing in it, as a sacrum, to associate it directly with the skull: certainly an anatomist would be surprised to learn that the weight of so massive a skull was transmitted to the pelvis by so slight a bone.

It is in the os innominatum, however, that Mr. Pycraft seems to have made his saddest mistake, because upon it he bases such extraordinary conclusions. He says that the portion of it upon which he has to work includes the acetabulum and the greater part of the great sciatic notch. Clearly this implies that he thinks that the greater part of the acetabulum is there, and that after he has reconstructed the small amount of the cavity which, according to him, is missing, Rhodesian man must have had a hip socket which truly was fearfully and wonderfully made. Then, with the deductive reasoning of a Sherlock Holmes, he points out that with such an extraordinary acetabulum, the patient must have had an extraordinary gait, an ape-like gait, with which he shuffled along, his thighs abducted and externally rotated, and his knees flexed.

Thus Mr. Pycraft leads us, step by step, to his culminating point, where he proposes a new genus, to be called *Cyphanthropus*, for Rhodesian man; and this he tells those of us who are less well versed in the classics than he, means 'stooping man.'

It seems that the whole of this rather dramatic climax would never have been reached had not Mr. Pycraft made rather a serious mistake in his osteology. The fragment of the os innominatum which he figures would serve quite well for that of a modern man if only he could realise that, instead of having nearly the whole of the acetabulum present, there is only a small segment of the upper part of it; a segment which gives us no reason to believe that the rest of the cavity was not perfectly normal in position and shape. There is therefore no reason for saying that the owner stooped, and the name *Cyphanthropus*, instead of being a label, becomes a libel.

One is glad that the writer tells us that "when the pelvis is orientated as in life with the body erect, the anterior inferior spine of the ilium is over the middle of the upper segment of the horse-shoe-shaped acetabular border." No first year's anatomy student would make such a blunder, and Mr. Pycraft would be more than astonished if he could see the effect of such an orientation on a living body trying to stand upright. One is glad, because it is a touch of local colour which enables us to see the pelvis with his eyes and, seeing, to understand what a curious mental picture of the human form he must have.

Even if Mr. Pycraft could show that his anatomy is irreproachable, his observation accurate, and his judgment sound, we still would submit that he has not justified the harsh sentence which he has passed upon *Homo Rhodesiensis*. Is this poor man to be branded as *Cyphanthropus* for all time because his head was found in the same cave as some limb bones which may or may not have belonged to him, and which Mr. Pycraft thinks have stooping tendencies? The creator of this new genus thinks that he is quite justified because, he says, "when the outstanding features of these several parts are critically studied it will be found that they display a reciprocal inter-relationship so intimate that any attempt to dissociate the skull from the remaining parts of the skeleton must do violence to all ordinary rules of evidence and inference."

Since we are not favoured with these reciprocal inter-relationships which are so intimate, we must take it that we have been told all that is good for us, and must gratefully accept Mr. Pycraft's dictum as dogma where anatomy is concerned; but we may be allowed to wonder what "critically examined" means to him, and whether he has not already done violence to the ordinary rules of evidence and inference.

The endocranial casts, by Prof. Elliot Smith; the pathology of the left temporal bone, by Mr. Macleod Yearsley; the teeth, by Mr. J. Thornton Carter; the mammalian remains found with the skull, by Mr. T. A. Hopwood; and the stone implements, by Mr. Reginald Smith, form short articles which follow that of Mr. Pycraft. They all are written by able experts and are of considerable interest and importance. F. G. PARSONS.

Starch.

A Comprehensive Survey of Starch Chemistry. Vol. 1. Compiled and edited by Robert P. Walton, in collaboration with the following authorities: Jerome Alexander, Carl L. Alsberg, Victor G. Bloede, Frederick D. Farrow, Auguste Fernbach, Herbert C. Gore, Sir James C. Irvine, Johann R. Katz, Arthur R. Ling, George M. Moffett, Walter A. Nivling, Amé Pictet, Eugen Preuss, Hans Pringsheim, Max Samec, Henry C. Sherman, Jokichi Takamine, Jr., T. Clinton Taylor, Harold G. Turley, Leo Wallerstein. Pp. 360. (New York: The Chemical Catalog Co., Inc., 1928.) 10 dollars.

AS specialisation in all subjects develops, there can be little doubt that the text-book of the future will consist of a series of short monographs by experts forming a symposium of the various phases of the subject. In this instance the single material starch requires eighteen such monographs, occupying 240 pages, to cover its chemistry and technology, and the remarkable bibliography which follows requires a further 330 pages.

Mr. Walton has been unusually fortunate in his collaborators—Pictet, Irvine, Ling, and Pringsheim are the four recognised leaders of the ranks of those who are endeavouring to elucidate the structure of starch. Fernbach and Sherman on the fermentation side, and the several writers on the technical side, are all names which inspire respect. There is evidence of careful editing, and one is struck at the outset with the absence of superfluous matter and the desire to make each section crisp, suggestive, and yet complete.

The structure and nature of starch is still the subject of lively discussion, and to the student the conflicting theories are necessarily somewhat confusing. According to Pictet, by distillation under reduced pressure, starch gives at least 30 per cent of lævoglucosan, a double anhydride of established constitution. Decomposition by heat in the presence of glycerine gives in turn hexahexosan, trihexosan, and α-glucosan, which is a double anhydride of known but different structure. There is thus evidence of both α- and β-linkages either in starch itself or formed during its degradation. Starch is regarded as a polymerisation product of a hexosan. Irvine, in discussing the evidence afforded by the methylation of starch, retains in the formula of maltose a furane ring structure for the second glucose unit, though it is not that generally accepted at the moment. He postulates an anhydrohexaglucose containing 6 side-chain hydroxyl groups as the starch nucleus, though he recognises the objections against so large a ring system. Ling considers starch to contain, as basal unit, hexa-amylose, which on hydrolysis yields a trisaccharide, β-glucosido maltose, from which by enzyme hydrolysis either maltose or isomaltose is obtained. Isomaltose still remains the elusive 'criminal' of starch chemistry—all attempts to isolate and to define its structure have failed, and there is reason for believing that its structure is so closely akin to maltose that it may be regarded as a labile form.

Pringsheim, who has obtained a series of amyloses by the bacterial degradation of starch, contributes a highly technical and valuable discussion. The polyamyloses are made up of hexosans which contain glucosidic residues. In the transition from hexosans to polyamyloses one of these is replaced by another, the constitution of which is yet unknown, and must be responsible for the tendency towards aggregation.

A new phase in starch chemistry is the recognition that amylopectin is a dibasic organophosphoric acid—this theme is developed by Samec in an interesting essay.

Hitherto, in bread-making, attention has almost entirely been directed to the protein and mineral constituents of flour, but Alsberg, in a suggestive treatise, is able to show that starch does play a rôle, even though a minor one, and acts as more than mere inert material. The manufacture of corn starch as an American and of potato starch as a German industry are clearly summarised, also the less known manufactures of dextrin and starch gums, starch and flour adhesives, all industries of increasing importance to-day.

Attention is also devoted to the use of starch for

sizing in the textile industry and to the application of enzymes for removing starch again. The conversion of starch in the fermentation industries receives adequate treatment by the experienced hand of Fernbach.

Enough has been said to indicate the range of the work; it remains to emphasise the suggestive and critical spirit which is so prominent. This makes it highly stimulating and it should be of the greatest value to workers in the many corners of this vast field. The bibliography demands a special word. It purposes to record all periodical literature, from 1811–1925 inclusive, dealing with the chemistry and technology of starches, their degradation products and enzymes. The references are arranged chronologically under classified heads involving 46 classifications. In many cases references are also given to English, French, and German abstracts of the original article, and, further, a brief indication of the contents of the paper is given.

The compilation is an altogether remarkable one, and though the labour of preparing it must have been very great, the time saved by future workers in this field should provide a perennial flow of thanks to Mr. Walton outweighing all material consideration.

E. F. ARMSTRONG.

A Great Indian Monarch.

Asoka (*Gaekwad Lectures*). By Prof. Radhakumud Mookerji. Pp. xiv + 273 + 16 plates. (London: Macmillan and Co., Ltd., 1928.) 21*s*. net.

TWO topics from India's past history seem to exercise a paramount influence on the minds of her modern scholars. One of them is the problem, or series of problems, connected with the Compendium of Politics by Kautilya, which was unearthed from a South Indian manuscript about twenty years ago by the late Mahāmahopādhyāya Ganapati Shastri. The other is the history of the great King Ashoka as it can be reconstructed from his inscriptions and from later, and to a great degree legendary, sources. On both subjects a vast lot of energy and learning has been spent in recent years —unfortunately, with results which do not stand in proper relation to the strenuous efforts made in achieving them.

Prof. Radhakumud Mookerji, whose name is well known through his history of Indian shipping and other learned works, has now entered the ranks of Ashokan investigators with an imposing volume of nearly three hundred pages. This work, we are informed in the preface, has grown out of the author's Gaekwad Lectures delivered to the University of Lucknow; and it does honour alike to its author and the enlightened Prince and Government who have financed these lectures and their publication. We feel inclined to disagree with Prof. Mookerji on more than one point, and should give expression to our doubts were this to be a review of scientific details. As it is not, we shall abstain from criticising minor points; and we shall content ourselves with saying that the author's learning, industry, and enthusiasm in his work are at any rate beyond criticism.

Ashoka stands out as the most clearly individual and undoubtedly the most noble of ancient Hindu rulers. It seems fairly obvious that, from a nationalistic point of view, Prof. Devadatta Bhandarkar should consider him to be far superior to men like Alexander, Cæsar, and Napoleon, though his reasons for propounding such views are wholly unhistorical. It also seems easily explicable that Ashoka's own countrymen should consider him to be one of the greatest of men—which possibly he also was. But that 'possibly' has to be somewhat strongly emphasised; for, after all, we know little enough of the man, and that little is simply what he himself has told us.

The later Buddhist sources tell us that in his younger years Ashoka was a loathsome tyrant who put all his brothers to death and invented a special sort of 'hell' where people were subjected to the most fiendish tortures. But there can scarcely be any doubt that these sources are wholly legendary. The glory of that faith preached by the Enlightened One would shine forth still more splendidly if it were able to convert this human fiend into a *jagadguru*, a parent of all living creatures. The inscriptions certainly afford us no reasons for believing such tales; the pious king, instead of telling us something about his previous cruelties, somewhat strongly opposes his own reign of righteousness to the less resplendent virtues of former rulers. Apparently, according to his opinion, *dharma*—which ought rather to be translated by 'compassion towards living beings'—had made its real entry into a brutish and sinful world with the beginning of his reign.

However, there was one fact that sorely troubled the saintly monarch even after he had started upon his conquest by righteousness. That fact was the conquest of Kalinga, which had been perpetrated eight years after his coronation. At that time hundreds of thousands had been slain and carried off into captivity; and our knowledge of the ruthless slaughter that had often been practised in Indian warfare does not lead us to think this to

be an exaggeration. This endless misery, however, led Ashoka to contemplate other triumphs, namely, those to be won in spiritual warfare ; and not only amongst his own subjects did he practise compassion and liberality and inculcate the rules of morality, but also he claims to have done this among the Greeks and Kambojas in the immediate borderlands, and even in the realms of the Seleucids, the Ptolemies, and other Greek rulers. It need scarcely be said that such a claim involves some slight exaggeration.

Prof. Mookerji describes to us Ashoka as he himself—and many other scholars besides—has conceived him from a careful study of the existing edicts. He presents us with what scanty notices we possess concerning the great ruler's early life and family, concerning his history and administration. To some length he dwells on his religion and the monuments which, in his pious zeal, he dedicated to the memory of Gautama Buddha and to the service and protection of his followers ; and then more than half of the book is taken up by a careful translation, with copious notes, of the edicts. The work winds up with a good and careful index. Altogether a useful book which reflects credit upon its learned author.

The picture of Ashoka given us here is the traditional one ; nor could we well expect anything else. But the real historical problem still remains to be solved, and will perhaps never reach a satisfactory solution. That problem, of course, is this : who was the real Ashoka, the one seen by his contemporaries and beloved or loathed by them ? We know the names of his father and grandfather, also the name of his family ; but whether that family was of noble breed or base-born we know not. We know the approximate length of his reign, and we cannot go far wrong in our calculations of his exact regnal dates. But of the man himself we know nothing more than that which his own edicts tell us ; no contemporary of his has left us even a line to give a corroborative or different shading to the picture drawn by himself. Was he then—as we all would fain believe, and evidently have very strong reasons for believing—a saintly, pious, self-sacrificing man who looked upon all living beings as his children ? Or was he—which to Indian minds will perhaps sound even sacrilegious—a sanctimonious hypocrite who preached every virtue to his co-fellows while leading a life of vice and cruelty ? The possibility is there, but happily only a very faint one ; and we need scarcely be afraid of losing faith in Ashoka, one of the everlasting glories of the land of the Hindus.

Our Bookshelf.

Penrose's Annual : the Process Year Book and Review of the Graphic Arts. Edited by William Gamble. Vol. 31. Pp. xvi + 184 + 72 + 74 plates. (London : Percy Lund, Humphries and Co., Ltd., 1929.) 8*s*. net.

THIS Annual is on the same lines as heretofore, and certainly maintains its reputation of recording by word and by examples the present possibilities of printing in its many branches. The present is the thirty-first issue ; its growth is indicated by the fact that whereas the first issue had 66 pages of text and 20 pages in colour half-tone, the present volume has 184 pages of text and 44 colour pages.

The first article is "The Editor's Review" of the year's progress. He tells us that though inventors have been at work at pictorial telegraphy for half a century, it is only during the past year that it has made the final strides that have brought it into daily use in the service of illustrated journalism.

A specimen from the Prismatone Company of Chicago shows the possibility of combining in one printing in four colours, artistic and commercial subjects, and also text matter, printing on both sides of the web without heat for drying the inks at a speed of four thousand cylinder impressions per hour. Rotary photogravure for one colour and also for three-colour printing from thin copper plates affixed to the cylinders, instead of using the surface of the cylinders themselves, is now a practical success. The coating of copper printing surfaces with a thin film of chromium is now in actual use, and its advantages, due chiefly to its hardness, are recognised. Specimens of colour prints and fine half-tones by the Blackmore Tintex Process, show excellent results on cheap newspaper, and point to the possibility of getting rid of the coarse screens generally used for this purpose.

The book includes many interesting articles on subjects not often dealt with in print, such as "Paper old and new," transparent paper (with photomicrographs), fancy paper (with examples), gummed paper—its varieties and their uses—each by a separate authority. Mr. Vernon Booth, the printer and printing instructor at St. Christopher School, Letchworth, advocates teaching children to cut printing blocks in linoleum, to help them to express their ideas.

Industrial Catalysis. By Stanley J. Green. Pp. xi + 507. (London : Ernest Benn, Ltd., 1928.) 50*s*. net.

SINCE each forward movement supplies a new resource to aid the next advance, progress in science and in those industries founded on it is taking place at an ever-increasing rate. In no instance is this statement better exemplified than in the highly specialised field of catalysis and the many industries which are based on its application. The author of the work before us records first the discovery of the scientific facts ; he then seeks to

show how they have been utilised or applied, and emphasises the consequences. To some extent the title chosen by him is misleading, as the book contains no account of the working of any actual processes in which the principles of catalysis are applied, nor does it provide any clue as to which of rival processes have stood the test of economic success: it is essentially a theoretical treatise, though exceedingly full and thorough in its consideration of the considerable scientific and patent literature of the subject.

After a brief survey of the history of catalysis, a longer chapter is devoted to the consideration of the phenomena, followed by an explanation of such physico-chemical theory as is required and a discussion of the theories of catalysis. These sections will be found of considerable value by the initiated, though, for ourselves, we find the wood to be rather full of trees and could wish the author had given us a clearer lead as to the path to follow. He sums up that only the intermediate compound theory and the adsorption hypothesis amongst the numerous suggestions of the past have stood the test of time, and rightly emphasises that the two theories possess one fundamental idea in common, namely, that the catalyst first associates itself chemically with one of the reacting substances, forming an intermediate complex—either a true chemical compound or a surface combination—which is more reactive than the initial substance. The further explanation of the progress of the reaction is the problem which awaits solution; of much interest, therefore, is the suggestion of Lewis that the specific energy conferred by the catalyst is in the nature of radiant energy of definite frequency.

The consideration of the great mass of detail is divided into chapters headed respectively oxidation and combustion, nitric acid, hydrogen and hydrogenation, ammonia, dehydrogenation, dehydration, and lastly the utilisation of coal. Mention of this last subject is sufficient to show how wide the ramifications of catalysis are about to become; undoubtedly the many workers in this field will derive useful hints from Mr. Green. E. F. A.

Science and Reality. By R. A. Sampson. (Benn's Sixpenny Library, No. 37.) Pp. 80. (London: Ernest Benn, Ltd., 1928.) 6*d*.

THE Astronomer Royal for Scotland has written an admirable essay on the general character of scientific knowledge. The argument, though much condensed and avoiding no difficulties, should be intelligible to any normal person who is prepared to apply his mind seriously to the matter. No special scientific or philosophical knowledge is assumed. It is to be hoped that the book will be widely read, as it is well designed to correct popular fallacies about science.

The author considers first the most abstract kind of science, taking geometry as his example, and then goes on to deal with more concrete types, taking first of all astronomy. The secret of the success of scientific method, and of its limitations, is found in the process of abstraction and definition; the distinction and separation of elements in experience, which can then be put together again. The method is often arbitrary and always involves unproved assumptions, but it is impersonal and cumulative; cumulative because impersonal. For this very reason science can never supply more than partial knowledge. "We are familiar with the fact that as a practical guide, theory is always dangerously incomplete. Its method is first to remove the life from any phenomenon before discussing it. Out of Nature's bounty of wild flowers it collects laboriously for its own reference a sort of *hortus siccus*."

One word of adverse criticism seems to be called for. The bibliography consists entirely of important and first-rate works, except for the first item. As that is the only work dealing primarily with the philosophy of science, it is a pity it should be an inferior one, when there are so many good books available on the subject, for example, those of Poincaré and Russell.

Culture and Social Progress. By Prof. Joseph Kirk Folsom. (Longmans' Social Science Series.) Pp. x+558. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1928.) 12*s*. 6*d*. net.

TEN years after the cessation of hostilities we are able to regard culture in as favourable an aspect as it deserves, being freed, as it now is, from the distasteful significance which it acquired with the advent, and during the continuance, of the War. This discursus by Prof. Folsom, dealing with "Culture and Social Progress," is one which presents the subject attractively; it is lucid in treatment, deft in arguments, dispassionate in conclusions, and for the most part convincing. The author submits that the true keynote of culture is personal liberty. He heads the chapter dealing with the elimination of waste with some words by Charles P. Steinmetz: "Work is a curse. The chief aim of Society should be to abolish work." His own arguments seem to support this unhealthy view: "Labour, by and large, is disagreeable, but its unpleasantness is mostly of that mild sort we call boredom," is merely one of the author's remarks in that direction. It is indisputable that waste is, in general, to be deprecated and avoided, but it may be confidently asserted that a world without work would be a world with no outlook. With the above as the main, and perhaps the sole, protest, it may be said that the book merits cordial approbation. P. L. M.

Tychonis Brahe Dani Opera Omnia. Edidit I. L. E. Dreyer. Tomus IX. Pp. viii+352. Tomus XIV. Pp. iv+327. (Hauniæ: Libraria Gyldendaliana, 1927, 1928.)

THESE two volumes, which have seen the light after the editor's death, would appear to complete his great edition of the works of Tycho Brahe, apart from an *index rerum*, which it would seem is still awaiting publication. Of these two volumes, Tomus IX. has been edited almost entirely by the late Dr. Dreyer's colleague, Dr. Ræder. Tomus

XIV. appears to have been edited almost entirely by Dr. Dreyer himself.

The two volumes are, on the whole, of more personal than scientific interest. The first 146 pages of Tomus IX. are occupied by meteorological observations in Danish extending from 1582 to 1597. Following this is a draft preface to an astrological and meteorological annual by a pupil. Then come a few pages written as a preface to Tycho Brahe's reply to Craig on comets. Next, after three brief medical treatises, comes a collection of Tycho's poetry, so far as it has not already appeared in earlier volumes. A compilation of various readings in the works contained in the first nine volumes, a Danish glossary, an index of names occurring in the meteorological observations, and addenda and corrigenda to the nine volumes complete this volume.

Tomus XIV. is wholly taken up by letters and documents in many languages bearing on the life of Tycho Brahe. Many of these are by Tycho Brahe himself. Their interest lies almost entirely in their value as biographical material. The volume closes with a genealogical table showing Tycho Brahe's nearest relatives and descendants.

J. K. F.

Die Entstehung und Besiedelung der Koralleninseln: nach neuen Gesichtspunkten auf Grund eigener Untersuchung. Von Prof. Dr. Augustin Krämer. Pp. viii + 53 + 4 Tafeln. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele) G.m.b.H., 1927.) 5 gold marks.

PROF. A. KRÄMER, an honorary professor of Tübingen and naval doctor, has returned from thirty years' wanderings in the South Pacific Islands, deeply interested in their welfare. He deplores for the sake of the inhabitants the view that the coral islands have an unstable basis, and are being slowly diminished by submergence. He accordingly describes Darwin's theory as "cheerless," and also rejects the view that the islands have been submerged by a rise of sea-level. He adopts the Chamisso-Murray theory, and holds that the foundations are stable and that the islands grow by the accumulation of limestone debris formed by the surf. Darwin's belief in a submerged central Pacific continent, the so-called Hawaiki, he rejects, as regards diluvial time, as being as improbable as Atlantis or Gondwanaland. That this continent should have lasted so late is unnecessary for Darwin's theory, and its dismemberment by submergence probably happened in the late Oligocene or Miocene. In spite of Dr. Krämer's knowledge of the Pacific coral islands and the new information he contributes regarding them, his explanation of their formation without submergence is unconvincing.

Assimilation and Petrogenesis: Separation of Ores from Magmas. By John Stansfield. Pp. 197 + 30 plates. (Urbana, Ill.: Valley Publishing Co., 1928.) 3.50 dollars.

THE question of the extent to which rocks have been made and modified by assimilation of extraneous material and ores have been formed by consolidation from molten rock, has been long discussed, and the possibilities shown by many experiments. Prof. Stansfield of Illinois has conducted an instructive series of experiments, and melted more than 550 mixtures of rock materials. His results support the view that assimilation may be an important factor, but do not confirm many suggestions such as the formation of the nepheline-syenites by the assimilation of limestone.

The extent to which assimilation has acted in Nature must be determined by the field evidence. In these experiments the materials were ground very finely, mechanically mixed, and fused at temperatures from 1230° to 1600° C. Under those conditions assimilation was more likely than under natural conditions. In the experiments on ore materials, some of the metallic sulphides were found to move upward instead of downward, as was expected from the theory that some ores are due to the settlement of the heavier constituents in the base of a molten mass.

The book is clearly and concisely written, and illustrated by 60 excellent photographs of the artificially formed rocks.

"World-Radio" Map of European Broadcasting Stations in relation to the British Isles. Prepared for the British Broadcasting Corporation under the advice of Rear-Admiral H. P. Douglas. Scale: 100 Statute Miles to 1 Inch. 38 in. × 28½ in., mounted on linen, folded. (London: British Broadcasting Corporation, 1928.) 3*s*.

THE British Broadcasting Corporation has issued a 'world-radio' map of Europe. The map is so constructed that the distances and the bearings of all continental stations can be found at once from it. Straight lines drawn from any point in the British Isles to continental stations can be regarded as representing great circles on the earth's surface, and the distances along them are on the scale of 100 miles to the inch. It is constructed on the 'zenithal' system, the centre of the map being near Manchester and Birmingham. Short-wave stations are marked differently from long- and medium-wave stations. It is interesting to notice that Sweden and Finland are plentifully dotted with broadcasting stations and that there are very few in Italy. To every one who possesses a sensitive receiving set and is interested in listening-in to distant continental stations the map will be of great value.

Pyroxylin Enamels and Lacquers: their Raw Materials, Manufacture, and Application. By Dr. Samuel P. Wilson. Second edition, enlarged. Pp. xv + 253. (London: Constable and Co., Ltd., 1928.) 18*s*. net.

THE subject of pyroxylin enamels is becoming increasingly important, and a revised edition of Dr. Wilson's book will be welcomed by those who are interested in this field. The information is essentially practical, and the raw materials include many which have recently come into use. The treatment of the subject is authoritative, and the book is a valuable contribution to the information required by the practical man.

Letters to the Editor.

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

Influence of Steam and of Hydrogen on the Burning of Carbon Monoxide.

IN connexion with the different views that have been expressed concerning the relative influence of steam and of hydrogen on the burning of carbon monoxide–air mixtures, may I point out that this influence may be shown in different ways according to the phenomena under observation and the conditions: for example, the rate of pressure rise in a bomb explosion, the temperature of initial ignition, the speed of the flame either in the slow uniform movement or in the explosion wave.

I think all workers are agreed that the rate of the explosion wave in carbon monoxide knall-gas under ordinary pressure is increased as steam is added to the mixture until between 5 and 6 per cent is present; and that a similar percentage gives the fastest uniform slow movement in carbon monoxide–air mixtures. On the other hand, Prof. Bone has found that in a bomb at high initial pressure, the rate of spread of the flame (as indicated by the rate of rise of pressure) increases rapidly on the addition of traces of steam, but reaches a maximum when less than 1 per cent of steam is present. The initial high pressure appears to favour the direct oxidation of carbon monoxide in the flame.

With regard to the effect of hydrogen added to the mixture, Prof. Bone and his colleagues find that the flame in the high-pressure bomb travels more rapidly with 1 per cent of hydrogen than with 1 per cent of steam; and therefore regard as heresy a phrase they quote from a paper by Payman and Wheeler that "moisture is more effective than hydrogen in promoting the combustion of carbon monoxide." Now some years ago it was shown in our laboratory that the explosion wave in carbon monoxide knall-gas was slightly faster with 1 per cent of hydrogen than with 1 per cent of steam (*J.C.S.*; 1923); and in the same year the experiments at Sheffield showed that in order to get a uniform flame in carbon monoxide–air mixtures of maximum speed, 6 per cent of steam was necessary, whereas only 3 per cent of hydrogen was required to produce the same effect. It was not, I take it, the *rates* of the flame, but the difficulty of *starting* the flame in the mouth of the tube containing the dry mixture, when less than about 2 per cent of hydrogen was present (a difficulty not found with a mixture containing much less than 2 per cent of moisture), that led to the words quoted, which had, by the way, the prefix "apparently."

I have recently been experimenting on the effect of hydrogen and steam on the ignition point of carbon monoxide in air by sending a small stream of carbon monoxide (with and without hydrogen) into an atmosphere containing known volumes of steam, both gas and atmosphere being pre-heated before they come in contact. The ignition temperatures so found are largely influenced by the pressure of the atmosphere, and the effect is different in the two cases. When hydrogen is added to the carbon monoxide and the air is dried, the ignition points fall regularly as the pressure is reduced from 1000 mm. down to 200 mm.; whereas when the carbon monoxide is dry, and steam is added to the air, the ignition points *increase* as the pressure is reduced from 1000 mm. to 600 mm. and then decrease. It happens, therefore, that carbon monoxide containing 1 per cent hydrogen may ignite in dry air either above or below the temperature at which carbon monoxide ignites in air containing 1 per cent of steam. It depends on the pressure.

At the other end of the scale, an unexpected result was found here in 1923, namely, that an explosion wave travelling through electrolytic gas when it impinges on carbon monoxide knall-gas (with either steam or hydrogen present) is damped down and loses its 'detonation' character, which it recovers only after an appreciable 'run.' This still wants explaining.

Prof. Bone, in his recent important work on high-pressure explosions, has now given us a new problem. He finds a marked acceleration in the pressure-rise when the hydrogen content exceeds 0·65 per cent in a carbon monoxide–air mixture fired at 50 atmospheres and at room temperature, when the explosion has the character of a detonation; but this sudden rise is not observed when the bomb, filled with the same charge, is heated before firing to 100°, the initial pressure being 64·4 atmospheres.

Again, the study of the radiation of carbon monoxide flames in Prof. Garner's laboratory has shown the marked effect of hydrogen in lowering the radiation while it accelerates the rate of the flame: and here also there appears to be a sudden change, giving a step-like curve, as if two different mechanisms were at work.

It was an active hare that was started in that Oxford laboratory fifty years ago.

H. B. DIXON.
University, Manchester.

The Quantum Theory of Nuclear Disintegration.

IN a very interesting letter published in NATURE of Sept. 22, p. 439, Gurney and Condon have used wave mechanics to give a qualitative explanation of many features of natural α-ray disintegration. It may be of interest to point out that using very similar assumptions, it is possible to give a quantitative explanation of these features and also to throw light on the phenomenon of artificial disintegration. I should therefore be glad to be permitted to give a short account of these investigations here.

In the model of the nucleus adopted (G. Gamow, *Zs. f. Phys.*, Bd. 51, p. 204) the region of the inverse square law forces extends inwards, without serious perturbations, to a critical distance r_0 which is appreciably less than the closest distance of approach of the α-particles, calculated on classical mechanics, for which inverse square law scattering at large angles is still observed. For distances less than r_0 there exist attractive forces which vary very quickly with the distance. An α-particle of suitable energy can stay inside the nucleus for long periods of time, periods which on the classical theory would be infinite, since the α-particle could never pass over the potential barrier. On the wave picture, on the other hand, no such barrier can ever completely prevent a gradual leaking out of the waves, representing the process of escape of α-particles.

The theory enables one to express the radioactive decay constant, λ, in terms of the velocity of the α-particle and the atomic number Z of the element. The approximate solution of the problem (G. Gamow u. F. Hautermans, *Zs. f. Phys.* in course of publication) gives the quantitative theory of the Geiger-Nuttall relation, including the explanation of the main deviations from it. In Fig. 1 the observed values of the logarithm of the decay constant λ are plotted against the velocity of the emitted α-particle v_α and connected by a continuous line. The dotted line

connects the theoretical values of log λ, calculated on the assumption that the critical distance r_0, where the very rapid potential fall takes place, has the value $7{\cdot}4 \times 10^{-13}$ cm. for the whole family. An almost perfect fit can be obtained if r_0 is taken to vary as the

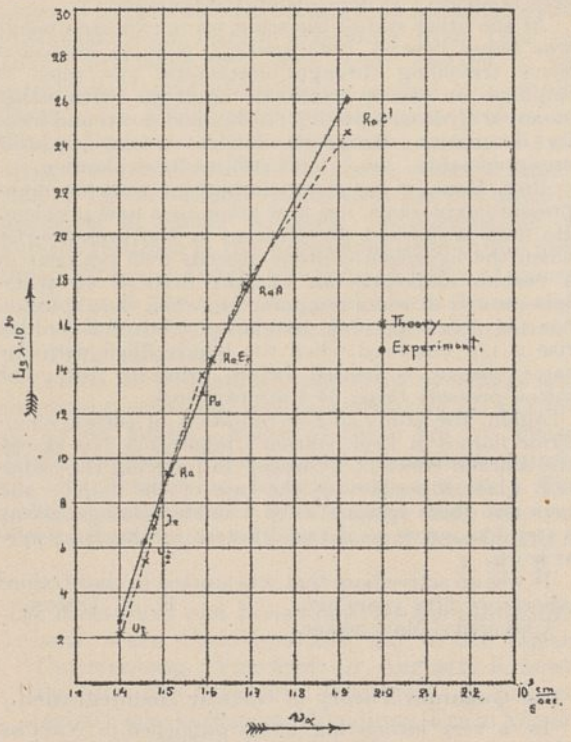

FIG. 1.

cube root of Z. Such values of r_0 make the internal nuclear volume nearly proportional to the total number of α-particles contained in the nucleus, and if extrapolated to light elements fit well with the critical distance $3{\cdot}4 \times 10^{-13}$ cm. deduced by Bieler from the deviations from inverse square law scattering in aluminium.

The same model of the nucleus allows us to calculate an upper limit to the probability of artificial disintegration by bombardment with α-rays, on the natural assumption that such disintegration is only possible if the incident α-particle enters the inner region of the nucleus (G. Gamow, *Zs. f. Phys.* in course of publication). We must again remember that on the wave picture the incident α-particle can penetrate the potential barrier even if its energy is less than the maximum opposing potential. We thus get a probability of penetration depending for a given element exponentially on the velocity of the incident particles and decreasing very rapidly with the atomic number of the element. These probabilities expressed in numbers of penetrations per cm. track in standard air per million incident α-particles are given in Fig. 2 as a function of the atomic number of the element bombarded; the full and dotted curves correspond to the initial velocities of α-particles from ThC′ and RaC′ respectively. In this calculation the critical distance r_0 is taken to have Bieler's value for aluminium. For light elements the difference between the opposing potential and the energy of the α-particle is small. The results therefore depend largely on the model adopted, as the largest atomic number for which classical penetration is possible can be estimated only approximately. The general shape of the curves will, however, remain the same, giving a very rapid decrease in the probability of artificial disintegration for heavier elements. Rutherford's observations for nitrogen and aluminium are shown by dots and circles for the two velocities.

Taking into account the approximate character of the calculations and the experimental uncertainties, the close agreement of the observed points with the curves may be taken to indicate that for these elements the ejection of a proton almost always follows immediately on the penetration of the α-particle into the central nuclear region. That no artificial disintegration was observed by Rutherford for certain other light elements is in no way contradictory to the theory, for it merely means that no proton is ejected even after penetration, and this is especially natural for the elements of atomic weight $4n$, where the nucleus in all probability is built up entirely of α-particles.

Such penetration without disruption of the nucleus can only result in the ejection of the α-particles approximately evenly distributed in all directions (induced radioactivity), and will probably be found to explain the remarkable increase of the scattering for large velocities of α-particles observed by Rutherford for the light elements. The remarkable feature of curves in Fig. 2 is the steepness of the fall to zero for larger atomic number (for example, for iron the probability of disintegration falls to 10^{-5} and for iodine to 10^{-16}). This is in most satisfactory agree-

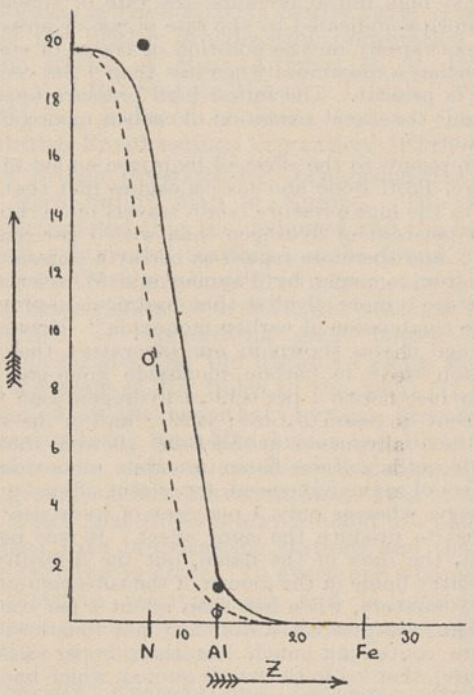

FIG. 2.

ment with Rutherford's observations, in which no artificial disintegration has been observed for any element heavier than phosphorus. On the other hand, it is quite impossible to bring the theory into agreement with the observations of Petterson and Kirsch, which not only show numbers of disintegration ten or more times as great as Rutherford's for light elements, but also show a considerable probability of disintegration for elements as heavy as iron.

G. GAMOW.

Institute for Theoretical Physics,
Copenhagen, Sept. 29.

The Ultra-Violet Light of the Sun as the Origin of Auroræ and Magnetic Storms.

A THEORETICAL investigation has been made of the outlying regions of the atmosphere of the earth and of the effect of sunlight on these regions; certain of the conclusions are given in this preliminary note. By the usual methods the temperatures and the pressures of the atmosphere to great heights were calculated for a quiet sun, that is, the sun in its normal state, with no terrestrial auroræ or magnetic storms. Because of the unequal balance at cold temperatures between the solar energy absorbed in the ultra-violet by the atmospheric gases and the energy re-emitted in the infra-red by the gases, the daytime temperatures above 100 km. were found to increase with the height above the surface of the earth, until at 300 km. or 400 km. temperatures of 1000° Kelvin seem reasonable. (There is, of course, nothing novel in this, although we have been interested in working the matter out more exactly perhaps than has been done heretofore.)

At heights above 400 km. the atmosphere becomes very rare and the free paths of the particles very long—practically infinite, in fact, were it not for the actions of gravity and of sunlight. A portion of the atoms (or molecules) of these remote regions dance up and down, receiving upward thrusts from thermal impacts below and falling back under gravity, and may be expected to reach heights up to 10,000 km., but scarcely above this. During the daytime a number of the outlying atoms are excited by the short-wave ultra-violet light of the sun to which they are exposed. A normal atom upon collision with the excited atoms may receive a high velocity (collision of the second kind), a velocity sufficient perhaps to send it beyond the gravitational attraction of the earth. A normal atom may also attain a high velocity by absorbing the energy of recombination of a positive ion and an electron. Therefore there are a number of high-flying atoms in the outer reaches of the atmosphere, and these give rise to interesting effects. Many of them might leave the earth never to return were it not for the sunlight. They do hasten out towards interplanetary space, but under the photoelectric influence of the solar ultra-violet radiations they soon become ionised. Once ionised they are caught by the magnetic field of the earth, and as ion pairs are constrained to spiral around the line of magnetic force, eventually being brought back to the earth. If the line ends in sunlit latitudes, the ion may start off on another wild heavenward chase, or it may wander down to more prosaic lower levels. If the magnetic line ends in night latitudes, as in the polar regions after sun-down, the ion pairs, upon plunging to the lower levels, hand over their energy of recombination to the atmosphere of those regions. This energy may go into heat, or it may, if conditions are suitable, reappear as light, such as the auroral display. (In passing, we may note that a complete theory of the rate of escape of planetary atmospheres should contemplate the ideas of the foregoing paragraphs.)

Quantitative estimates indicate that an appreciable fraction of the solar ultra-violet energy is carried to a zone 20° to 30° from the magnetic poles by high-flying ion pairs ejected to heights of 20,000 to 40,000 km. above the earth. The estimates have depended upon a knowledge of such quantities as the intensity of sunlight in the extreme ultra-violet, the number of excited atoms, absorption coefficients (Einstein's B), etc. These quantities are imperfectly known, but, so far as can be seen, reasonable values have been used. For the case of a quiet sun, the amount of energy transferred to the auroral zones appears about sufficient to supply the energy of a mild auroral display. This is in keeping with the fact that the aurora occurs on a rough average two or three times a week throughout the year, with no very marked seasonal variations. From the velocities of ejection of the high-flying atoms and the time which elapses before they become ionised, it comes out that a majority of the ion pairs plunge to the earth in a zone roughly 20° to 30°, or 1400 to 2000 miles, from the magnetic poles, and that relatively few get down to regions within 1000 miles of the magnetic poles. This is in accord with the observed 23° zone of maximum auroral frequency. Since the auroral energy at a given magnetic meridian is regarded as being brought in from the sun-lit latitudes on roughly the same meridian, one would expect (as is observed) the aurora to be brighter (or to occur more often) in the early hours of the night than in the later hours. In brief, the main characteristics of the aurora receive logical explanation on the present theory.

When the sun becomes active, the magnetic effects of the high-flying ions, perhaps inappreciable during intervals of solar quiescence, become pronounced and result in the magnetic storms. We assume that the sun when active sends out a sudden blast of ultra-violet light. For example, if 1/10,000 part of the solar surface, which normally is at a temperature of 6000°, were removed and there were exposed the black body radiations from regions at a temperature of 30,000°, the total ultra-violet energy in the wave-lengths 500 to 1000 angstroms would be increased by 10^5, whereas the solar constant would be increased by only one per cent. Actually, in times of solar activity, variations of three or more per cent in the solar constant are observed, and the increase at λ3500 angstroms is such as to suggest even higher temperatures than 30,000°. The number of the high-flying ions is then increased by, say, a factor of 10^5 over the number formed during undisturbed solar periods. The ions, no matter what their velocities are, under the combined action of gravity and the earth's magnetic field, move at right angles to these two vectors with a velocity approximately mg/He, the positive and negative ions moving in opposite directions. Thus there is an electric current around the earth, the lines of current flow being roughly circles in planes perpendicular to the magnetic axis of the earth, with centres on the axis. (Each cubic centimetre of the high atmosphere, of course, remains electrically neutral at all times in spite of the current flowing through it.) Calculation of the energies and processes involved, indicated that the blast of solar ultra-violet light produces enough high-flying ion pairs to give rise to a current of 10^6 amperes for an hour or so. This causes a magnetic field of the order of 10^{-3} gauss simultaneously over the whole earth, which is the order of magnitude observed in the first phase of the world-wide magnetic storms. It has long been realised that an equatorial current would account for the world-wide magnetic storms, and several hypotheses have been suggested as to the cause of the current. The hypotheses have, however, contained a number of difficulties which are absent from the present theory.

The high-flying ions descend in large numbers to the zones about 25° from the magnetic poles and form there diamagnetic concentrations of considerable intensity. On the assumption that the blast of ultra-violet light does not die away abruptly, but continues with lessening intensity for a day or so, the diamagnetic polar atmospheric concentrations wax with the day and wane with the night. Upon working out the changes in the earth's magnetic field caused by this diamagnetism, agreement is found in practically

every detail with the observed complicated diurnal storm variations in the three magnetic field components at all latitudes.

H. B. MARIS.
E. O. HULBURT.

Naval Research Laboratory,
Washington, D.C., U.S.A.,
Sept. 30.

The Understanding of Relativity.

I HAVE read with great interest the leading article on "The Understanding of Relativity," contributed by H. D. to NATURE of Nov. 3. I do not doubt Einstein's work. His conclusions have been tested crucially and found correct. But though I believe, I do not understand. I can only suppose, as H. D. indicates, that the expositors of Einstein have expressed themselves in language which does not convey to ordinary men the meanings they intend. For example, H. D. asks, "What is there difficult to understand in the statement that if we watch a man moving quickly we shall find that his clock will not keep time with ours?" But I do find it difficult. If our clocks are good, why will they not keep time? What has space to do with it? I can understand that his clock will not, in a sense, keep time with the sun; for if he starts at midday and travels with the sun, and as fast, he will always be at midday. But surely his clock will measure the passage of time with mine, tick by tick; and surely it is possible to explain in simple language that which H. D. finds so simple.

Another paradox which puzzled me before ever I heard of Einstein, and which to this day I do not understand, is that, while I am told that parallel lines are those which keep a certain distance apart—say a yard—I am also told that parallel lines, if continued far enough, will ultimately meet—owing to the curvature of space, or some such reason incomprehensible to me. But, if they always keep a yard apart, how can they meet? Is paradox necessary in science? So far as I am able to judge, paradox always means words used with unlike meanings. A horse-chestnut and a chestnut horse is an example.

I feel I am airing my ignorance; but this sort of ignorance is so widespread that its dispersal is worth while. Science, limited to "only three (or is it eleven?) people in the world," is very limited. For the mass of people it is dogma, that refuge of authority and that bane of science. Once again I ask, in what sense will the other man's watch not keep time with mine? Since H. D. declares in effect that it is not difficult to understand, he should find it easy to explain.

G. ARCHDALL REID.

20 Lennox Road South,
Southsea, Nov. 6.

SIR ARCHDALL REID'S inquiry, which is very much to the point, arises, I think, from an indefiniteness in the word 'understanding.' When applied to a scientific deduction outside present possibility of observation, this word has at least three distinct meanings. First there is the simple comprehension of what is predicted; secondly, the understanding of why it should be so, expressed in terms of more elementary scientific concepts; thirdly, the understanding of why scientific men have been led to predict it. To take an example—suppose the earth were permanently cloud-bound, and a physicist predicted that above the clouds space would appear blue. Understanding in the first sense would correspond to a clear mental picture of what was meant by the statement. In the second sense it would mean the mastery of the theory of the scattering of light. In the third sense it would mean the understanding of the reasons which led to the prediction, which might conceivably involve a knowledge of the behaviour of a photoelectric cell in a sounding balloon.

Of these three meanings, the one implied throughout the article in question was the first. It may seem the most trivial, but it is actually the most important for the non-scientific man, for it represents what is for him the most vital part of science; that part, namely, which he can assimilate and use in forming his own personal creed or philosophy. He can dispense with details of technical interest, but he cannot dispense with a knowledge of what it is that science is actually finding out. It is the provision of this kind of understanding that is the aim of expositors who employ the properties of curved mirrors to illustrate the requirements of the special theory of relativity or those of 'parallel' lines drawn on spheres to represent the effects of the curvature of space. The devices are admirable, and have been admirably utilised by more than one writer. So far as I know, it is not possible to improve on them, and students infinitely lower in scale of intelligence than Sir Archdall Reid can, by their aid, understand the requirements of relativity as well as they understand that the sky is blue. The reason why they question this, as I conceive it, I have stated in the article; it is simply scepticism.

I think this interpretation of the position is really borne out by Sir Archdall Reid's letter. He asks why the clocks of observers in quick relative motion will not keep time. This is asking for understanding of the second type, and I can only answer: I do not know; it is simply a fact of Nature too elementary to be explained in this sense. But the interesting thing is to consider why Sir Archdall Reid asks this question. He does not ask why two Admiralty chronometers, one at Greenwich and one at Chatham, should keep time. Although, presumably, he has not made the experiment, I take it he would not regard the result as beyond understanding. Yet it is on precisely the same footing as the relativity result. The facts that clocks at these two different places keep time, and that clocks in quick relative motion do not keep time, are equally elementary facts of conceivable observation. Why, then, 'seek for a sign' in one case and not in the other? I suggest that it is simply because the first confirms a preconception and is therefore credited, while the other violates a preconception and is therefore instinctively discredited. If Sir Archdall Reid really believed Einstein, why should he require an explanation from him and none from the Astronomer Royal?

H. D.

The Universe and Irreversibility.

ON the assumptions that space-time is finite spatially but not temporally (apart from supernatural events such as creation), and that atoms and radiation are mutually convertible, Sir James Jeans (NATURE, **122**, p. 689; 1928) arrives at the conclusion that the universe is progressing towards a final state of maximum entropy from which no return is possible. While such a state has a maximum *a priori* probability, it does not follow that it is final.

Supposing the state of maximum entropy to be reached, and all atoms capable of such a transformation to be dissolved into radiation, Sir James Jeans (NATURE, **121**, p. 674; 1928) calculates that the probability of existence of one non-permanent atom is of the order of $10^{-10^{11\cdot6}}$. In other words, during only $10^{-10^{11\cdot6}}$ of the rest of eternity will there be even one non-permanent atom. Now the minimum number of atoms in the present universe, according

to Hubble (*Astrophysical Journal*, **64**, p. 321; 1926), is about 10^{81}. Then, as Sir James Jeans (NATURE, **121**, p. 674; 1928) points out, the probability of a universe with as little entropy as it possesses at present is of the order of $(10^{-10^{11\cdot6}})^{10^{81}}$, or $10^{-10^{92\cdot6}}$, assuming that an appreciable fraction of the present atoms are non-permanent, and that most of the energy of the present universe is in the form of radiation of frequency too small to build atoms readily. This probability is very small, but finite, and remains finite however large the finite universe may be. Now in the course of eternity any event with a finite probability will occur. Hence if the present universe melts away into radiation, another equally improbable will develop in the course of about $10^{10^{100}}$ years. But the improbabilities involved are so vast that it is perhaps unlikely that even a single atom will be built up from radiation in inter-galactic space during the 'life' of the present universe. Fluctuation can generally be neglected in practical life, but not in the contemplation of eternity.

If the above argument is correct, there is no need to assume a break in the order of Nature to account for the beginning of the present universe. In this case the time taken by such events as the 'life' of a star is instantaneous in comparison with its re-creation; and eternity is, on the whole, dull. Indeed, all but $10^{-10^{100}}$ of it is duller than the present moment. But during most of eternity there can be no living creatures at all resembling ourselves to be bored. For since all organisms live by the utilisation of processes involving increase of entropy, they can presumably only exist during the aftermath of a very large fluctuation. This is why we are witnesses of this excessively unusual occurrence.

This letter is not intended to suggest that the above view of the universe is correct, but that it is consistent with Sir James Jeans's premisses, even if the actual numbers involved are very different from those here assumed. J. B. S. HALDANE.

Sir William Dunn Institute,
University, Cambridge.

MAY a self-constituted Anubis of the scientific philosophy of 'the ancients' raise a plaint outside the door of the Temple of Modern Knowledge from which he hears the voice of its Secretary stating his opinion about their views? (Supp. NATURE, Nov. 3). The irreversibility of living energies was fundamental knowledge on which the ancient scientists of Aryavarta based their doctrines of evolution, human and cosmic; and the ancients will be pleased to know that the moderns have, in their turn, discovered this law of Nature. Everything in the universe, from atoms to stars, is subject to 'birth' (manifestation) and 'death' (withdrawal into latency). Periodical cycles of appearance and disappearance of all forms of life is the method of the evolution of *consciousness*. The phœnix rises out of the dead ashes at the close of the dark half (Pralaya) of the cycle. The ancients would agree with the view expressed in the notes on p. 703 referring to Sir James Jeans' lecture "that a degradation of the physical universe is not necessarily a degradation of the world of spirit." To them a *Manvantara* is a cycle of a solar system: a *Mahamanvantara* that of the cosmos. These cycles are "The days and nights of Brahmâ." Oxford has published "The Sacred Books of the East" in many volumes, but Cambridge is advised to read the English translations of Indian scholars, who understand better the technical language and scientific symbols of their ancestors. W. W. L.

An Attempt to Polarise Electron Waves by Reflection.

AN experiment has been made to test whether or not electron waves are polarised by reflection from the face of a crystal.

The experiment is similar in method to the double mirror experiment by which one demonstrates the polarisation of light by reflection from glass. A homogeneous beam of electrons is reflected at 45° incidence from a {111}-face of a nickel crystal, and the reflected beam proceeding from the first crystal is then reflected at the same angle of incidence from a second similar crystal. A double Faraday box is placed to receive electrons proceeding from the second crystal in the direction of regular reflection, but only such electrons are allowed to enter the collector as have retained all or nearly all of their initial energy through the two reflections. Electrons which have lost amounts of energy corresponding to more than two equivalent volts are excluded by an opposing potential.

The second crystal and the collector are joined rigidly together, and the system comprising these parts may be rotated about an axis which coincides with the axis of the beam proceeding from the first to the second crystal. It is possible, therefore, to vary the dihedral angle between the plane of incidence of the second reflection and that of the first. There are two positions of the moveable system for which these planes coincide, and for these 'parallel' positions the current entering the collector should be a maximum provided asymmetry is impressed upon the electron beam at reflection; for the intermediate 'transverse' positions the current should be a minimum.

The observation is that, if such a doubly periodic variation of the current with angle exists, its amplitude is less than two one-hundredths of the total current, which corresponds to the uncertainty of the measurements. So far as our observations go, there is no polarisation of electron waves by reflection.

The measurements have been made at bombarding potentials in the range 10 to 150 volts. Within this range the intensity of the doubly reflected beam exhibits five maxima, occurring at bombarding potentials 20, 55, 77, 103, and 120 volts. The maxima corresponding to the highest three of these voltages were observed in our earlier experiments on electron reflection (*Proc. Nat. Acad. Sci.*, **14**, 624 (Fig. 3); 1928). The two at the lower voltages were outside the range of these previous observations.

The beam at 120 volts is particularly strong, and with regard to this beam it may be stated that the amplitude of the variation due to polarisation is less than one-hundredth of the total current.

The current incident upon the first crystal is about 2×10^{-4} amp., and the current received in the collector is of the order 5×10^{-12} amp. C. J. DAVISSON.
L. H. GERMER.

Bell Telephone Laboratories, Inc.,
New York, N.Y., Oct. 19.

Radiovision.

IN steering clear of the hybrid 'television' in a note in NATURE of Nov. 3, p. 704, you lead to a confusion of terms which, unfortunately, is common.

'Radiovision' is suitable for 'television' by radio, but 'television' can also be transmitted by telegraph or telephone line.

Near the end of the note you refer to "the radio pictures," meaning 'television.' The broadcast of radio pictures—phototelegraphy—is now being done by the B.B.C., and is in a state much nearer practicability than 'television.'

In several countries there is great controversy over the use of terms in this new branch of applied science. It is almost certain that these words will remain: television, in English-speaking countries; télévision in France; and fernsehen, in Germany. It would be well for the sake of preventing misunderstanding if the philological quibbles were dropped immediately.

WILLIAM J. BRITTAIN.
Lake Drive, Hull.

MR. BRITTAIN raises the question of what is meant by radiovision and television. As a rule, we have to be guided largely not only by the context but also by the nationality of the user. At one time it was thought that radio-telegraphy should replace wireless telegraphy, and many committee meetings were held by electrical engineers to consider this question. It was found that commercial interests, including patent rights, had to be considered, and so as a compromise the British Engineering Standards Association agreed to sanction both. As a matter of fact it has become common practice to use both, and the question of the survival of the fittest may never arise. In America, 'radiovision' is largely used to denote the transmission of living pictures partly through the ether, and an attempt is made to restrict television to the transmission of living pictures through wires. Photo-telegraphy is another art altogether. It is the reproduction of photographs, pictures, etc., by electric impulses sent through wires or through the ether. The Post Office and the Marconi Company make extensive commercial use of this method, and we have seen admirable reproductions of photographs made in a few minutes sent from Berlin to London. Perhaps it would be best to use the hybrid word 'television' to denote the art of sending practically instantaneous living pictures over long distances either by wire or by the ether and restrict the hybrid word 'radiovision' to the latter method of transmission. The use of words like 'televisor,' which is a trade word registered by the Baird Company, to denote a special kind of apparatus, is obviously restricted.—[EDITOR, NATURE.]

Stellar Spectra in the Far Ultra-Violet.

STELLAR spectra cannot be studied in the far ultra-violet spectral region, because the earth's atmosphere has too strong an absorption beyond about 3000 A., due to the amount of ozone in the upper atmosphere. There is no doubt that this ozone is formed by the photochemical action of the sun's radiation. Most of this ozone is at a height of 45-50 km., although the measurements of Dobson and his co-workers show that perhaps about 30 per cent of this ozone diffuses to deeper layers, probably to 20 km. or lower. On the other hand, we can suppose that in the higher layers (100 km. and more) less ozone will be formed, corresponding to the lower pressure.

If we consider that in the midwinter in a polar region of about 4000 km. diameter the sun's radiation does not penetrate deeper than to a height of 50 km. at the edge of this circle, and not deeper than to about 700 km. over the north pole, we should expect that at this time no ozone will be formed there. We should also expect that the ozone formed during the summer will be decomposed before midwinter. Then we should not find a strong absorption of ultra-violet light in this arctic region in the midwinter unless convection were to move ozone from southern regions to this polar zone. But under favourable conditions we can also expect that a large amount of ozone will be decomposed before it reaches the place of observation. It is not probable that the endothermic ozone can be driven 4000 km. or more from the place of photochemical formation to the place of observation without any decomposition.

Therefore at a place in the polar region near the edge of the arctic night we should find a better chance of observing shorter wave-lengths in stellar spectra than at any other time and any other place. With only a small percentage of the normal amount of ozone, we should find the whole spectrum to about 2100 A., where the absorption of the oxygen molecule begins. What the real conditions are we do not know, but in any case we can expect with certainty from a study of stellar ultra-violet spectra in the arctic night just as important results for astrophysics as for meteorology and geophysics.

This paper was communicated by Prof. H. N. Russell at the meeting of the International Astronomical Union in Leyden to Prof. S. Rosseland and Prof. C. Störmer (Oslo). They expect to arrange experiments to study this problem at Tromsö.

GUNTHER CARIO.
(Fellow of the International Education Board.)
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The Structure of the Benzene Ring.

AN X-ray examination of hexa-methyl benzene, $C_6(CH_3)_6$, recently completed, has led to certain definite and fundamental conclusions concerning the symmetry and form of the benzene ring.

The crystals belong to the triclinic system and there is only one molecule in the unit cell. The maximum molecular symmetry is therefore a centre, in agreement with previous results on benzene and the fully halogenated benzene derivatives (E. Gordon Cox, NATURE, **122**, 401, and others). One of the possible minimum cells, however, has its a and b axes very nearly equal (9·010 A. and 8·926 A. respectively), while the angle between them is 119° 34′, that is, nearly $2\pi/3$. There is an excellent cleavage parallel to the (001) plane, and the reflections from the various orders of this plane diminish in intensity in almost the same proportion as those from the (001) cleavage plane of graphite. There is also a marked periodicity in the intensities of reflection from planes in the [001] zone. The reflections from $(h\,k\,0)$ planes correspond closely to those from $(k\,\overline{h+k}\,0)$ and $(\overline{h+k}\,h\,0)$ planes. There is a similar, though less obvious, resemblance between $(h\,k\,l)$ $(k\,\overline{h+k}\,l)$ and $(\overline{h+k}\,h\,l)$ planes.

These intensity variations prove quite clearly the existence (hitherto assumed for crystallographic purposes) of pseudo-hexagonal or hexagonal symmetry in the benzene ring, and also that, in this compound at least, the benzene ring is almost if not quite *flat*; that is, it resembles the rings of six carbon atoms existing in graphite rather than those in diamond.

A further analysis of the intensities shows that the only possible arrangement of carbon atoms is one in which the side of the benzene hexagon (distance between centres of neighbouring carbon atoms) is 1·42—1·48 A. The least C—C distance in graphite is 1·42 A., while the side of the hexagon obtained by *projecting* Bragg's 'puckered' benzene ring on to the mean plane of the ring is 1·45 A. The substitution, therefore, of a flat benzene ring for the puckered rings in naphthalene and anthracene would not affect the periodicity in the c direction, which is one of the most striking features of those crystals (W. H. Bragg, *Zeit. f. Krist.*, **66**, 27).

A more detailed account of this investigation is now being prepared and will be published elsewhere.

K. LONSDALE (*née* YARDLEY).
The University, Leeds.

The Palæozoic Mountain Systems of Europe and America.[1]

By E. B. BAILEY.

TWO factors are involved in the geological classification of folded mountains, namely, date and position. One-half of the surface of Europe has escaped mountain deformation since the dawn of the Cambrian. This area, which we may call Baltica, has its base on the Urals and its apex in South Wales.

Two Palæozoic mountain chains meet in South Wales about the western angle of Baltica. In 1887 Suess named the older of them Caledonian, out of compliment to Scotland. It runs north-east and its folded, cleaved, and broken rocks appear at the surface in many parts of the British Isles, in most of Norway and along much of the Swedish frontier. They frequently include marine representatives of the Cambrian, Ordovician, and Silurian; but the Devonian, where developed within the Caledonian belt of Britain and Scandinavia, and often in adjacent districts, is of continental or, in other words, of Old Red Sandstone facies; and is later than the more violent of the mountain disturbances.

Near Girvan we find, in addition to the post-Silurian unconformity, another of intra-Ordovician date, sufficiently important to bring Upper Llandeilo conglomerates on to Arenig plutonic intrusions. This earlier unconformity disappears with amazing rapidity towards the south-east; but north-westwards it increases in scope, while in the same direction the post-Silurian unconformity fails.

The evidence for these propositions lies partly in the Southern Uplands and partly in exposures to the north-west. The interpretation of the Southern Uplands is one of the miracles of science. We owe it to Lapworth, an English schoolmaster attracted to Galashiels by the charm of Scott's romances. During the seventies of last century Lapworth demonstrated that the hitherto despised graptolites furnish an extraordinarily sensitive time-scale for Ordovician and Silurian stratigraphy. This led him on to the discovery that many of the rock groups that pass with broken complication through the tightly compressed steep isoclinal folding of the district change profoundly in thickness and character from south-east to north-west.

The total thickness of the Upper Llandeilo, Caradoc, and Llandovery at Moffat in the centre of the Southern Uplands is given by Peach and Horne as 220 feet, consisting of black graptolitic shale and unfossiliferous mudstone. At Girvan, which is only 25 miles to the north-west in cross-strike measurement, these same formations are reckoned as more than 4800 feet thick, and their constituents include conspicuous conglomerates, grits, flags, grey shales, shelly beds, and one 60-foot limestone, in addition to subordinate intercalations of black graptolitic shales. The coarse deposits mark an approach to a coast line lying to the north-west, and their material contains much recognisable debris of Arenig cherts, lavas, and intrusions that must have formed part of a land surface in that direction. The great thickness of such shallow-water marine sediments indicates long-continued subsidence of the sea bottom, preparatory, as it were, to mountain upheaval.

The most impressive geological phenomenon in Scandinavia is the marginal over-riding of Baltica by the Caledonian mountains. It is best displayed in the province of Jämtland, where there are comparatively wide exposures of fossiliferous Cambrian, Ordovician, and Silurian. These formations lie undisturbed in the south-eastern part of their outcrop. Gradually, north-westwards, tranquillity is replaced by isoclinal folding, small-scale thrusting, and intense distributed shearing. Above lies the great Scandinavian thrust-mass or 'nappe,' the cause and origin of all the trouble.

When, in 1888, Törnebohm first propounded his overthrust theory of the Scandinavian Chain, he mentioned sixty miles as a minimum displacement, and compared this estimate with the half-mile of overthrusting previously described by himself from Dalsland and with Peach and Horne's ten miles from the North-west Highlands of Scotland. In 1896, by which time he had received important help from Högbom, he was able to demonstrate that the Scandinavian thrusting exceeds eighty miles.

The North-west Highlands of Scotland show the opposite margin of the Caledonian Chain to that studied by Törnebohm in Jämtland. A British audience knows full well the history of discovery in this wonderful region. Peach and Horne's lucid and beautifully illustrated descriptions, dating from 1884, 1888, and 1907, have, in Suess's words, "rendered our northern mountains transparent." The fossiliferous sediments of Durness, over which the Moine crystalline schists are thrust, are of Cambrian and probably Lower Ordovician age. They are essentially a quartzite-limestone (largely dolomite) succession, and in lithological character and fossil content they belong much more nearly to North America than to the rest of Britain.

The Atlantic seaboard of North America, southwards from Newfoundland, is constituted of Palæozoic mountains, locally concealed beneath a coastal spread of Cretaceous and Tertiary rocks. American geologists call their ancient mountains the Appalachian System. To European eyes they appear as a complex of two systems, rather than as a single system; but for the moment we may let this pass. Beyond the Appalachian Mountains lies an enormous interior region, the Laurentia of Suess, which, like Baltica, has remained unaffected by folding since late pre-Cambrian days.

The age and relations of the portion of the Appalachian complex, which borders the St. Lawrence Lowlands of Laurentia, justifies our grouping it with the Caledonian System. It was Marcel Bertrand who, in 1887, saw that the Appalachian Mountains, as a whole, could be partitioned among the two great Palæozoic systems that, on our side of the water, meet in South

[1] From the presidential address to Section C (Geology) of the British Association, delivered at Glasgow on Sept. 10.

Wales. In Newfoundland, Canada, and northern New England the Appalachian Mountains belong to the Caledonian System, in the sense that their main movements were completed before the close of the Devonian period.

On Dec. 31, 1860, Logan addressed a long letter to Barrande, and told him how he had been forced to recognise a zone, situated on the mountain front, where older rocks are habitually overthrust upon younger. He actually laid down the course of his postulated thrust all along its Canadian outcrop from Lake Champlain to the extremity of Gaspé. On this account the Champlain—St. Lawrence thrust-zone is often spoken of as the Logan Line.

Logan was of course only applying a familiar principle; for, in the States, thrusts had been described by the brothers Rogers so early as 1842, and, in the Alps, by Escher in 1841. Still, there can be no question that Logan's letter to Barrande furnishes one of the main landmarks of tectonic science.

Logan also recognised that the north-westward frontal thrusting of the Caledonian Mountains of Canada followed a much older line of slope, leading down south-eastwards from the platform of Laurentia to the comparative depths of the Caledonian sea bottom. He gave his theoretical slope a double function. First of all it had to act as a boundary to early sedimentation, and then as a guide to later thrusting and folding. There is, however, another aspect of Logan's Slope that has not, I think, attracted sufficient attention. This slope, when completely submerged, seems to have furnished a dividing line between clear-water Ordovician limestones (American facies), that grew on its top to the north-west, and muds and sands (Caledonian facies) that, creeping from the opposite direction, came to rest at its foot. The fossils of the two sets of deposits are as distinct as the rocks themselves, and this has led certain distinguished palæontologists to postulate continuous land barriers, or isthmuses, separating the two fields of accumulation. On the other hand, I think it can be established that the limestone of the one field has repeatedly landslipped down upon the mud of the other; in which case the division cannot have been an isthmus, but merely a submarine slope.

My conception of the Logan Slope is a slight modification of Logan's original. Let us picture the slope, not as a rigid feature of pre-Cambrian date, eventually obliterated by Palæozoic sedimentation, but as tectonic in origin and intermittently renewed by hinged subsidence. Earthquakes connected with the intermittent renewal were probably responsible for the landslips to which I have just alluded. It is well known that most of the major earthquakes of to-day originate on submarine slopes, and that important submarine landslips precipitated by such earthquakes have been described, for example, in connexion with the Tokyo disaster of 1923. Of late years Kendall has reawakened British students to the possibility of recognising earthquake phenomena in the records of the past. I believe that a story of recurrent earthquakes is written in the submarine landslip-deposits of the Logan Slope.

If now we cast our minds back to the change of facies that Lapworth recognised in the Southern Uplands of Scotland, we find it on the whole of more gradual type than that characteristic of Canada. In the Southern Upland sea, mechanical sediment travelled down a tectonic slope, and change of facies depended upon the arrest of coarse material

FIG. 1.—Tectonic map of Europe. The ornamented regions (Baltica, Laurentia, etc.) have remained unaffected by mountain-folding since pre-Cambrian times. Their pre-Cambrian outcrops are shown by ticks, Cambrian and later by stipple. Contractions are used for Black Forest, Edinburgh, Girvan, Jämtland, Liège, Stonehaven, Trondhjem, Valenciennes, Wicklow.

by deep water. In the Canadian sea, mechanical sediment reached the foot of a tectonic slope up which it was unable to climb. In both cases we notice subsidence preceding mountain elevation—an idea which had its beginnings in a publication of Hall's on the Appalachians, dated 1859, and its subsequent development more especially in the writings of Dana and Haug.

In 1887, the later of the two great Palæozoic chains that meet in South Wales received a double name from Suess. He distinguished along its course a couple of congruent mountain arcs with an inflectional junction of their fronts (syntaxis) near Valenciennes on the Franco-Belgian border. The eastern arc he called Variscan, the western Armorican. The names are based on the Latin for the Bavarian town of Hof, *Curia Variscorum*, and for the French province of Brittany, *Armorica*. The meeting of the two arcs near Valenciennes is closely comparable with the meeting of the Carpathians and Alps near Vienna.

The date of the Armorican and Variscan folding varies somewhat according to locality, but lies either within, or at latest shortly after the close of, the Carboniferous. Bertrand, publishing the same year as Suess, classed these mountains on a purely age basis, as part of his Hercynian System (called after the Harz). Unfortunately, Bertrand's name Hercynian was preoccupied; but I propose to use it in his sense in the present description.

The Franco-Belgio-German coalfield at the northern front of the Hercynian Mountains has provided a favourite theme among tectonists from the days of Dumont and Rogers, 1832 and 1849. In 1877, Cornet and Briart, and in 1879, Gosselet, announced large-scale overthrusting, the first of the kind to be recognised in European Palæozoic chains. Of recent years, much the most delightful addition to our knowledge of the ground has been afforded by Fourmarier's 1905 interpretation of the Window of Theux, south of Liège.

The preparatory hinged subsidence that we have met with in the history of the Caledonian Chain, in southern Scotland and again in Canada, reappears in the Hercynian record of western Europe. Broadly speaking, the Devonian of the Hercynian Foreland is continental (Old Red Sandstone), while that of the Hercynian Mountains is marine. Evidently the marine Devonian gathered on a tectonic slope that, descending southwards to the site of the future mountains, was constantly renewed by subsidence.

The contrast between the foreland and the mountain region is particularly striking along the Franco-Belgian front of the chain, even when we make allowance for exaggeration by overthrusting. The Lower Devonian and the lower part of the Middle Devonian of the thrust region sometimes total 17,000 feet, while both divisions are absent in the over-ridden foreland to the north. The line at which this great mass of sediment fails is known as the Condroz Crest. I prefer to speak of it, when

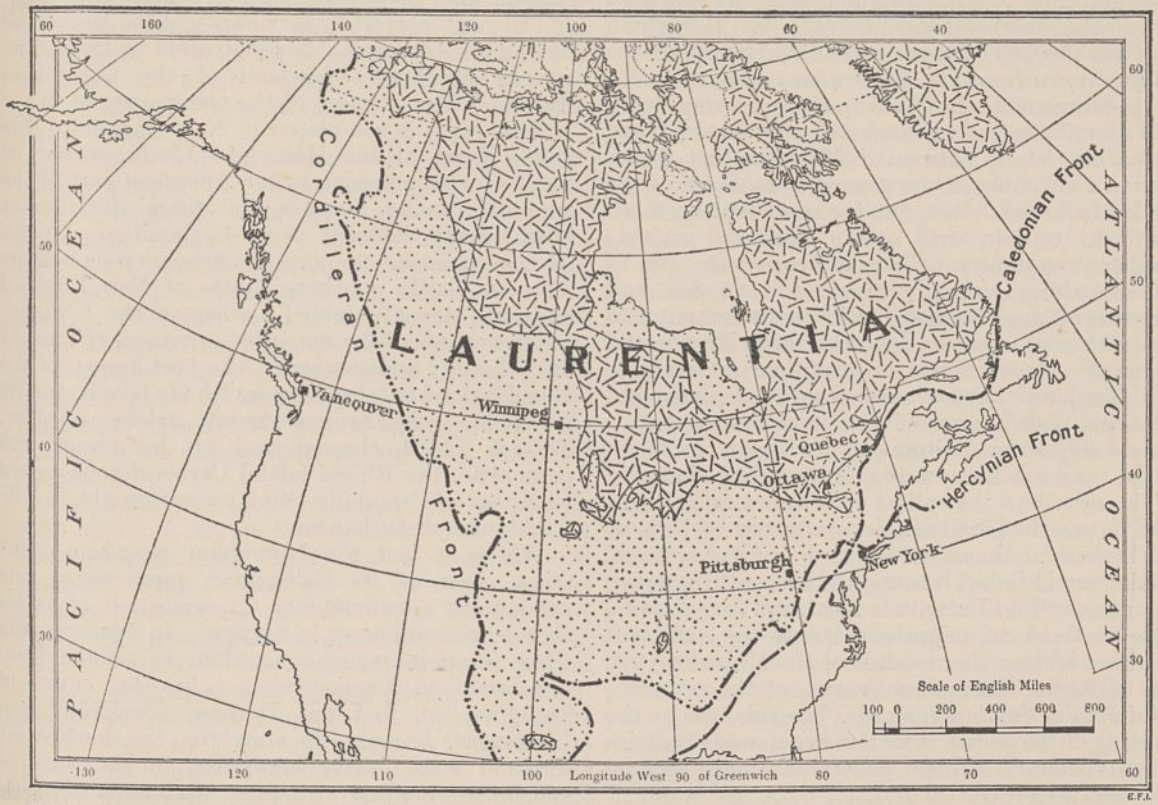

FIG. 2.—Tectonic map of North America. The ornamented region (Laurentia) has remained unaffected by mountain-folding since pre-Cambrian times; its pre-Cambrian outcrops are shown by ticks, Cambrian and later by stipple. The western cordillera is of Mesozoic and Tertiary date.

concerned with its pre-thrust character, as the Condroz Slope.

During Lower Carboniferous times, marine transgression submerged the Hercynian Foreland far and wide. A northern continent persisted, but its waste was retained along a deltaic belt that stretched through southern Scotland and northern Ireland. Accordingly, clear shallow waters covered much of the foreland in Belgium, England, and Ireland, where it encouraged the growth of Carboniferous Limestone. At the same time, the interior Hercynian zone, lying to the south, showed signs of mountain development, and its uplifted portions furnished sand and mud to the contiguous sea. It is almost certain that the northward travel of the Hercynian mud was checked by a successor of the Condroz Slope leading down from the shallow waters of the submerged foreland to the foredeep of the growing chain.

Without attempting to sketch this history even in outline, let us pass on to Millstone Grit times, when a slackening in the general subsidence of the foreland allowed deltas from the persistent northern continent to join with others from the growing southern mountains. They met upon the site of the erstwhile Carboniferous Limestone Sea and thereafter placed Scotland in frequent communication with contemporary land regions in France and Germany. Just at this critical time, as Kidston and Traquair have shown, the land flora and estuarine fish fauna of Scotland underwent a remarkably sudden alteration; whereas the fauna of the open sea showed no corresponding change.

The new flora that all at once appeared in Scotland, is one that has been demonstrated by Potonié and others to have arisen in a normal gradual fashion on the deltas fronting the nascent Hercynian Mountains; and I attribute its abrupt introduction into Scotland to migration across the confluent southern and northern deltas of the Millstone Grit. The contemporaneous renovation of the estuarine fish fauna of Scotland can also be explained by the meeting of the deltas, since this event made Scottish rivers tributary to the general drainage system of western Europe.

There is another aspect of the deltaic apron of the Hercynian Mountains which used to appeal insistently to the imagination of Marcel Bertrand. This deltaic accumulation gathered in the frontal depression of the growing Hercynian Chain, and to-day it furnishes the greatest belt of coalfields in the whole of Europe. We know it in Upper Silesia and again in the Ruhr, Belgium, north-east France, Dover, Somerset, and South Wales.

The phenomenon of mountain crossing receives two independent illustrations along the course of the Hercynian Mountains of western Europe. In Upper Silesia the front of the Hercynian Chain emerges from beneath the Carpathians, while in the British Isles it obliterates for the time being the south-westward continuation of the Caledonian Chain. Where the Carpathians and Alps have trespassed upon the domain of the Hercynian Mountains the latter had already been buried beneath an unconformable cover of Mesozoic and Tertiary marine sediments. Similarly, where the Hercynian front crosses the Caledonian Chain in Ireland, the new mountains, at the present level of denudation, consist of Devonian and Carboniferous sediments.

In America, from New York southwards, the north-west front of the Appalachian complex consists of folded and often overthrust Palæozoic sediments that extend upwards into Coal Measures. This belt it was that gave the brothers Rogers material for their ever-famous address delivered in 1842 before the American Association of Geologists. The last great movement seems to have been in the early Permian. Accordingly, Marcel Bertrand, in 1887, placed this frontal Pennsylvanian belt of the Appalachian Complex in his Hercynian System.

The most interesting peculiarity of the Hercynian System in America is its penetration to Laurentia, to the north-west foreland of the Caledonian System. The crossing of the chains, begun in the British Isles, is completed in New England. The actual front of the Hercynian Chain cannot be mapped with precision in the American part of the zone of crossing, because the critical district has been largely denuded of its Carboniferous rocks. At the same time, important Carboniferous outliers do occur in the southern States of New England and are strongly folded; whereas the Carboniferous spreads of the maritime provinces of Canada are tolerably undisturbed. The best known of the New England outcrops crosses Rhode Island, and its prevailing rocks are conglomerate, arkose and slate. Though folded, cleaved, and cut by granite and pegmatite, the Rhode Island Carboniferous agrees with that of Canada in being unconformable to the Caledonian disturbances.

Where at last the Hercynian Mountain front steps clear of its Caledonian predecessor, one encounters a sedimentary superposition of facies that is quite unknown in Europe. In Pennsylvania there is an immense concordant succession from Cambrian to Carboniferous. In the cores of anticlines we find our Durness (Beekmantown) Limestone, because we stand on the north-west foreland of the Caledonian Chain. In the hearts of synclines we discover Upper Carboniferous Coal Measures (Pennsylvanian) derived from the waste of the growing Hercynian Mountains, and we follow Bertrand in our thoughts to South Wales, the Ruhr, and Upper Silesia.

The study that we have made of mountain chains with their folds and their thrusts, which individually may be of the order of 100 miles, involves a recognition of some type of continental drift. Of late years Wegener has developed this idea on a particularly grand scale. He has accounted for many recognised correspondences in the geology of the two sides of the Atlantic by supposing that the ocean has flowed in between the Old World and the New, as the two continental masses, with geological slowness, drifted asunder. One cannot help feeling that Wegener may perhaps be telling us the truth. The available evidence is crude and ambiguous; but it is certainly startling to be confronted on the coasts of Britain and America with what read like complementary renderings of a single theme: the crossing of Caledonian Mountains by Hercynian.

Sir Joseph Banks, Bart.

PRESIDENT OF THE ROYAL SOCIETY FROM 1778 UNTIL 1820.

THE forthcoming anniversary meeting of the Royal Society is the hundred and fiftieth anniversary of the election of Joseph Banks, the distinguished naturalist and companion of Captain Cook in his first voyage of discovery, as president of the Society. Banks was elected a fellow in 1766, chosen president in 1778, and served in that office for a period of forty-one years. Those who comprised the pageant of science during his presidency, choosing names in a catholic sense and in order of years, included Count Rumford, Cavallo, Desaguliers, William Herschel (who communicated to Banks the name Georgium Sidus for the new planet), James Watt, Wollaston, Lavoisier, Volta, Davy, Cuvier.

Beyond a wide knowledge of botany and of races of people, fully appreciated in his case, it is difficult to gauge accurately—and no attempt is made here—what Banks's precise hold was on the men of his time that he should obtain practically undisputed pre-eminence in the official world of science. Certainly he was rich, extremely hospitable, a sound friend, and devoid of petty excesses in language. He had the grand manner, the Georgian patriotic instinct, the love of Imperial expansion. He lived to witness the steps that were taken for the colonisation of Australia and New Zealand.

Joseph Banks was a Londoner, born on Feb. 2, 1743 (O.S.), in Argyle Street, hard by what is now Oxford Circus. His family was of Yorkshire extraction. Sent to Harrow at an early age, at thirteen he was removed to Eton, on leaving there becoming a gentleman commoner at Christ Church, Oxford. Here it was that his love of natural history broadened and shaped his future career. Banks was created a baronet in 1781, a Knight of the Bath in 1785, and a Privy Councillor in 1797. He died without lineal issue, at Spring Grove, Isleworth, on June 19, 1820, his wife surviving him.

In the year of his election into the Royal Society (1766), Banks decided to visit Newfoundland and Labrador in quest of botanical specimens, and accepted an offer to accompany Lieut. Phipps, commanding H.M.S. *Niger*, a boat on government service. It was his first venture, his baptism of exploration, and those earlier studies at Oxford in botany and general natural history were now to undergo the test of enlarged opportunities on virgin territory. He kept a journal (ending Nov. 17, 1776)—faithfully treasured at Adelaide, and he collected many plants. But a larger undertaking, which through its magnitude and momentous scope appealed to Banks, was at hand, namely, Cook's projected voyage to the Pacific in the *Endeavour*. Approach was made to the council of the Royal Society requesting a place in the complement. It is recorded that the council "very earnestly" asked the Lords of the Admiralty that in regard to Mr. Banks's great personal merit, and for the advancement of useful knowledge, he also, together with his suite, and with their baggage, might be received on board of the ship in command of Captain Cook. Banks was then twenty-five years of age, and he was the possessor of an ample fortune. The journal which he compiled during the voyage, or rather diary, is a classic. Sir Joseph Hooker, its latter-day editor, refers in eulogistic terms to Banks's untiring activity, whether in observing or collecting animals and plants, investigating and recording native customs and languages, bartering for necessaries with the inhabitants, or preventing the pillaging to which the ship was frequently subjected. Surely a man of vision in advance of his years and period, and a worthy pioneer companion for Cook in strange seas and lands.

There was an incident at Otahite relating to a stolen quadrant. Says Banks (April 2, 1769), "This morning the astronomical quadrant which had been brought ashore yesterday, was missed." To recover this Banks and his colleagues journeyed four miles from their base, only to learn that yet another three miles must be traversed to secure the instrument. But success came. "We packed up all," he writes, "in grass, and proceeded homewards. After walking about two miles we met Captain Cook with a party of marines coming after us."

On the completion of the Pacific voyage, Banks received from his *alma mater*, the University of Oxford, the D.C.L. degree. Soon his portrait was painted by Sir Joshua Reynolds. The metropolis welcomed him with affectionate fervour. So ardent a collector and naturalist could not, however, but seek fresh extension of his studies. In 1772 plans for Cook's second voyage of circumnavigation were going forward, and it was the wish of Banks to accompany him. In regard to the resultant failure, Sir John Barrow, in retrospect, was at no pains to conceal his views. "Such a system," he wrote, "was adopted by the Navy Board to thwart every step of his [Banks] proceeding, whereby his patience was worn out, and his indignation so far excited as to cause him, though reluctantly, to abandon this enterprise altogether." Instead, Banks directed his energies towards organising and equipping a scientific expedition to Iceland. He sailed on July 12, 1772, and much valuable material accrued through his efforts and those of his coadjutors.

Most men of science know that numbers of Banksian letters and records were dispersed long ago through the medium of auction sales. In the case of Banks's Iceland journal, fortunately, through certain favourable circumstances arising after his death, a copy was made, and it is pleasing to direct attention to the issue, this year, by the Cornell University Library, of the work "Sir Joseph Banks and Iceland." The author and

annotator, Dr. Halldór Hermannsson, prints the following significant paragraph: "This manuscript, with other of Banks's papers, went to the family of his wife, and Lord Brabourne, a relative [great nephew] of hers, finally sold them at a public auction in 1886, and its whereabouts (*i.e.* original MS.) is unknown, if it is still in existence." It was Lot 21 in the sale.

After his Iceland tour, Banks established himself at a house in Soho Square, and thenceforward devoted himself to the advancement of science in fulfilment of personal hopes and aspirations. On Mar. 16, 1820, Banks occupied the presidential chair at the Royal Society for the last time; for reasons of health he very shortly intimated his wish to resign his charge. Upon solicitation he withdrew his resignation; but in June following he died, and, like Newton, whilst in office. The Royal Society possesses a portrait of Banks, painted by Thomas Phillips, R.A.

Obituary.

Sir Hugh Anderson, F.R.S.

SIR HUGH ANDERSON, who died on Nov. 2, was one of the most influential and the best-loved men in Cambridge. Modest to a fault and ready to see merit in all but himself, he was nevertheless a far-sighted and resolute administrator, and the driving force behind most of the recent changes in the University. But a man of science who is modest about his own work and is withal a capable man of affairs must be drawn almost inevitably to the administrative side. Anderson's research work came to an end in 1905, when the calls on his time became more and more urgent. For many years he hoped to return to the laboratory to work at his unfinished problems 'when he had a moment to spare,' but he never had that moment. In the end he used to say that he was out of it for good, and that all he could do was to encourage the younger men. But the truth is that he was never out of it, for everyone came to him for sympathy and advice, and his wise guidance has had an indirect effect on the scientific work of the University which it would be hard to over-estimate.

Anderson's own research work was mostly carried out in collaboration with Prof. Langley, and dealt with the then obscure problem of the nerve supply to the viscera. To Langley must belong the credit of producing the complete systematic account of the autonomic nervous system as we know it to-day, but the papers which he published with Anderson mark the most important phase of the whole work. The arrangement of the sympathetic system had been made fairly clear by Gaskell's morphological work and Langley's brilliant application of the nicotine method, but there remained the more difficult problem of the cranial and sacral autonomic nerves, and in the course of twelve years—from 1892 to 1904—Langley and Anderson worked together, tracing out the innervation of the iris and of the pelvic viscera and arriving finally at a complete account of the parasympathetic system. In their final papers they rounded off their work by experiments on the union of different kinds of nerve fibres.

In 1905, Anderson published two papers of his own, analysing the effect of drugs on the iris and clearing up various points which remained obscure in its nervous control, and then administrative work claimed him. But although his research work extended only from 1892 to 1905, it was throughout of a very high order; it produced results of the first importance, and it left him with a vivid interest in the physiology of the nervous system, and a power of illuminating suggestion and criticism which never seemed out-of-date. It left him, too, with an insight into the difficulties of the scientific worker which made his advice so much sought after by colleagues of all generations, and in the end we may hope that a partial realisation of the encouragement and help he gave to others may have consoled him a little for his own unfinished researches.

Anderson's work for the Royal Commission on Oxford and Cambridge, for the medical and biological schools, and as Master of Caius, make an impressive record of service to learning; but no record can do full justice to the vivid and friendly personality of the small, active figure whose loss means so much to his University.

We regret to announce the following deaths:

Dr. H. M. Benedict, professor of botany in the University of Cincinnati, and a former president of the Ohio Academy of Science, who carried out work on senility in plants, on Oct. 17, aged fifty-four years.

Mr. Douglas J. P. Berridge, for several years secretary and recorder of the Educational Science Section of the British Association, and for thirty-four years science master at Malvern College, on Nov. 11, at fifty-nine years of age.

Prof. C. O. Esterly, professor of zoology at the Occidental College, Los Angeles, and zoologist at the Scripps Institution of Oceanography, California, a distinguished worker on copepods who was president of the American Microscopical Society in 1925, on Aug. 10, aged forty-nine years.

Dr. Josef Hepperger, former professor of astronomy in the University of Vienna and Director of the Observatory, on Sept. 13, aged seventy-three years.

Mr. Alfred Smetham, a past president of the Society of Public Analysts and an original member of the Society of Industrial Chemistry, who had much experience of the agricultural side of chemistry, on Oct. 11, aged seventy-one years.

Sir Nestor Tirard, emeritus professor of medicine at King's College, London, and senior editor of the 1914 edition of the "British Pharmacopœia," on Nov. 10, aged seventy-five years.

Mr. Edmund White, president from 1913 until 1918 of the Pharmaceutical Society, who was intimately associated with the 1911 and 1923 editions of the British Pharmaceutical Codex, on Nov. 5, aged sixty-two years.

News and Views.

AT the annual dinner of the Royal Society of Medicine, held on Nov. 15, Mr. Rudyard Kipling, who was one of the guests of honour, disappointed and mystified his audience by a discourse on Nicholas Culpeper, the astrologer physician who flourished in the first half of the seventeenth century and gained considerable notoriety by an unauthorised translation of the Pharmacopœia of the Royal College of Physicians and a work on herbal medicine which had an enormous vogue for nearly two centuries. His theory was that "this creation, though composed of contraries, is one united body of which man is the epitome, and that he, therefore, who would understand the mystery of healing must look as high as the stars." This view, according to Mr. Kipling, was derived from the doctrine of the old Greek philosophers, that the universe is one in ultimate essence, which essence is sustained, embraced, and interpenetrated by the pneuma, a creative motion or inner heat. Mr. Kipling suggested that if Culpeper were to return to earth to-day, he would have no difficulty in explaining the progress made in the art of healing since his time. It is true that he would find by a visit to Greenwich Observatory that the study of the heavens is not carried on with any relation to diseases or epidemics, but the therapeutic action of radium on morbid growths he would regard as an example of celestial influence. Mr. Kipling, who, like many other literary men throughout the ages, shows a sympathy for the quack as opposed to the orthodox medical practitioner, is inclined to think that Culpeper's views were not really so absurd as they appear, and suggested that at some future time, when the bacteriologist and physicist are at a standstill, they should lay their problem before the astronomer. We doubt very much whether such collaboration would be either probable or profitable.

SIR JAMES CRICHTON BROWNE celebrates his eighty-eighth birthday on Wednesday next, Nov. 28, and most hearty congratulations are extended to this veteran member of the scientific world. Educated in the first instance at Dumfries Academy, afterwards at Trinity College, Glenalmond, he graduated in the medical faculty of the University of Edinburgh. An authority on mental and nervous diseases, Sir James was Lord Chancellor's Visitor in Lunacy from 1875 to 1922. For a long term of years, beginning in 1889, he was treasurer of the Royal Institution. He was elected a fellow of the Royal Society in 1883, and is Hon. LL.D. of St. Andrews and Aberdeen, and Hon. D.Sc. of Leeds. Possessing in unusual measure the gift of graceful speech and apt verbal expression, Sir James has always commanded public interest. We recall a notable utterance within the Royal Institution on the occasion of the death of John Tyndall in 1893: "I think I may venture to say that it is good for us to be here this afternoon—to withdraw ourselves for a brief period from business pursuits or pleasures, to assemble together in a place hallowed by the life-work of a great man who has just passed from amongst us—to build an altar to his memory, to burn therein the incense of our gratitude and admiration." While the demands of a busy professional life have not allowed Sir James to engage directly in the preparation of scientific papers, he is the author of some books and of various essays and addresses indicative of versatility and judgment. Among the former may be instanced "Dreamy Mental States" (1898), and "Prevention of Senility" (1905); in the latter category, "Victorian Jottings" (1926) and "Stray Leaves from a Physician's Portfolio" (1927).

WE congratulate Sir Jagadis Bose, F.R.S., on the attainment of his seventieth birthday, which falls on Nov. 30. It is a satisfaction to know that the event will find him still actively engaged in the researches which, for thirty years, he has prosecuted on the sensitivity and motility of plants, researches which have contributed so much to the knowledge and understanding of their organisation, and have made him so widely known. Bose approached the subject from the physical, not the physiological side, and to this much of his success is attributable. Although as an undergraduate at Cambridge he attended the courses of physiology and of botany, his attention was chiefly devoted to physics, which he studied under the late Lord Rayleigh, at that time Cavendish professor of physics in the University, who formed a high opinion of his abilities and afterwards strongly supported his candidature for the fellowship of the Royal Society on account of the merit of his electrical researches.

THE observation of electric phenomena presented by metals led Bose to extend his experiments to living matter. The researches of du Bois-Reymond and other physiologists had shown that functional activity of animal tissue, whether muscle, nerve, or gland, is accompanied by an electric variation detectable by the galvanometer. Bose applied this method to plants, beginning with the motile leaves of the sensitive plant, *Mimosa pudica*, and found that their movement is accompanied by an electric variation like that of contracting muscle. Nor is this reaction confined to actively motile 'sensitive' plants: for he observed it when any part of any living plant was stimulated, even although the responsive movement was almost imperceptible. Sensitivity and contractility are then fundamental properties of the living protoplasm of which both plants and animals consist. Bose's early physical training developed his natural gift for devising ingenious and highly sensitive apparatus, by means of which it was possible to record automatically the usually rather feeble response of the plant to stimulation, and to discover in the plant-body the channels along which 'nervous' excitation travels, and the sap is propelled by the rhythmic contraction of propulsive cells, which may be regarded as his crowning achievement. Naturally, such results as these have not escaped criticism, but no rebutting experimental evidence has been adduced. No good wish will be more welcome to him on this occasion than that he may live to see the Research Institute which he has founded at Calcutta developing into an active centre of fruitful investigation in all branches of biology.

IN the *Daily Mail* for Nov. 14 there appears under headlines of the usual startling character a description of an invention which, it is alleged, will revolutionise all our present ideas about electricity. It is true that the article begins with "if the claims made for the Harrison-Wood patent are substantiated," but the impression produced is that it is quite possible that the manufacture and distribution of electric energy may become obsolete. We are told that the inventors claim that by attaching a small machine to an equally small accumulator an average sized villa can be illuminated for an indefinite period at a trifling cost. If the villa is already equipped for electric supply, all that is necessary is to put a plug in the socket of the nearest lampholder and the machine will reduce the annual cost to one-sixth its present value. The *Daily Mail* says that "it is stated" that this has actually been done over a period of some months, and it is to be done again for the Government test. We wonder which particular department of the Government is seriously undertaking this test. We do not think that any useful purpose is served by a paper publishing preposterous claims under heavy type, especially when it takes no responsibility for them and states nothing to justify them. Sudden outbursts like this—sensational in presentation and unscientific in substance—can only do harm and are much to be deprecated.

AN exhibition, which suggested possibilities for Nature preservation, was held in Edinburgh on Nov. 14–16. It was the first Silver Fox Exhibition to be held in Scotland—the third of its line in Britain. This show of some 150 silver foxes, the best individuals from the stocks of a score of fur-farms in Great Britain, demonstrated at once the success in quality which has attended the propagation in artificial conditions of a wild and shy animal, and the hold which the new industry has taken. The silver fox is a sport of the American red fox, but the name is unfortunate, since the 'silver' is confined to a slight whiteness or 'frosting' on the tips of jet black hair. Indeed, the classification adopted by breeders grades the animals according to the amount of surface upon which 'frosting' is developed, from three-quarter silver, half silver, quarter silver, to a pure black. The silver-fox sport occurs in Nature, and has been known to turn up in litters with normally reddish young, but the strain seems now to be well established as a domesticated race. The natural skins were always highly prized and fetched large prices at the fur auctions, but the fact that pelts of the best quality can now be bred is bound to affect the intensity of the slaughter of the wild stock, and so indirectly to act towards the preservation, or rather against the extermination, of the native animals. In normal course it ought also to bring about a reduction in the price of the furs, for scarcity and high prices are generally closely correlated. But the intrinsic beauty of texture and colour of the pelts of the show animals exhibited in Edinburgh is sufficient guarantee that the skins will always be in great demand, so long as fur is in fashion. This is shown by the prices demanded for well-bred stock animals—one important fur-farm near Edinburgh offering cubs from selected litters at prices ranging from £100 to £300 each. Such prices suggest that the competition for good pelts is very keen, and perhaps also that silver-fox breeding is no child's play.

PROF. PONTE'S predication on Nov. 8 that the eruption of Etna would last at least another week has been fully justified, for the emission of lava appears to have continued up to the evening of Nov. 16. From then the lava became increasingly viscous, and by Nov. 18 it had solidified, at least superficially, right up to the last of the active sources. Prof. Malladra, the Director of the Vesuvius Observatory, has spent several days investigating the nature of the eruption. He estimates the average daily output of lava at 46 million cubic yards, and states that the initial temperature was 1030° C. It has also been recorded that from one of the craters the effervescent lava rose in a glowing fountain for 50 feet, and at night was "the colour of molten gold." The gases and vapours given off during the earlier stages of the eruption seem to have been unusually mild, water-vapour predominating. The close of the eruption, however, was marked by the appearance of sulphurous gases. Although the eruption has been a relatively minor one—that of 1892, for example, lasted six months and discharged an enormously greater flood of lava—the damage to property has unfortunately been more than usually severe. In addition to the destruction of villages and services, nearly 2000 acres of vineyards, orange and lemon orchards, and chestnut groves have been totally destroyed, the loss amounting in all to the value of £2,000,000. Vesuvius began to display increased activity on Nov. 14, but this is of a normal character. There is no ground for the suggestion that Vesuvius is acting in sympathy with its more vigorous neighbour. The habits and lavas of the two volcanoes are of widely different types.

ACCORDING to the *Revue Générale des Sciences* of Oct. 15, the great electromagnet which M. Cotton has built for the Paris Academy of Sciences has now been completed and is installed at Bellevue at the national office for scientific research. The object in view in constructing this electromagnet was quite different from that which Kapitza had in constructing the Cambridge electromagnet. In the latter, magnetic fields having intensities of several hundreds of thousands of gausses are produced for periods of about the hundredth part of a second. They exist also only in the interior of little bobbins. The French electromagnet produces intense permanent fields of appreciable volume. The field produced by an electromagnet can be increased almost without limit by using polar points worked and centred with geometrical accuracy. The total weight of the new magnet is 120 tons, of which 105 are iron and 9 are copper. In a space bounded by two faces four centimetres in diameter and two centimetres apart, a magnetic field the intensity of which was 43,500 gauss was obtained. By the use of ferro-cobalt pole pieces, this field can be increased by about 6 per cent.

MANY electrical undertakings in Great Britain will soon be converted from generating stations into supply stations, and this will ultimately be for the benefit of the consumers. It is advisable, therefore, that attention should be devoted to the problems that are arising out of this national reorganisation of the electricity supply in order that justice be done to those who are affected by it. In particular the question of the displacement of the staff requires careful study. We are glad, therefore, that Mr. W. J. Bache discusses this question in his chairman's address on "Problems of Electricity Supply" to the western centre of the Institution of Electrical Engineers. The engineers and workmen who have served undertakings efficiently and loyally and now, through no action of their own and for the benefit of the nation, may lose their normal occupation, are entitled to generous treatment. The questions of the probable number of men to be affected and the possibility of many of them being still retained in their own undertakings should be considered. There are about 570 undertakings in Britain and the total number of generating station engineers likely to be affected is a little more than a thousand. Mr. Bache thinks that if both sides show good will and a spirit of reasonableness, there should not be much difficulty in providing employment for the displaced technical men in their own undertakings. He points out, however, that the specialised knowledge and experience obtained by a generation engineer does not necessarily qualify him to be equally useful as a distributing engineer. It is necessary that he obtain further knowledge. He must supplement his book knowledge by observation of the practical processes of the new work he will have to do. As the assistant engineer usually has an eight-hours' day, Mr. Bache thinks that he can devote a few extra hours every week to acquiring the necessary practical knowledge. For example, he allows his own assistants to aid in the work of the mains department, in laying cables, in managing substations, in testing meters, in inspecting installations, and in office work dealing with consumers' accounts. We hope that his example will be widely followed.

THE fate of Colonel Fawcett in the Brazilian forests seems to have been established beyond reasonable doubt by Commander Dyott's recent expedition, although no conclusive proof of the Indian reports was obtainable. The story is pieced together from Com. Dyott's dispatches in the *Geographical Journal* for November. In April 1925, Col. Fawcett started into the very difficult country about the head-waters of the Paranatinga and Xingu Rivers, and no news has been received from him since a dispatch dated May 30 in that year from Dead Horse camp in lat. 11° 43′ S., long. 54° 35′ W. From the Cuyaba River, a tributary of the Paraguay, Com. Dyott reached the Kuluene River, one of the head streams of the Xingu, and there obtained news that Col. Fawcett had been killed by Indians five days after passing east of the Kuluene River. Com. Dyott followed some distance in the tracks of Col. Fawcett's party and obtained confirmation of this story. Eventually, however, owing to the hostility of the Indians, he was forced to make a hurried retreat down the Xingu. Further details are awaited on the return of Com. Dyott.

THE improvement in typography during the last twenty or thirty years has been slow in making its influence felt in the lettering on maps. In a lecture before the Royal Geographical Society on Nov. 12, Capt. J. G. Withycombe traced the development of cartographical lettering. Until the latter half of the eighteenth century the alphabets used were evolved from hand-written script in Roman lowercase and Italic type. The Roman capitals were carefully drawn and often treated decoratively. The alphabets deteriorated when a commercial round hand or 'copper-plate' took the place of the pointed Italian script. Hair lines were introduced and the proportions of the letters altered. The capitals were narrowed and the serifs so exaggerated that they concealed the distinctive form of the letters. The type lost in beauty and legibility. The Ordnance Survey has always been noted for the neatness of its lettering, but now that the helio process has entirely replaced the copper plate, improvements in typography are to be introduced in the revision of the 1-inch map that is to be begun shortly. In the Roman capitals the proportions of the letters have been restored and the serifs are not too obtrusive. Violent contrasts between up and down strokes do not appear, and the white spaces within the letters are clean. The lowercase alphabet is based on pen strokes. The Italic alphabet is rounder and more legible, and there are no hair lines. Altogether, the new alphabets show considerable typographical improvement on the old.

IN his opening lecture at the Royal Academy of Arts, delivered on Nov. 14, Prof. A. P. Laurie dealt with the scientific examination of pictures. A microscopic examination gives valuable information as to repainting, and also makes it possible, in many cases, to identify the pigments used; this examination having, in some cases, to be supplemented by tiny samples taken with a fine hypodermic needle. As new pigments have come in from time to time in the history of painting, and others have disappeared from the artist's palette, they form an invaluable guide for fixing the date of a picture, and, in addition, it is sometimes found that the palette of a given artist is peculiar to himself. The microscope also enables forged signatures to be detected. Another useful weapon is the X-ray photograph. By this means it is possible to detect whether one picture has been painted over another, and also whether the artist has made alterations—such alterations indicating that the picture is genuine, and is not a copy or a replica. The X-rays are also very useful in detecting repairs or, rather, in showing whether repainting covers extensive repairs and, therefore, cannot be safely removed. Magnified photographs of the brush-work are of great assistance in deciding whether a picture is by the master or by one of his school. Recent scientific research has also enabled additional methods to be discovered which are not yet sufficiently advanced for publication. Dealers and connoisseurs have been very slow to realise the valuable work that can be

done by means of scientific investigation, but, now that the public is beginning to realise the possibilities of scientific research in this direction, the time is coming when no important picture will be sold without a scientific report, and a scientific laboratory will be considered part of the necessary equipment of the national galleries of Europe.

THE Research Association of British Rubber and Tyre Manufacturers can be congratulated on the Library Catalogue, and the periodic Summary of Current Literature issued to its subscribing members. They give evidence of the most careful attention to type and lay-out—matters which are too often overlooked—and they are printed on excellent paper. Some idea of the growing perplexity of the problems confronting any particular industry can be gathered from the fact that this special library, which owes much to the enthusiasm of Dr. S. S. Pickles, chairman of the Library and Information Bureau Committee, now contains nearly two thousand volumes of books and British and foreign periodicals, and a larger collection of pamphlets. The Summary of Current Literature contains abstracts of papers under the following headings: planting, latex, raw-rubber (its preparation and properties, treatment and applications), gutta-percha, compounding ingredients, fibres and textiles, vulcanised rubber (including its various uses), general works processes and materials, machinery and appliances, organisation, commerce and statistics, chemistry and physics, English patents. Obviously the indexing, cataloguing, and abstracting of this varied material is a task of considerable magnitude, demanding for its proper performance special acquaintance with the needs of the industry, a knowledge of foreign languages, and a thorough grasp of the trend of modern research work. It is a costly undertaking, and beyond the resources of most individual firms. For this reason alone industrial research associations are an imperative necessity, particularly to small concerns, which unfortunately are usually the last to appreciate the worth of co-operative research activities.

THE third triennial Empire Mining and Metallurgical Congress is to be held in South Africa in 1930, at the invitation of the Union Government. An executive committee has been appointed by the South African constituent institutions, and an attractive programme is in course of preparation. The Congress will commence in Cape Town on Monday, Mar. 24. A tentative itinerary has been arranged, which comprises visits to all the principal mining centres in the Union and Rhodesia, as well as places of scenic interest. There will be opportunities of visiting the diamond mines at Kimberley, the gold mines and works of the Witwatersrand, the gold, diamond, platinum, coal, asbestos, and copper mining districts in the Transvaal, and the Sabie Game Reserve. The Rhodesian tour will include the Victoria Falls, gold, copper, zinc, lead, asbestos, and coal mines, and the Zimbabwe Ruins. Members will also be enabled to visit the coalfields of Natal, as well as some of the beauty spots of that Province and the Port of Durban, returning to Cape Town by a circuitous route which will take in Bloemfontein, Port Elizabeth, Oudtshoorn (Cango Caves), and the Knysna Forest. Opportunities will also be afforded of visiting some of the more important industrial developments throughout the country. Sessions will probably be held in Cape Town, Kimberley, Johannesburg, Bulawayo, and Durban. The itinerary, as planned provisionally, will occupy 47 days, the whole distance being a little more than 7000 miles; special trains will be provided by the South African Railway Administration. It is hoped that the total inclusive cost of the tour in South Africa will not exceed £140. The secretary of the Congress is H. A. G. Jeffreys, 100 Fox Street, Johannesburg, Transvaal.

AT University College, London, on Nov. 16, Dr. W. Perrett gave a very interesting demonstration in support of his theory of the 'tierce-tone scale,' so called because each tone is divided into three parts. The apparatus used for the demonstration consisted of a set of tuning-forks, carefully tuned to the ordinary diatonic scale, supplemented by a second set of forks, also forming a diatonic scale, but a Greek semitone above the first set, the interval of the Greek semitone being 20/21. There were further five supplementary forks, introduced to give the scale of C minor. With this battery, Dr. Perrett showed that it is possible to form a harmonically correct common chord on any note of the scale, there being of course no tempering in the scale. The acceptability of the scale to the modern ear is a matter which can only be decided by experiment, but there is no doubt that to the ear of ancient Greece such intervals as 5 to 7, and 7 to 10, taken exactly, were grateful. Dr. Perrett announced that a keyboard instrument, which will enable compositions to be played with his scale, is now in course of manufacture. When completed it will obviously enable more satisfactory tests to be made than are possible with a tuning-fork battery. A further interest of the tierce-tone scale is that it may form a link between the music of the East and of the West, since intervals less than a semitone are generally used in the non-harmonic music of the East.

THE Rochdale Literary and Scientific Society celebrated its jubilee on Friday, Nov. 9. The Society was founded on Nov. 9, 1878, and has grown to be an important local institution for the promotion of scientific investigation. It was among the first to investigate, if not discover, the flint implements used by pre-historic man on the Pennines, and has contributed several fossils new to science to the British Museum. It first issued Herr Stolpe's English translation of "Ornamental Art of Savage People," which has just been reissued by the Swedish Academy Aktiebolagen Familijeboken. The Society has also made an exhaustive investigation of the Roman Road on Blackstone Edge, which the authorities have recently decided to schedule as a National Monument. Prior to the jubilee celebrations, the Society presented to Dr. J. R. Ashworth his portrait in oils, painted by the Hon. John Collier, in recognition of his forty-three years' honorary secretaryship of the Society.

THE Technological Museum of the Department of Public Instruction, New South Wales, is largely concerned with problems of economic importance to the State, in the departments of chemistry, zoology, and botany. The Annual Report for 1927, prepared by the recently appointed Curator, Mr. A. R. Penfold, shows that the scientific staff investigated, on the chemical side, essential oils and poisonous properties of Australian plants, dugong oil, and oil from the livers of sharks, as well as various substances fondly believed by the finders to be ambergris. The zoologist continued his work on the life-history of the king prawn, and on the sex-ratio of New South Wales commercial oysters (*Ostrea cucullata*), while the botanist carried out mechanical tests upon many timber samples, and studied the tanning properties of bark, particularly in connexion with wattle bark. The occupation of the staff in such scientific activities would appear to leave little opportunity for museum exhibition work, for apart from the rearrangement of certain of the art collections no reference is made to the public galleries, which were visited by 65,000 persons during the year.

THE council of the Geological Society of London announces the receipt of a generous gift of 10,000 dollars of Dominion of Canada 4½ per cent Bonds from Mr. J. B. Tyrrell, the well-known Canadian mining geologist, for the foundation of a fund, to be known as the J. B. Tyrrell Fund, the interest of which is to be devoted to the furtherance of knowledge of the geology of the Dominion of Canada among the geologists of Great Britain and Ireland. The first award from this fund will be made in February next, and applications are invited from British and Irish geologists who desire to visit the Dominion of Canada for the purpose of study or research, and require assistance in the payment of the necessary travelling and living expenses. The amount of the fund available for the award is £100. Details of the conditions governing the disbursement of the fund, and of the form of application required, can be obtained from the secretaries, Geological Society of London, Burlington House, Piccadilly, London, W.

THE issue of the *Physikalische Zeitschrift* for Sept. 1 contains a description by Dr. W. Meissner of the new low-temperature laboratory at the Reichsanstalt and its equipment. With the exception of a portion of the equipment provided by the Notgemeinschaft, the funds were provided by the German government. The ground floor plan is 100 ft. by 40 ft., the centre half being occupied by the machinery for liquefying gases, and the two ends by the machine shop and the laboratories respectively. Below part of the machinery room is a basement, and over the ground floor laboratories are laboratories on the first floor. The gas liquefaction plant is capable of producing 20 litres of liquid nitrogen, 10 litres of liquid hydrogen, and a small quantity of liquid helium per hour. With the help of the latter, observations at temperatures in the neighbourhood of 1·2° absolute have been made. Great precautions have been taken to avoid escape of hydrogen and sparking of electrical machinery, but in case of an explosion the doors are arranged to move bodily outwards and the roof to lift in one piece. Details are given of the liquefying plant, and it is stated that use of the facilities of the laboratory will be open under certain conditions to workers not on the laboratory staff.

A NOTEWORTHY commemoration of the tenth anniversary of the foundation of the Czechoslovak State, celebrated on Oct. 28, was the gift of Dr. Josef J. Frič's Žalov Observatory to the Charles' University of Prague. The observatory is at Žalov, near Ondřejov, 36 km. south-east of Prague. Two enthusiastic astronomers, Joseph and Jan Frič, established their own workshop in 1883 in Prague to enable them to build the observatory. After the premature death of the brother Jan in 1897, Joseph Frič alone undertook the great task of fitting up the observatory from his workshop, which has since developed into the well-known factory for the manufacture of surveying, astronomical, and polarising instruments. In memory of his deceased brother, Joseph Frič called the Observatory Hill 'Žalov' (the place of sorrow). The buildings consist of a studio, two domes, and four smaller observing houses situated in a beautiful park on the top of the hill among deep forests, in a country free from industrial works. It is equipped with an 8-inch Alvan Clark Refractor and other modern instruments, and contains a fine astronomical library with recent and ancient prints. This property, worth more than 3,000,000 Kč. (about £20,000), has been presented to the Faculty of Sciences of the Charles' University, to promote advanced research in astronomy.

OF the articles in the October number of the *Natural History Magazine*, the most outstanding is Dr. John Parkinson's account of the work of the British Museum East Africa Expedition, under the title "The Dinosaurs of Tendaguru." Other interesting, though less original articles, deal with the Bactrian camel, showers of fish, the fluorescence of minerals, and the control of locusts. The last paper deals more with the life history of these pests than with control proper, no mention, for example, being made of the elaborate systems of ditches, corrals, and traps recommended by the Agriculture Department of the Argentine Government, but it points out that ultimate effective control must have a biological sanction, and must be concentrated rather upon the breeding-grounds than upon actual migratory flights. The present number, the eighth in the series, concludes the first volume of the magazine, and a full index shows how varied has been the fare provided by the staff of the Natural History branch of the British Museum.

THE first part of a new publication, the *Bulletin of the Raffles Museum* (No. 1, Sept. 1928), Singapore, Straits Settlements, has come to hand. Hitherto this museum has had no journal of its own, and papers written by the staff and others on its collections have had to seek publication in the journals of various societies and institutions. The *Bulletin* will be issued as material becomes available, each part being complete in itself, and when sufficient parts are published they will form a volume. This first part is devoted to a paper by Dr. R. Hanitsch, dealing

with the Blattidæ of the Mentawi Islands: fifty-three species are enumerated, of which nineteen are new, together with one new genus. The paper consists of 44 pages, with two plates, and the part is sold at 60 cents, or 1*s.* 6*d.*, by the Museum.

SIR ARTHUR KEITH will deliver the Huxley Memorial Lecture of the Royal Anthropological Society in the lecture room of the Royal Society on Nov. 27 at 8.30 P.M., taking as his subject "The Evolution of the Human Races."

PROF. W. E. GIBBS, the newly appointed Ramsay professor of chemical engineering in the University of London, University College, will deliver a public inaugural lecture on Dec. 3, at 5.15 P.M., taking as his subject, "Chemical Engineering Education and Research in Great Britain."

MR. B. D. H. WATTERS, of the Physics Department, Middlesex Hospital, has been appointed science editor of the *British Journal of Actinotherapy*, recently vacated by Dr. L. T. M. Gray through pressure of business. Mr. Watters is associated with Prof. Sidney Russ at the Middlesex Hospital, and has contributed to the advance of actinotherapy and actinology in various directions.

BY direction of the Minister of Health, the Committee on Maternal Mortality has drawn up an inquiry form for the investigation of maternal deaths due to pregnancy or childbirth, to be used in such inquiries by medical officers of health, so that the data may be collected in a generally uniform manner. The form is now being issued, together with an explanatory note and a covering letter from the Ministry (*Circular* 934).

IN a notice of Mr. J. B. Scrivenor's volume, "The Geology of Malayan Ore-Deposits" (NATURE, Nov. 17, p. 767), it was remarked that some of the fundamental facts of Malayan geology are left in uncertainty. Such questions will no doubt be discussed in a volume on the general geology of Malaya which, we are informed, is being prepared by Mr. Scrivenor.

IN reviewing Burton's "The Water Supply of Towns and the Construction of Waterworks" (NATURE, Nov. 10, p. 721), reference was made to inclusion at the end of each volume of trade advertisements of firms specialising in water supply appliances. Mr. Dumbleton, editor of the new edition of the work, informs us that all negotiations in respect of advertisements were conducted entirely by the publishers. In the preface it is stated that where special products of individual manufacturers are mentioned, these are quoted as representing a type and are not recommended as preferable to any other similar products. Mr. Dumbleton says that, so far as he is concerned, this applies equally to advertisements.

A PARAGRAPH referring to the movement to establish a central museum in Twickenham was published in NATURE of Nov. 17, p. 781. Mr. C. Carus-Wilson, whose election as mayor of the borough will give much satisfaction to his many scientific friends, writes to correct one or two misapprehensions which may have been conveyed by our note. It appears that the meeting mentioned was not public, but a meeting of supporters of the scheme only, convened for the purpose of forming a committee to develop the museum pending its formal transference to the Corporation on completion. From the first, Mr. Carus-Wilson has only advocated the preservation of objects of local interest, and his experience of museums and museum work of many kinds should ensure that a collection of real scientific and educational value will eventually be established at Twickenham.

WE have received an interesting and well-illustrated little book of 25 pages, which gives many technical details concerning Imperial plates for process work (Imperial Dry Plate Co., Ltd., Cricklewood, N.W.2). Photomicrographs of half-tone dots show the superiority of these plates without any after-treatment even to wet collodion plates after the usual 'cutting' and intensification. The issue is free but the edition is strictly limited.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in agricultural biology at the Seale-Hayne Agricultural College—The Principal, Seale-Hayne Agricultural College, Newton Abbot (Dec. 1). A director of the laboratory for clinical investigations at the Manchester Royal Infirmary—The Registrar, The University, Manchester (Dec. 3). An assistant pathologist in the Pathological Department of the London School of Clinical Medicine, at the Dreadnought Hospital—The Secretary, Seamen's Hospital, Greenwich, S.E.10 (Dec. 4). An electrical engineer and a mechanical engineer as technical assistants at the Royal Arsenal, Woolwich—The Chief Superintendent of Ordnance Factories, Royal Arsenal, Woolwich, S.E.18 (Dec. 8). An agricultural engineer in the Burma Agricultural Department—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Dec. 14). A lecturer in physiology as applied to hygiene, at the London School of Hygiene and Tropical Medicine—The Secretary, London School of Hygiene and Tropical Medicine, Malet Street, W.C.1 (Dec. 20). A Geoffrey Duveen travelling studentship in oto-rhino-laryngology in the University of London (open to graduates of the University of London in medicine and surgery)—The Academic Registrar, University of London, South Kensington, S.W.7 (Dec. 31). A research officer in the Civil Veterinary department of the Government of India for research in connexion with the diseases of elephants, draught buffaloes and other domestic animals in Burma—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Jan. 31, 1929). A pathologist and bacteriologist at the Cumberland Infirmary, Carlisle.—The Secretary, Cumberland Infirmary, Carlisle. A cytologist in the genetics department of the Research Station at Trinidad of the Empire Cotton Growing Corporation—The Secretary, Empire Cotton Growing Corporation, Millbank House, 2 Wood Street, S.W.1. Two junior assistants under the directorate of ballistics research, Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18.

Research Items.

ROMAN BRITAIN.—The Ordnance Survey has published a second edition of the map of Roman Britain (Southampton: Ordnance Survey. Price 4*s*.), which contains a number of additions and differs in other respects from the first. Land between 50 and 100 feet is now indicated by a layer-colour, and submarine contours and hypsometric colouring are added. Regions of natural woodland have been restored on a geological basis. The area shown has also been enlarged. This has made it possible to show the Roman Wall in Scotland and the military remains of Strathmore. In addition to the towns and military camps, the map shows 'villas' and other large houses, villages, permanent settlements, as indicated by finds, and inhabited caves. An introductory note discusses the character and distribution of villas and their relation to native villages, which appear to be complementary to villas. They cluster, for example, on Salisbury Plain, where villas are almost entirely absent. Almost entirely agricultural, they are found among the Celtic fields revealed by air survey. The relative distribution of chalk downs and clay as shown, the latter being covered with woods, brings out the control of settlement by vegetation and the preference shown for the chalk in the distribution of villas along the North and South Downs, converging to the most extensive group on the Hampshire uplands. A comparison of the two editions of the map affords an index to the progress of research discovery in Roman Britain, especially to be marked in several important additions to our knowledge of the road system, the most noteworthy being the western road into Scotland from Carlisle by Birrens, Burnswark, and Annandale towards Clydesdale and the western end of the Scottish Wall.

A SOUTH INDIAN GAME.—In *Man* for November, Mrs. H. G. Durai describes a game known in Tamil as *pallanguli* or 'many holes.' It is played on a board which is sometimes beautifully carved, and in which are two parallel rows of holes, varying in number, but here taken as seven. The game is played with tamarind stones, pebbles, or cowrie shells as pieces. Two players take part, one sitting on each side of the board. Six pieces are placed in each hole. The player on one side takes up six pieces from one hole on his side and begins to play by placing one piece in each hole, proceeding round the board counter-clockwise. When all six pieces have been deposited, he picks up the pieces from the next hole and proceeds as before until he ends next to an empty hole. Then he captures all the pieces in the hole next the empty one, and his move ends. If he deposits his last piece in a hole next to two empty holes he captures nothing. The move then passes to the opponent. The round ends when all the pieces have been captured in the manner described, and the next begins by the players replacing their captured pieces in the holes, each on his side of the board, six at a time. If either player has not enough pieces to fill any one or more of the holes, a leaf or piece of rubbish is placed on this 'rubbish' hole, which may, however, be filled again at a later stage of the game by recaptured pieces. When in the course of play empty holes are refilled and the number of pieces reach the number four, this is known as *pasu*, a cow, and the pieces are taken by the player on whose side is the hole. The game ends when one of the players has not enough pieces to fill even one hole at the commencement of a round. In South India this is principally a women's game, but it is played by men for gambling purposes. It bears a close resemblance to games played in Africa. Mrs. Durai's note is illustrated by reproductions of *pallanguli* boards from both India and Ceylon, the Indian board of ivory, those from Ceylon of wood carved, one of them in the form of a fish.

DUTY AND INTEREST.—The inaugural lecture recently delivered at Oxford by Prof. H. A. Prichard in connexion with the White's chair of moral philosophy, and now published by the Clarendon Press, deals with the subject of 'duty and interest.' A careful analysis is made of the way in which philosophers have treated the question of whether we perform an act of duty for the sake of advantage, either our own or the community's, or for some other reason. The attitudes of Plato and Butler are followed by that of Green, who found himself confronted by those who were influenced by the growth of physical science, and contended that for a *theory* of ethics there should be substituted a *science* of ethics. In pointing out the line that Green should have taken against his opponents, Prof. Prichard maintains that our moral convictions imply for their explanation the prior existence of the corresponding capacity on our part, which only becomes actualised given the appropriate stimulus.

MORTALITY AMONGST HOUSE-SPARROWS.—In view of the importance of the house-sparrow as a pest in corn-fields and in gardens, any factor that makes for its increase or decrease is of economic interest. The extraordinary disappearance of this species in Fair Isle, and in the Shetlands, has been described by Rear-Admiral J. H. Stenhouse in a recent issue of the *Scottish Naturalist* (p. 162). Formerly, about eight hundred sparrows lived on Fair Isle, a small islet between the Orkney and Shetland Islands, made famous by the bird migration observations of Dr. Eagle Clarke and the author of this paper. In September 1926 the number had decreased to forty, by May 1927 it had fallen to ten breeding pairs, and in April 1928 only four pairs were to be seen. From the mainland of Shetland comes the same tale of disappearance. From Sumburgh in the extreme south, from Bressay and Mid Yell, in all of which sparrows were formerly abundant, reports have been received of the gradual or total extirpation of the species. The reports indicate that the mortality is due to some disease which is manifested in swollen heads and bulging eyes, but, so far, attempts to obtain specimens for pathological examination have been unsuccessful.

INVESTIGATION OF MUTILLID WASPS.—No. 143 of the *Bulletin of the United States National Museum* (1928) is a bulky publication of more than 350 pages with 5 plates, and its author, Mr. Clarence E. Mickel, of the University of Minnesota, has produced a monograph which should prove of great value to all students of the family. It is estimated that 3500-4000 species of these insects have now been described and they are included in about a hundred genera, but their true classification is still very obscure, and this is largely due to lack of knowledge of their biology. Part I of this *Bulletin* is devoted to a discussion of what is known concerning the habits of Mutillidæ. All the species are believed to be parasites, but the hosts of only 39 of them have so far been discovered. The most usual hosts are various bees and wasps, but in a few cases beetles of the genus *Clythra* or tsetse flies (*Glossina*) are utilised. The host appears to be attacked in the prepupal or pupal stage: the female Mutillid penetrates the cocoon or puparium, as the case may be, with its ovipositor and deposits an egg either on the host or on the inner wall of the cocoon. The young larva devours the host, becoming fully

grown in a few days, when it spins its cocoon within that of the host. Part 2 of the *Bulletin* consists of a reference catalogue of type species of the genera of Mutillidæ, and Part 3, which forms the greater bulk of this publication, is a revision of the North American species of the genus *Dasymutilla*. At the end there is a very complete bibliography of the whole family, including about six hundred references.

ALIMENTARY AND RESPIRATORY SYSTEMS OF *CALAMOICHTHYS*.—Mr. G. Leslie Purser (*Trans. R. Soc. Edin.*, vol. 56, pt. 1, No. 4; 1928) concludes his account of the alimentary and respiratory systems of the Ganoid *Calamoichthys calabaricus*. He remarks on the lack of unanimity with regard to the exact application of the names applied to the parts of the alimentary canal posterior to the pharynx, and suggests definitions of the main divisions of the canal as a contribution to a clearer and more exact nomenclature. The so-called stomach of *Calamoichthys* is only partially lined by a typical gastric mucosa, the remainder having a lining resembling that of the œsophagus. For a composite organ of this kind, partly œsophageal and partly gastric, he suggests the term œsogaster. In the same way the post-pyloric portion of the alimentary canal is termed simply the intestine, there being no histological differentiation into large and small intestines as in the tetrapod vertebrates. The author describes four types of cell in the intestinal lining, and comparisons with other lower vertebrates make it appear that *Calamoichthys* has a more complex mucosa than any of the others. This difference is attributed to the refinements of modern technique rather than to the absence of one or other of the cellular elements in other types, it being probable that these elements are present, but earlier workers, lacking modern facilities, have failed to recognise them. The musculature of the wall of the alimentary canal is less developed than in any other described lower vertebrate.

CONTROL OF CANADA THISTLE.—Canada thistle (*Cirsium arvense*) is reported as being effectively reduced by means of chlorates, under conditions in which other herbicides failed to effect a clearance (Åslander, *Jour. Agric. Res.*, **36**; 1928). The underground parts of the weed were killed by the application of 200 kgm. per hectare of sodium chlorate, or 250 kgm. potassium chlorate, used as dry salt on the ground during the winter. This dressing had no injurious effect on the oats sown during the next season. Spring applications were, however, less efficient in killing the thistles. The effectiveness of chlorates is due to their rapid penetration through soil and their slow rate of decomposition, especially at low temperatures. Other herbicides fail because they do not comply with one or both of these two conditions. Sodium thiocyanate decomposes too rapidly, sodium cyanide does not seem to penetrate the soil under field conditions, while sodium arsenite penetrates very slowly. The rate of penetration of the herbicides was determined by a specially constructed apparatus. Autumn applications of herbicides had no influence on the ammonification and nitrification processes in the soil during the following spring.

UNUSUAL FEATURES IN THE CYTOLOGY OF POLLEN.—From the description given by K. Piech (*Bull. Internat. de l'Acad. Polonaise des Sciences et des Lettres*. Ser. B, Sciences Nat. (Bot.) Jan. 1928) the development and gametogenesis in the pollen grain of *Scirpus* presents several unusual features. In the pollen mother cell at the close of the reduction and succeeding nuclear divisions, the usual four nuclei are present, but only one pollen grain is formed, and three of these nuclei degenerate and remain encapsuled in a 'callose-like' accumulation in the thickened wall. The generative nuclei develop in the pollen grain, and the first division to form the generative cell shows peculiar features in that in the anaphase, the phragmoplast, that characteristic appearance between the re-forming daughter nuclei which precedes the deposition of the new cell wall, becomes curved around the generative nucleus as a sort of spherical phragmoplast or 'phragmosphere.' In this way a generative cell is separated off *within* the cytoplasm of the pollen grain, and this remains separated from the rest of the pollen cell in later developmental stages by a special plasma layer. The generative cell also divides within the pollen grain to give rise either to two sperm cells (*Scirpus palustris* L.) or to two naked sperm nuclei (*S. lacustris* L.).

GEOLOGY OF THE HIGHLAND BORDER.—The rocks and structures along the Highland Boundary Fault, the northern limit of the Central Valley of Scotland, have given rise to some of the most fascinating problems of British geology. During the last few years Dr. D. A. Allan has been working the belt from Tayside to Noranside, and his results, beautifully illustrated and accompanied by a one-inch map of more than 130 square miles, are now published in the *Trans. Roy. Soc. Edin.*, vol. 51, Pt. 1, No. 3, 1928. A new exposure of the Highland Border Series has been mapped, and, though no fossils were detected, the rocks closely resemble lithologically the Jasper and Chert Series which elsewhere are known to be about Upper Cambrian. A careful re-investigation of the serpentine belt shows that visible junctions against the Lower Old Red Sandstone are everywhere fault planes. The serpentine intrusions clearly date from pre-Lower Old Red Sandstone times. The Lintrathen porphyry, previously thought to be an intrusion, is now found to be a lava-flow of typical dacite. On account of its widespread extension it is a valuable key horizon in mapping the Lower Old Red Sandstone. In subdividing the latter it has been found possible to employ the units of the classification adopted by Dr. R. Campbell in his work on the Old Red Sandstone in Kincardineshire. The Highland Boundary Fault is shown to be a steeply inclined reversed fault. It probably began as a monoclinal flexure slightly overfolded from the north-west; fracture took place along the more or less vertical limb of the fold, and the rocks to the north overrode those to the south, thus concealing part of the succession.

EROSIVE ACTION OF FLOOD WATER.—The bursting of the dams in the Porth-Llwyd valley, North Wales, in November 1925, gave opportunities for studying the effect on the topography of the erosive action of flood waters of a known volume. Prof. W. G. Fearnsides and Mr. W. H. Wilcockson deal with this subject in a paper in the *Geographical Journal* for November. A report on the subject was also presented to the British Association in 1927 by a committee appointed for the purpose. The flooding between the Llyn Eigiau reservoir and the Coed-ty dam was done by a maximum flow of 20 million cubic feet of water per hour in a channel never more than 5000 sq. ft. in sectional area. On slopes of less than 1 in 20 there was no appreciable erosion. On a slope of 1 in 15 the river entrenched its bed 10 or 12 ft. deeper into boulder clay, and trundled down its bed thousands of tons of boulders up to five tons in weight. Below Coed-ty dam the flow was for a time reinforced by 12 million cubic feet an hour, and the rate of flow increased to a maximum of 30 million cubic feet an hour. As the slope steepened to 1 in 8 and 1 in 6, the

only blocks which survived within the track were blocks larger than ten-foot cubes. On a slope of 1 in 4 to 1 in 2, every projecting block not *in situ* was rooted out and swept away.

TIME LAG IN THE PHOTOELECTRIC EFFECT.—According to an investigation described by E. O. Lawrence and J. W. Beams in the September number of the *Physical Review*, photoelectrons start to leave a potassium hydride surface less than 3×10^{-9} sec. after light starts to fall upon it. The delicate time control that was needed to establish this result was obtained by operating the different parts of an apparatus by means of electric pulses travelling away from a spark gap along wires, the disturbance reaching two successive places with a time interval equal to the difference in the wire paths to them, divided by the velocity of light. In this case, two of the wires passed to compensated electro-optic Kerr cells which were set up between crossed Nicol prisms, which served to produce a transitory flash of light lasting for about 10^{-8} sec., whilst a third lead controlled the potential of the active surface of the photoelectric cell which was exposed to the flash. It is a curious fact that the greatest source of trouble in these experiments was again the occurrence of high frequency oscillations, both in the photoelectric cell, which was a three-electrode device, and elsewhere. This investigation has incidentally demonstrated directly for the first time the extraordinary steepness of the front of the potential wave which is initiated by a spark, only about 5×10^{-9} sec. being taken for half of it to go past a point six metres along the wire.

A THERMAL PROPERTY OF MATTER.—In the *Rendiconti della Reale Accademia delle Scienze dell' Instituto di Bologna* for 1926 (recently received), Prof. Majorana describes experiments which, made with the object of obtaining evidence supporting his hypothesis of gravitational absorption, have revealed a curious thermal property of matter. Certain substances, in particular lead and iron, are found to be capable of exhibiting, in relation to the surrounding medium, thermal superelevations which depend on the previous treatment of the substance and are not in accord with the well-known laws of the progressive cooling of bodies. Use was made of a highly efficient thermostatic arrangement which admitted of the temperature being maintained constant to within about one-thousandth of a degree for a month or more. In a typical experiment, two pieces of lead, one of which had been fused just prior to the commencement of the experiment, whereas the other had not been melted for a considerable period, were cooled for an hour in the same running water and then introduced into two similar small cylindrical Dewar vessels. These were inserted in the thermostat, and the temperatures of the metals observed by means of sensitive constantan-copper or constantan-iron thermoelectric couples. A temperature difference between the two pieces of metal was revealed immediately, this becoming constant after two or three days, when the block recently fused had a temperature higher by 0·02° or 0·03° than that of the other. The difference in temperature gradually diminished in amount and, after the lapse of ten days or more, vanished completely. This phenomenon is regarded as due to a progressive emission of thermal energy by matter after being heated to any marked degree.

NEW ZEISS EPIDIASCOPE.—The increasing use of projection screen illustrations in class teaching and lecturing has been encouraged by the production of easily portable and moderately priced epidiascopes. These may be used not only for the projection of the ordinary lantern slide but also for illuminating and projecting upon the screen the image of an opaque object, and thus the necessity for making lantern slides is in many cases obviated. Several novel features which modern practice in the use and manufacture of projection apparatus has shown to be desirable are embodied in a new model, the Zeiss Ikon epidiascope. The silver-surfaced reversing mirror necessary for episcopic projection is totally enclosed in the lamp house, and is therefore protected from dust, and the possibility of its being damaged is diminished. The illumination is obtained from a specially designed 500-watt lamp. The size of the illuminated aperture is $6\frac{1}{2}$-in. square, and the stage, which is adjustable, permits of the accommodation of objects up to 3-in. thick. In order to obtain an image of sufficient brilliance upon the screen, a lens of a large working aperture is necessary, and the Zeiss Ikon instrument is fitted with an anastigmat of aperture F/3·7 and focal length $14\frac{1}{2}$ in. The position of the lamp and the condenser lens can be instantly changed, and the instrument used for lantern slide projection. A useful attachment, embodying a microscope objective of about $1\frac{1}{2}$-in. focus fitted with a heat-absorbing screen, may be fitted into the tube in place of the usual lantern objective. By its means microscopic slides can easily be projected, the slide being held in position by a pair of spring clips which form part of the attachment. The London distributors of Zeiss Ikon epidiascopes are Messrs. Sands, Hunter and Co., Ltd., 37 Bedford Street, Strand, W.C.2.

HEAT OF SOLUTION OF FINELY GROUND SODIUM CHLORIDE.—It was recently found by Lipsett, Johnson, and Maass, that finely divided sodium chloride had a heat of solution different from that of the coarsely ground salt. The finely divided salt was prepared by sublimation, and the difference in the heat of solution was attributed to the energy bound up in its surface. The results were used to calculate the surface energy of solid sodium chloride. In a further paper in the *Journal of the American Chemical Society* for October, the same authors describe the determination of the heat of solution of pure salt finely ground in an agate mortar. The results resemble those obtained with the sublimed product, and the finely ground material has a heat of solution smaller in magnitude by about 25 cal. per mole than that of coarsely ground sodium chloride.

PHOTOCHEMICAL OZONISATION.—In the *Journal of the American Chemical Society* for October the relation of photochemical ozonisation to the question of the polymerisation of oxygen is discussed by O. R. Wulf. The formation of ozone from oxygen under pressure by radiation of wave-lengths 2070 A. and 2530 A. has been studied quantitatively by Warburg, who concluded that the primary photochemical process is the dissociation of the O_2 molecule. A consideration of electronic levels indicates that radiation of either of these wave-lengths is probably incapable of effecting the dissociation of the O_2 molecule, and hence the resulting ozonisation appears to indicate the existence of another molecular species in the gas. The absorption of light by oxygen under high pressure and in the liquid state, and the work of G. N. Lewis on the magnetic susceptibility of oxygen under these conditions, indicate the presence of O_4 molecules to a considerable extent. It is therefore suggested that, at the wave-lengths used by Warburg, the absorbing molecule is O_4, which dissociates into O_3 and O, and his results are discussed from the point of view of this theory.

Records of Oceanographic Work in Japan.

UNDER this title the National Research Council of Japan has commenced the publication of a journal dealing with physical and chemical oceanography, fundamental marine biology, and fisheries technology. In the first number—March 1928—an account is given of the work done by the Imperial Marine Observatory and the Imperial Fisheries Institute, with well-equipped research vessels of 125 and 200 tons respectively, and of the new Marine Biological Station at Asamushi.

This station was completed in July 1924, with the aid of a government grant, as a marine station of Tôhoku University. It is now becoming a centre for the promotion of biological science in Japan.

Research workers and post-graduate students from other institutions are welcomed and provided with laboratory facilities to prosecute their own researches. In addition, living accommodation is obtainable either in a boarding house or in one of several residences attached to the station, the visiting investigator having only to defray the cost of meals. The list of papers which have already been published shows that the opportunities afforded have attracted workers on varied biological problems.

The buildings consist of an aquarium room with a number of tanks, a range of laboratories, including rooms equipped for physiological and biochemical research, while an additional large biochemical laboratory is now under construction. A unique feature of the station is a building half submerged in the sea at the shore line, the floor being about 6 feet below sea-level. Three aquaria along one wall are supplied with natural sea water, which is continuously being changed with the ebb and flow of the tide. Since the temperature and other conditions are quite similar to that of the open sea, animals can live under practically normal conditions.

The Japanese government is far-sighted in fostering biological research by providing these facilities in one of the most delightful summer resorts, so that the staff of their universities and other institutions may continue their researches during the summer vacations under pleasant conditions and without expense.

Investigations concerning the principles controlling life, such as are prosecuted every summer by visiting workers at marine biological stations, as Woods Hole in the United States, Plymouth in Great Britain, and elsewhere, are yielding results of widening interest. Thus the attention of physiologists is turning to the possibility of attacking many fundamental problems by experiments upon the tissues of simple marine animals—a method of attack which is leading towards the interpretation of the results of investigations which have hitherto been chiefly limited to land vertebrates. The great advances in knowledge which have increased the amenities of life during the past century, have usually arisen from such investigations of purely academic interest. To attract those relatively few individuals, usually engaged in teaching at the universities, who are capable and willing to carry out such original research during their vacations, is a worthy aim for any government, for thereby the community as a whole is likely to benefit—as it has benefitted already from the fruits of 'purely academic' research. Furthermore, it is economy, in the true sense of a much-used term, to utilise fully the resources of a country's scientific learning.

A list of papers and reports bearing on oceanography and published during 1927 shows that this subject is now receiving considerable attention in Japan, which is actively participating in the International Committee for the Oceanography of the Pacific, founded to carry out similar liaison work to the International Council in the North-Western Atlantic. Other countries taking part are the United States and Australia, where the building of a marine biological station is under consideration.

Surface Actions.[1]

G. I. FINCH AND J. C. STIMSON.—The electrical condition of hot surfaces during the adsorption of gases. Part 2. When a nickel sheet is heated *in vacuo* or in contact with a gas it becomes electrically charged. The magnitude of the charge depends upon the temperature of the metal and its previous history of heating. At 850° C. the charge due to O_2, $2CO + O_2$, $2H_2 + O_2$, CO_2, H_2O, H_2, A and N_2 could be removed within 45 minutes by evacuation to less than 10^{-5} mm. On the other hand, the carbonic oxide charge could only be removed by 'burning off' with oxygen. The charge on nickel oxide *in vacuo* is the same as that on reduced nickel. Oxygen or hydrogen is far more active in charging the surface than either argon or nitrogen.

It is concluded, *inter alia*, that (*a*) the charge on a hot metal surface in contact with a gas is due to an activation of adsorbed gas molecules; (*b*) there are at least five different kinds of adsorption of a gas on a hot surface, ranging from a purely physical, electrically neutral adsorption or condensation to a definite stable chemical compound formation which is likewise electrically neutral.

P. C. ALLEN AND C. N. HINSHELWOOD.—The catalytic decomposition of gaseous acetaldehyde at the surface of various metals. Experiments have previously been made to compare the kinetics of simple homogeneous reactions, such as the decomposition of nitrous oxide, with the corresponding catalysed reactions. In continuation, the catalytic decomposition of a more complex substance, acetaldehyde, the homogeneous decomposition of which is bimolecular, has been investigated. Electrically heated wires of gold, platinum, platinum-rhodium alloy and tungsten were used as catalysts.

The reaction at the surface of each of these metals involves two molecules of acetaldehyde, but for initial pressures of more than 150 mm. tends to appear unimolecular owing to the saturation of the surface with adsorbed molecules. The mechanism suggested for the reaction is that molecules from the gas phase react with molecules adsorbed on the surface, when these latter molecules acquire the necessary energy of activation from the metal atoms.

A remarkable and unusual similarity is found between the different metals in respect of (*a*) relation between reaction rate and pressure, (*b*) heat of activation, and (*c*) absolute rate of reaction. This would have suggested that the reaction really occurred in a zone of heated gas, were it not for the evidence that surface saturation controls the rate of reaction. The aldehyde adsorption is evidently of a loose, non-specific kind. The hot wire does not appreciably modify the stability of the adsorbed aldehyde molecules (the heat of activation being nearly the same as for the homogeneous reaction), but merely acts as

[1] Abstracts of papers read before the Royal Society on Nov. 1.

a source of energy. Examination of the molecular statistics of the reaction indicates that collisions between molecules from the gas and adsorbed molecules are inelastic, with a duration of 10^{-6} to 10^{-8} sec.

R. CHAPLIN.—The sorption of carbon tetrachloride at low pressures by activated charcoals. A detailed description is given of the apparatus and experimental technique by means of which the low-pressure sorption isothermals of pure carbon tetrachloride vapour on charcoal, in the absence of foreign gases, were determined. The pressures were measured by means of a Pirani hot-wire gauge; the quantities sorbed were determined by direct weighing. Various difficulties were encountered, due to the presence of traces of foreign gases and vapours in the charcoals and in the apparatus. Six charcoals of varying origin were employed. The pressure limits worked between were $2{\cdot}3 \times 10^{-1}$ and 1×10^{-4} mm. of mercury. Most work was done at 25° C., but several series of isosteres were also obtained, which permitted of the indirect determination of isothermals at higher temperatures.

Stream-flow.[1]

H. LEVY AND A. G. FORSDYKE.—The steady motion and stability of a helical vortex. The characteristics of a right helical vortex are investigated as regards steady motion and stability. The steady forward motion along, and uniform rotation about, the axis is calculated for various angles of pitch; a critical pitch exists, at which this rotation vanishes. An examination of the possible fundamental modes of vibration of the filament suggests further that this critical pitch marks the division between stable and unstable helices. The results are of importance in connexion with the extension of the Kármán vortex street to three-dimensional motion.

R. J. CORNISH.—Flow in a pipe of rectangular cross-section. The paper contains the results of an investigation into the flow of water in a pipe of rectangular cross-section 1·192 cm. by 0·402 cm.

In the region of laminar motion the flow corresponded closely with that expected by calculation. The effect of the distance between the entrance to the pipe and the point at which pressures are measured is shown, and later in the paper is a note on the conclusions of Messrs. Davies and White (*Proc. Roy. Soc.*, May 1928) from their observations of this effect. The critical value of mS/v (where m = hydraulic mean depth, S = average velocity, v = kinematic viscosity) is about the same for the rectangular section as for a circular section; the effect of the proportions of the channel on the critical value is deduced. In the region of turbulent flow the curve obtained by plotting $R/\rho S^2$ (where R = resistance per unit area, ρ = density) against mS/v is approximately the same as that obtained by other workers on pipes of various sections.

Appendix 1 gives the actual numerical results of the experiments, and appendix 2 contains an outline of the mathematical solution of laminar flow in a pipe of rectangular section.

A. T. DOODSON.—The analysis and prediction of tidal currents from observations of times of slack water. The problem of obtaining harmonic constants for the principal tidal constituents representing the current flow, from a knowledge of the times of slack water only, has been solved. The solution is not one of great exactness, but resulting predictions have been considered sufficiently accurate to be included in standard tide tables. The times of maximum current can be predicted, but the velocities of maximum currents can only be stated on an arbitrary scale unless a few values of maximum currents have been observed.

[1] Abstracts of papers read before the Royal Society on Nov. 1.

The method can be applied to obtain fairly good approximations to the tidal elevation at a place, for the times of high and low water, or for the times of half-tide. Two variations of the method are given, one being suitable for the discussion of observations of all slack water times during a month and the other being suitable for the analysis of observations taken during daylight for a whole year.

University and Educational Intelligence.

CAMBRIDGE.—Prof. Dean, Trinity Hall, Mr. J. F. Cameron, Gonville and Caius College, and Mr. H. Thirkill, Clare College, are among the newly elected members of the Council of the Senate. Mr. T. R. Parrington, Sidney Sussex College, has been appointed Strickland Curator in the Museum of Zoology.

The Gedge Prize for research in physiology has been awarded to Dr. W. A. H. Rushton, Pembroke College. Mr. F. H. Woodward has been elected to a fellowship at Selwyn College. A grant of £50 has been made from the Balfour Fund to Dr. S. M. Manton, Girton College, for research on the biology and development of the Syncarida.

Mr. F. J. M. Stratton, fellow and senior tutor of Gonville and Caius College, has been elected to succeed Prof. H. F. Newall in December next as professor of astrophysics.

THE following free public lectures in connexion with the Armourers and Brasiers' Company are announced: "Certain Aspects of the Solidification of Metals and Alloys," by Dr. S. W. Smith, at the Sir John Cass Technical Institute, on Nov. 28, Dec. 5 and 12, at 8.15; and "The Manufacture of Tinplate," by Dr. C. A. Edwards, at the Borough Polytechnic Institute, on Nov. 29, Dec. 7 and 14, at 5.30. No tickets will be required.

EDUCATION in India in 1925–26 is dealt with very briefly in a report issued by the Educational Commissioner with the Government of India last May. The report shows that the percentage of males under instruction in recognised institutions, although still small (6·5) increased rapidly during the ten years following 1916, when it was only 4·7. During the same period the percentage of females under instruction increased even more rapidly, namely, from 0·9 to 1·3. The cost of education is rising fast, the expenditure in 1925–26 having been 10 per cent higher than in the preceding year. Under the heading of higher education, universities show a slight decrease in the number of students, arts colleges an increase of 8 per cent, and professional colleges an increase of 3 per cent. There was a falling off in the numbers of medical, veterinary, forest, and commercial college students and of men students in teacher-training institutions. The scheme for founding a university in Rajputana was abandoned owing to the lack of support from the Native States. The report refers to the constitution of a new affiliating university at Agra, and another (the Andhra or Telugu) at Bezwada, and a project for establishing a Tamil university. Statistics of university students show a total of 96,158 in 16 universities. Calcutta, with 31,496 students, must be almost, if not quite, the largest, in point of numbers, in the world. Seventy-five per cent of the total number of students enrolled belonged to the four universities of Calcutta, Madras, the Punjab, and Bombay. An article on Indian students in Great Britain shows a notable decrease from 583 in 1925 to 390 in 1926 in the number of Indians studying in the Inns of Court. Nearly 200 were preparing for degrees or diplomas in engineering, and more than 100 were studying medicine; 147 (including 21 women) were government scholars.

Calendar of Customs and Festivals.

November 25.

St. Katharine: saint and martyr, next to the Virgin Mary the most celebrated of female figures in Christian hagiology. She was martyred at Alexandria under Maximius after this emperor had commanded a company of the ablest of heathen philosophers to dispute with her. These she converted, and they too suffered martyrdom. She was bound upon an ingeniously contrived engine of four wheels set with spikes intended to tear her to pieces when they moved, but the cords were broken asunder by the power of an angel. Hence St. Catherine's wheel and her patronage of those who use the wheel for spinning, rope spinners, and spinsters. She is also the patroness of Christian philosophers.

Though the cult was introduced late into England —in the twelfth or thirteenth century, it is thought by the Crusaders—in a short time it became widely popular. On St. Katharine's eve, Strype records, "The 24th (1556), . . . at six of the clock at night St. Katharine went about the battlements of St. Paul's Church accompanied with fine singing and great lights; this was St. Katharine's procession."

St. Katharine was especially the patroness of spinsters, hence the proverbial expression of *coiffer Ste. Catherine* to express the state of an 'old maid.' It was customary for young women to gather together for merrymaking on this day, the special form of entertainment being divination of their future state in regard to wedlock. This custom was known as 'Kathar'ning.' One charm consisted in a number of young women, not exceeding seven nor less than three, assembling in a room at eleven o'clock at night. A sprig of myrtle which had been borne in the bosom all day was wrapped in paper, and then each girl burnt nine hairs from her head, the parings of toe and finger nails, with myrrh and frankincense on a brazier of charcoal. The myrtle was fumigated over the charcoal and then placed under the head of the inquirer as she went to bed on the clock striking twelve. She dreamed of her future husband. In Ireland women used to fast all the year round on Wednesday and Saturday and on St. Katharine's day. This got them good husbands or, if they were married, a better one.

For the survival of the custom of 'Catterning' among children in the Midlands, *see* under St. Clement (Nov. 23). At Worcester Cathedral the chapter prepared a rich bowl of wine and spices, called the 'Cathern bowl,' for the inhabitants of the college and precincts. At Peterborough the tallest of the female children in the workhouse was selected as queen and adorned with crown and sceptre. Then all the children, dressed in white with scarlet ribbons, went in procession around the city, stopping at the principal residences and reciting verses in honour of St. Katharine.

St. Katharine was specially honoured by the lace-makers in Northamptonshire and Bedfordshire. In Buckinghamshire on 'Cattern Day,' the lace-makers held merrymakings, at which cakes called 'wigs'—a kind of light gingerbread with curled edges—and ale were consumed. The rope-makers of Woolwich Arsenal had a procession very similar to that of the smiths on St. Clement's two days previously, in which a female represented 'Her Majesty,' dressed in white, with sceptre and crown and Roman banner. The carpenters of Chatteris in Cambridgeshire held a feast on St. Katharine's day, while the carters of the Isle of Thanet used to place a small figure on a wheel on the front of their cart sheds on this day.

The importance of nuts, and more particularly of apples, as articles of diet in earlier days may be gauged from their prominence in the survivals of the customs of Hallowmas, St. Clement, and St. Katharine, and also in certain municipal customs. A feature of the 'Lawless Hour' at Kidderminster (*see* Oct. 1) was the showering of apples on the bailiff from each house he visited. At Newcastle-under-Lyme the election of Mayor on the Tuesday after Michaelmas Day (later moved to the Tuesday after Nov. 9) was accompanied by the custom of 'clouting out,' when boys visited the tradespeople in the expectation of receiving nuts and apples, for which they scrambled. The apples collected at 'souling' on Nov. 1 or Nov. 2 were used in various forms of divination and for games. They were also required for the making of 'lamb's-wool,' a bowl of hot spiced ale and roasted apples. The custom of hanging apples on strings or placing them in bowls of water and catching them with the teeth—'bobbing'—a game played on all these festival days—was responsible for the name Bob Apple Day or Bite Apple Day applied in Staffordshire to St. Clement's Day. Sometimes they were roasted on a string before the fire, stuck thickly over with cloves and allowed to fall into a vessel beneath, while set verses in honour of "Catt'n and Clement" were sung. Another method of preparation was to use oats instead of cloves, afterwards spitting the apples on a wooden skewer and dredging them over with flour.

November 30.

St. Andrew, the Apostle martyred A.D. 69 at Patræ in Achaia on a cross in the form known as decussate, *i.e.* X, which hence became his emblem. Relics of the saint were brought to Scotland in 369 and deposited at the spot where St. Andrews now stands. The saint became the patron of Scotland and of the Knights of the Golden Fleece, as well as titular saint of Russia.

The close relation of St. Andrew's Day to the beginning of Advent, a period in the Church of fast and solemn observance, marks it as a time appropriate for divination. Martin Luther refers to the custom in his country of young maidens stripping themselves naked and reciting a prayer addressed to St. Andrew in order to learn what kind of husbands they should have, and from other references the custom appears to have been widespread. The injunction of nudity as part of the ritual points to an early stratum of belief, as it is often an essential element in magic rites of a very primitive character.

It is recorded that singed sheep's heads used to be borne in procession before Scots in London on St. Andrew's Day—a custom which may be connected with the Martinmas sacrifice and slaughter of cattle and sheep. In the "Statistical Account of Scotland," it is stated that citizens of Edinburgh used to resort to Duddingston, near that city, to feast on singed sheep's heads, which were thus disposed of after the sheep from the neighbouring hills had been slaughtered and the carcases sent to market. Though a summer custom without reference to Martinmas, that feast may possibly have been the origin of the practice.

Although St. Katharine as the patron of spinners was honoured by the lace-makers of Northamptonshire, they specially regarded St. Andrew and celebrated him in a festival to which the name 'Tandrew' or 'Tander' was given. The connexion has been conjectured to be due to the forms assumed by threads in the making of pillow-lace. The day was given up to drinking and merrymaking, and in the schools 'barring out' the master. In the evening men paraded in women's clothes and the women in those of men. Visits were paid from cottage to cottage to drink 'eldern wine,' and mumming followed.

Societies and Academies.

LONDON.

Royal Society, Nov. 15.—S. W. J. Smith, A. A. Dee, and J. Young: The mode of formation of Neumann bands. (1) The mechanism of twinning in the body-centred cubic lattice. A discussion of atomic movements which can occur, under the influence of transient shearing stress, in a single crystal possessing a body-centred cubic lattice. (2) The evidence that the bands are twins. The orientation of these lamellæ with respect to the matrix is determined quantitatively by means of etch-figures. (3) The movement from which the twinning results. A study of the phenomena which accompany the crossing of one band by another shows that the movement is of the kind indicated as most likely in (1).—C. F. Elam: An investigation of some banded structures in metal. With an appendix by G. I. Taylor. Crystals showing a banded structure similar to twins of the spinel type were found in aluminium and silver. The crystallographic relationship has been studied.—F. H. Rolt and H. Barrell: The difference between the mechanical and optical lengths of a steel end-gauge. A set of block gauges is optically measured by an interference method. By comparing the sum of the optical lengths with the optical length of a wrung combination of the same gauges, the average difference between mechanical and optical length of a gauge may be derived. It may be calculated for all wave-lengths greater than $0{\cdot}55\mu$, by the formula $(M-O)=p\lambda+t'$ where $p=0{\cdot}27$, $t'=0{\cdot}005\mu$, and λ is in microns. For light of wave-length $0{\cdot}62\mu$, $(M-O)$ is $6{\cdot}8\times10^{-6}$ inch.—D. A. Jackson: Hyperfine structure in the arc spectrum of cæsium and nuclear rotation. The most satisfactory method of excitation is by external electrodes, using a very high-frequency alternating current, on a tube filled with helium at about 2 mm. pressure containing a small quantity of cæsium. Lines belonging to principal series are very close doublets with nearly constant frequency differences; their origin can be explained by assuming a nuclear spin of one-half quantum.—A. Fowler and E. W. H. Selwyn: Further investigations of the spectrum of singly ionised carbon (C II).—O. W. Richardson and F. C. Chalklin: The soft X-ray levels of iron, cobalt, nickel, and copper. All the well-established soft X-ray inflections for iron above 48 volts, as well as two below, have been accounted for. A similar scheme applies about equally well to cobalt and nickel, and possibly, but not so well, to copper.—H. Jeffreys: On aerofoils of small thickness. Existing methods of determining the flow around an aerofoil of infinitesimal thickness and the forces on such an aerofoil have been extended to cover the general case where the thickness and camber are both small but neither of them negligible.—G. I. Taylor and C. F. Sharman: A mechanical method for solving problems of flow in compressible fluids. An analogy between the irrotational flow in two dimensions of a fluid of variable density and the flow of electricity in a conducting sheet of variable thickness is developed. A shallow tank with a bottom of paraffin wax holds a shallow layer of copper sulphate solution serving as a conducting sheet. Any given distribution of thickness could be obtained by cutting the wax bottom. Applying the method to the flow of air past a circular cylinder, it appears that when the speed of the cylinder is as much as half that of round, the flow past it cannot be irrotational.—A. S. Eddington: A symmetrical treatment of the wave equation. Dirac's linear wave equation represents one special choice of matrices. Much of the general theory is obtained more simply and symmetrically by employing only commutative and other general properties of a 'perpendicular' set. An apparently more fundamental way of reaching the wave equation is to take the observed invariance of proper-mass of electron. This new wave equation corresponds to two electrons with opposite spin.—T. H. Havelock: The wave pattern of a doublet in a stream.—A. T. Price: A mathematical discussion on the structure of wood in relation to its elastic properties. The observed elastic anisotropy of wood can be explained in detail by the fact that wood is built up of long hollow cylinders, of which the majority are arranged parallel to the grain and the remainder are grouped into bundles extending radially. The annual layers appear to have little influence on this elastic anisotropy. The non-elastic slipping at stresses much lower than those usually associated with elastic failure, observed in tests involving longitudinal shearing, possibly occurs between thick-walled cells and between medullary rays and adjacent cells, and also as gross slip in the layers of weak spring-wood tissue.—E. J. Williams, J. M. Nuttall, and H. S. Barlow: The special distribution of photoelectrons produced by X-rays. The photoelectron emission from oxygen and nitrogen due to absorption of X-rays of wave-length 0·54, 0·61, and 0·71 A. respectively, as observed by the Wilson cloud-expansion method, shows: (1) Spread or dispersion of the photoelectrons may be satisfactorily represented by the $\cos^2\theta$ law, and (2) longitudinal asymmetry, if distribution corresponds to an average forward momentum of photoelectrons, about 40 per cent greater than that of an absorbed quantum.—L. W. Nordheim: The effect of the image force on the emission and reflection of electrons by metals. In thermionic emission the average reflection amounts only to a few per cent. For the intense field emission the image force reduces the value of the field strength calculated by Fowler and Nordheim by a factor about 0·8.—W. G. Kannuluik and T. H. Laby: The thermal and electrical conductivity of copper crystals at various temperatures. Thermal conductivity of copper is 0·989 cal. cm. sec. deg. at 19·4° C., 1·054 at −73·7° C., and 1·131 at −174·8° C. At 19·4° C. it is about 4 per cent greater than that of polycrystal copper, while at the lower temperatures it is considerably less. Electrical conductivity of single crystal is the same as that for ordinary polycrystal.—H. D. H. Drane: Elastic constants of fused quartz. Change of Young's modulus with temperature. The modulus increases continuously with rise in temperature between −183° and 700° C., showing no minimum value which would correspond to the minimum volume exhibited by fused quartz at −80° C. For a given increment of temperature the increase in modulus is more rapid at lower temperatures. Differing samples of quartz show slight variations in behaviour, and semi-permanent changes in the modulus at room temperature have been observed after heating above 400° C., due to fact that fused quartz is not ordinarily a single phase of silica.

(*To be continued.*)

Linnean Society, Nov. 1.—V. S. Summerhayes: Revision of the Australian species of *Frankenia*. Among the most important characters for taxonomic purposes are the arrangement and number of ovules, and the nature of the leaves. Niedenzu divided the genus into two subgenera—*Afra* and *Oceania*—and the latter, containing the Australian species, into the sections *Toichogonia* and *Basigonia*, but a series of ovular arrangements leading insensibly from *Toichogonia* to *Basigonia* has been found. The genus *Frankenia* actually seems to be composed of a number of parallel evolutionary series progressing from the

'toichogonial' to the 'basigonial' stage. The genus seems to be an ancient one, which in Australia has found favourable conditions, producing many species there. Western Australia appears to be the original home of the genus in the continent.—**Helene E. Bargmann**: Morphology of the central nervous system in the Gastropoda Pulmonata. There are eight types into which the Pulmonate nervous system can be divided, according to the degree and mode of concentration of the visceral ganglia. Variation in the type of nervous system takes place within families and within genera, but variation within species is slight and not enough to affect the combination of the ganglia as a whole. Grouping based on the nervous system, compared with groupings based on systematic classification, shows that affinities are by no means well understood.—**T. L. Prankerd**: Specificity in graviperception. Upwards of 2000 experiments have been made on the fronds of seven species of ferns in order to determine quantitatively their reaction to gravity at different stages in their ontogeny. The results are expressed as curves, termed *graviscripts*, which naturally fall into two groups corresponding to the two genera—*Asplenium* and *Osmunda*—into which these species have long been grouped on morphological grounds. Response to stimulus thus affords criteria of taxonomic value. *Osmunda cinnamomea*, which will under certain conditions respond to a stimulus lasting only twenty seconds, is the most sensitive plant to the force of gravity known.

Society of Public Analysts, Nov. 7.—**Julius Grant**: The determination of small quantities of antimony in the form of stibine. An improved form of apparatus of the electrolytic Marsh type is described, by the use of which antimony is completely and rapidly removed from its solution in 0·5 *N* hydrochloric acid, in the form of stibine, by means of a swift stream of hydrogen bubbles impinging on the point of an inverted cone lead cathode. Small quantities of antimony (10 to 0·001 mgm.) have thus been determined in alloys, ores, rubber, etc., in the presence of other metals.—**E. Lester Smith**: The determination of unsaponifiable matter in oils and fats. In most methods the extraction of unsaponifiable matter is incomplete (80 to 98 per cent), and hydrolysis of dissolved soap while washing the ethereal extract may result in fatty acid being weighed with the unsaponifiable matter. Two methods in which these errors are avoided are described.—**Paul Arup**: The composition of Irish butter. There is no marked tendency for the volatile acids to be associated with oleic groups in preference to the stearic and palmitic groups; the acid groups seem to be impartially distributed among the different glycerides.—**H. B. Dunnicliff**: The volumeric determination of mercury. The method is based on the reduction of mercuric chloride solution by means of stannous chloride in the presence of sodium tartrate in an atmosphere of carbon dioxide.

PARIS.

Academy of Sciences, Oct. 1.—**G. Bigourdan**: The coordinates of the Observatory of the rue de Paradis. Deduced from data in notes by Delambre.—**G. Charpy** and **P. Pingault**: The conditions of formation of cementite. The carburation of solid iron by potassium cyanide or by hydrocarbons tends to form cementite, at least for temperatures up to 1000° C.—**Georges Claude**: The production of power by steam passing between two masses of water.—**Serge Bernstein**: The growth of polynomials.—**E. Huguenard, A. Magnan**, and **A. Sainte-Laguë**: An experimental determination of the polar of an aeroplane and of a bird in flight.—**Léon** and **Eugène Bloch**: The spark spectra of selenium and tellurium: The use of the oscillating electrodeless discharge separates clearly the spark lines of the first order of sulphur and selenium from those of higher order. The same method has also been applied to tellurium.—**André Job** and **Jean Rouvillois**: The preparation of a tungsten carbonyl through the intermediary of an organo-magnesium compound. Carbon monoxide is absorbed by a mixture of tungsten hexachloride and phenyl magnesium bromide. Crystals of tungsten carbonyl, of the composition $W(CO)_6$, can be isolated from the products of the reaction.—**Mlle. L. Remy**: The influence of the fertilised ovule on the tissues of the fruit.—**A. Guichard**: The origin, direction, and torsion of the inverse fibro-vascular bundles of *Claudium Mariscus*.—**Rodolphe Dostál**: The reproductive organs of *Caulerpa prolifera*.—**A. Guillaumin**: The storage of seeds in a medium deprived of oxygen as a means of prolonging their germinating faculty. It has been proved in a previous communication that seeds kept in a good vacuum retain their germinating power longer than when exposed to the air. It is now shown that an atmosphere free from oxygen has a similar effect in prolonging the vitality of seeds.—**Wünschendorff** and **Ch. Kilian**: Observations on the metabolism of *Ustulina vulgaris*. The cultures contain ammonia, amino-acids, urea, and creatinine, but neither indol, aldehydes, nor acetone. In the presence of carbohydrates, acids (oxalic, lactic, citric, malic) are formed.—**J. Bordas** and **P. H. Joesse**: The reducing action exercised by fungi of the genera *Fusarium* and *Verticillium*, parasites of the wood vessels.

LENINGRAD.

Academy of Sciences. *Comptes rendus*, Nos. 20-21.—**F. Loewinson-Lessing**: What is dunite? Two types of dunite must be distinguished: dunites, strictly speaking, which are olivines, or olivine-serpentines with chromite; and enstatitic dunites, in which there is more than 5 and up to 25 per cent of enstatite.—**G. Vereschagin**: Preliminary consideration on the origin of the Baikal fauna. Up to 1925 there were recorded from Lake Baikal 725 species of plants and animals, but recent expeditions of the Academy added more than 600 forms, including more than 300 belonging to new species, genera, and even families. Geological evidence tends to show that the greatest depths of the lake developed probably only in the Quaternary period, and this is corroborated by the fact that all deep-water animals of the lake are closely allied to those living nearer the surface and are little specialised. Faunistic elements in the lake are as follows: widely distributed Siberian forms; ancient fresh-water forms dating back probably to the Tertiary period; marine forms, which must be regarded as relics of the former connexion with the ocean; and forms of uncertain origin.—**N. T. Fedorov**: An adjustment of Glan's spectrophotometer for investigations in physiological optics.—**V. Emelin** and **G. Zeiss**: The control of trypanosome infection in camels in Russia. The trypanosomiasis of camels is widely distributed in Russia, and two species of trypanosomes have been recorded in connexion with it, namely, *Trypanosoma ninæ* Kohl-Jakimova and *T. su-auru* Ilovajski. Bayer's preparation 207 proved to be effective against all species of trypanosomes. Blood-sucking flies (*Tabanus*, *Chrysops*, and *Hæmatopota*) are considered as mechanical carriers of the trypanosomes.—**M. Serebrennikov**: A synopsis of Russian squirrels. There are ten subspecies of *Sciurus vulgaris* L. and one subspecies of *S. anomalus* Gm. in the Russian fauna. Short diagnoses and the distributions of all of them are given.—**N. M. Kulagin**: Contribution to

the study of moulting in the White Sea seal (*Histriophoca grœnlandica* Lepechin). Histological study of hairs and the epidermis of moulting seals.—**N. Kusnezov**: *Oligamatites martynovi*, gen. et sp. n., a fossil Amatid Lepidopteron from the Oligocene beds of Central Asia. Re-examination of original descriptions of all reputed fossil Noctuids leads to the conclusion that they are all based on very doubtful examples; thus, the insect described in the present paper is the first unquestionable fossil Noctuid known, and also one of the very few incontestable fossils of the order Lepidoptera. The first authentic Lepidoptera are found not earlier than in the lower Tertiary, and the representative of the family Amatidæ described also belongs to that epoch, although the family is unanimously recognised as one of the most specialised ones.—**A. Vasiliiev**: The accuracy of triangulations in the Spitsbergen meridian measurements.—**Z. Nemova**: Determination of minerals in the *volkanic tchernozem* of the volcanic lava fields in Armenia. Mineralogical analysis of volcanic black soils of Armenia.—**M. Neibourg**: The materials collected by the Ashutas expedition of the Geological Museum of the Academy. The expedition to the Ashutas Mountains at the Mongolian border brought back more than seventy species of fossil plants, 14 species of fossil insects and other palæontological material.—**A. Formozov**: The desert elements in the fauna of South-Eastern Europe. Many species of animals belonging to the Aralo-Caspian desert fauna are distributed westwards from the Volga and reach northern Caucasus, while many of them extend even farther westwards. Numerous examples are given, and it is suggested that detailed studies of the fauna of xerothermic habitats in South-West Russia will increase their number.

Official Publications Received.

BRITISH.

Melbourne Observatory. Hourly Values of the Magnetic Elements at Toolangi, in 1926. Observed and reduced under the direction of Dr. J. M. Baldwin. Pp. vii+41. (Melbourne: H. J. Green.)

The Victorian Bush Nursing Association. Report and Statement of Accounts to 30th June 1928. Pp. 221. (Melbourne.)

Records of the Geological Survey of India. Vol. 61, Part 2. Pp. 147-206+plates 2-20. (Calcutta: Government of India Central Publication Branch.) 2.12 rupees; 5*s*.

Echinoderma of the Indian Museum, Part 10. An Account of the Echinoidea. By Prof. René Kœhler. 3: Échinides réguliers. Pp. 158+27 planches. (Calcutta: Zoological Survey of India.) 25 rupees.

Memoirs of the Indian Museum. Index, Vol. 8, 1924–1928. Pp. iv+xvi. 10 annas; 1*s*. Vol. 9, No. 1. Pp. 27+4 plates. 2 rupees; 3*s*. 6*d*. (Calcutta: Zoological Survey of India.)

Records of the Indian Museum. Vol. 29, Appendix: List of Literature referring to Indian Zoology (excluding Insecta) received in Calcutta during the Year 1927. Pp. xix. 1 rupee. Vol. 30, Part 1, April. Pp. 145+3 plates. 2.12 rupees; 5*s*. Vol. 30, Part 2, July. Pp. 147-215+plates 4-7. 2.12 rupees; 5*s*. (Calcutta: Zoological Survey of India.)

Colony of the Gambia. The Annual Report of the Department of Agriculture for the Year 1927–8. Pp. 54. (London: The Crown Agents for the Colonies.) 5*s*.

The British Mycological Society. Transactions. Edited by Carleton Rea and J. Ramsbottom. Vol. 13, Parts 3 and 4. Pp. 145-351. (Cambridge: At the University Press.) 15*s*.

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1927. Part 2. Pp. iv+110+4 plates. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

Proceedings of the Cambridge Philosophical Society. Vol. 24, Part 4. Pp. 471-609+viii. (Cambridge: At the University Press.) 7*s*. 6*d*. net.

The Association of Special Libraries and Information Bureaux. Report of Proceedings of the Fifth Conference held at New College, Oxford, September 14th-17th, 1928. Pp. 136. (London.) 5*s*.

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 9: A Synthesis of 5:7:2′:4′-Tetrahydroxyflavone and of 7:2′:4′:6′-Tetrahydroxyflavone. By Dr. Nicholas Michael Cullinane, Dr. Joseph Algar and Dr. Hugh Ryan. Pp. 77-83. 6*d*. Vol. 19 (N.S.), No. 10: The Estimation of Diphenylamine and Diphenylnitrosamine in the Presence of their Derivatives. By Dr. H. Ryan, Dr. J. Keane and J. Dunne. Pp. 85-100. 1*s*. Vol. 19 (N.S.), No. 12: The Commercial Utilisation of Java Citronella Oil. By Dr. Brendon O'Donoghue, James Drum and Dr. Hugh Ryan. Pp. 113-120. 6*d*. Vol. 19 (N.S.), No. 13: The Action of Alcoholic Hydrochloric Acid on Methyldiphenyltetrahydropyrone. By Dr. Hugh Ryan and Dr. J. J. Lennon. Pp. 121-124. 6*d*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Journal of the Chemical Society: containing Papers communicated to the Society. October. Pp. iii+2631-2829+x. (London: Gurney and Jackson.)

India Meteorological Department. Catalogue of Exhibits displayed at the Opening of the New Headquarters Office at Poona on 20th July 1928, together with an Introductory Note on the Work of the Department. Pp. 16. (Poona.)

Report on the Administration of the Meteorological Department of the Government of India in 1927–28. Pp. 14+4 plates. (Simla: Government of India Press.)

Battersea Polytechnic, London, S.W.11. Report of the Principal for the Session 1927–28. Pp. 42. Examination Lists, August 1928. Pp. 35. (London.)

Board of Education. Report of the Consultative Committee on Books in Public Elementary Schools. Pp. xxi+162. (London: H.M. Stationery Office.) 1*s*. 3*d*. net.

FOREIGN.

Sudan Notes and Records. Vol. 10, 1927. Pp. iv+251+28 plates. (Khartoum.) 30 P.T.; 6*s*.

Proceedings of the American Academy of Arts and Sciences. Vol. 63, No. 3: The Petrology of the North Conway Quadrangle in the White Mountains of New Hampshire. By Marland Billings. Pp. 67-137+2 plates. 1.20 dollars. Vol. 63, No. 4: Studies on the Fauna of Hot Springs in the Western United States and the Biology of Thermophilous Animals. By Charles T. Brues. Pp. 139-228+6 plates. 1.60 dollars. (Boston, Mass.)

Rubber Research Institute of Malaya. Planting Manual No. 2: The Budding of Hevea in Modern Plantation Practice. By F. Summers. Pp. iii+100. (Kuala Lumpur, F.M.S.) 2 dollars.

Pisma Marjana Smoluchowskiego z polecenia Polskiej Akademji Umiejętności. Tom Trzeci. (Œuvres de Marie Smoluchowski, Tome 3.) Pp. v+349. (Krakowie: Uniwersytetu Jagiellońskiego; Paris: Ch. Béranger.)

United States Department of Agriculture. Circular No. 45: The Application of Sodium Fluosilicate by Airplane in an Attempt to control the Sugar-Cane Moth Borer. By T. E. Holloway, W. E. Haley and J. W. Ingram. Pp. 8. (Washington, D.C.: Government Printing Office.) 5 cents.

Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 1, No. 3, September. Pp. 297-485. (Washington, D.C.: Government Printing Office.) 25 cents.

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 158-159: Über das Krötengift. Von Munio Kotake. Mitteilung 1: Die Zusammensetzung des chinesischen Arzneimittels "Senso"; Mitteilung 2: Die giftigen Bestandteile des Sekretes der japanischen Kröte Bufo (bufo japonicus). Pp. 99-115. 25 sen. No. 160: On the Stark Effect of Helium. By Yoshida Ishida and Genji Kamijima. Pp. 117-140+plates 3-5. 45 sen. No. 161: On the Stark Effect of Lithium. By Yoshida Ishida and Masaichi Fukushima. Pp. 141-150+plates 6-7. 25 sen. No. 162: The Crystal Structure of some Rhombic Formates. By Isamu Nitta. Pp. 151-163. 20 sen. No. 163: Relations between Carbon, Hydrogen and Oxygen Contents, in Cotton Cellulose under Thermal Decomposition, and its Weight Loss. By Takeo Akahira. Pp. 165-180. 25 sen. (Tōkyō: Iwanami Shoten.)

Annalen van de Sterrewacht te Leiden. Deel 15, Tweede Stuk: A Catalogue of 1073 Stars in the Zone of North Declination 55′ to 60°, observed in the Years 1926 and 1927, together with a Discussion of the Differences with the A.G.C. Helsingfors. By C. H. Hins. Pp. 43. (Leiden.)

Proceedings of the United States National Museum. Vol. 74, Art. 5: Fossil Footprints from the Fort Union (Paleocene) of Montana. By Charles W. Gilmore. (No. 2750.) Pp. 4+3 plates. (Washington, D.C.: Government Printing Office.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 21, Part 5: Zweiter Beitrag zur Ichneumoniden-Fauna Japans. Von Toichi Uchida. Pp. 177-297+3+3 Tafeln. (Tokyo: Maruzen Co., Ltd.)

Bulletin of the American Museum of Natural History. Vol. 58, Art. 2: A Synopsis of the Mutillidæ of the Belgian Congo. By J. Chester Bradley and J. Bequaert. Pp. 63-122. (New York City.)

CATALOGUES, ETC.

The Cambridge Bulletin. No. 61, October. Pp. 32+8 plates. (Cambridge: At the University Press.)

Calendar for 1929. (London: British Museum (Natural History).)

Diary of Societies.

FRIDAY, NOVEMBER 23.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botanical Lecture Theatre, Imperial College of Science and Technology), at 2.30.—R. H. Stoughton: The Relation of Environmental Conditions to Angular Leaf Spot Disease of Cotton.—Dr. W. F. Bewley: The Effect of Environmental Factors on Diseases under Glass.—T. Small: Temperature and Humidity in Relation to *Cladosporium fulvum*.

ANATOMICAL SOCIETY OF GREAT BRITAIN AND IRELAND (Annual Meeting) (in Anatomy Department, King's College), at 3.—J. H. Mulligan: Complete Absence of Corpus Callosum in Human Brain.—Prof. C. J. Patten: The Mechanism involved in the Technique of Bird Utterances.—Dr. A. B. Appleton: An Example of the M. Cervico-costo-humeralis (Gruber).—C. P. G. Wakeley: A Note on the Architecture of the Ilium.—Dr. R. J. Gladstone: The Origin of the Vena Azygos Major.—Dr. V. E. Negus: The Function of the Cartilage of Santorini.—Dr. F. W. R. Brambell: Histology of the Gonads of an Hermaphrodite Pig.—Dr. D. M. Blair: Note on Submaxillary Lymph Glands.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 5.—Dr. H. M. M. Mackay: Nutritional Anæmia in Infancy—Some Observations on a Common Deficiency Disease.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Dr. G. Temple: The Physical Interpretation of Wave Mechanics.—A. Monkhouse: The

Effect of Superimposed Magnetic Fields on Dielectric Losses and Electric Breakdown Strength.—A. Campbell: A New A.C. Potentiometer of Larson Type.—Prof. E. F. Herroun and Prof. E. Wilson: Ferromagnetic Ferric Oxide.—Demonstration by R. H. Humphry of Emulsions showing Chromatic Effects.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—Lt.-Col. C. H. S. Evans: Searchlights and their Applications.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (jointly with Manchester Association of Engineers) (at Manchester), at 7.—R. Brooks: Electric Traction on Railways.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow), at 7.—Tornblad and Mitchell: Hartmann Spiral Bricks.

JUNIOR INSTITUTION OF ENGINEERS, at 7.—C. F. Moore: A Survey of Cadmium.

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.—R. Brooks: Electric Traction on Railways.

ASSOCIATION OF ENGINEERING AND SHIPBUILDING DRAUGHTSMEN (Birmingham Area) (at Chamber of Commerce, Birmingham), at 7.30.—F. H. Boden: Bearings.

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8.—Dr. H. Newsholme: Individuality and Epidemic Disease.

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB.

SATURDAY, NOVEMBER 24.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. W. C. Whittaker: North Country Folk Music (II.).

BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute), at 3.30.—Dr. M. Culpin and Miss May Smith: The Nervous Temperament: Its Incidence, Measurement, and Expression.

MONDAY, NOVEMBER 26.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Botany School, Cambridge), at 4.30.—Work in Progress at, or in Connexion with, the Low Temperature Research Station:—Sir W. B. Hardy: Introductory Remarks.—F. Kidd and C. West: A Mass Experiment with Apples.—Dr. T. Moran, J. R. Vickery, and E. C. Smith: (*a*) The Freezing of Gels; (*b*) Critical Temperatures; (*c*) Muscle Proteins.—Dr. A. J. Smith: Transport Problems; the East Malling Station, its Design and Equipment.—Dr. J. Barker: The Covent Garden Market Survey.—R. G. Tomkins: The Effect of Temperature and Humidity on Spore Germination.

INSTITUTE OF ACTUARIES, at 5.—R. Thodey: Life Insurance in Australia.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—E. S. Ritter and others: Discussion on Picture Telegraphy.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—Informal Discussion on Automatic Network Voltage-Regulating Equipments.

ROYAL SOCIETY OF ARTS, at 8.—Dr. F. Kidd: Biology and Refrigeration (Cantor Lectures) (III.).

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—Dr. E. W. Fish: Dead Tracts in Dentine.—Sir Frank Colyer: Irregularities of the Teeth in Erythrocebus (Patas Monkey).

TUESDAY, NOVEMBER 27.

ROYAL SOCIETY OF ARTS (Dominions and Colonies Meeting), at 4.30.—Col. H. L. Crosthwait: Air Survey and Empire Development.

ROYAL SOCIETY OF MEDICINE (Medicine Section) (Clinical Meeting at University College Hospital), at 5.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: Diamonds (II.).

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—Informal Discussion.

INSTITUTE OF METALS (Birmingham Local Section) (at Engineers' Club, Birmingham), at 7.—D. F. Campbell: Electric Furnace Developments.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—S. E. Sheppard and E. P. Wightman: The Effect of Environment on Photographic Sensitivity. Part I.—S. E. Sheppard: Anti-fogging and Anti-sensitising Effects.

INSTITUTION OF AUTOMOBILE ENGINEERS (London Graduates' Section) (at Watergate House), at 7.25.—S. Miall: Petrol-electric Transmission.

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 7.30.—T. H. Turner: Fighting Corrosion.

ROYAL ANTHROPOLOGICAL INSTITUTE (at Royal Society), at 8.30.—Sir Arthur Keith: The Evolution of the Human Races (Huxley Memorial Lecture).

ROYAL AERONAUTICAL SOCIETY (Leeds Branch).—Flight Lieut. B. C. H. Cross: Some Practical Aspects of Flying Boat Developments.

INSTITUTION OF MECHANICAL ENGINEERS (Swansea Branch—Graduates' Meeting).

WEDNESDAY, NOVEMBER 28.

ROYAL SOCIETY OF MEDICINE (Comparative Medicine Section), at 5.—Dr. W. G. Savage: Unsolved Problems of Salmonella Food-poisoning.

INSTITUTION OF AUTOMOBILE ENGINEERS (Manchester Centre) (at Engineers' Club, Manchester), at 7.—Dr. E. C. Wadlow: The Comparative Merits of Road and Dynamometer Testing for Motor Vehicles.

ALCHEMISTS' SOCIETY (in University, Glasgow), at 7.30.—A. D. Kent: Address.

ROYAL SOCIETY OF ARTS, at 8.—J. H. Estill: The Port of London.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—Film by J. M. Leonard of the Recent Canadian American Tour.

GLASGOW PHILOSOPHICAL SOCIETY (at 207 Bath Street, Glasgow), at 8.—Dr. K. G. Fenelon: Modern Industrial Tendencies.

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at 11 Chandos Street, W.), at 8.30.—Dr. G. Groddeck: Psychic Treatment of Organic Diseases.

THURSDAY, NOVEMBER 29.

IMPERIAL COLLEGE CHEMICAL SOCIETY (in Chemical Technology Department), at 5.—Dr. D. M. Newitt: High Pressure Syntheses.

LINNEAN SOCIETY, at 5.—T. A. Sprague and E. Nelmes: The Herbal of Leonhard Fuchs.—Edith L. Stephens: Exhibition of Lantern Slides illustrating Some Aspects of the Natural History of the Country about Cape Town.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. E. D. Adrian: The Mechanism of the Nerves (II.).

BIOCHEMICAL SOCIETY—UNIVERSITY OF BIRMINGHAM (at Birmingham), at 5.30.—Dr. F. W. M. Lamb: Some Anomalies in the Metabolism of Heavy Metals, with particular reference to Iron and Lead.

CHEMICAL SOCIETY (at Institution of Mechanical Engineers), at 5.30.—Prof. F. G. Donnan: Physical Chemistry in the Service of Biology (Liversidge Lecture).

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—F. Sigrist: Production Problems.

BURNLEY TEXTILE SOCIETY (at Mechanics' Institute, Burnley), at 7.15.—Lecture on Calico Printing.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at Royal Hotel, Luton), at 7.30.—E. C. Thompson: Purchasing.

INSTITUTION OF CIVIL ENGINEERS (Yorkshire Association) (at Hotel Metropole, Leeds), at 7.30.—J. Gilchrist: Some Experiments in Measuring the Strain in the Reinforcing Bars of Concrete Steel Beams.

ROYAL SOCIETY OF MEDICINE, at 9.15.—Sir William Bragg: Faraday's Diary (Lloyd Roberts Lecture).

TEXTILE INSTITUTE (Irish Section) (at Belfast).—F. Scholefield: Some Cases of Light Action in the Dyeing and Bleaching of Textiles.

INSTITUTION OF MECHANICAL ENGINEERS (Manchester Branch).—Dr. H. W. Swift: Power Transmission by Belts: an Investigation of Fundamentals.

FRIDAY, NOVEMBER 30.

TEXTILE INSTITUTE (Manchester), at 1.15.—E. E. Canney: Rational Development in the Organisation of the Cotton Industry.

ROYAL SOCIETY (Anniversary Meeting), at 4.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. W. E. Dalby: The Possible Vibration of a Ship's Hull under the Action of an Unbalanced Engine (Thomas Lowe Gray Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—Dr. E. V. Telfer: Frictional Resistance and Ship Resistance Similarity.

TEXTILE INSTITUTE (jointly with Leigh Municipal College Textile Section) (at Leigh), at 7.15.—W. Bailey; Various Methods of Winding Artificial Silk Yarns.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—C. W. Harvey: The Manufacture of Decorative Metal Work.

INSTITUTION OF AUTOMOBILE ENGINEERS (Scottish Graduates' Branch) (at 51 West Regent Street, Glasgow), at 8.—W. P. Kirkwood: Brakes.

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch).—W. Lind-Jackson: Napier Aero Engines.

SATURDAY, DECEMBER 1.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. W. C. Whittaker: The Violin Sonatas of William Young (17th Century).

PUBLIC LECTURES.

FRIDAY, NOVEMBER 23.

KING'S COLLEGE, at 5.30.—C. J. Gadd: Assyrian Studies in the Past.

SATURDAY, NOVEMBER 24.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Ancient Egyptian Mummies.

MONDAY, NOVEMBER 26.

UNIVERSITY OF LEEDS, at 5.15.—C. N. Hinshelwood: The Laws of Chemical Change.

UNIVERSITY COLLEGE, at 5.30.—Prof. C. B. Fawcett: Some Problems of Geography.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—Dr. A. G. Ruston: The Pros and Cons of Grass and Arable Farming.

UNIVERSITY COLLEGE OF THE SOUTH-WEST, EXETER, at 7.30.—Dr. P. B. Ballard: Open-Air Schools (Chadwick Lecture).

WEDNESDAY, NOVEMBER 28.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. H. M. Vernon: The Fatigue of Heavy Industrial Work, and its Influence on Health and on the Duration of Working Life.

GOLDSMITHS' HALL, E.C., at 4.30.—Prof. J. Arthur Thomson: The Culture Value of Natural History (Norman Lockyer Lecture of British Science Guild).

KING'S COLLEGE, at 5.30.—Prof. Doris L. Mackinnon: The Indebtedness of Industry to Pure Science: The Practical Applications of Zoology.

SIR JOHN CASS TECHNICAL INSTITUTE, at 8.15—Dr. S. W. Smith: Certain Aspects of the Solidification of Metals and Alloys (Armourers and Brasiers' Company Lectures). (Succeeding Lectures on Dec. 5 and 12.)

THURSDAY, NOVEMBER 29.

BOROUGH POLYTECHNIC INSTITUTE, at 5.30.—Dr. C. A. Edwards: The Manufacture of Tinplate (Armourers and Brasiers' Company Lectures). (Succeeding Lectures on Dec. 7 and 14.)

SATURDAY, DECEMBER 1.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—M. A. Phillips: Bird Life.

CONFERENCE

ON RECENT CHANGES IN SYSTEMS OF HUSBANDRY IN GREAT BRITAIN.

TUESDAY, NOVEMBER 27.

ROTHAMSTED EXPERIMENTAL STATION, HARPENDEN, at 11.30 A.M.

C. S. Orwin: The Relative Advantages of Intensification and Extensification of Farming.

H. W. Drewitt: Recent Breaks from the Old Rotations in the Chichester District.

Col. G. H. Long: The Entry of Sugar Beet into the Economy of the Farm.

H. V. Taylor: Fruit and Vegetables as Adjuncts to the Farm.