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## Rationalisation.

TO be reasonable may seem, to the follower of custom, to involve a disturbing rashness : and to be scientific may seem to imply an unnecessary exactness where 'hit or miss' has been the method used. Thus in Great Britain rationalisation may appear to be either revolutionary or too meticulous ; although it is only the inevitable result of the advance in industrial methods which has occurred during the past twenty years. Words have a mythological power. In German 'pure reason' is admired ; and the Germans seem to have invented the non-psychological, industrial, use of the word 'rationalisation'. In the United States, because there men revere 'science'—with little understanding of it—the phrase first used for the new policy was 'scientific management'. In general, as Mr. Urwick shows in his book, "The Meaning of Rationalisation", this name for an industrial policy implies the application of the exact methods of science to the organising of production. In its primitive form this policy involved only Taylor's plan for studying the movement of workers in machine-production, for the purpose of eliminating unnecessary effort ; but now the policy of rationalisation involves also (1) scientific research on materials, machinery, and sale-methods, and (2) scientific or 'exact' replanning of the managerial and financial organisation of an enterprise, leading in many cases to amalgamation of enterprises.

As an example of the need for reorganisation after a period of unorganised growth, mention may be made of a particular enterprise which has greatly expanded in the past twenty years : On investigation, the managing director of the firm in question found that his office was sending about 300 orders for stationery during the year to about 30 different firms. The incidental waste of energy and money affected the cost of production ; but the system was the result of 'accretion' without 'design'. Still more costly waste occurs in the iron and steel processes which some firms have inherited ; and in methods of distribution the waste incidental to changes in the places where people live and changes in their habits are obvious in our streets. Of the need for thinking and for replanning traditional methods there is no doubt : the only common doubt appears to be how far we should carry our thinking.

Scientific research is clearly desirable, for the days of chance discovery of material or processes are probably over. But research on an adequate scale is too costly for small enterprises and therefore

research is one of the reasons for more inclusive organisations. The results of research on dyes have been discussed by Mr. James Morton in his recent paper, read before the Royal Society of Arts, on "Fast Dyeing and Dyes". The Department of Scientific and Industrial Research provides some of the needs which are more generally supplied in Germany and the United States by large industrial organisations, independent of the State.

Again, it is generally agreed that new machinery or new processes will reduce the cost of production; and rationalisation may therefore increase productivity, with less effort on the part of the worker and lower 'overhead charges', even when the new machinery is expensive. In the Clyde engineering and shipbuilding trades, the same production as in 1914 can now be obtained with only about 60 per cent of the labour. There was an indication of the new situation when an engine was placed in a ship in one afternoon, which it would have taken three weeks and perhaps six times the number of men to place in a ship in 1914. Similarly, in the United States "automatic electro-pneumatic systems of freight-car control have eliminated switchmen. Seven men used to operate trains in the New York subways: now with automatic controls one motorman and one guard compose the crew. The Boston and Maine railroad has a freight-handling mechanism to take care of a million freight-cars a year. Switchmen and brakemen are eliminated. One skilled man in a tower directs the process. It saves the labour of four hundred workers." Such is the descriptive example given in Mr. Stuart Chase's "Men and Machines".

From one point of view this process looks like an elimination of waste or of unnecessary effort: and thus it is connected with the elimination of unremunerative plant, which, as the *Times* City notes on Dec. 17 expressed it, has "become obsolete through the rapid march of science". The same notes continue: "the bankers must bear some share of the responsibility for the slowness with which the principles of rationalisation have been practised"—they continue to give financial facilities to obsolete processes. How many balance-sheets include values for assets that are really worthless? Thus rationalisation comes to mean 'facing facts' and eliminating waste plant and deleting mythical 'capital', as well as dismissing unnecessary labour.

It is here that a new aspect of rationalisation appears, which is being studied by the International Industrial Relations Association, which exists for the promotion of satisfactory human relations in industry. Passing beyond the old 'scientific management' into what is now known as 'industrial psychology', in the work of our own National Institute of Industrial Psychology, Miss Mary van Kleeck, of the Russell Sage Foundation, and other observers, have shown that more skilful management of men is essential to true rationalisation. Heavy manual labour is being decreased and machine-minding is becoming commoner, which may produce 'Robots'. A new type of worker in industry is arising; and the old type of foreman and manager is already obsolete. Again, the contraction of employment in the older processes is causing unemployment among the older men and women and the new processes are taking up the young. Evidently new psychological problems are involved in rationalisation.

In this connexion the establishment of the Institute of Industrial Administration is important.[1] Evidently we cannot afford to trust to the appearance at the right moment of 'heaven-sent' managers; for the management of men and the organisation of production require training, and we are now in the position of being able to use exact knowledge of methods. In spite of differences in different trades and different traditions in different enterprises, there are some common factors in all industrial management. Rationalisation implies the use in each enterprise of the knowledge of these common factors; but many employers and directors are still at the mental stage of those older teachers, who distrusted training for teachers on the ground that a teacher was born and not made. The trouble is that an insufficient supply of 'natural' teachers is born: and Nature supplies the art by which the deficiencies of Nature are amended. So training and a test of competence are required for the supply of competent 'executives' in industry.

There is, however, one of the most fundamental problems which the advocates of rationalisation and its practitioners are not considering. The increase of productivity with less labour employed involves a decrease in the total of wages paid to the reduced number of workers; and wages are purchasing power. Therefore the power to produce is increasing by methods which themselves decrease the power to consume. If the same amount of production is obtained with only 60 per cent of the labour, then 40 per cent of the former number of workers have lost their power to purchase; and the unemployment benefit only just barely

[1] Registered Office: 47 King William Street, London, E.C.4.

keeps their purchasing power at a minimum. Now, most of the active business men who are rationalising are 'employers' or organisers of production, rather than commercial salesmen. They tend, therefore, to aim in rationalisation at restricting the use of the new productive power to meet a shrinking market. Profits are thus secured by preventing the use of productive power. Not simply are 'less economic' enterprises closed down; but the whole of a great organisation may be used to cut production to the size of the market; and since less labour is needed every day, the market shrinks. Unemployment is breeding unemployment.

This is a problem of price rather than cost. There is a need for house-room and clothing which cannot become 'effective demand', to set the productive power going, because those in need have not purchasing power at the existing prices. But there are ways of reducing prices, so that the gain from reduced costs may not all be pocketed by the producers, but may accrue to the final consumer. It follows that for truly scientific consideration of the factors involved, we need a rationalisation of the market. The use of credit, instalment buying, increased advertisement, and a changed education may be good or bad as means for reducing prices; but clearly some such means must be studied, if the rationalisation of the productive process is not to leave on our hands a problem greater than the problem it solves. Traditional 'trial and error' in economic policy should give place to the scientific consideration of the market by an economic general staff.

Rationalisation involves not merely greater efficiency of the labour used, and greater competence in management, but also large-scale, long-sighted economic policy. Such policy must be based upon a scientific knowledge of the resources, natural and human, available for producing goods and services, a knowledge which the traditional 'business man' does not possess because he has confined his attention to his own enterprise. The traditional economic science may also be proved to be inadequate for true rationalisation, since it rests upon a fatalism with regard to the market which is the result of a neglect to study 'consumption'. Rationalisation in economic policy cannot omit to consider the needs which are not in fact 'effective demand'; for there is no reason to suppose that a 'hidden hand' will provide a market if we think only of costs and not of prices, and there is every reason to believe that we can, if we give our minds to it, increase the market to meet increases of productive power.

C. DELISLE BURNS.

## Agricultural Science and Grassland.

*The World's Grasses: their Differentiation, Distribution, Economics and Ecology.* By Prof. J. W. Bews. Pp. xii + 408. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1929.) 21*s.* net.

RECENT years have witnessed quite a remarkable development in the application of science to questions associated with the utilisation and management of grassland. The agricultural scientific workers of nearly all countries of the world appear to be devoting more and more attention to the manifold problems connected with grassland, and nowhere is this in greater evidence than in Britain and in the overseas territories of the British Empire. So great is the volume of research now in progress relative to grassland, that it is no unusual thing to hear the view expressed that our workers in agricultural science are perhaps running the risk of neglecting the no less pressing problems of arable farming. Apart altogether from the fact that there is an immense amount of leeway to be made up in connexion with the critical scientific study of grassland, and to the further fact that grassland contributes so materially to the agricultural wealth of nations, it should never be forgotten that pastures and meadows, and still more so temporary leys, have always taken, and are likely always to take, an important place in most schemes of husbandry largely based on the use of the plough. Perhaps a truer criticism relative to the vast amount of research in progress is that it is being conducted from so many different angles, and without relation to any general philosophical attitude towards the grassland problem as a whole.

The appearance of Prof. J. W. Bews's important book on "The World's Grasses" is, on this account, profoundly opportune—for in the last resort all studies of grassland must come back to the contributing species, and notwithstanding the fact that leguminous plants are of great importance, and although it is becoming to be realised to an ever-increasing extent that numerous plants belonging to other natural orders are of decided significance, yet the fact remains that it is the order Gramineæ that sets the seal to the world's grasslands.

The value of Prof. Bews's book at the present juncture is that it at once rivets the attention of the student of grassland on species *qua* species—the bricks and mortar with which any proper appreciation of the grassland complex can alone be

built. The merit of this arresting book lies in the fact that our author has not been content merely to describe the grass species of the world, and to prepare a very carefully planned key to the tribes and genera, but he has boldly assumed the rôle of systematist, ecologist, and physiologist, and has welded the immense amount of evidence brought forward into a definite thesis—a definite guiding principle—which is presented in the stimulating form of an endeavour to trace the phylogeny of the various genera and their evolution in relation to ecology.

It follows that Prof. Bews has written what is at once a book of reference and a highly suggestive treatise on the etiology of the world's grasslands. The former aspect of the book is embodied in Chap. iii. with its key to the tribes and genera—a fine achievement this, to bring all the genera of so large an order into one key—and Chaps. iv., v., and vi., which deal with the distribution, ecology, and economics of the genera.

These chapters introduce no controversial subjects, and alone render the book one which should be available to all workers concerned with grassland. For here is a remarkably trustworthy body of information collected in the compass of 167 pages (rather less than half the book). The nature of the treatment calls for generalisation, which must inevitably in certain particulars be somewhat indefinite, and perhaps more especially where particular species are concerned. Thus, for example, it is stated that *Poa trivialis* is closely allied to *Poa pratensis* "and has the same habit", whereas the former species spreads by means of stolons and the latter by means of rhizomes. An error, which from the context would seem to be quite accidental, occurs when it is said that *Bromus secalinus* is sometimes grown for hay. The statement would be correct for *B. arvensis*, which is mentioned in the preceding sentence.

To attempt any detailed and unbiased criticism of the remaining—the challenging—chapters of the book is itself difficult, for specialists in different branches of botany are bound to hold their own views, and it would be almost unfair to the author, who advisedly has adopted the synthetic treatment and lays no claim to being a specialist in all the subjects necessarily brought under discussion. All will agree, however, that Prof. Bews's unique knowledge of the Gramineæ as revealed on almost every page of the book, affords a complete justification for his manner of treatment—indeed he may almost be said to have placed himself under an obligation to take a philosophical view of his subject—and consequently the real achievement of these chapters turns on the fact that he has envisaged our grasses and grasslands from a fundamental and really scientific point of view.

We cannot, however, resist the temptation to quarrel mildly with Prof. Bews on certain points of detail, and the more readily since he almost invites us to do so. The main argument adopted from a phylogenetic point of view appears to be that in general a reduction in the inflorescence or in any of its parts, or the hardening of the structures surrounding the paleæ, indicates an advance upon the primitive form, while the primitive habitat is taken to be moist (or even wet) and warm. Advance, then, means the capacity to occupy the extremes of dry and cold habitats. The chief drawback to the whole system is of course that it necessarily places great emphasis on floral similarity and dissimilarity, and perhaps does not lay sufficient stress on vegetative characters. The system adopted is perfectly satisfactory for taxonomic purposes, in which connexion there can be little objection to genera as dissimilar as *Phleum* and *Agrostis*, which are alike in little else but the unifloral condition of the spikelet, both being placed in the Agrostideæ. Similarly, on the basis of the organisation of the inflorescence, *Lolium* undoubtedly finds a fit place in the Hordeæ, and yet it might reasonably be argued that phylogenetically it comes much nearer the genus *Festuca* in the Festucineæ than to any member of the Hordeæ, on account of the fact that *Lolium perenne* has been successfully intercrossed with three species of *Festuca*. These examples at least show the danger—and a danger which the author has himself emphasised—of forcing phylogenetic interpretation upon a system of classification based essentially upon floral characters, and the danger is perhaps the greater because in the main such a system has the undoubted appearance of being natural.

In his wholly admirable discussion on wide grassland types in their ecological aspects, the author is undoubtedly faced with certain fundamental difficulties—difficulties which in some cases are hard to surmount, especially when it is attempted to correlate phylogeny (based on taxonomy) with ecological facts. In our view, the author has somewhat added to his difficulties when, for example, discussing temperate and alpine 'meadows' and 'pastures', he attempts to regard these as separate entities. We thus find such a plant as *Lolium perenne*, so characteristic of the best old British grasslands, excluded from 'meadows'—but these characteristic swards would seem inevitably to fall

into the 'meadow' category, particularly since *Cynosurus cristatus* is regarded as a constituent of meadow herbage. If it is legitimate, and we think it is, to include *Lolium perenne* in the 'meadow' category together with *Phleum*, *Alopecurus*, and other species, it would then also be incumbent upon us to contradict the statement that "meadow grasses are also relatively primitive types".

In dealing with the vast and relatively lightly grazed areas of grassland, the biotic factor—man and his grazing animals—is often of relatively slight significance, but the author has shown how greatly these grasslands may be altered when this factor comes into play. When dealing with temperate 'meadows' and 'pastures', and even with mountain and alpine grasslands, the author has perhaps not taken the biotic factor sufficiently seriously into consideration, for wherever grazing reaches any sort of intensity, wherever domesticated animals come upon the scene, the biotic factor undoubtedly ranks with the edaphic and climatic as of supreme importance.

*Festuca* and *Poa*, "regarded as representing the most primitive of the ordinary grasses", yet have a very wide range in temperate regions. The dominant place taken by *Poa pratensis* over considerable areas in North America (areas which by no means represent particularly primitive habitats), for example, is due wholly or in very large measure to the biotic factor.

It is not easy to estimate the extent to which the human-biotic factor has influenced mountain, and particularly alpine grassland, but the occurrence together of *Poa alpina* and *Phleum alpinum*—two species of very different taxonomic-phylogenetic position—under alpine conditions may perhaps be considered significant rather than merely interesting.

These closing remarks have been made solely to indicate the magnitude of the task which the author had set himself. For this very reason, because Prof. Bews has written this book, all who are interested in the science of grasses and grassland are placed under a deep sense of obligation to him. The illustrations (the subjects of which have been well chosen to show the range of differentiation exhibited by the tribes and genera), the bibliography (which is extensive and in the main complete, despite the rather unexpected omission of Sinclair's "Hortus Gramineus Woburnensis"), and the index (the chief references to the genera are shown in heavy type) are worthy of the book and of the author.

## Pliny as a Chemist.

*The Elder Pliny's Chapters on Chemical Subjects.* Part 1. Edited, with Translation and Notes, by Dr. Kenneth C. Bailey. Pp. 249. (London: Edward Arnold and Co., 1929.) 12*s.* 6*d.* net.

IN the preface to this delightful and scholarly volume, Dr. Bailey complains that recently published histories of chemistry usually fail to give fair consideration to the chemical knowledge of the Romans. Admitted, however, that Roman chemistry does generally receive scant notice, the reason surely lies in the comparative lack of material rather than in any wilful neglect on the part of the historian. Rome has, in short, left us no grand chemical generalisations or striking chemical discoveries. An eminently practical people, the Romans were quick to perceive the value of applied science, and Roman artificers and engineers were unequalled in skill and ingenuity. Yet when the historian of chemistry attempts to lay his finger on definite advances which the Romans made, he finds it an almost impossible task. Perhaps here and there a recipe is given that cannot be paralleled in an earlier age; here and there is a process which seems particularly appropriate to special circumstances; here and there an apparently new operation is described; but that is all. Roman craftsmen for the most part merely applied old knowledge with new efficiency, and Roman thinkers were more attracted to the laws of the State than to the laws of Nature.

To understand later developments, it is nevertheless important to be able to gauge accurately the scope and content of Roman empirical chemical knowledge, and for this purpose Pliny's "Natural History" is invaluable. The most modern translation of the whole of this great work is that of Bostock and Riley, published in 1855 and now almost *introuvable*. In the long interval that has elapsed, the advance of both chemistry and the history of chemistry has been extremely rapid, and, as Dr. Bailey justly observes, the historian now has at his disposal weapons so much more powerful as to warrant a new translation. We are fortunate in that Dr. Bailey has himself undertaken the task of editing and translating the chemical sections, the difficulties of which are numerous and often very perplexing.

Pliny, whose numerous public activities culminated in his appointment as Admiral of the Fleet, collected a vast amount of miscellaneous information, and as he was by no means deficient in the critical faculty, much of it is closely accurate.

The chemical sections, scattered throughout the "Natural History", are consequently in general plain statements of fact, largely free from the superstitious embellishments so exasperating to the student of early chemistry. It is true that the statements are often erroneous, but they are at least not deliberately mystificatory.

Primitive chemical writings present two categories of difficulties: first, the establishment of the text itself; and second, the interpretation of technical terms and obscure allusions in the text when established. Dr. Bailey has not shirked either variety, and where the problems with which he was confronted proved insoluble, he has not hesitated to admit failure; these cases are, however, few, and are usually of such a nature as to seem permanently incapable of solution.

As interpreted by Dr. Bailey, Pliny's chemical knowledge surprises us by its extent and more particularly by its accuracy in detail. As an example of the latter, it may be noted that Pliny mentions that the colour of minium (mercuric sulphide) is changed by heating but is regained on cooling; that it is, however, completely destroyed if the minium is heated with lime; that minium is turned black by the action of light; and that mercury may be obtained from it either (*a*) by the action of heat, or (*b*) by triturating it with vinegar in a copper mortar with a copper pestle. Dr. Bailey, with admirable thoroughness, tested the second of these methods experimentally. He finds that in the cold the reaction is very slow indeed, but that on heating it takes place readily enough, copper sulphide being formed, while the surface of the copper turnings becomes covered with a copper-mercury amalgam, from which the mercury may be driven off by heating.

The sections on salt contain many interesting points. Thus in Book xxxi. para. 67, Pliny states that four *sextarii* of water will dissolve one *sextarius* of salt and no more—one of the earliest estimates of solubility (though not a very accurate one). As to the celebrated *sal Hammoniacus*, Dr. Bailey agrees with Beckmann, Stillman, and others in believing it to have been an impure variety of sodium chloride; he says that we have no proof that the name was used of ammonium chloride before the tenth century A.D. Among Arabian writers, ammonium chloride is generally called *nushadhir*, but this is not infrequently equated with *milh armaniyyu* or 'Armenian salt'; between the latter and 'Hammoniacal salt' there is an obvious possibility of confusion.

'Chrysocolla', which travelled via Islam to medieval Europe, where it emerged as *harsufle*, is identified as malachite or copper carbonate, which is known to have been prepared in the way described by Pliny. The natural product, says Pliny, although harder than the artificial, can be dyed with the herb called *lutum* (*Reseda luteola*). Dr. Bailey finds that this is indeed so, and that the dyed compound possesses a fine emerald-green colour far superior to that of the original malachite. Noteworthy is the name *uva* for natural chrysocolla, doubtless a reference to the botryoidal masses in which malachite often occurs.

On gold, Pliny has a great deal to say, much of which is—as the modern abstractor would express it—'polemical' against Roman habits of luxury. He mentions, however, that the best proof of the purity of gold is a high melting-point (*quam difficillime accendi*); that nothing can be beaten into thinner leaves; that it will not rust; and that brine and vinegar have no effect upon it, but that it is less dense and less malleable than lead.

The present volume, which forms the first part only (Books ii.-xxxiii.), contains the Latin text and English translation on opposite pages, together with a short introduction, 86 pages of notes, and a useful index. We trust that Dr. Bailey will soon complete the task he has so successfully begun, for, in addition to the intrinsic interest of the subject, it is pleasant to meet again the 'portly and somewhat pompous' Pliny, who, though a bookworm and a pedant, came to an untimely end through his insatiable scientific curiosity.

E. J. H.

## Cicadas.

*Insect Singers: a Natural History of the Cicadas.* By Dr. J. G. Myers. Pp. xix + 304 + 8 plates. (London: George Routledge and Sons, Ltd., 1929.) 21*s*. net.

THIS work, notwithstanding its title, is not a popular book, but a serious scientific treatise on Cicadas. Dr. Myers seems to have read and digested practically everything written pertaining to these insects, besides carrying out a considerable amount of personal investigation of their structure and behaviour.

References to Cicadas date far back into ancient mythology (tenth or eleventh century B.C.), and the two chapters on this subject form a scholarly dissertation. The two succeeding chapters are devoted to external anatomy and internal anatomy respectively. The much-debated subject of the

morphology of the head sclerites is not discussed, but the author adopts a reasonable interpretation of the parts concerned. Dr. Vogel's little-known work, on the existence of chordotonal organs in the so-called mirror of the tympanal organs, is dealt with in some detail. It is of much importance, because it affords the only reasonable proof of the existence of any structures capable of sound reception among these highly 'musical' insects. In dealing with evolutionary problems, the author concludes that the Cicadas are a very isolated group with no ancestors among any fossil forms yet discovered: the earliest known fossil Cicada is from the lower Cretaceous, and there is a wide gap until the definitely modern types appear in the Oligocene amber beds.

In the account dealing with life-histories, the difficulties involved in recognising the nymphs of different species are stressed, but in so far as the New Zealand Cicadas are concerned, Dr. Myers finds that they can all be separated by characters afforded by the fore-femora. We also observe that he dispels the deeply imbued idea that Cicadas pass through a quiescent pre-imaginal instar: the so-called 'pupa' being nothing more than the nymph in its final instars.

Passing over a number of sections dealing with distribution, relations with plants, insect and vertebrate enemies of Cicadas, etc., the concluding chapters are concerned with sensory perception and psychological problems. Especial attention is given to the 'song' of these insects, and the author has carefully analysed the various notes of a number of species and expressed them in the form of graphic music. The chief rôle of the song is, he believes, an assembling one, but he also concludes that it operates to arouse in one or both sexes the emotions necessary to consummate the sexual act. At the end of the book there is an extensive bibliography, the bulk of which is partly owing to the inclusion of references to all the taxonomic papers wherein new species of these insects are described. A combined author and subject index follows.

As a whole the book is a very good one; it is crammed with information and with extracts from the publication of different authorities; but it is not exactly a readable volume, but rather one which will be resorted to for reference. Most of the illustrations are line figures, somewhat heavily drawn, and lacking in finer detail. They give the impression of being hurriedly executed, but they serve to explain the points intended.

A. D. I.

## Our Bookshelf.

*Australian Nature Studies: a Book of Reference for those interested in Nature-Study.* By Dr. J. A. Leach. Second edition, revised and reset. Pp. vii + 525. (Melbourne and London: Macmillan and Co., Ltd., 1929.) 12*s.* 6*d.* net.

THERE is in this book an abundance, indeed an excess, of material from which teachers, either in Great Britain or in Australia, can construct courses. About one-third of the volume is devoted to plant life; rather less than half to animal life; while the remainder is concerned with studies of inanimate Nature, such as soil, wind, water, denudation, and physical geography. An essay on Nature study in education, and a suggested course in the subject, form an appendix. This last should be consulted at the outset by those proposing to adopt the book.

Amid the many styles and modes of address employed by the author, whose death, we understand, has occurred since his book appeared, we are puzzled, in spite of the sub-title, to know for what class of readers he intended his book. Books of these dimensions and at this price are not for pupils of tender years. Yet frequently the mode is on heuristic lines, questions and instructions being addressed direct to the pupil. Elsewhere the address is to the teacher; while repeatedly the dialogue style is adopted, an imaginary teacher Socratically leading an imaginary, gesticulating class. Interspersed among these variations is the style usual in text-books. The effect of these changes is not pleasing; and wastage of space results. Moreover, too much has been attempted; the lists of plants and animals are needlessly lengthy, while the brief notes on them are often of little value. A careful study of fewer would have produced a more interesting and more educative work.

The illustrations are numerous and helpful: they need close attention, for much that in most books appears in the text is here condensed in them; but we have found no difficulty in grasping the significance of any one of them.

*Fables of the Veld.* By F. Posselt. Pp. xi + 132. (London: Oxford University Press, 1929.) 6*s.* net.

MR. POSSELT has collected these folk-tales among the natives of Southern Rhodesia—not from one, but from a number of tribes. The tales are not grouped either under tribe or subject, but the tribal origin of each is given in the table of contents. Happily, the author has made no attempt to 'improve' the material and has aimed at preserving the spirit of the original.

The tales are distinctly readable apart from the many points of interest they present to the folk-lorist. The hero of a considerable group is the hare, who displays the cunning of Br'er Rabbit, but, like that worthy, frequently overreaches himself. The Tar Baby here appears as a tortoise who covers himself with bird-lime in which the hare becomes entangled. Other parallels with

Uncle Remus are numerous. 'Throwing the bones', the ritual of the South African witch doctor, here takes the place of the 'Table be covered' formula in Grimm.

*Jute and Jute Spinning.* Part 1: *Production of Fibre; Cultivation, Batching, Preparing and Carding.* By Thomas Woodhouse and Peter Kilgour. Second edition. Pp. xx + 301 + 21 plates. 20*s.* net. Part 2: *Drawing and Roving Frames.* By Thomas Woodhouse and Peter Kilgour. Pp. xxiv + 350 + 19 plates. (London: Macmillan and Co., Ltd., 1929.) 20*s.* net.

THESE two volumes form a very welcome addition to textile literature. The authors have a thorough grasp of their subject and a sympathetic understanding of the needs of students. As text-books, the student of jute spinning will find them most comprehensive. Very few text-books on textile subjects cover the ground so completely. The practical man will also have a most reliable source of reference, as the various types of machines and workings have been described and discussed in detail. The subject matter is well arranged and the wealth of detail is presented in a manner that makes the reading of it most interesting. This latter is in itself no mean accomplishment. The line drawings are very clear, and the value of the work has been enhanced by the inclusion of photographs that in many cases were taken in the mills. Practically everything possible has been done to explain the principles underlying the various operations.

In the main, Part 1 is the same as in the 1920 edition, but in order to bring the matter up-to-date, an appendix, wherein improvements and changes in 'batching' and 'carding' are recorded and discussed, has been added. The chapter on motive power gives a reasoned summary of an important item in manufacture. This will be greatly appreciated, as, generally speaking, such information is only obtained from a search through a number of books and, this search completed, the application to a particular trade or machine requires to be worked out.

In Part 2 is described and discussed at considerable length a wide range of drawing and roving frames. The comparison in the treatment of flax and jute fibres is most instructive.

While the volumes are primarily intended for those in the jute trade, they will also be of much service to candidates for the diplomas of the Textile Institute and to many others. The authors and publishers are to be congratulated on a most successful production. We anticipate a wide circulation for the new edition.

ANDREW R. GEARY.

*Enzyme Actions and Properties.* By Ernst Waldschmidt-Leitz. Translated and extended by Robert P. Walton. Pp. xviii + 255. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 20*s.* net.

PROF. WALDSCHMIDT-LEITZ has given a condensed description of the most important principles of the chemistry of enzymes and of the characteristics of the more important members of the group. In other words, the material available has been selected and the viewpoint adopted is that of the Willstätter school. The translator has extended the original German text with the help of the author, so as to bring the volume up-to-date.

An important aspect of the subject dealt with is that of the quantitative determination of activity: by taking into consideration both the relative activity and the amount of material obtained, it has been possible to follow the enzyme through a series of purifications, with considerable success in the development of methods of preparation. Somewhat less than half the text is devoted to the general properties of enzymes and their preparation: the remainder considers the different ferments separately, the esterases, proteases, and peptidases, aminoacylases, carbohydrases, catalases, peroxydases, oxydases, and fermentation enzymes. There are numerous references to the literature. One point attracted our attention; the author is described on the cover as Waldschmidt, instead of Waldschmidt-Leitz.

This appears to be a very useful volume on the subject and should find a wide circle of readers, as enzyme activity plays a part in every field of biochemistry.

*The Zoological Section of the Nuzhatu-l-Qulūb of Hamdullāh al-Mustaufi-al-Quazwīnī.* Edited, translated, and annotated by Lieut.-Col. J. Stephenson. (Oriental Translation Fund, New Series, Vol. 30.) Pp. xix + 100 + 126. (London: Royal Asiatic Society, 1928.) n.p.

THIS learned translation affords a vivid glimpse of the zoological knowledge current in Persia in the early half of the fourteenth century, and may be compared with the "Physiologus", so long the zoological text-book of medieval Europe. It discusses the appearance and properties of 228 different animals, and the accounts lean to the economic point of view, for the uses of animals and their parts in medicine and magic assume much greater importance than habits or structures. Judging from the frequency with which certain diseases are mentioned in this primitive materia medica, Col. Stephenson regards the following as among the commoner diseases of fourteenth century Persia: cataract, corneal opacities, stone in the bladder, ringworm of the scalp, leprosy, quartan fever, tuberculous glands.

Many of the animals described are figments of imagination, but with the substantial creatures all are grouped in a simple classification based upon habit and habitat. There is very much of interest in these old descriptions: we mention just two points. It is strange that although 'domestic animals' include the cat and nine others, the dog is omitted, although subsequent references (p. 34) show that it was used for several purposes; and there is a prophetic suggestion in the association of mosquitoes with malaria—"three mosquitoes given along with a quantity of gum for three days to one with quartan ague will take away the fever" (p. 64).

## 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.*]

### The Identity of the Colloidal Particles in Soap Sols and Jellies.

TEN years ago we found that two portions of the same solution of soap could be brought into the states of either sol or typically transparent jelly respectively at the same temperature, and that such significant properties as conductivity, lowering of vapour pressure, concentration of sodium ion as measured with the sodium amalgam electrode, etc., were identical in both these states. Sol and jelly differed only in mechanical properties such as rigidity and elasticity. We therefore drew the obvious conclusion that the rigid structure of the jelly must be built up by progressive linkings together of the particles which pre-existed in the sol (*Trans. Chem. Soc., London*, **117**, 1506; 1920).

Recently this subject has received much attention and our conclusion has been called in question. However, we submit that the essential point has been entirely overlooked. The whole question is whether or not it is possible to prepare specimens of jelly in which the typical mechanical properties of jellies are manifested without altering any of the quantitatively measurable properties of the original sol. If this can be done our conclusion appears to be inevitable. No attempt to attain such good specimens is recorded as having been made by the other investigators. K. Krishnamurti, in a recent letter to NATURE (Nov. 2, 1929, vol. 124, p. 690), contents himself by saying that light scattering capacity is even more significant than any property we measured and that his specimens differed distinctly in this respect. Now it is perfectly easy, as we showed, to obtain a soap solution in almost any desired degree of whiteness and opacity through curding or crystallising out; that is, through formation of innumerable excessively fine fibres of soap crystals like cotton wool on a much finer scale. Parallel with this increasing whiteness, intensity of scattering and opacity goes a falling-off in conductivity, etc. Analysis of the mother liquor from which the curd fibres are crystallising, naturally shows that it is becoming correspondingly depleted in soap. It is obvious that a soap curd is wholly different from a sol or jelly, and that the crystals are forming through the destruction and disappearance of the colloid which existed in the sol or jelly.

We now therefore put on record that we have prepared samples of the same solution of sodium oleate, some of which were fluid sols and others typical jellies, but the light scattering of which was identical within the experimental error of a fraction of a per cent.

For the measurements, we employed a 0·5 *N* solution of pure sodium oleate (made from metallic sodium, conductivity water and purest oleic acid prepared according to Lapworth). The specimens were illuminated by an arc, and the scattered light viewed through a large Schmidt and Haenach photometer with special Lummer Brodhun prism. The intensities were matched by altering the width of the slits which were operated by micrometer screws, graduated into 560 divisions. Interchange of sol and jelly in front of the same slit led to identical readings, plus or minus the small experimental error indicated above, when matched against any constant standard. For example, the maximum divergences between sol and jelly are represented by readings such as 312, 314, 312, 314, for sol, jelly, sol, jelly, respectively. Occasional specimens gave readings differing in the opposite direction. At 24° the jelly is soft and could be made to flow; at 10° the sol and jelly show much greater light scattering, but are still equal to each other. The jelly may be cut into pieces with a knife, whilst the sol is quite fluid. The hysteresis in the change of light scattering of a soap sol with changing temperature mentioned by Krishnamurti is also exhibited by all other properties of soap sols, as we have repeatedly pointed out. The final values, however, are reproducible when sufficient time is allowed.

L. Arisz (*Koll. Zeit.*, **7**, 49; 1915) found that the light scattering of solutions of gelatine both in sols and jellies changes greatly with time, temperature, and concentration without any discontinuity in the region of gelation. Gelation then appears as almost irrelevant to the changes taking place in the colloidal particles and merely makes use of those present at the time.

Our original observations and conclusions therefore stand and are not invalidated, as claimed, for example, by Hatschek (*Koll. Zeit.*, **48**, 246; 1929) in his work on cloudy agar gels or by Zsigmondy and Theissen (*Z. anorg. und allge. Chem.*, **179**, 266; 1929) on partially curded soap gels. We would of course agree with von Weimarn (see E. Iwasi, *Koll. Zeit.*, **43**, 70; 1927) in principle, that if two colloidal particles join even at a molecular point their composition or hydration must be to that minute extent altered. Nevertheless, the piling or the cementing of bricks to form a larger structure is like the loose junction of particles of a sol to produce a jelly. The formation of curd from a jelly is as drastically different an operation as would be the dissolution of the bricks in hydrofluoric acid or the fusion of them into a single casting.

M. E. LAING MCBAIN.
JAMES W. MCBAIN.

Stanford University,
California,
Dec. 18, 1929.

### The Classification of the Primates.

I HAVE for some time been interested in the classification of the Primates, from the point of view of a student of geographical distribution, and have suspected that the differences between the Platyrrhines and Catarrhines are more fundamental than is generally supposed, and that their resemblances may be due to convergence.

Prof. Elliot Smith's new classification, in NATURE of Dec. 7, appears to take little account of the differences between the Platyrrhines and Catarrhines, as he unites the monkeys of both groups to form a sub-order Pithecoidea, and separates the apes and man from the Catarrhines as a sub-order Anthropoidea. The purpose of this letter is to show that there are at least good reasons for other views as to the classification of the Primates. Prof. Elliot Smith is, of course, perfectly well acquainted with the evidence I will cite, but interprets it differently.

J. Thornton Carter (*Proc. Zool. Soc.*, 1922) has studied the microstructure of the enamel of the teeth of the Primates, and has found that there are two types of enamel pattern. In the Mascarene Lemurs, the Eocene Lemuroids *Pelycodus* and *Notharctus*, and the Catarrhines, the enamel prisms have straight edges, and are separated by a slight amount of interstitial substance. In the Asiatic and African Lemurs (Lorisoids), Tarsioids (*Tarsius* and the Eocene *Hemiacodon*), and Platyrrhines, the prisms have wavy edges and are separated by a considerable amount of interstitial substance. Carter emphasises the constancy of

the enamel pattern in natural groups ; he writes, " In the long and well-authenticated series comprising the ancestry of the horse, the microstructure of the enamel does not change, in spite of the modification of the teeth.—Fossil rodents from the Eocene exhibit a close similarity in enamel structure to recent forms, and where, as in *Chiromys*, a Lemur has evolved a rodent dentition, the structure of the enamel still retains its Lemurine characters." I quote these remarks of Carter in order to show that it is not unreasonable to regard the microstructure of the teeth as of primary importance in the classification of the Primates. A classification based on enamel pattern is :

*A*. Prisms with straight edges. *Lemuroidea, Catarrhina.*

*B*. Prisms with wavy edges. *Lorisoidea, Tarsioidea, Platyrrhina.*

It may be noted that Gregory's description of the Eocene *Notharctus* (*Mem. Amer. Mus.*, **3**, 1920) leaves no doubt that it belongs to the same group (*Lemuroidea*) as the Mascarene Lemurs, with which it agrees in enamel pattern.

As regards the groups with wavy enamel prisms, a memoir by Beattie (*Proc. Zool. Soc.*, 1927) on the anatomy of *Hapale* is of interest as showing the close relationship between Tarsioids and Platyrrhines. According to Beattie the similarity in structure of the skull of *Hapale* and *Tarsius*, particularly of the nasal region and the orbit, is so close, that when other similarities are considered, it is evident that these two animals are nearly related.

The series *Lorisoidea-Tarsioidea-Platyrrhina* therefore offers no difficulties. But it must be admitted that the Catarrhines are the most advanced group of the Primates, and that most of their characters may be interpreted as further developments of Platyrrhine structure. Nevertheless, the microstructure of the teeth indicates their direct derivation from the Lemuroidea, which stand at the base of the Primate stem.

The absence of monkeys from the Tertiary beds of North America has led some authorities to explain their present distribution by means of a Tertiary land connexion between Africa and South America. This hypothetical connexion is unnecessary if the monkeys are diphyletic. Tarsioids were present in North America in Eocene times : they may have entered South America when the connexion with it was established at the end of the Oligocene ; their earliest known Platyrrhine descendants are found in Miocene deposits. Catarrhines were present in Africa in early Oligocene times, but are unknown in Eurasia before the Miocene. Probably, like the Proboscidea, they originated in Africa during the Eocene, when that continent was isolated.

C. TATE REGAN.

British Museum (Natural History),
South Kensington, S.W.7.
Jan. 2.

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### Evolution and Evidence.

THE transfer of Down House to the British Association led me to place on record elsewhere a few memories intended to illustrate my father's character. One recollection I refrained from adding, both because it related to science and because at the critical point in my story my memory becomes hazy. Here it is, however, in case NATURE should care to publish it.

On more than one occasion I remember my father either pointing out or alluding to a part of a meadow where year after year the vegetation was different from that found in the immediate vicinity. This he did with the object of indicating that though each of these different vegetations was evidently better adapted than the other to its own locality, yet no explanation of this fact could be given, though all was taking place under our eyes. Then, with more warmth than was usual with him, he would show how weak in the light of such observations were certain arguments often brought forward against his views. But what were these arguments ? It is here unfortunately that my memory becomes defective.

All that I can do is to mention a few fallacious arguments which I *believe* are *illustrative* of what was in my father's mind when he spoke. A wonderful record now exists of the stages in the evolution of the horse, and yet we cannot indicate in what way the later forms were better adapted to their surroundings than were the earlier ones. Hence, so it is urged, this evolutionary movement cannot have been the result of improvements in adaptation due to natural selection. But if we cannot point out the nature of many of those adaptations which we know to exist in the organisms that surround us, is it not futile to hope often to be able to recognise adaptations in the imperfect records of animals which existed millions of years ago in changing environments concerning which we are very ignorant ?

Another example is the erroneous reasoning often met with in regard to orthogenesis. We should expect to find that somewhat similar species would be somewhat similarly and continuously changed in the process of evolution in order to make them better and better adapted to their somewhat similar surroundings ; and this explanation of the parallelism and continuity of direction of certain evolutionary changes which took place in the past is not proved to be false by the fact that in none of the organisms concerned can we demonstrate that an improvement in adaptation was really taking place. Then again it has been asserted that no use can be assigned to certain first recognisable modifications in fossil remains, although they seem to have been the foundations on which were built certain evidently beneficial structures which appeared in subsequent ages. But if we cannot indicate what are the relative advantages of the major differences between the plants inhabiting different parts of our meadows, why expect to be able to indicate the value of minor evolutionary changes which occurred in the remote past ?

If at the risk of uttering biological platitudes I add a few more words, it is only in the hope that I may be putting into modern dress some thoughts the underlying basis of which I probably absorbed years ago at Down. We may regard each individual organism as springing from a group of genes fortuitously selected, in accordance with certain rules, out of the limited number of different kinds of genes which are to be found at any one time in the species in question ; whilst the germinal material as a whole had been acting as a store-house for the small mutations which had taken place from time to time in the past. Some individuals will be better and some worse adapted to their surroundings, and the superior will survive in a biological sense in greater number than the inferior. When the next generation is being formed, the groups of genes thus selected will be to some extent dispersed throughout the whole interbreeding group in question. But the greater the number in the species of those genes which together would make a favourable combination, the more often would these superior individuals appear as the result of the fortuitous reassembly of such groups of genes.

If we take any two antagonistic qualities of the same individual, such as strength and agility, selection is always tending to produce the appearance of the best possible compromise between them ; and this optimum compromise may vary in accordance with very small differences in surroundings. Different

races will therefore begin to arise in different localities; for example, the weaker and more agile forms becoming more numerous where the nature of the country especially favours rapid movement. Or the same kind of differentiation of forms may take place in consequence of a different use of certain elements in the environment being made by different individuals. After this bifurcation had thus begun, other qualities would have to be differently modified so as to be brought into harmony with these changes, thus causing a further increase in differentiation; for example, in order to make the best adaptation, the weaker and swifter forms might be benefited by a change in some third quality different from that which would be beneficial to the stronger and slower types. When once bifurcation had begun, the paths along which the evolutionary changes in these local races was taking place might thus become slowly more and more divergent. We feel no jar at a railway junction, and yet we may before long be miles away from where we should have been if the points had been set differently. In somewhat the same way, the circumstances which millions of years ago turned the current of evolution in one direction rather than in another have, as a rule, left no relic by means of which they could now be recognised, even though we can clearly see the differences in the utility of many structures which afterwards came into existence.

To sum up, at Down I was led to believe that negative evidence, or rather the absence of positive evidence, can do but little towards condemning any evolutionary theory; whilst it is to positive evidence that we must look in order to decide whether in our existing state of knowledge natural selection is to be accepted as the most probable hypothesis in order, in the main, to account for such adaptations as are clearly recognisable in Nature.

LEONARD DARWIN.

Cripps's Corner,
Forest Row,
Dec. 28, 1929.

## Gaseous Combustion.

SOME years ago we began to investigate certain aspects of gaseous combustion phenomena in closed vessel explosions and in gas-engines with the aid of flame photography. Our experiments, however, appeared to lead to absurd conclusions when the flame photographs were interpreted in the light of the view that the emission of luminous radiation in gases results directly from chemical combination, and we have since been attempting to trace the origin of the luminous emission.

We are now clear that the intensity of the luminosity in an exploded gaseous mixture is wholly, or almost wholly, dependent upon its temperature (as inferred from its pressure), and that the amount of chemical combination taking place at any time has little effect, if any, upon the intensity of the emission at that time; indeed luminosity is manifest in our exploded gases at a time long after that at which combination (as inferred from the chemical analysis of rapidly cooled samples) has been completed, and if the gases in this state are adiabatically compressed they become brilliantly luminous again. Flame photographs, therefore, while they give invaluable information as to flame propagation in inflammable mixtures, yield no information as to the chemical state of the gases behind the flame front, but merely indicate their temperature.

The work of Pringsheim and others, however, has shown that the more permanent gases do not become self luminous when heated externally to temperatures at which luminosity is manifest in our exploded gases. We are thus led to infer that molecules after combination are in an abnormal condition and that in this condition the luminous vibrations of which they are capable are excited by much softer collisions than those necessary to excite the corresponding vibrations in normal molecules.

Such an inference would perhaps be easy to accept were it not for the fact that we have to postulate a very long life history for the abnormal molecules (when the combination takes place wholly in the gaseous phase). We have, for example, recently made an explosion experiment under conditions such that cooling after maximum pressure took place very slowly, in which luminosity was estimated to last for at least 14 seconds after maximum pressure, and we have little doubt that this period could be considerably extended by arranging for still slower cooling.

That chemical combination in the gaseous phase results in the formation of long-lived abnormal molecules seems to be supported by another series of experiments which we have made. In these experiments continuous records of the temperature of thin platinum rhodium wires immersed in the inflammable gases were taken during explosion and subsequent cooling and correlated with continuous records of pressure, from which, of course, the mean gas temperature could be estimated. We found that wherever the platinum wire was placed in the explosion vessel, and even when the most violent turbulence was arranged for in order to secure uniform temperature distribution in the exploded gases, the temperature of the wire was some hundreds of degrees (often 500° C. and more) above the gas temperature (as inferred from the pressure) both during explosion and for some seconds afterwards, and therefore long after all chemical combination had ceased. Similar experiments were made in a gas engine with like results. It seems possible to account for these results only by assuming that the molecules after combination hold an excess of internal energy which can be rapidly unloaded upon the surface of the hot platinum wire when they come in contact with it, and in view of the fact that the phenomenon may last for some seconds, it would appear that the molecules persist in this condition for some time when in the gaseous phase.

Reviewing our work as a whole, we think that the most probable explanation is to be found in the suggestion that combination results in the formation of molecules of carbon dioxide and water of abnormal *structure*, which may persist for some time when in the gaseous phase, but pass instantaneously into molecules of normal structure on coming into contact with a hot surface.

Briefly, our suggestion is that the overall process of combustion may be broadly analysed into two stages. The first (the combination stage) may be represented thus:

$$\boxed{A} + \boxed{B} \rightarrow \boxed{A}\ \boxed{B} + (H - x),$$

where $H$ is the heat of combustion; and the second stage (which in the gaseous phase may take many seconds), thus:

$$\boxed{A}\ \boxed{B} \rightarrow \boxed{AB} + x.$$

If A and B represent atomic nuclei and $\boxed{\ }$ an electron atmosphere, $\boxed{A}\ \boxed{B}$ gives an indication of a possible type of abnormal structure and $\boxed{AB}$ that of the normal structure. For $\boxed{A}\ \boxed{B}$ it will be remembered we have to postulate a considerable stability in the gaseous phase, but it may be that the stability is apparent rather than real, and that the apparent stability is due to continual dissociation and recombination brought about by collision or to continual interchange of partners with neighbouring molecules.

The platinum wire experiments suggest that $x$ may be an appreciable fraction of $H$, and we hope presently to test this by calorimetric methods both in closed vessel explosions and in a gas-engine.

An account of our experimental work has been prepared and will be published shortly.

It is of interest to note that our platinum wire experiments suggest that the temperature (translational energy) of a Bunsen flame may be considerably less than 1800° C., which is the usually accepted figure.

W. T. DAVID.
W. DAVIES.

Engineering Department,
The University, Leeds,
Dec. 19, 1929.

### The Mechanism of Electrolytic Rectification.

UP to the present, the two most acceptable hypotheses which have been advanced to account for the electronic valve-action of electrolytic rectifiers are (1) the hypothesis of Burgess and Hambuechen, and (2) that of Gunther-Schulze. The first accounts for the high anodic resistance, and the consequent rectification of alternating currents by assuming the formation on the anodes of an oxide-hydroxide film pierced with small holes or pores which grow smaller when the electrode functions as the anode, and larger when it functions as the cathode, thus providing a variation in electrical conductivity correlated with the direction of the current. The second hypothesis, commonly known as the gas-layer hypothesis, assumes the formation of a porous oxide-hydroxide film on the surface of the active electrode, in the pores of which oxygen gas is occluded. While functioning as the cathode, the electrons are freely discharged from the metal through the gas-layer, whereas, since electrolytes contain no free electrons, current can only pass in the opposite direction by forcing the anions through the gas-layer that they may liberate their charges to the metal—an action which demands the expenditure of very considerable energy.

During intensive work over the past four years in a successful attempt to make available the important electronic valve-action of aluminium and some of its alloys, freed from the former defects which, hitherto, have made it of little practical value, the mechanism of electrolytic rectification has been studied microscopically, and from these studies it appears that neither of the current hypotheses of electrolytic rectification are quite correct.

The chief trouble with the aluminium rectifier, both in action and while under observational investigation, has been the use of electrolytes which on electrolytic dissociation liberate ions that readily attack and combine with the electrode metals.

By using a special electrolyte which exhibits electrolytic reversibility with anodes of aluminium or aluminium alloys and cathodes of ' passive ' steel (the subject of Patent No. 284039 and others pending) it has been found that the internal resistance, together with the chemical stability of the cell, remains constant, and that the oxide-hydroxide layer on the aluminium does not, to any appreciable extent, increase in density during action.

Under these conditions the surface of the anodes in action can be seen to acquire an exceedingly thin oxide-hydroxide layer below which, here and there on the metal surface, small ' cushions ' of gas are formed. One side of the gas-cushions is in contact with the metal surface while the other is in contact with the overlying layer. When as the cathode, electrons pass from the metal into these gas-cushions, they penetrate the gas, and piercing the oxide-hydroxide layer, in ionic linkage, pass as cations to the anode. The resultant condition of the active electrode is that the metal surface is covered by the oxide-hydroxide film which, at various situations, is pierced by small holes immediately over the small cushions of gas. The minuteness of the holes, the surface-tension and gravitational pressure of the electrolyte, retain the gas within their chambers, and the unidirectional conductivity of the gas operates between the metal surface and the electrolyte.

Thus it would seem that the hypotheses of Burgess and Hambuechen, and of Gunther-Schulze, are both partially correct, and that a combination of these two hypotheses is the true explanation. Further proof of this has been found in studies of what occurs at the ' sparking-voltage ', for then the dancing scintillation denotes the disruption of the gas-cushions, the renewed access of electrolyte to metal surface, the re-formation of the rectifying gas-points, and the sequence of subsequent disruption and re-creation.

MALCOLM E. MACGREGOR.

Greenbriar,
Cobham, Surrey.

### Globular Lightning.

I HAVE recently had an opportunity of investigating what would appear to be a case of globular lightning, and as this phenomenon is relatively rare, it seems of sufficient interest to record.

In the afternoon of a day early last December, when there was a severe lightning storm in Liverpool, Mr. Holder and his sister were sitting in the morning-room of their house Browside, Mossley Hill, just

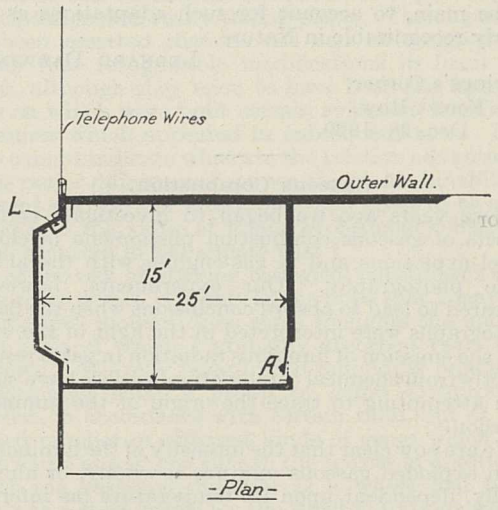


FIG. 1.

outside Liverpool. (A plan of the room in which they were sitting is shown in Fig. 1.) Almost at the same time that a heavy thunder-clap was heard, Mr. Holder observed a globe about the size and colour of an orange at the point marked $A$ in the plan. He did not observe any motion of the globe, which he first noticed when it was close to the metal door handle of the room. Immediately afterwards the globe disappeared and there was a loud explosion in the room, of such violence that the servants came from the kitchen to see what was the matter. On examination of the wall and the door there was no sign of burning, but there was a strong smell similar to that which is commonly observed near Wimshurst machines or with ozonair apparatus. The phenomenon is similar in character to those described by Dr. Russell in his

presidential address to the Institution of Electrical Engineers in 1924, and by Dr. Simpson in his review of Dr. Walther Brand's book on ball lightning (NATURE, vol. 113, 1924, pp. 677-678).

It is difficult to suggest a satisfactory explanation of this phenomenon. The only one that has occurred to me is that the lightning discharge induced a high-frequency current in the telephone wires which were carried from the side of the house to a pole about 50 or 60 yards distant, and that this high-frequency current produced something like standing waves in the telephone lead (shown as a dotted line in Fig. 1). If an antinode of pressure was formed at the point *A*, something analogous to globular lightning might have been produced at this point and thus have given rise to the phenomena observed.

The windows of the house were not open at the time and it is therefore evident that the discharge must, in some way, have been produced inside the room. Its general character corresponds fairly closely with the descriptions of globular lightning given by Dr. Russell and others, namely, "a sphere of incandescent gas of a dull reddish colour".

E. W. MARCHANT.
Laboratories of Applied Electricity,
The University, Liverpool,
Jan. 3.

### Periodicity of Leaf-fall in Singapore.

DURING the last two years I have kept regular observations, in the Singapore Botanic Gardens, of the behaviour of individual trees of species which show a marked periodicity of leaf-development and leaf-fall. I hope to publish a full report after three years, but a brief account of the results already obtained may be of interest.

Some of the trees are species of wide distribution, or exotic species, which in climates with a regular annual dry season have a leaf period of twelve months. Most of these species in Singapore have periods of less than a year. For example, the following are the approximate dates on which a tree of *Adenanthera pavonina* (Leguminosæ) has begun to produce new leaves, after brief leafless periods:

| | | | | |
|---|---|---|---|---|
| | 27.8.1927 | 22.3.28 | 21.10.28 | 28.4.29 |
| Intervals: | | 6·8 months | 7 months | 6·2 months. |

The tree is now (Nov. 1929) losing its leaves again. This species is recorded by Wright as being annual in its behaviour in four successive years at Peradeniya, Ceylon, its new leaves developing there between November and January. The tree in Singapore has flowered freely with every new crop of leaves, and has borne a full crop of ripe fruit before leaf-fall.

I have records of the behaviour of trees of a number of different species, and in some cases of more than one individual of a species. The majority of the trees keep to fairly constant periods of their own, and trees of the same species often synchronise in their periods, but not always; where they differ in times of leaf-fall, trees of the same species usually have periods of approximately the same length. Some individuals, however, appear to differ constantly by a small amount in the length of their periods from others of the same species. For example, of two trees of *Cratoxylon formosum* (Guttiferæ), one has had periods of 9·3 and 9·2 months, the other of 8·5 and 8·3 months.

In some species where the lengths of successive periods are very different, it appears that the occurrence or absence of flowering has a marked effect on the length of the periods. In the cauliflorous *Ficus polysyce*, leaf-period and fruit-period appear to be quite independent of each other. Trees with a strictly annual period appear to be rare, either among native or introduced species. Examples of annual behaviour are three very large trees of the family Leguminosæ, *Koompassia malaccensis*, *Parkia Roxburghii*, and *Hymenæa courbaril*. Of these, the first named has produced new leaves in September in three successive years, and the other two in February. Some Malayan species have periods of considerably more than a year.

The regularity of period, usually not annual, is undoubtedly connected with the very uniform climate of Singapore, both as regards temperature and rainfall. Though on the average the distribution of rain throughout the year is very uniform (there being no regular dry season), no two years are alike; I cannot, however, see any connexion between the leaf-periods of any of the trees observed and the changes of rainfall.

R. E. HOLTTUM.
Botanic Gardens, Singapore,
Nov. 24, 1929.

### A First Order Solid Phase Reaction.

IN the course of an investigation on the kinetics of the thermal decomposition of ozone sensitised by the presence of bromine vapour, a very interesting reaction came to light. Under certain conditions as to temperature and concentration of ozone and bromine (see *Z. f. anorg. Chem.*, **182**, 182; 1929; *Z. f. Elektrochemie*, **35**, 651; 1929), it was found that the bromine disappeared slowly but quantitatively from the gas phase and was deposited on the walls of the containing vessel as a solid oxide of bromine (*hitherto unknown*). Under these conditions of complete oxide formation, the residual ozone decomposed at a constant rate until nearly all of it had disappeared. The final result can be represented as $2O_3 \longrightarrow 3O_2$.

The magnitude of the constant rate portion of the reaction was found to be directly proportional to the concentration of bromine originally present, that is, $+\Delta p/\Delta t = k(Br_2)$, and therefore to the mass of bromine oxide crystals on the wall. The concentration of bromine was varied a hundredfold (0·3 mm. to 30 mm. Hg.). The rate is independent of the amount of surface, kind of material used for the reaction vessel, and oxygen, foreign gases, and ozone concentrations over a large range.

It was shown that the ozone decomposition does not take place in the gas phase. Nor can it be a surface reaction in view of the ineffectiveness of large increases in surface. Furthermore, were the latter the case, one would have expected the rate to deviate from the above relation as the surface became saturated with oxide. Even though exceedingly thick layers of oxide were deposited, the strict proportionality held.

We have been led, therefore, to the conclusion that the reaction is of the first order and takes place in the solid phase of the crystals, that is, a definite fraction of the oxide decomposes per unit time. *This appears to be the first known reaction of this kind.* For a given amount of oxide the reaction appears to be zero order, because any oxide which has decomposed is immediately re-formed by ozone, maintaining a sensibly constant amount of oxide.

The presentation and discussion of the results of this work, which was done at the Physical Chemistry Institute of the University of Berlin, will appear shortly in the *Zeitschrift f. Physik. Chem.*

BERNARD LEWIS.
Bureau of Mines,
Pittsburgh, Pa.
HANS-JOACHIM SCHUMACHER.
International Research Fellow,
Princeton University,
Nov. 30, 1929.

### A New Relativity Theory of the Unified Physical Field.

I HAVE succeeded in applying to the above question what appears to be an important new conception regarding the significance of relativity mathematics with noteworthy results.

I have abandoned altogether the quasi-geometrical interpretation with such hazy notions as parallel displacement in a curved space of $n$ dimensions. Instead, we construct an indeterminate vector field by means of Eddington's displacement rule, considered now as an association rule, and identify it at every point with the velocity a material particle might have if present there and then. Vector lines in this field are necessarily the orbits of material particles under any physical conditions.

We now construct an indeterminate tensor field, and by its means define the invariant magnitude of the elementary arc of these vector lines.

Actual physical vector and tensor fields are necessarily determinate at every point, and these are defined as usual by applying the association rule round a closed loop. This gives the usual symmetric and antisymmetric field tensors.

When the antisymmetric field tensor vanishes the vector lines reduce to Einstein's so-called geodesics. The electric field is given by the antisymmetric tensor, and here the vector lines become mathematically equivalent to the known orbit equations. Maxwell's first set of field laws are identically satisfied, and the set referring to electric charge and current are approximately true for small fields. In strong fields in the neighbourhood of atomic nuclei the electron orbits reduce again to geodesics, independent of negligible radiation due to their acceleration, and Maxwell's second set of laws no longer hold. This is obviously very strong support for our theory. But further: the introduction of field laws which reduce to Einstein's in the pure gravitation field appear to lead to a principle of selection among the orbits in nuclear regions.

Before leaving England this summer I prepared a hurried account of the above theory intended for publication in the *Proceedings of the Royal Society*. It unfortunately gave no explanation of the mathematics, which latter were faulty at one point. A careful and complete revision has now proved the soundness of the theory, and publication will follow as quickly as possible. WILLIAM BAND.

Physics Department,
Yenching University,
Peking, Nov. 26, 1929.

### Aucuba or Yellow Mosaic of the Tomato Plant: Reaction of Infected Juice.

IN the course of investigations into the physiology of virus diseases, it was observed that if the expressed juice from a tomato plant infected with aucuba mosaic disease be mixed with an aqueous colloidal solution of tomato chlorophyll, that is, the mixed green pigments extracted from fresh plant material by the method of Willstätter and Stoll from a healthy tomato plant, a marked action occurs under suitable conditions. The most striking manifestation of this action is the development of a brown colour and, apparently, the destruction of a greater or lesser amount of the chlorophyll. This browning action is either not shown or is shown to a very much smaller degree by the sap from a healthy plant.

The reaction appears to show a marked sensitiveness to light and to be greatly accelerated by a light intensity of the order of 800 foot candles at a temperature of about 30° C., thus showing a certain parallel to the development of symptoms of mosaic disease in the living plant. The reaction has not been found to occur to the same degree with a sample of infected sap which has been boiled for a few seconds, neither does it appear to be directly correlated with the oxidase or peroxidase content of the sap.

Under the conditions of experiment, the browning has not been observed to take place to any marked degree with infected sap exposed to light in the absence of colloidal chlorophyll, although it is a matter of general observation that the sap from an infected plant either is brown or becomes brown on keeping. Yet at the dilutions employed in the experiments referred to, this brown colour is scarcely perceptible and cannot account for the marked change on exposure to light, which is not shown by the sap in the absence of colloidal chlorophyll.

These observations suggest that this reaction may provide a quick and quantitative means of studying *in vitro* the nature of the virus and its reactions, the examination of which up to the present has entailed prolonged inoculation experiments.

Critical investigations are in hand with the view of obtaining a fuller understanding of this and cognate phenomena. W. F. BEWLEY.
BERNARD J. BOLAS.

Experimental and Research Station,
Cheshunt, Herts.

### The Vapour Density of Sodium.

THERE is plenty of evidence in the literature to the effect that the vapour of sodium is monatomic. Robitsch (*Ann. Physik*, **38**, 1027; 1912) determined the velocity of sound in the vapour at the boiling point and calculated the ratio of specific heats to be 1·68, and Taylor (*Phys. Rev.*, **28**, 576; 1926) found no evidence of molecules at pressures of $10^{-2}$ mm. Other evidence, which need not be considered here, tends to corroborate this opinion.

With the discovery of the band spectra of diatomic molecules in the vapour of the alkali metals, it became necessary to consider the possibility of molecular association in the vapour state. Carelli and Pringsheim (*Zeit. f. Physik*, **44**, 643; 1927) calculated the heat of dissociation for the potassium molecule to be 0·61 volt. A thermodynamic calculation indicates that potassium vapour will be associated to a very slight extent. For sodium the best value of the heat of dissociation is that of Loomis (*Phys. Rev.*, **31**, 323; 1928), $1{\cdot}0 \pm 0{\cdot}1$ volt, and thermodynamic calculations have been made which predict that there will be more molecules than atoms in the vapour of sodium near the boiling point. Recently, Mr. E. G. Walters, working with me in this laboratory, has re-determined very carefully the vapour pressure and vapour density of sodium. A complete account of the work will be published elsewhere, but it may be noted here that an apparent molecular weight of 25 was found for the saturated vapour at 706° C. By substituting the value of the equilibrium constant calculated from this result in the equation of Gibson and Heitler (*Zeit. f. Physik*, **49**, 465; 1928) a value of about 0·75 volt is obtained for the heat of dissociation. The agreement between this result and the value obtained by Loomis from band spectra cannot be considered entirely satis factory without extending unduly the limits of probable error for one or both of the determinations.

There is no reason to change the value for the entropy of monatomic sodium vapour calculated by Rodebush (*Proc. Nat. Acad.*, **13**, 185; 1927).

W. H. RODEBUSH.

University of Illinois,
Nov. 25, 1929.

### Native Policy in South Africa.

I HAVE not read a full report of General Smuts's recent lecture at Oxford, but the note on p. 816 of NATURE of Nov. 23 suggests some questions.

Is not the suggestion of segregation of the indigenous peoples of South Africa just about three hundred years too late? The first colony of Europeans was established at the Cape of Good Hope in 1651. If the Africans were segregated, should they be denied the benefits of modern science, especially in health, hygiene, and transport? In July there were articles in a Cape Town newspaper mentioning rates of infant mortality among the Africans, commonly 300 to 400 to the 1000 and rising in certain places to more than 500 to the 1000, while in the case of Europeans it was said to be less than 100 to the 1000. To this was attributed the stability of the ratio between Europeans and coloured in South Africa at the present time. The full benefits of science can only follow the general spread of education.

Is not the advantage of trying to maintain tribal distinctions a fallacy? Have there not been discussions in favour of a United States of Europe? How would tribal segregation have worked in Britain? Think of the Scots pursuing their native customs north of the Tweed within a ringed fence, so to speak. The breaking down of small tribal units and the synthesis now in progress must be beneficial in stemming strife and helping advancement. This is occurring particularly under the influence of the great mining organisations, drawing labour from distant fields, and in turn calling on farmers for more foodstuffs so that they also have to employ more labour.

With the increasing ease of communication, which the African has been quick to adopt, the problem of the relations of the races must be solved on a basis much wider than that afforded by the limits of the Union of South Africa. With this in view, the colonists in South Africa are no doubt already studying conditions in other parts of the Continent.

G. W. GRABHAM.

The Athenæum,
Pall Mall, S.W., Dec. 15, 1929.

### The Stern-Gerlach Experiment with Active Nitrogen.

IN view of the frequent use of these columns for the discussion of the problem of active nitrogen, it may be of interest to record the following observation. A stream of nitrogen, activated by means of a condensed electrical discharge, was submitted to analysis by the Stern-Gerlach method. The active nitrogen, after passing through the non-homogeneous magnetic field, struck a screen coated with silver nitrate, producing a brownish-black trace thereon. To be able to interpret the trace, the apparatus was calibrated by running hydrogen through it, so obtaining the trace for atomic hydrogen, the splitting of which corresponds to mg. $= \pm 1$. The trace obtained with active nitrogen gave mg. $= \pm \frac{1}{3}$. This value is characteristic of the $^2P_{\frac{1}{2}}$ state of the atom. This observation thus gives a partial confirmation of the most recent views as to the nature of active nitrogen. Thus Kaplan and Cario (*Zeits. f. Phys.*, **58**, 769; 1929) suppose that the after-glow in nitrogen is produced by the interaction of a metastable nitrogen molecule in the $^3\Sigma$ state with metastable atoms in the $^2P$ and $^2D$ states. The chemical activity is ascribed to the metastable atoms. The presence of $^2P$ metastable atoms and the fact that they are chemically active is established by the above observation.

It is, however, of considerable interest to note that though the exposures were continued up to as much as 40 hours, no evidence of anything but the $^2P_{\frac{1}{2}}$ state was obtained, although the $^2P_{\frac{3}{2}}$ state, in particular, would have been expected as well, since the whole $^2P_2$ level is presumably metastable and the separation $^2P_{\frac{3}{2}} - {}^2P_{\frac{1}{2}}$ is only about 1 cm.$^{-1}$, according to Compton and Boyce (*Phys. Rev.*, **33**, 145; 1929).

Full details will be published elsewhere.

L. C. JACKSON.

H. H. Wills Physical Laboratory,
The University, Bristol.

### The Spectrum of Ionised Mercury Hydride.

WHEN an arc discharge between mercury and tungsten electrodes in an atmosphere of hydrogen at 2 mm. pressure takes place at such a low voltage (about 60-70 volts) that it cannot last more than a fraction of a second, the system of mercury hydride bands appears with remarkable intensity. The set of bands occurring in the far ultra-violet, which was first recorded by Jezewski (*Jour. d. Phys. et le Radium*, Sept. 1928), has now been found to be associated with ionised mercury hydride. It can be definitely proved that it belongs to a $^1\Sigma \rightarrow {}^1\Sigma$ system, the molecular constants being:

| | $B_0$ | $\alpha$ | $J_0$ | $r_0$ | $\omega_0$ | $x$ |
|---|---|---|---|---|---|---|
| Final state $^1\Sigma$ | 6·57 | 0·19 | $4{\cdot}21 \times 10^{-40}$ | $1{\cdot}59 \times 10^{-8}$ | 2016 | 0·020 |
| Initial state $^1\Sigma$ | $5{\cdot}8_8$ | $0{\cdot}3_2$ | $4{\cdot}7_0 \times 10^{-40}$ | $1{\cdot}6_9 \times 10^{-8}$ | $164_7$ | $0{\cdot}04_2$ |

Zero-lines of the bands arranged in the $n'/n''$ table are:

| $n'$ \ $n''$ | 1/2 | 3/2 | 5/2 | 7/2 |
|---|---|---|---|---|
| 1/2 | 44108 | 42168 | 40302 | |
| 3/2 | | 43676 | 41810 | 40029 |
| 5/2 | | | | 41398 |

Details will be given elsewhere.

TAKEO HORI.

Physical Laboratory,
Port Arthur College of Engineering,
South Manchuria.

### Width of Head and Pelvis in *Homo*.

IN the *American Journal of Physical Anthropology*, April–June 1929, Prof. John Cameron cites cranial measurements of numerous races, showing that the female skull is proportionately broader than that of the male. The races measured are Bushman, Hottentot, various groups of negroes, Melanesian, Tasmanian, and Australian. It occurred to me that the adaptive character of a broad pelvis might perhaps be correlated with an increased breadth of the head, the latter being then a secondary consequence of a sexual character of functional importance. The breadth of the head (relative breadth) might again perhaps have other consequences.

Prof. Cameron writes me that the idea had not occurred to him, and his present opinion is that we have to do with a coincidence. Yet the suggestion may be worth considering. It would, of course, be very easy to obtain numerous head and pelvic measurements from living individuals, which would show any individual correlation that might exist.

Possibly this whole matter has been discussed somewhere already. Darwin remarks that some believe that the shape of the pelvis influences by pressure the shape of the head of the child.

T. D. A. COCKERELL.

University of Colorado,
Boulder, Colorado, Dec. 11, 1929.

## Weather Recurrences and Weather Cycles.[1]

By Sir RICHARD GREGORY.

EVERY year the weather is in some sense abnormal, but the past twelve months have given us rather more than our fair share of extremes, beginning with the most severe winter since the famous frost of 1895, continuing through several long periods of drought to the rainiest November on record. Unusual weather always leads to much discussion in the Press of the time-honoured subject of weather cycles, and 1929 was no exception. The point that the interval of thirty-four years since 1895 was within a year of the famous Brückner cycle was not missed, and the spells of cool rainy weather which tempered the dryness of spring and summer have been widely hailed as manifestations of the ' Buchan cold spells '.

Buchan, it may be recalled, was much interested in tracing annually recurrent spells of unexpected weather. Thus a cold spell has been stated to occur regularly early in May, and has been associated with the so-called ' ice-saints '. Various explanations have been offered to account for this cold spell, the most popular being that in the course of the regular annual series of pressure changes which result from the increasing power of the sun in spring, an anticyclone develops over northern Europe at the time and causes a period of north-easterly winds. Another cold spell is supposed to occur in June, caused by the development of monsoon winds blowing into the interior of Europe. Buchan in 1869 enumerated as many as nine such periods, to which he assigned the following dates :

| *Cold Periods.* | *Warm Periods.* |
|---|---|
| 1. Feb. 7–14. | 1. July 12–15. |
| 2. April 11–14. | 2. August 12–15. |
| 3. May 9–14. | 3. Dec. 3–14. |
| 4. June 29–July 4. | |
| 5. Aug. 6–11. | |
| 6. Nov. 6–13. | |

These nine periods were deduced from observations in Scotland during a period of ten years in the middle of the nineteenth century. In spite of this limitation, however, they have been assumed by many newspaper correspondents to be equally valid for the temperature of London in the twentieth century. Such an assumption is quite unwarranted, and Buchan, if he were alive to-day, would be the first to reject it. No scientific evidence has ever been adduced that cold or warm periods have any tendency to occur in London on Buchan's dates.

Alone among modern weather cycles, that of thirty-five years has a background of tradition, for it was described by Sir Francis Bacon before 1625. Many people are familiar with the passage from his essay " Of Vicissitudes of Things ":

> There is a toy, which I have heard, and I would not have it given over, but waited upon a little. They say it is observed in the Low Countries (I know not in what part) that every five and thirty years the same kind and suit of years and weathers comes about again, as great frosts, great wet, great droughts, warm winters, summers with little heat, and the like, and they call it the prime ; it is a thing I do the rather mention, because, computing backwards, I have found some concurrence.

This weather cycle was rediscovered and carefully investigated by the late Dr. Eduard Brückner, then professor of geography at the University of Bern, and it is now known generally as the Brückner cycle. His great work, " Klimaschwankungen seit 1700, nebst Bemerkungen über die Klimaschwankungen der Diluvialzeit ", published in 1890, has become a classic for the patient collection and analysis of material from a great variety of sources. He studied all the long records of rainfall, pressure, and temperature available at the time, and carried the record back into earlier centuries by utilising the variations of level in the Caspian Sea and other lakes in enclosed basins and in the great river systems of the world, the historic variations of ice conditions on the rivers of Europe, the dates of the wine harvest, and the frequency of severe winters.

From all this material Brückner deduced the existence of a long succession of cycles—series of generally warm and dry years alternating with series of generally cool and rainy years. From A.D. 1020 to 1890 he found twenty-five cycles, giving an average length of 34·8 years, but the individual cycles varied between twenty and fifty years. With this in mind, we must not expect too much from the Brückner cycle, for so great is this variation that only one cycle out of five comes within $2\frac{1}{2}$ years of the expected length. When in addition one remembers that the amplitude of the variations is so small that in meteorological statistics the existence of the cycle can only be seen at all as the result of extensive smoothing, it becomes obvious that the Brückner cycle is useless for the purpose of making long-range forecasts of weather, and the interval of thirty-four years between the cold winters of 1895 and 1929 takes its proper place as a mere coincidence.

The true value of Brückner's work lies in a different direction. Although the amount of rainfall may vary widely from one year to the next, the quantity of water which is stored up on the land areas, in the soil, in lakes, and in glaciers, varies far more slowly. This stored water is not so closely related to the rainfall of the one preceding year as to the average rainfall of the ten preceding years, and if these ten years fall in the wet half of a Brückner cycle, the quantity of stored water will be great. Again, in the dull rainy countries of north-west Europe, warm dry years are favourable for crops and vegetation, and on the whole the dry warm half of a Brückner cycle will yield better crops than the cool wet half, although there may be wide variations from one year to the next. An agricultural community must take the bad years with the good, and trust to the surplus from a rich

[1] From the presidential address to the Royal Meteorological Society delivered on Jan. 15.

harvest to tide over a year of dearth; but at the end of the warm half of the cycle the community will be prosperous, while at the end of the cold half it will be poor. Hence waves of emigration and the movements of peoples are closely related to climatic cycles such as Brückner's, which in this way may leave their mark on history. That, and not long-range forecasting, is the rôle of the weather cycle.

In the rainfall of Great Britain the Brückner cycle is far less important than one of fifty years. The authoritative pronouncement made by the Council of the Royal Meteorological Society in the matter of the supposed influence of broadcasting on weather contained a passage pointing out that groups of wet years in England have occurred about 1770, 1821 to 1830, 1871 to 1880 and 1922 to 1928, four recurrences at intervals of about fifty years, separated by groups of dry years in 1741–50, 1801–10, 1851–70 and 1891–1910, the inference being that the wet years since 1922 were due to some natural period of oscillation of the rainfall, and not at all to the relatively small electrical disturbance of the ether by human agencies.

Much attention has been given to the sunspot cycle in relation to weather, and the literature of this subject is enormous. Sunspots are a useful index of the activity of the sun, and they go through a not very regular cycle with an average length of 11·125 years. Taking account of the change of polarity discovered by Dr. G. E. Hale, it is more accurate to say that sunspots go through a double cycle of 22·25 years. In terrestrial phenomena, these changes of solar activity are accompanied or closely followed by fluctuations in the elements of terrestrial magnetism and by variations in the frequency of auroræ. In matters of weather, a connexion with temperature was first suspected by Ricioli so early as 1651, and was clearly demonstrated, for tropical regions, by W. Köppen in 1873. A fairly close relationship has been traced by Dr. C. E. P. Brooks between the sunspot number and the rainfall in certain parts of equatorial Africa, especially the plateau of Lake Victoria, and the eleven-year cycle in the level of this lake, which rises and falls with the rise and fall of solar activity. This is one of the most striking illustrations of the connexion between solar and terrestrial phenomena, as may be seen from the accompanying diagram (Fig. 1), reproduced from Dr. Brooks's memoir.[2] A similar relationship is found in Lake Albert and farther south in Lake Nyasa, though in the latter it is somewhat obscured by the large annual variation in the level of the lake and by other factors.

In Great Britain the eleven-year sunspot cycle, like the Brückner cycle, is of little importance. Although we are undoubtedly governed in the long run by solar influences, these find their way from equatorial to temperate latitudes by many and sometimes devious routes, winds, ocean currents, and so forth, so that their unity becomes lost and they appear as an irregular series of changes following no apparent law. For example, it was found by Dr. G. Hellmann that the rainfall of Europe has two maxima and two minima in each sunspot period, and he explained this as due to the combination of two causes, the direct effect of the solar variations on the weather of Europe and the indirect effect due to changes at the equator extending their effect northwards. In 1928, Dr. Brooks, after an examination of the relation between sunspots and pressure, both at individual stations and the distribution of pressure as a whole, concluded "that at present the variations of sunspots in the eleven-year cycle cannot be taken into account in predicting quarterly mean deviations of pressure in the eastern North Atlantic or western Europe.

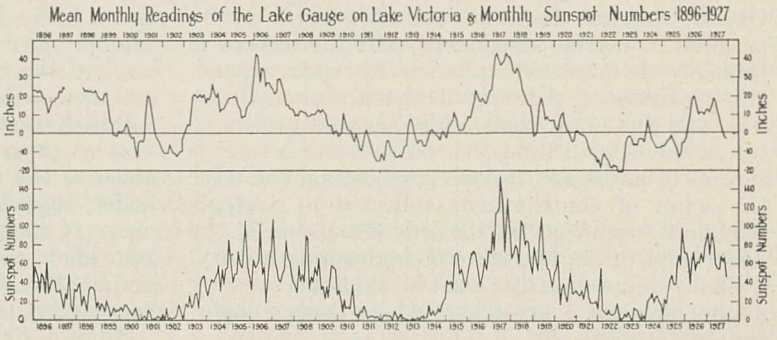


FIG. 1.

The suggestion has been made, notably by Defant, that there is a natural period of about $3\frac{1}{2}$ years in the oscillation of the earth's atmosphere, which requires to be set going by some vigorous impulse; Defant found such an impulse in a violently explosive volcanic eruption. Others, notably Sir Norman and W. J. S. Lockyer, have found in them yet another manifestation of solar influence, such for example as is shown in the distribution of solar prominences. In some parts of the world, notably the East Indies, these periodicities of a few years are of undoubted value in forecasting the general rainfall some months ahead; in Great Britain they have at times reached a spectacular development, but always, just when they seemed to have established themselves thoroughly, they changed the length of their phase, or otherwise proved themselves unstable as water.

As the result of a great amount of research into a single definite problem, Mr. J. Baxendell was able to show in 1925 that we possess more exact information about a 5·1-year periodicity in British weather than about any similar phenomenon. The story of this period, as unfolded by the late Carle Salter and J. Glasspoole, begins in 1868. For fifteen years, up to 1882, each fifth year (1872, 1877, 1882) was very much wetter than any

[2] Air Ministry, Meteorological Office. *Geophysical Memoirs*, No. 20. (London: H.M. Stationery Office, 1923.)

of the remaining twelve. Then this series broke down, but from 1889 until 1909 there was a most remarkable sequence in which every third year was abnormally wet. The years 1891, 1894, 1897, 1900, 1903, 1906, and 1909 were all wetter than the average; of the remaining eighteen, one was exactly normal and the others were all dry. After 1909, however, the sequence changed to an almost equally remarkable two-year oscillation. From 1910 until 1922 the even years were all much wetter than the average, while the odd years were all dry, with the sole exception of 1915, and even that year was drier than either 1914 or 1916. After 1922 this two-year sequence broke down, and now we seem to have returned temporarily to the three-year type.

## Progress in Naval Engineering.

By Eng. Capt. EDGAR C. SMITH, O.B.E., R.N.

THOUGH surpassed in length by the presidential address of Sir William White to the Institution of Civil Engineers in 1903, the Thomas Lowe Gray lecture delivered to the Institution of Mechanical Engineers on Jan. 3 by Engr. Vice-Admiral R. W. Skelton, Engineer-in-Chief of the Fleet, on progress in marine engineering, bears comparison with it as an authoritative official review of an important subject. While Sir William White traced the evolution of mercantile and naval vessels, Admiral Skelton confined himself to the progress in marine machinery, and his lecture is probably the most extensive survey so far written. His predecessors, Admirals Durston, Oram, Goodwin, and Dixon, in their addresses and papers to the technical institutions, have all dealt with various aspects of naval and marine engineering, and were the series of contributions collected in a single volume it would go far towards filling one of the many gaps in the literature of engineering history. Such a volume should at least be available in every man-of-war and every school where marine engineering is studied.

Though not mentioned by Admiral Skelton, the first suggestion for a steam-driven war vessel was made to the Admiralty by Earl Stanhope. For him the authorities built the 'ambinavigatorship', called the *Kent*, and so sure did Stanhope feel that he was on the high road to success that in June 1794 he signed a bond with a penalty of £9000 "to indemnify the public in case the said ship should not answer the purpose of Government". The inventor did not merely intend to produce a result, but he hoped "to establish every part of the subject on clear and irrefragable proofs, and to ascertain demonstratively what is the best possible plan". The experiments failed and the matter was dropped, without Stanhope, however, being kept to his bond. Twenty years elapsed before the Navy had anything more to do with steam, and then the suggestion came from Sir Joseph Banks. Capt. Tuckey was preparing for surveying the river Congo in the *Congo*. Why not fit her with a steam engine? Constructed by the greatest engineering firm in the world, Boulton and Watt, the engine was delivered, put into the ship, taken out again and set up in Chatham dockyard. So heavy was the machinery that the *Congo* would have foundered in any sort of sea, and Capt. Tuckey therefore wisely decided to stick to sails. Five or six years passed and with the building of the *Comet*, *Lightning*, and other small steam craft began a series of revolutionary changes in everything pertaining to warships.

It cannot be said that early naval requirements made any severe call on the engine constructors of the day. Fulton had launched the *Clermont* in 1807, Bell the *Comet* in 1812, and steam vessels were proving their worth on every ocean. But few realised the value of steam in war vessels, and there was no more stubborn opponent of steam than Capt. Sir William Symonds, the Surveyor of the Navy. The Russian War of the 'fifties, however, showed the futility of any longer trusting exclusively to the wind, and on April 22, 1854, the officers and men of the Black Sea fleet saw for the last time a British frigate in action under sail. By that time, slow as progress had been, the paddle had given place to the screw, the flue boiler to the tubular boiler, engines were becoming more powerful, and many of the younger generation of naval officers, who knew more about railways and electric telegraphs than of the fighting of the Napoleonic wars, had eagerly taken up the study of engineering.

Admiral Skelton gave much interesting information regarding those early days, and then proceeded to review matters which are more familiar to our ears. He was unable to read the whole of the lecture, which, however, will be published in full by the Institution of Mechanical Engineers. When available it will be seen to contain as an appendix a tabulated statement of some forty ships, from the fine paddle frigate *Terrible* of 1842 to the cruiser *Berwick* of 1925. It is a happily chosen list, and the progress of naval engineering could well be traced by a study of a ship from each decade. The fourth ship in the list is the *Agamemnon* of 1851. Other wooden two-deckers had been altered to receive the screw, but the *Agamemnon* was the first of her class to be designed as a screw ship. Her engine by Penn would reflect credit on any shop to-day. It was a simple expansion horizontal engine with two cylinders fitted with trunk pistons something like the pistons found in a motor-car. The square tubular boilers generated steam at 20 lb. pressure, and the engine developed 2268 h.p. The machinery weighed 320 lb. per h.p., cost £15 9*s*. per h.p., and consumed 5 lb. of coal per h.p. per hour. Compare this with the *Berwick*, the machinery of which, developing 80,000 h.p., weighs only 45·5 lb. per h.p., cost but £5·6 per h.p., and consumes only 0·89 lb. of oil per h.p. per hour.

Under the command of Capt. W. R. Mends the

*Agamemnon* was sent to the Mediterranean under sail; took part in the bombardment of Sevastopol in October 1854, and the following month successfully rode out the great storm which worked havoc in the fleet. Mends, who had studied the steam engine, had an anxious time, but after the storm wrote to his wife: "I soon had a third anchor down and kept the engine going to ease the cables, which, thanks to James Watt, enabled the good ship *Agamemnon* to ride easily".

The twenty pounds pressure of the *Agamemnon* represented the general practice at sea, marine engineers being timid regarding the use, and ignorant of the value, of high pressure steam. A step forward was made in the *Constance* of 1860, which had John Elder's compound engines working with 30 lb. pressure. No one would want to be shipmates with her engines to-day, for they were most difficult to handle and maintain. Elder, however, was the leading advocate of the compound engine, around which a tremendous controversy raged, but which by the 'seventies was specified for all naval vessels. The early twin-screw ironclad *Dreadnought* of 1872, for example, had vertical compound engines of 8207 h.p. working at 60 lb. pressure, and her coal consumption was but 2·32 lb. as against the 5 lb. of the *Agamemnon* of twenty years earlier. It was about this time that engineers began to understand something of the work of Joule and his contemporaries on the mechanical equivalent of heat. In the Royal School of Naval Architecture and Marine Engineering, too, naval engineers were trained under some of the finest teachers of the day, among whom was Prof. Unwin, who is happily still with us, a veteran of more than ninety years.

From the 'seventies onward change succeeded change. The compound engine of Elder gave way to the triple expansion engine of Kirk, square boilers were replaced by cylindrical boilers, steam invaded every part of the warship, and the chief engineer of an ironclad became the head of a staff upon whose efforts mainly depended the efficiency of the ship as a fighting machine. Nineteenth century mechanical engineering could show nothing finer than the great triple-expansion reciprocating engines such as were found in the Atlantic liners, and in such cruisers as the *Drake* and *Good Hope*, each set of the engines of which developed 15,000 h.p. They were constructed when the demands of the naval authorities for greater speeds were incessant and when the attempts to comply with those demands brought a whole host of difficulties. There were troubles with boilers, with condensers, with bearings, thrusts, pistons, pumps, auxiliaries, packings, pipes, joints, glands, and valves. Engine designers did their utmost to overcome the defects, but it was, as Admiral Skelton said, upon the engineering branch of the Navy that the brunt of the work fell. Yet it was also in the arduous times of the 'eighties and 'nineties that naval engineers gained the experience which proved of such vital importance to the Empire during the War.

Of the forty-four ships in the Table, fifteen are turbine driven. The list begins with the *Amethyst* and *Dreadnought*, and includes such well-known vessels as the *Glasgow*, *Lion*, *Hood*, and *Nelson*. No one is likely to disagree with the remark that the successful application of the steam turbine afloat was largely due to the soundness of the conceptions of the inventor and his thorough exploratory work in connexion with the marine application. Had all innovations into the engine rooms of warships been accompanied by as few setbacks as was the turbine, naval engineering recollections would be far less interesting than they are. The importance of the change from reciprocating engine to steam turbine is comparable with the importance of the change from paddle to screw; and so far as can be seen at present the turbine appears likely to hold its own for warship propulsion for a long time.

The introduction of the water-tube boiler came before the turbine, but the change from coal burning to oil burning has taken place in the last twenty years, and improvements in the stokehold have been as great as those in the engine room. The results can be seen by comparing the *Dreadnought* of 1905, the *Hood* of 1916, and the *Berwick* of 1925. The weight of machinery per horse-power, has diminished in the ratio 184 : 84 : 45·5, the square feet of floor space required per horse-power in the ratio 0·45 : 0·136 : 0·118, while the cost of the machinery per horse-power of the three ships was £13·9, £9·6, and £5·6 respectively. There is necessarily an ultimate limit in the possible reduction in weight and size and fuel consumption, and some writers forty years ago thought they were within measurable distance of it, but the age of improvement is still with us and engineers are still striving, like Earl Stanhope, to determine "what is the best possible plan".

## Obituary.

### Major P. G. Craigie, C.B.

MAJOR PATRICK GEORGE CRAIGIE, the leading authority for some half a century on agricultural statistics, died on Jan. 10 at the age of eighty-six years. Educated at Perth, the University of Edinburgh, and St. Catharine's College, Cambridge, he acted as secretary to the Local Taxation Committee from 1871 until 1890 and of the Central Chamber of Agriculture from 1879 until 1890. He was twice employed by Royal Commissions to report on the markets of Paris and Brussels, and on the agricultural schools of France. Shortly thereafter, on the formation of the new Board of Agriculture, he was selected as the obvious man for the directorship of the Statistics, Intelligence, and Education Branch, a post which he held from 1890 until 1897, when he became Assistant Secretary, retiring in 1906. Craigie was the founder of modern British agricultural statistics, and their value is largely due to his enthusiasm and initiative.

In spite of the heavy pressure of official duties, Craigie found time for much other work. He became a fellow of the Royal Statistical Society in 1874, acted as one of the honorary secretaries from 1887 until 1902, and during 1902–4 occupied the presidential chair. To the *Journal* of the Society he contributed a long series of papers, amongst others: "The Cost of English Local Government", 1877; "Ten Years' Statistics of British Agriculture", 1880; "Statistics of Agricultural Production", 1883; "The Size and Distribution of Agricultural Holdings in England and Abroad", 1887; "The English Poor Rate, Some Recent Statistics of its Administration and Pressure", 1888; and his presidential addresses of 1902 and 1903.

He was president of Section F (Economic Science and Statistics) of the British Association in 1900, and of the Sub-Section for Agriculture at the Winnipeg meeting of 1909. In the work of the International Statistical Institute he took a very active part, attending the meetings for many years as official British delegate; for a short period he was secretary-general and later treasurer. The value of his services to statistical science, especially in relation to agricultural statistics, was recognised by the award to him, in 1908, of the Royal Statistical Society's Guy Medal in gold.

A most kindly and genial man, "a redoubtable champion of agricultural interests, a pioneer of agricultural progress, a successful administrator during the seventeen years that he laboured at the Board of Agriculture, and probably the most loved of all officials who ever entered its portals", as Lord Bledisloe states in the *Times*, Major Craigie was greatly missed by many friends in London when, after his retirement, increasing years and infirmity kept him at his home in the west of England.

## Herr Carl Schoch.

Carl Schoch died on Nov. 19, 1929, at the age of fifty-six years. His death deprives astronomy of a very active student of ancient astronomical records, who has contributed to the improvement of chronology by the identification of several eclipses and other astronomical phenomena: for example, his identification of the lunar eclipse observed at Ur in B.C. 2283 is used by Prof. S. Langdon in his recently published chronological tables. His astronomical studies have been going on since 1900. He made a new determination of the *arcus visionis*, or distance from the sun at which different objects could be detected at their heliacal rising. He also studied the rules that were followed in Babylonia, etc., as regards the insertion of intercalary months, a matter of great importance in the identification of recorded phenomena. He worked for a time at Oxford, assisting Dr. J. K. Fotheringham in the studies that he made, in conjunction with Prof. Langdon, on the Venus tablets of Ammizaduga. That work contains, as an appendix, tables of the moon and planets prepared by Schoch, which extend back to B.C. 3507. The secular accelerations play an important part in deducing positions at such remote dates. Schoch made an independent study of these, reaching results nearly identical with those deduced by Dr. Fotheringham. In 1928 he published a revision of Oppolzer's 'Syzygientafeln', which greatly increased their accuracy. Many of his astronomical conclusions have been referred to from time to time in our columns.

We regret to announce the following deaths:

Prof. H. L. Callendar, F.R.S., professor of physics in the Imperial College of Science and Technology, on Jan. 21, aged sixty-six years.

Prof. Ludwig Claisen, of Kiel and Berlin, well known for his work in organic chemistry, on Jan. 5, aged seventy-eight years.

Dr. Harry Taylor Marshall, since 1908 Walter Reed professor of pathology and bacteriology in the University of Virginia, who was president in 1922 of the American Association of Pathology and Bacteriology, aged fifty-four years.

Mr. F. P. Ramsey, lecturer in mathematics in the University of Cambridge, on Jan. 19, aged twenty-six years.

Sir George Thane, professor of anatomy at University College, London, from 1877 until 1919, on Jan. 14, aged seventy-nine years.

Dr. Victor C. Vaughan, formerly dean of the Medical School of the University of Michigan, member of the National Academy of Sciences and past president of the American Medical Association, known for his work on bacterial toxins, on Nov. 21, aged seventy-eight years.

## News and Views.

Congratulations from many in the world of science will be accorded in the coming week to Sir Robert Elliott-Cooper, K.C.B., a past president of the Institution of Civil Engineers, and among the oldest of English engineers, who celebrates on Jan. 29 his eighty-fifth birthday; also to Dr. Henry O. Forbes, anthropologist, botanist, and pioneer traveller in many lands, who is seventy-nine years of age on Jan. 30. The former is a Yorkshireman, and he was educated at Leeds Grammar School. Entering the firm of Messrs. John Fraser, of Leeds, he left them in 1876 to engage in professional work in London, gaining a high reputation as a civil engineer. Whilst president of the Institution of Civil Engineers, Sir Robert was responsible (1912) for an address which embodied a comprehensive and detailed survey of engineering projects completed or in hand in the overseas Dominions, Crown Colonies, and other parts of the British Empire. Then, during the War, he was chairman of the War Office Committee of the Institution, perhaps the most signal as well as final expression of consistent and devoted public service. We may add, however, to the record, his active interest in the advancement of the National Physical Laboratory. There is a portrait of Sir Robert hanging in the apartments of the Institution of Civil Engineers.

DR. HENRY O. FORBES was born at Aberdeen, and educated there at its Grammar School, graduating afterwards at the university, and at Edinburgh. Exploratory work in little-known regions of the world became a fascinating and compelling outlet for his activities, and this very early in life. More than fifty years ago he was exploring and collecting in Java, Sumatra, and Timor. The Royal Geographical Society allotted him the Gill Memorial Award in 1893 for explorations and observations in New Guinea, the Malay Archipelago, and Chatham Islands. In 1890–93 he was director of the Canterbury Museum, New Zealand. From 1894 to 1911 he was Director of Museums to the Corporation of Liverpool. The British Association found a zealous coadjutor in Dr. Forbes, whether as a member of council, lecturer, or in a consultative capacity. Apart from book-writing, Dr. Forbes is the author of various memoirs, detailed in the Royal Society's "Catalogue of Scientific Papers", among which is "New Guinea: attempted Ascent of Mount Owen Stanley". The Government of Peru commissioned him in 1911–13 to report upon the birds of the Guano Islands. Dr. Forbes is an honorary LL.D. of Aberdeen.

AT the annual general meeting of the Royal Meteorological Society on Jan. 15, the Symons Memorial Medal for distinguished work in meteorology was presented to Dr. G. C. Simpson. Dr. Simpson received his academic training at the University of Manchester, where he became interested in meteorology, and especially in atmospheric electricity. A research studentship enabled him to carry out an investigation into the ionisation of the air in high latitudes, at Karasjok in Lapland. On his return to England, he was for a short time attached to the Meteorological Office, after which he took up an appointment as reader in meteorology at his old university, where he conducted an important series of kite ascents at the University Observatory on Glossop Moor. In 1906 he joined the Indian Meteorological Department, and in 1910–12 he was granted leave of absence to take part in Capt. Scott's second South Polar Expedition. His two volumes on "Meteorology", which form part of the results of that expedition, added greatly to our knowledge of the atmosphere in the Antarctic.

AFTER a period of War service, in 1920 Dr. Simpson was appointed a member of the Nile Irrigation Commission, and spent six months studying conditions in Egypt. In September of that year he became Director of the British Meteorological Office. Throughout his career he has maintained his interest in research, especially in atmospheric electricity, where his fundamental investigations into the origin of the electric charges in thunderstorms by the breaking of raindrops were followed by critical studies of the mechanism of thunderstorms and the nature of lightning. In recent years he has become interested in the problems of radiation, and has shown how cycles of solar radiation are able to account in a remarkable way for the phenomena of the Quaternary Ice Age, including the succession of glacial and interglacial periods and the increased rainfall in unglaciated regions.

REFERRING to our remarks last week (p. 97) on Syon House and estate at Isleworth, where it is proposed to place a sewage disposal works, a correspondent reminds us that during the life of Sir Henry Percy, ninth Earl of Northumberland, Syon House was frequently the home of some of the early English men of science. Born in 1564, Earl Percy served in the Low Countries, fitted out a ship for fighting against the Spanish Armada, and was a staunch supporter of the Stuarts. Though a Protestant, he was, however, tried for treason after the Gunpowder Plot and spent many years in the Tower. His love of astrology and scientific experiments caused him to be called "The Wizard Earl". The English mathematician Nathaniel Torporley (1564–1632), the friend of Vieta, Thomas Allen (1542–1632), who wrote an exposition of the works of Ptolemy, and Thomas Harriot (1560–1621), "the universal philosopher", a correspondent of Kepler, and the first in England to observe sunspots, were all patronised by the Earl, and Harriot for many years lived in the old Syon House. After the Earl had been committed to the Tower, Walter Warner, Thomas Hughes, and Harriot, like Raleigh, often kept him company there and were known as his "three magi". Torporley bequeathed to Syon House all his books, maps, and instruments.

THE Institute of Industrial Administration, to which reference is made in our leading article this week, has laid down a definite course of instruction and established an examination for a diploma in industrial administration. This is a step towards making industrial management a 'profession'; and it should do something to mediate between the equally excusable but equally unsatisfactory opposite suppositions—that educated men, on one hand, are incompetent in industry and, on the other, that the hand-to-mouth methods of the uneducated practical man are efficient. Clearly, we can combine practical experience of the workshop with a wider knowledge of psychology, economics, and government than our old-fashioned managers had. A more fundamental issue, however, has still to be faced, if we are in earnest about rationalisation; for the directors themselves in certain enterprises seem to be incompetent. It is not good sense, for example, to have as directors in a chemical trade men who know nothing at all of chemistry, or to have architects who know nothing about the chemistry of the new or the old building materials. Even if shop-organisers and employment-managers are competent, they will be helpless so long as the directors in control of policy do not understand the *ABC* of the sciences which they might use. The president of the Institute of Industrial Administration is Mr. A. S. Comyns Carr, and its address 47-51 King William Street, London, E.C.4.

THE report of the twentieth meeting of the Indian Central Cotton Committee, held on Nov. 11 last at the Institute of Plant Industry, Indore, contains several matters of scientific significance. The interest taken by leading industrialists in India in the scientific development of agriculture is exemplary. The work of the Institute of Plant Industry has impressed Indian industrial leaders and ministers so much that large

sums of money have been given to develop the new variety of Malvi cotton which the Institute has selected, and to put into practice the suggestions made by the Institute for the improvement of agriculture generally. This interest may be illustrated by the following extract from the report of the speech of the Prime Minister of the Holkar Government at the meeting: "We must naturally proceed slowly and only take up improvements and new ideas after they have been carefully considered and also carefully tested by scientific investigators whose experience, performance, and standing carry weight". This statement shows that the important part which science plays in industrial development is thoroughly understood by some Indian leaders.

WE find later in the report that the Committee's plans are widening to include the cotton manufacturing industry. A few years ago the Committee built the Cotton Technological Laboratory at Matunga, Bombay. The laboratory has a large and capable scientific staff and is well equipped with modern apparatus and a complete spinning plant. The standardisation of Indian cottons was its primary function, but its recent bulletins have included investigations in the technology of cotton spinning which are noteworthy contributions to this branch of applied science. Again, Indian industrial interest has been stimulated by the work of a scientific laboratory with the result that it was decided at the Indore meeting to extend the work to meet the requirements of the mill industry and the cotton trade generally. This step now brings within the control of the Indian Central Cotton Committee the scientific development of all branches of the Indian cotton industry, from the selection and raising of the crop to the production of the finished article. The Committee is to be congratulated on its foresight, and all scientific men will appreciate its efforts to apply scientific control to the development of the Indian cotton industry.

THE three leading events in the history of the steam railway were the opening of the Stockton and Darlington railway on Sept. 27, 1825; the famous Rainhill locomotive trials of October 1829; and the inauguration of the Liverpool and Manchester Railway on Sept. 15, 1830. If the first of these events showed the practicability of passenger transport by railway, the second demonstrated the superiority of the steam locomotive over all other methods of traction, while the world's railway system may be said to have had its birth with the completion of the Liverpool and Manchester Railway, when on Sept. 15, 1830, a train composed of eight locomotives and twenty-eight carriages, containing some six hundred persons, proceeded along the line. The following day, Sept. 16, regular trains were run, and by the end of the week there was a daily service of six trains in each direction. To commemorate this epoch-making event, arrangements are being made to hold a pageant and an exhibition at Liverpool on Sept. 14–21 next, when it is hoped to bring together a collection of books, pictures, models, locomotives, etc., illustrating the progress of railroad transport. An executive committee has been formed representing both civic and railway interests, with headquarters in the Royal Liver Buildings, Liverpool, and an appeal has been issued for information from anyone interested in the development of railways who can supply particulars of historic exhibits.

IT is announced that the Latinisation of the Russian alphabet is a probable development of the near future. A Moscow commission has studied the technical details and has almost completed its investigations. Immediately after the Revolution, the Russian alphabet was simplified by discarding one or two superfluous or little-used letters. There are still more than thirty letters in the Cyrillic alphabet as against twenty-six in the Latin, so that any change will necessitate either the elimination of further letters or, which is most likely, the introduction of diacritical marks to express sounds for which there is no precise equivalent among the simple Latin letters. It will be recalled that some years ago Prof. Bohuslav Brauner advocated this (the Czech) mode of transcription from Cyrillic to Latin in NATURE (April 29, 1922, vol. 109, p. 552) on the grounds of simplicity and faithfulness to the original. The following changes involve the introduction of diacritical marks over consonants

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| ш | becomes | š | pronounced as | *sh* in she |
| щ | ,, | šč | ,, | *shch* |
| ч | ,, | č | ,, | *ch* in church |

The letter ц, if transcribed to *c*, must be pronounced like *ts* in its. The change from the Russian to the Latin alphabet is to be welcomed, for not only will it be easier for educated Russians to learn western European languages, but it will also facilitate the acquiring of a knowledge of Russian by others.

THE fifth International Botanical Congress is to be held at Cambridge on Aug. 16–23 next. The sequence of congresses in this series is Paris 1900, Vienna 1905, Brussels 1910; the 1915 Congress was to have been held in London, and arrangements were well in hand when War broke out. After active hostilities had ceased an international congress was formally discussed on several occasions, but it was considered that more would be lost than gained unless all nations could take part. Eventually, American botanists offered to hold a congress at Ithaca in 1926 if British botanists would waive their title to precedence. The conference was held as the International Congress of Plant Sciences (Fourth International Botanical Congress). The 1930 Congress returns to the old terminology.

A PRELIMINARY programme of the Cambridge meeting has been circulated giving a summary of information for the benefit of foreign visitors and also the names of presidents, vice-presidents, recorders, secretaries, etc., of the Congress as well as of the eight sections: bacteriology, phytogeography and ecology, genetics and cytology, morphology, mycology and plant pathology, plant physiology, palæobotany, taxonomy and nomenclature. The programme gives expression to the general opinion that more benefit is likely to arise from discussions than from individual communications, and the sectional programmes give the titles of the proposed discussions, usually with a list

of those who have promised to speak. Any person interested in botany may become a member of the Congress on payment of the subscription of £1, which should be sent to the honorary treasurer, Dr. A. B. Rendle, British Museum (Natural History), S.W.7, by April 1 next.

IT is seldom that we refer to the weaknesses of popular natural history articles, but the *Nineteenth Century* for January published one on "The Badger and its Reputation", which moves us to protest. In this ten-page article, the first six pages, containing much general denunciation of the ignorance and inaccuracy of naturalists, scarcely mention the badger. The remaining four, amongst otherwise simple information, state that "the badger appears to possess senses entirely unknown to science", that "unlike any other animal, he seems to be able to exist almost entirely without air", that the hedgehog, "another insectivorous creature", is in most of his ways a badger in miniature. The Nature-loving public deserves something better than this.

INDEED, the same number of the *Nineteenth Century* includes another Nature article of very different stamp. In "The Origin of Right", A. Wyatt Tilby records the results of much observation and consideration of the curious fact that right-sidedness is a widely spread feature in the animal world. Right-handedness is predominant amongst men, and more start off on the right foot than on the left. Cats are said to be right-footed, so are civets, genets, giraffes, and camels. Even molluscs have usually right-twisted shells. On the other hand, wolves and deer are left-footed, whereas dogs, horses, and antelopes start off indifferently with the right or left foot. The author does not say under what conditions or from how many observations these results were obtained, but one of his conclusions is that practically every animal that grips, climbs, or hunts uses the right approach or the right foot first in preference to the left. He also endeavours in a series of interesting paragraphs to trace the causes which may have contributed to the formation of the 'right' habit and its survival in different categories of animals. Our impression is that the subject is still very hazy.

IN an address in honour of Mr. Edison at the dedication of the Edison Institute of Technology, the gift of Mr. Ford, President Hoover paid a notable tribute to men of science and their work. "Our scientists and inventors are amongst our most priceless national possessions. There is no sum that the world could not afford to pay these men who have that originality of mind, that devotion and industry to carry scientific thought forward in steps and strides until it spreads to the comfort of every home; not by the profits of all the banks in the world can we measure the contribution which these men make to our progress. And they are the least interested in the monetary results. Their satisfactions are in their accomplishment—in the contribution of some atom of knowledge which will become part of the great mechanism of progress. Their discoveries are not the material for headlines. Their names are usually known but to a few. But the nation owes them a great honour and is proud to demonstrate through Mr. Edison to-day that their efforts are not unappreciated. The country can well pay its tribute to the men of this genus by expanding the facilities for their labours. The nation to-day needs more support for research. It needs still more laboratories." The address, which was delivered at Dearborn, Michigan, on Oct. 21 last, is a fine example of pointed eloquence. It is published in the *Scientific Monthly* for December.

LEONARDO DA VINCI, whether considered as artist, sculptor, architect, engineer, inventor, biologist, or physicist, is such an outstanding figure of his time, and the works he executed and the manuscripts he left are of such intrinsic value, that he is bound to attract the attention of succeeding generations of students. His versatility was ably brought out by Mr. E. McCurdy, in his lecture to the Royal Institution, reported in NATURE, May 6 and 13, 1920. Dr. I. Hart has treated of his mechanical investigations, and a list of his contributions to pure and applied science is contained in Prof. Usher's "History of Mechanical Inventions". It was G. B. Venturi (1746–1822) who first directed attention to the significance of Leonardo's scientific work, and much has been written since. A further contribution to the study of his views is contained in the first number for 1930 of *Scientia*, in which R. Marcolongo, of the University of Naples, deals with "The Dynamics of Leonardo da Vinci". The article is published in Italian. After a brief review of the writings of the Greeks and of some little-known work of the fourteenth century, the writer, using the manuscripts of Leonardo, quotes his statements regarding weight, force, gravity, the laws of motion, and motion down a plane and in the arc of a circle; showing him to be a precursor of Galileo and Newton. Leonardo was essentially a reformer and belonged to that age which produced Erasmus, Copernicus, Dürer, Luther, Agricola, and Paracelsus.

RAPID progress is being made in constructing the Bavarian Zugspitze Mountain Railway, as it is desired to open service on this line, with the exception of the aerial ropeway to the top, before March. This date was chosen so that visitors to the famous Passion play at Oberammergau may have an opportunity of seeing the beautiful mountain scenery traversed by the railway. In many respects it will be like the Jungfrau railway. According to *A.E.G. Progress* for December last, the final station will be on the summit, 9750 feet above sea-level. The first section of the line, 4·7 miles in length, will be run by ordinary adhesion locomotives, the maximum gradient being only 3·5 per cent. The next section, 6·9 miles long, will be a rack railway, and the final aerial ropeway to the summit will be 0·37 mile long. The maximum gradient on the rack railway is 25 per cent, and on the aerial ropeway 68 per cent. The Schneeferner Haus is a hotel at an altitude of 8750 feet, which has been planned by the railway company so as to provide plain accommodation for the ordinary traveller and luxurious rooms for the wealthy. When the final section leading to the summit is com-

pleted next summer, the total time taken by the trains from the low-level station at Garmisch-Partenkirchen (altitude 2300 feet) to the summit will be one hour and fifty minutes, three minutes only being required for the aerial ropeway. The electric energy required for the railway is supplied by three-phase current from the Isar power station. At the sub-station it is converted into direct current at 1500 volts by glass-bulb rectifiers. At full load these will work at 1650 volts. These rectifiers are novel in design and are being used in practice for the first time.

THE December number of the *Journal of Scientific Instruments* gives many illustrations of the uses to which science can be put by means of robust instruments which almost any one can safely use. An apparatus is described by means of which the change in the moisture content of small quantities of a powder can be readily and accurately determined by means of a torsion balance. Curves are shown and can be quickly found giving the rate at which moisture is absorbed by industrial products like flour, starch, and tobacco. Results obtained in this way are of great use in commerce. The General Electric Co. describes apparatus which, when perfected, will measure the colour, temperature, and luminous output of an incandescent lamp. Photoelectric cells are used, and it is satisfactory to find that definite results can be obtained. An ingenious method of measuring the internal diameters of transparent tubes, perfected at the National Physical Laboratory, is described. The two-ball method described enables the diameter to be easily measured in any given axial plane. Thus the ellipticity as well as the variation in size of the cross section can be determined. The method can also be applied to opaque tubes. Steel balls the diameters of which increase by very small steps from 1/16 in. to 1 in. are readily obtainable. The method can be applied to tubes the bore of which is only about three millimetres. A description is given of an instrument for measuring the thickness of compressible solids, for example, fabrics, over a very wide range of pressures. This instrument should be of use for the woollen and worsted industries. The use of elinvar instead of steel in the spring of the Galitzin vertical seismograph at Kew has enabled the temperature coefficient of elinvar to be determined. It is only one-tenth that of the steel spring. A clear description is given of the Moll recording microphotometer for use in the investigation of photographed spectra. This journal contains much interesting information which should prove of value to all engaged in industrial research.

AT the annual general meeting of the Royal Microscopical Society, which was held on Wednesday, Jan. 15, the report of the council was adopted, and the following were elected officers and new members of council for the ensuing year:—*President*: Prof. R. Ruggles Gates; *Treasurer*: Mr. Cyril F. Hill; *Secretaries*: Mr. J. E. Barnard and Dr. Clarence Tierney; *New Members of Council*: Prof. W. A. F. Balfour-Browne, Mr. E. W. Bowell and Prof. Doris L. Mackinnon; *Librarian*: Dr. Clarence Tierney; *Curator of Instruments*: Mr. W. E. Watson Baker; *Curator of Slides*: Mr. E. J. Sheppard. The council's report stated that the Society continues to play an increasingly important part in the application of science to British industries. In the absence of the president, Mr. J. E. Barnard, through illness, the chairman announced that the presidential address on "Resolution and Visibility in Medical Microscopy" would be delivered at the Society's meeting in March. A paper was read by Dr. W. E. Cooke on asbestosia, in which he described the history and incidence of this disease amongst those engaged in the industry, and its identification. A valuable contribution to our knowledge was also submitted by Mr. T. D. Hamilton in a paper on "The Preparation of Thin Microscope Sections of Whole Organs by the Paraffin Method".

THE inaugural meeting of the eighty-third session of the Pontifical Academy of Sciences, held at Rome on Dec. 29 last, was honoured by the presence of His Holiness Pope Pius XI., who was received by the president, Prof. P. Giuseppe Gianfranceschi; the secretary, Prof. Pietro De Sanctis; and the vice-secretary, Prof. Giuseppe Martinelli. A number of papers were communicated, including the following: A. Belluigi: rules for obtaining a good thermal yield with Schmidt magnetic variometers; P. Luigioni: second contribution to the knowledge of the entomological fauna of the National Park of Abruzzo: a new species of Chrysochloa; A. Anile: new researches on the etiology of scarlatina; A. Neviani: lower marine organisms of supposed vegetable character; V. Zanon: diatoms of the Permian and Carboniferous; G. Franchini: experimental reproduction of leprosy in the ape; P. Humbert: Bessel functions of the third order; S. Ranzi: physiology of the embryo of cephalopods; Pasquini: new experimental results on the grafting of the eye in Axolotl; C. Gorini: bacterial chymases; G. De Angelis d'Ossar: geology and the Roman catacombs. One-half of the prize of 10,000 lire offered for dissertations on the quantum theory has been awarded to Prof. Wataghin, the other half being divided equally between Profs. Straneo and Carrelli.

THE ninety-eighth annual meeting of the British Medical Association will be held at Winnipeg, under the presidency of Prof. W. Harvey Smith, professor of ophthalmology, Manitoba Medical College. According to the provisional programme, the annual representative meeting of this year will be at the British Medical Association House, Tavistock Square, London, W.C.1, on July 18–22. The statutory annual general meeting will be held in Winnipeg on Tuesday, Aug. 26, and on the evening of the same day the incoming president, Prof. W. Harvey Smith, will deliver his address to the Association. An exhibition of surgical appliances, foods, drugs, and books will be open during the Winnipeg meeting. The presidents of the sections so far appointed are: *Medicine*: The Right Hon. Lord Dawson of Penn; *Surgery*: The Right Hon. Lord Moynihan of Leeds; *Obstetrics and Gynæcology*: Dr. Comyns Berkeley; *Bacteriology, Pathology, Physiology, and Biochemistry*: Prof. Robert Muir; *Diseases of Children*: Dr. Robert

Hutchison; *Mental Diseases and Neurology*: Sir E. Farquhar Buzzard; *Ophthalmology*: Mr. N. Bishop Harman; *Laryngology and Otology*: Sir St. Clair Thomson; *Preventive Medicine*: Dr. A. S. M. Macgregor; *Tuberculosis*: Prof. S. Lyle Cummins; *Radiology*: Dr. A. E. Barclay; *Medical Sociology and History of Medicine*: Sir Humphry Rolleston, *Anæsthesia*: Mr. Raymond E. Apperly. The honorary local general secretary of the annual meeting is Dr. J. D. Adamson, 102 Medical Arts Building, Winnipeg, Manitoba.

PROF. A. C. SEWARD, professor of botany in the University of Cambridge, and Prof. V. Grignard, professor of organic chemistry in the University of Lyons, have been elected associates of the Royal Academy of Sciences, Letters and Arts of Belgium.

PROF. THOMAS HUNT MORGAN, of the California Institute of Technology, who is widely known for his experimental work on the mechanism of inheritance, has been elected president of the American Association for the Advancement of Science and will preside at the 1930 meeting in Cleveland.

DR. J. S. PLASKETT, Director of the Dominion Astrophysical Observatory, who has been awarded the Gold Medal of the Royal Astronomical Society for his valuable observations of stellar radial velocities and the important conclusions derived from them, will deliver the George Darwin Lecture of the Society at the ordinary meeting on May 8.

THE President and Council of the Royal Society have appointed Dr. A. S. Parkes to the Foulerton Research Studentship, rendered vacant by the appointment of Dr. R. J. Ludford to a senior post on the staff of the Imperial Cancer Research Fund. Dr. Parkes at present holds a Senior Beit Research Fellowship and is working in the Department of Physiology and Biochemistry at University College, London.

THE following have been elected officers of the Royal Meteorological Society:—*President*: Mr. R. G. K. Lempfert. *Treasurer*: Mr. Francis Druce. *Secretaries*: Dr. C. E. P. Brooks, Mr. W. M. Witchell, Dr. A. Crichton Mitchell. *Foreign Secretary*: Mr. C. J. P. Cave. *New Members of Council*: Mr. David Brunt, Prof. Sydney Chapman, Dr. Bernard A. Keen.

A CONFERENCE on grassland problems will be held at the Harper Adams Agricultural College, Newport, Salop, on Wednesday, Feb. 5, commencing at 2 P.M. Addresses dealing with the formation, maintenance, and utilisation of temporary and permanent pastures will be given by Dr. J. A. Hanley, principal of the Royal Agricultural College, Cirencester, Mr. W. B. Mercer, principal of the Cheshire School of Agriculture, Reaseheath, and Mr. R. Boutflour, director of dairy husbandry at the Harper Adams College. Each address will be followed by open discussion. Arrangements are also in progress for an exhibit of implements especially designed for grassland work. The Conference is intended primarily for farmers, but an open invitation to attend is given to all interested in the subject.

AN account of the life and activities, literary and other, of Mr. H. G. Wells is being written by Mr. Geoffrey West. As Mr. Wells received his scientific training at the Royal College of Science, and has many friends in scientific circles, Mr. West would much appreciate the assistance which any of them may care to afford in the way of reminiscences, impressions, or letters (or transcripts of letters), especially any referring to Mr. Wells's earlier years or to specific activities. Original letters (or transcripts to be returned) will be handled only by Mr. West, and sent back without delay by registered post. Matter may be sent direct to him at Acacia, Dane Bridge Lane, Much Hadham, Herts, or c/o Messrs. Gerald Howe, Ltd., 23 Soho Square, London, W.1.

AT the monthly general meeting of the Zoological Society of London, held on Jan. 15, it was stated that the total number of visitors to the Society's Gardens during the past year was 2,047,090, the receipts amounting to £65,933, showing a decrease of £5723, as compared with 1928, and an increase of £86 as compared with the average for the corresponding period of the previous five years. The number of visitors to the Aquarium during 1929 was 422,929, the receipts amounting to £15,657, showing a decrease of £1736, as compared with 1928.

THE Diary for 1930, issued by the *Chemist and Druggist*, which has been sent to us, is a considerable volume, containing not only diary proper, but also an extensive trade directory and a buyers' guide, a summary of the legal enactments which affect the pharmacist, formulæ of approved remedies and toilet accessories, and much other useful information.

A REVIEW of artificial light therapy, with records of its value in medical and surgical practice, compiled and edited by Dr. R. King Brown, has been issued by the Actinic Press (17 Featherstone Buildings, W.C.1, 2s. net). As reports have recently appeared casting some doubt on the value of artificial light treatment, this pamphlet will be of use as presenting evidence on the other side.

FUR-FARMING continues to gain adherents in Great Britain. It was stated recently in the *British Fur Trade* that the number of silver-fox farms in Great Britain had increased from 19 in 1928 to 32 in 1929, and the number of foxes from 500 to 801. In view of the wide interest in this new industry, attention may be directed to a leaflet, "Hygiene in Fox Farming", just issued by the Biological Survey Bureau of the U.S. Department of Agriculture. No attempt is made in this 6-page leaflet to discuss diseases of foxes or their treatment, but directions are given for simple measures of hygiene and sanitation which may be employed with advantage by any fox farmer.

MESSRS. Bernard Quaritch, Ltd., 11 Grafton Street, W.1, have just circulated a catalogue of their publications and of remainders. Librarians and collectors should find it of service.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A second assistant pathologist at St. Mary's Hospital, W.2

—The Secretary, St. Mary's Hospital, Paddington, W.2 (Jan. 28). An assistant pathologist at Ancoats Hospital, Manchester—The Gen. Supt. and Secretary, Ancoats Hospital, Manchester (Jan. 28). A demonstrator in pathology and bacteriology in the University of Leeds—The Registrar, The University, Leeds (Jan. 31). A head of the Mechanical Engineering Department of the School of Engineering and Navigation, Poplar—The Education Officer (T.1), The County Hall, Westminster Bridge, S.E.1 (Feb. 1). A lecturer in biology at the Cheshire School of Agriculture—The Principal, Cheshire School of Agriculture, Reaseheath, Nantwich (Feb. 8). A foreman-recorder and demonstrator at the Denham Demonstration Station of the Middlesex Agricultural Committee—The Secretary, Education Offices, 10 Great George Street, S.W.1 (Feb. 8). A lecturer in physiology in the University of Stellenbosch—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (Feb. 15). A lecturer in entomology in the University of Sydney—The Agent-General for New South Wales, Australia House, Strand, W.C.2 (Feb. 28). An assistant agricultural instructor in the department of the Federated Malay States — The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (Mar. 1). A professor of mathematics in the Queen's University of Belfast—The Secretary, Queen's University, Belfast (April 30). A junior physicist or engineer for research work on problems of heat conduction and insulation ; a junior physicist or engineer for research work on aeronautics ; a junior physicist for research work on electrostatics ; a junior physicist for research work on X-rays ; a junior physicist for research work on photo-electricity and television ; a junior physicist for research work on ultrasonics ; a junior physicist or physical chemist for research work on radioactivity ; an assistant research physicist for work on electrical engineering ; an assistant research physicist for work on aerodynamics and hydrodynamics ; an assistant research physicist for work on mathematical physics, all at the National Research Laboratories of Canada—S. P. Eagleson, Secretary, National Research Council, Ottawa, Canada. A junior pathologist and a junior soil chemist at the Rubber Research Institute of Malaya—The Secretary, London Advisory Committee, Rubber Research Institute of Malaya, 2-4 Idol Lane, Eastcheap, E.C.3. A secretary of the Institution of Structural Engineers —The President, Institution of Structural Engineers, 10 Upper Belgrave Street, S.W.1. A professor of zoology in the University College of North Wales, Bangor—The Registrar, University College of North Wales, Bangor.

## Our Astronomical Column.

**Wilk's Comet.**—Dr. C. H. Smiley has deduced the following orbit of this comet from observations on Dec. 21, 29, and Jan. 5.

| | | |
|---|---|---|
| T | 1930 Jan. 22·3005 U.T. | |
| $\omega$ | 157° 31′ 1″ | 1930·0 |
| $\Omega$ | 179 2 27 | |
| $i$ | 124 30 10 | |
| log $q$ | 9·827489 | |

Dr. A. C. D. Crommelin obtained the following observation on Jan. 19, when the comet was bright enough to observe before the end of twilight :

| | R.A. 1930·0. | S. Decl. 1930·0. |
|---|---|---|
| Jan. 19d | 18h 6m 3s·7 | 21h 41m 48s·03 1° 9′ 9″·7 |

The comet was moving south and approaching the sun in Right Ascension. It is not likely that further observations will be obtained in Europe, but Mr. J. P. Möller has prepared an ephemeris for March and April for the use of southern observers (*I.A.U. Circ.*, No. 244). Judging from its present brightness the comet should be followed at least until mid April, when it will be in Decl. −49°, and distant from the sun 1·66 units.

**Changes in the Period of the Variable Star *R* Hydræ.**—*Astr. Nach.*, No. 5669, contains an article by R. Müller on the remarkable changes in the period of this variable. As it occasionally reaches mag. 3·5 at maximum according to Chandler, and is seldom fainter than mag. 4·9 at that time, it is an easy object to the naked eye and records go back to the year 1662 ; H. Ludendorff deduced from these that the period was then 486 days and that it increased to a maximum of 507 days about 1708 ; records are then scanty up to 1784, at which date the period was just under 500 days. It then diminished rapidly and fairly uniformly ; early in the present century it was little above 400 days. According to Mr. Müller, it has now begun to increase again. He shows that Ludendorff's formula for the date 1915 needs considerable modification ; he gives the formula for the dates of maximum $J.D.\ 2423040{\cdot}0 + 411{\cdot}7\ E + 0{\cdot}8838\ E^2$ ; the first date is 1921, Dec. 16. As no law has yet been determined for the changes of period, the terms depending on the square or higher powers of $E$ are only provisional.

**Revision of Newcomb's Occultation Memoir.**—Newcomb was engaged for thirty years on this important memoir, which was finished during his last illness. It discusses the occultations of stars by the moon observed between 1672 and 1908. The publication since then of Brown's Tables of the Moon enables the comparison between theory and observation to be made more rigorous. This has been done by Dr. H. Spencer Jones in *Mon. Not. Roy. Ast. Soc.* for November last. Corrections of − 1·64″, and − 1·78″ (at the epoch 1800) are found for Brown's values of the moon's perigee and node. The corrections to their centennial motions are much smaller than their probable errors. Brown omitted Hansen's constant term of − 1·00″ in the moon's latitude, but now admits that a term of about half that amount is required. This is confirmed by the occultations.

The discussion throws some light on the ellipticity of the earth. The reciprocal of this is concluded to lie between 294 and 297. Newcomb's equinox is found to require a correction of − 0·71″ at the epoch 1850, but the correction to its centennial motion is small and doubtful. Eichelberger's larger correction of − 0·057$^{sec.}$ per century is concluded to be erroneous. The solar parallax was determined from the parallactic inequality, using also recent occultations observed at the Cape, as 8·799″ with a probable error of 0·003″. A large diagram of the moon's errors in longitude shows that the occultations indicated smaller oscillations during the period 1750 to 1830 than those found from Greenwich meridian observations.

## Research Items.

**Bushman Craniology.**—M. Eugène Pittard, following up his study of Hottentot and Griqua skulls, has contributed to *L'Anthropologie*, T. 39, No. 4, the results of the examination of a series of nineteen Bushman skulls from rock-shelters, undoubtedly representing an ancient population. The measurements are studied in detail, but the general results may be summed up as follows: The mean cephalic index is 75·46 for males and 76·90 for females. These indices indicate sub-dolichocephaly. But among the females of the series are two, one sub-brachycephalic, the other brachycephalic, which cannot belong to the ethnic group. The males show no indication of brachycephaly, the highest male index (79·23) being masaticephalic, while the highest female (86·71) is hyperbrachycephalic. In height the majority of the crania are chamæcephalic; one female skull alone is hypsicephalic. The skulls are also mesognathous, one female being prognathous with a gnathic index of 106·59. The facial index, 47·34 male and 46·60 female, brings them within the chamæprosopic class, one female, however, being leptoprosopic. The orbital index is microseme, a few of the females being megaseme. The cranial capacity is 1476 c.c. for the males and 1357 c.c. for females. There are some interesting differences between the male and female skulls, apart from the naturally smaller absolute dimensions in the female. The female are less often dolichocephalic than the male and their mean index is higher. The occipital foramen, which is highly developed in both sexes, is larger in the female than the male, but the female index of prognathism is lower. The nasal index is higher in the female, being 59·35 as against the male index of 58·49. It is probable that the group upon which the study is based had not entirely preserved its primitive purity.

**Danish-Carib Crosses.**—A contribution to the study of racial crossing in man has been made by Mr. O. A. Merritt Hawkes (*Jour. of Heredity*, vol. 20, No. 10), who describes the descendants through four generations from a mating which took place about 1770 between a Frenchman in the West Indies and an Indian woman, probably a Carib. Their daughter married a blue-eyed Dane and had six children. Photographs of many of these individuals and their descendants are given. The Indian characters are regarded as dominant over European in $F_1$, but it is doubtful if this term is strictly applicable. The general points distinguishing the two races are given. An $F_1$ woman married to a Dane produced a boy and a girl of Danish type, fair skin with blue eyes, and three girls and a boy with dark hair and eyes and more or less Indian features. Hence this family showed segregation. Similarly, one of the dark daughters married to a blonde, blue-eyed Dane had five children, two Danish in type, one intermediate or mixed, and two remarkably Indian in appearance although reared in Copenhagen. The results in this and the fourth generation suggest a tendency to segregation of Danish and Carib types, or in other words, to linkage of the respective racial characters. But the appearance of mixed types as well indicates that such linkage is incomplete. That the son of a partly Carib woman and a Dane can be more Indian in 'type' than his mother is an interesting fact which requires further analysis.

**Spread of the Mountain Hare.**—The mountain hare or arctic hare is a native of Scotland north of the line of the Forth and Tay, but at various times about the middle of the nineteenth century it was set free in the southern uplands of that country. From two main centres of dispersal there it has succeeded in colonising the whole of the south country and has crossed the borders into Northumberland and Cumberland. From information furnished by the shepherds on the hill-pastures, Dr. James Ritchie (*Scot. Nat.*, p. 169; 1929) has traced the progress of the hare's movements, showing that less than half a century sufficed for the colonisation of this considerable area.

**Behaviour of Starlings in Winter.**—Starlings are well known to congregate in common roosting-places in winter and the behaviour associated with their roosting habits has been the subject of an intensive and interesting study by V. C. Wynne-Edwards (*British Birds*, October and November 1929). The area investigated was in Devon and Cornwall, and in its 3000 square miles the starling population was estimated to be of the order of five millions. Winter roosts were ten in number, and the two most populous accommodated about 500,000 birds each, while in the others numbers ranged from about 50,000 to a quarter of a million. The flights of the birds to and from their feeding grounds were traced, and it was discovered that the feeding area of one of the largest roosts covered approximately 130,000 acres, and that while in general not more than five to fifteen miles were covered in the daily flight outwards, flights extended up to 24 miles. Apparently the flight stimulus is associated with the increasing intensity of light at dawn and its waning towards evening, for a table of observations shows a close correlation between the start of the first flight each day and sunrise. Roosting in winter is probably a much more common habit in birds than has been realised. In his own district, the author has traced twelve species of birds to roosts, some of considerable size, and he adds some interesting speculations on the advantage of the gregarious habit.

**New Method of Treating Frequency Curves.**—In a particularly arresting paper appearing in the *Journal of the International Council for the Exploration of the Sea*, vol. 4, No. 2, 1929, H. J. Buchanan-Wollaston and William C. Hodgson describe at some length a new method of treating frequency curves in fishery statistics. The method is based on three assumptions, quite new and fundamentally different from previously existing ideas on the treatment of statistical data, and producing fundamentally different results. Their applicability depends upon treating each sample of fish measurements separately, or on treating together only such data as are limited to a very restricted 'area' in time and space. It seems worth while to quote in full the authors' definitions of their three assumptions. They are: (1) that every fre-frequency curve of fish measurements is compounded of several substantially different symmetrical curves of narrow range, similar to the curve of error; (2) that every maximum shown in the rough frequencies corresponds to a real mode; and (3) that the comparative rough frequencies given by the data, even if very small in number, correspond sufficiently well with the actual frequencies of fish at each length on the ground to be treated as absolutely correct, with an insignificant error. These assumptions, the authors wisely add, can be justified only by results. Some results of the application of the new method, particularly to herring data, are given.

***Terra Nova* Madreporaria.**—Prof. J. Stanley Gardiner records ten species of Madreporaria from the Antarctic (glacial) area of the Ross Sea and from the temperate

area north of New Zealand (Madreporaria (b). Turbinolidæ and Eupsammidæ, Cœlenterata. Part 4, British Antarctic (*Terra Nova*) Expedition, Zoology, 5, No. 4, 1910. Natural History Report, British Museum (Natural History), 1929). Of the Madreporarian corals obtained by the *Terra Nova* Expedition, those from the Atlantic Ocean and belonging to the genus *Favia* have already been reported on by Prof. George Matthai (*Zoology*, 5, No. 2; 1919). The present reports deals with the remainder, three out of the ten being new species. The genus *Gardineria* of Vaughan is recognised, to which two of the new species belong, a possible third or even two more being mentioned. Much of the text is taken up with a description of *Gardineria antarctica* n. sp., which is figured in a good plate with *Gardineria lillei* n. sp., also from the Antarctic, *Dendrophyllia japonica* Kent and *Flabellum harmeri* n. sp., the last two from New Zealand. Notes on collecting and preservation are a useful addition to this work. The author prefers spirit for preserving corals. If kept in the dark, the flesh alters little or not at all in thirty years.

**Arthropods as Intermediate Hosts of Helminthes.**—Maurice C. Hall (*Smithsonian Misc. Coll.*, vol. 81, No. 15, 1929) has prepared a useful list of arthropods which have been shown to act as intermediate hosts of helminthes. The list of arthropod hosts of cestodes is prefaced by the remark that the known number of such cases is so small that a comprehensive list can be given, but since the life-histories of only about one per cent of the known species of tapeworms have been worked out, generalisations must be made with care. Probably many cestodes now known as having only one intermediate host will be found to require two. The list of cestodes and their intermediate hosts (10 pp.), of trematodes (9 pp.), of nematodes (15 pp.), and of Acanthocephala (4 pp.) is followed in each case by comments on the life-histories of the different families. The next part of the work consists of a table of arthropod hosts of helminthes arranged systematically—the orders of insects, the Arachnida, Myriapoda, and Crustacea. There are altogether 143 species of helminthes parasitic in vertebrates which have arthropods as intermediate hosts and for which the primary hosts are known; there are also 61 larval forms for which the primary host is unknown. The author pleads for better co-operation between parasitologists and those who work on arthropods and suggests that the latter should direct the attention of parasitologists to any larval helminthes which they find during the dissection of insects.

**Peter I. Island.**—This antarctic island, lying off the antarctic continent to the south of the Pacific, has seldom been sighted and never explored since Bellingshausen discovered it in 1821. In 1927 it was visited by the Norwegian whaler *Odd 1*, and again in 1927 by the *Norvegia*. An article on the explorations, with a map of the island, by Capt. W. Sachse, appears in *Petermanns Mitteilungen*, Hefte 11 and 12, 1929. The island appears to be entirely volcanic and fringed with steep cliffs. It is almost entirely covered with ice even to the summit, which is at about four thousand feet. The length of the island is about fifteen miles, and the breadth about seven miles. The position of the centre is lat. 68° 50′ S., long. 90° 35′ W. There is no harbour of any value, and landing is practically impossible.

**The Length of a Nautical Mile.**—The nautical mile being one minute of longitude varies in length from equator to pole. The variations depend of course on the figure of the earth. The accepted mean of 6076·8 feet is taken in practice as 6080 feet for navigational purposes. This is 1853·2 metres. At the International Hydrographic Congress held at Monaco in April 1929, it was decided to recommend that the nautical mile should have a length equal to 1852 times that of the standard metre. This has an equivalent of 6076·0 feet. In *La Géographie* for Sept.-Oct. 1929, M. Vallaux gives some of the lengths now in use in various countries. The figure of 1852 metres has been used in France since 1906, and also by Germany, Denmark, Iceland, Norway, Sweden, Greece, and Japan. Belgium has a mile of 1854 metres, Italy and Spain 1854·8 metres, and the United States 1853·25 metres or 6080·2 feet.

**The 'Green Flash' at Sunset.**—A satisfactory account of the origin of the 'green flash' of the upper limb of the sun when it disappears at sunset is given by Lord Rayleigh in the January issue of the *Proceedings of the Royal Society*. As he points out, the colour cannot be due to retinal fatigue, since it can also be seen at sunrise, and it has come to be generally recognised that it is due to the dispersion that accompanies atmospheric refraction, the green usually seen being more refrangible than the general light of the disc at the horizon. The main point remaining to be decided was whether the normal dispersion of the atmosphere was sufficiently large to explain the effect, and Lord Rayleigh has now shown that it is in fact probably adequate, and has also been able to demonstrate a 'flash' in some neat laboratory experiments with a glass prism of small angle as the dispersing medium. As possible causes of the natural 'flash' being green rather than the more refrangible blue, he mentions the inferior visual luminosity of the pure blue of the spectrum, and the relatively greater toll taken of the blue by atmospheric scattering. Lord Rayleigh refers to Prof. R. W. Wood's suggestion (NATURE, Mar. 31, 1928, vol. 121, p. 501) that the flash is seen best when for some reason the atmospheric dispersion near the horizon is unusually large, and remarks that, if this is the case, sunset should be deferred upon such occasions by a time of the order of two minutes, a phenomenon for which he hopes to have search made in tropical seas.

**Protective Devices on Electric Supply Networks.**—The necessity of protecting the networks of cables and overhead wires which now link electric power stations with their consumers and with other power stations from accidental damage due to short circuits or lightning has led to an extensive use of protective devices of all kinds, the manufacture of which is an important industry. In modern practice, networks, instead of receiving, as formerly, a supply from a single feeding point, receive it from many points. As a result, when a 'fault' occurs, the direction of the current flow in a main depends upon the position of the fault in the network. Those devices, therefore, which act when the current flow is in one direction only are no longer applicable. The more elaborate protective devices being tried are naturally more expensive, but engineers regard this cost as the insurance premium for their mains. On the Continent, the neutral point of a network of overhead power lines is generally insulated from the earth. If a fault develop on one of the mains, it is usually followed by an arc carrying a large current. Damage is usually done by the arc, and so a special device for its suppression called a Petersen coil is connected between the neutral point and the earth. It is adjusted so that in the event of the capacity to earth of one of the mains being short-circuited, the coil resonates with the capacity of the remaining mains and thus lowers the voltage and extinguishes the arc. When an insulator

flashes over, the operation of the coil is so quick that the arc is usually suppressed before the other safety devices begin to act. T. W. Ross and H. G. Bell in a paper read to the Institution of Electrical Engineers on Jan. 9 discussed the merits of the various types of protective devices used for the protection of three phase lines and ' feeders '. They conclude that at the present time it is possible to protect adequately the mains of a supply network by means of some of the devices that are in use, but as the networks continue to grow, still more elaborate devices will soon be required.

**History of Bell-founding.**—At a meeting of the Newcomen Society held on Dec. 18, Mr. A. A. Hughes read a paper on the art of bell-founding. In England, the art can be traced back to Saxon times, there being records of bells at Whitby, York, and Canterbury in the seventh and eighth centuries, while in the tenth century seven bells were presented to Crowland Abbey. The earliest instructions recorded in Great Britain are contained in a manuscript by Walker of Odyington, a monk of the time of Henry III., preserved in the library of Corpus Christi College, Cambridge. Mr. Hughes gave particulars of the methods used in designing, moulding, casting, and tuning bells, and said that fundamentally the actual processes of moulding and casting have altered only slightly during the last six or seven centuries. Quality of tone depends more upon correct shape and correct proportions of thickness at various points than upon the quality of metal. The theory was apparently partly understood by a few early English founders, and it was certainly understood by some sixteenth and seventeenth century Flemish founders. After the design is settled, a ' strickle ' is used for forming the moulds, which are built up from bricks and loam, the surfaces of the moulds being dressed with plumbago and polished. Bell metal contains about 76 per cent copper and 23 per cent tin. Great advances have been made in the tuning, the first machines for which were made at Gloucester and at the Whitechapel Foundry about a hundred years ago. In olden times surplus metal was removed by hand, but vertical lathes are now used, while the note and the harmonic tones are recorded by registering tuning-forks.

**Isotopes of Oxygen.**—The presence of an isotope of oxygen of mass 18 in the earth's atmosphere was reported by Giaque and Johnston (in NATURE of Mar. 2, 1929, p. 318), and in the December number of the *Journal of the American Chemical Society* these authors show that the atmospheric absorption spectra obtained by Babcock at Mount Wilson Observatory indicate the presence of another isotope of mass 17. A series of very weak lines is interpreted as due to the molecule $O^{16}O^{17}$, present to the extent of 1 part in 5000 as a maximum The $O^{18}O^{16}$ molecules are present to the extent of 1 part in 625. The existence of oxygen of mass 17 has previously been reported by Blackett, by Kirsch and Pettersson and by Harkins and Shadduck from data obtained on collisions between $\alpha$-particles and nitrogen nuclei. One or two collisions per 100,000 result in combination of the $\alpha$-particle with the nitrogen, forming an unstable isotope of fluorine, which immediately ejects a proton and becomes oxygen 17. A full list of calculated and observed lines in the *A* bands is given in the paper.

**Production of Helium from Monazite.**—The industrial sources of helium have in recent years attracted a considerable amount of attention in view of the use of this gas in place of hydrogen for filling the gas containers of airships. In the United States a considerable amount of helium extracted from natural gas, the rich varieties of which contain about 1 per cent of helium, is available and in use. An alternative source of helium which is of great interest in the possible applications of the gas in the British Empire is the mineral monazite, the raw material for the production of thoria for incandescent gas mantles, which is found in large quantities in Travancore, India. In the issue of Dec. 27 of the *Journal of the Society of Chemical Industry*, Mr. R. Taylor, who has been working in the Chemical Research Laboratory at Teddington under the direction of Sir Richard Threlfall and his successor, Prof. G. T. Morgan, describes some interesting experiments on the production of helium from monazite. The mineral contains about 1 c.c. of helium per gram, and thus in the working up of every 100 tons of monazite about 100,000 litres of helium are allowed to escape into the atmosphere. The gas escapes on heating, and the paper describes how it is purified by treatment with hot metallic calcium, which absorbs nitrogen and other gases. It is advantageous to remove most of the nitrogen by heated magnesium before treatment with calcium. Working drawings of the apparatus are given in the paper.

**Autoracemisation.**—The spontaneous or autoracemisation of bromosuccinic acid has been studied by T. Wagner-Jauregg, who discusses the reaction at some length in a paper in the *Sitzungsberichte* of the Vienna Academy of Sciences, vol. 138, Suppl. p. 791. The author has been able to show that the racemisation, so far from being spontaneous, is catalysed by mere traces of hydrogen bromide, which are too small to be precipitated as silver halide and have hitherto escaped detection. Racemisation can be eliminated either by repeated distillation under very low pressures, or by the presence of certain salts or metals such as silver, copper, mercury, or zinc, but not magnesium or platinum. The catalytic activity of the ions increases rapidly in the order chlorine, bromine, and iodine, the latter being nearly twelve times as active as chlorine. The velocity of racemisation varies also with the solvent, acetone being very much more active than methyl alcohol. Other ions appear to be inactive. In discussing the mechanism of the process, the author suggests that the halogen ion on approaching the asymmetric molecule induces a charge upon it in such a way that the hydrogen atoms are detached as protons from the asymmetric carbon atoms (cf. Lowry, *J. Chem. Soc.*, p. 2557 ; 1927). A stream of valency electrons begins to flow out through the carbonyl oxygen of the acid group to meet the free protons, thus enabling the hydrogen atoms to re-enter the molecule. As this process involves enolisation, the asymmetry is destroyed by the temporary formation of a double bond, so that the regenerated molecules are of necessity racemic in structure.

**Fuel Testing in Canada.**—The report of " Investigation of Fuels and Fuel Testing for 1927 ", issued by the Canadian Department of Mines (Ottawa, F. A. Acland, 1929, Paper No. 696), gives a belated account of the activities of the Dominion fuel research organisation for that year. The report shows that State effort is being given to encourage the domestic use of coke instead of anthracite, supplies of which are difficult. This gives point to the recorded study of the coking properties of Canadian coals. The gasoline survey reveals a slight deterioration in the quality of motor spirit. A study of peculiarly Canadian importance deals with the assay of the bituminous sands which occur in Alberta.

## A Table of Electronic Configurations of the Elements.

MR. ROY GARDNER gave an interesting paper on "A Method of Setting out the Classification of the Elements" at a recent meeting of the New Zealand Institute. The paper included the accompanying Table, which shows the distribution of electrons into groups corresponding to the principal quantum numbers for all the elements and at the same time preserves the most essential features of the two-dimensional arrangement of Mendeléef. Elements having the same complete groups (that is, all stable groups of 8 or 18) are placed in the same horizontal row, and the vertical columns include elements with the same number of electrons in the incomplete outer groups. The electronic configurations are those given by Sidgwick ("Electronic Theory of Valency", 1927). An asterisk marks elements for which the 'normal' atom is thought to have only one electron in the outermost group, but as practically all these give divalent ions, the point is of minor interest chemically. Distribution of electrons into *k*-subgroups is unnecessary; these have at present little significance for chemical purposes, and in any case the subgroups are considered to be filled in order to the maxima 2, 6, and 10. The electronic arrangements are read off as shown by the following examples:

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 . . . . | 2 | 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 9 9 . . . . | 9 | 9 |
| | | | | | | | | | | | | | | | | | | 19 20 . . . . | 30 | 31 |
| | | H | | | | | | | | | | | | | | | | | | |
| 2 | He | Li | Be | B | C | N | O | F | | | | | | | | | | | | |
| 2 8 | Ne | Na | Mg | Al | Si | P | S | Cl | | | | | | | | | | | | |
| 2 8 8 | A | K | Ca | | | | | | | | | | | | | | | | | |
| 2 8 | | | | | | | | | Sc | Ti | V | Cr* | Mn | Fe | Co | Ni | Cu* | | | |
| 2 8 18 | | | Zn | Ga | Ge | As | Se | Br | | | | | | | | | | | | |
| 2 8 18 8 | Kr | Rb | Sr | | | | | | | | | | | | | | | | | |
| 2 8 18 | | | | | | | | | Yt | Zr | Nb* | Mo* | Ma* | Ru* | Rh* | Pd* | Ag* | | | |
| 2 8 18 18 | | | Cd | In | Sn | Sb | Te | I | | | | | | | | | | | | |
| 2 8 18 18 8 | X | Cs | Ba | | | | | | | | | | | | | | | | | |
| 2 8 18 18 | | | | | | | | | La | | | | | | | | | | | |
| 2 8 18 | | | | | | | | | | | | | | | | | | Ce . . . . . | | Yb |
| 2 8 18 32 | | | | | | | | | Lu | Hf | Ta | W | Re | Os | Ir | Pt | Au* | | | |
| 2 8 18 32 18 | | | Hg | Tl | Pb | Bi | Po | . . | | | | | | | | | | | | |
| 2 8 18 32 18 8 | Em | . . | Ra | | | | | | | | | | | | | | | | | |
| 2 8 18 32 18 | | | | | | | | | Ac | Th* | . . | U* | | | | | | | | |

Sb 2; 8; 18; 18; 5
Fe 2; 8; 14; 2
Ce 2; 8; 18; 19; 9; 2.

The existence of four types of elements is emphasised—(1) those with all groups complete; (2) those with one incomplete group; (3) those with two incomplete groups (transition elements); (4) those with three incomplete groups (rare earth elements). The upper limits of existence of covalencies of 8, 6, and 4 are marked by heavy horizontal lines.

## Electrical Research in Industry.

ONE of the most important functions of the research department of a manufacturing company is to study the development of science with the view of its industrial application. At the beginning of the War there was a wide gulf between research and industry, although it was beginning to get narrowed. In 1915 there was a national movement in Great Britain to accelerate the application of science to industry, and this contributed largely to our industrial progress.

We have received from Messrs. Metropolitan-Vickers Electrical Co., Ltd., of Trafford Park, Manchester, an account of their research activities during 1929. This bears out how advantageous it is to make full use of scientific methods and the latest scientific developments in industry. An example of this is the development of a low vapour pressure grease for use with vacuum pumps and valves. This has made commercially possible the manufacture of vacuum apparatus which can be taken to pieces. With the highest vacua used at the present time, grease can be used for sealing the joints which has no appreciable evaporation products. The research work on the 'creep' of steels and other materials has led to important results. Apparatus has been made which enables the creep characteristics to be determined immediately by comparison with a standard up to temperatures of 800° C. The study of the rates of strain has enabled a tolerance limit to be fixed in turbine construction. The effect of combina-

tions of various stresses in thin walled tubes has led to important results. It has been found that the structural changes which occur in carbon steels at high temperatures also take place at the working temperatures of present turbine practice. In all future designs, the rate of creep and permanent distortion of the steel will have to be taken into account.

Many experimental turbine tests were carried out. The work has demonstrated that the correct formation of blade passages in turbines varies in different parts of the machine. A novel activity is the development of a means of studying nozzle efficiency by observation of the stream flow of the steam. This method has now been developed to a stage where it is giving very valuable guidance on the understanding of steam flow phenomena.

The quantitative tests made in the new acoustical laboratory on the noise emitted by electrical and mechanical apparatus has led to important results which are now being applied in practice. The 'skin' effect produced when electric currents flow in large conductors has been studied to help with the design of bus bars for central stations. In this connexion a study of the flow of heat from hot bars along irregular paths has also yielded useful results. The design of induction furnaces has now advanced so far that a furnace having a capacity of one ton is being constructed.

A cathode ray oscillograph has been completed, the first of its kind in England, for taking accurate oscillograms of very rapid electrical disturbances. The periodic time of the instrument is of the order of the millionth of a second. Much work has been done on domestic apparatus which has led to great improvements. A new range of fire elements has been developed and the existing elements used in hot plates, grills, and ovens have been made more efficient and trustworthy. An investigation has been made on the breakdown voltage of very long air gaps, and sparks up to fourteen feet long have been obtained. The safe working limits under all conditions of the high voltage testing equipment have been determined. High voltage tests have been particularly useful in testing insulators for use on the national 'grid' for distributing electrical energy.

## Water Supply of London.

IN a lecture delivered before the Junior Institution of Engineers on Jan. 17, Mr. G. Andrew-Marshall gave some interesting figures indicating the immensity of the responsibility involved in undertaking the supply of water to so great an area and population as is comprised in the district served by the Metropolitan Water Board. Thus the area supplied is about 560 square miles in extent; the population 7,381,000; and the quantity of water distributed last year was 100,723 million gallons, the average daily supply being 276 million gallons; a little more than the half of which quantity was equivalent to the combined supply for Manchester, Liverpool, Birmingham, Sheffield, Nottingham, Leeds, and Brighton. The net amount received for water rental amounts to about £4,500,000 a year, and the capital debt is £53,856,000. The number of officers employed by the Board is about 950 and of workmen 4290. The capacity of the storage reservoirs is 19,657 million gallons, and of service reservoirs there are 92, holding 321 million gallons; there are 176 acres of filter beds; about 7000 miles of mains, and a total horse-power of 27,270 is required to pump water through the system.

The raw water comes from three sources; the largest, giving 58 per cent of the total, being the River Thames; 24 per cent comes from the River Lea, and the remainder from wells sunk in the Thames Valley and in Kent at Addington, Eynsford, etc. Notwithstanding the great capacity—321 million gallons—of the service reservoirs, the daily quantity used—276 million gallons—makes continuous pumping necessary, and the reservoirs in many cases only serve as jack heads and cannot generally be looked upon as reservoirs for the storage of filtered water for anything but a short period.

The enormous capacity of the storage—as distinct from the service—reservoirs, namely, 19,657 million gallons, is essential to compensate for the great variation in the flow of the river sources of supply at different periods of the year. Thus in December 1929 the flow of the River Thames as gauged at Teddington Weir was nearly 10,500 million gallons in twenty-four hours, whereas in the previous July it was only 170 million gallons, about sixty times less than the former figure. It is, therefore, only possible to collect water at favourable periods of the year, and the reservoirs have to be of such capacity as to be able to span the periods of drought.

In addition to storing water, the storage reservoirs have another function—the clarification of the water by precipitation of suspended particles of matter and its improvement from a bacteriological point of view. Thirty days was generally considered a desirable period; in this time the number of bacteria of all kinds was reduced and the microbes of water-borne disease devitalised. The systematic purification of Thames water was commenced more than a hundred years ago by James Simpson, the engineer of the old Lambeth and Chelsea Water Companies, who passed it through sand filters. Many improvements in this system have been made, though the principle remains the same, and in the latest developments primary and secondary sand filters are installed, the conjunction enabling the slow sand filters to be worked at a faster rate. The normal rate of filtration by slow sand filters varies from 1½ to 2 million gallons per day for a bed of about 1 acre, but by passing prefiltered water on to them they can be made to work at about three times that speed.

## Composition of the Population of Canada.

A NEW departure by the Dominion Bureau of Statistics at Ottawa is the publication of a volume entitled "Origin, Birth, Nationality, and Language of the Canadian People". In this volume the data of the population according to the figures collected in the census of 1921 are analysed in some detail and made to afford much interesting and sometimes illuminating information relating to the composition of the Canadian people, especially in such matters as affect immigration in relation to growth of the population.

In 1921, about 55 per cent of the Canadian people was of British stock and nearly 28 per cent French, other European stocks constituting 14·16 per cent of the population. Of these, north-western Europeans (other than British or French) exceeded the Latin and Slav elements by approximately 20 per cent, though the latter group has in recent census periods been rapidly overtaking the former.

In 1921, about 97 per cent of the French-Canadians and three-quarters of the people of British stock were Canadian born, elements from other parts of Europe

showing proportions of Canadian-born ranging from 50 per cent to 80 per cent, those of the Germanic group being highest. Many of the people of Scandinavian or Germanic origin reach Canada from the United States. During the decades elapsing between the censuses of Canada, the proportion of the population which is Canadian-born has continued to decrease, and there has been a corresponding increase in the immigrant proportion.

The various provinces of Canada present different racial textures, and it is not surprising that in Quebec 80 per cent of the population is of French origin and only 15·12 per cent of British stock. In Ontario the position is reversed, more than 77 per cent being of British stock and more than 8 per cent of French stock, nearly 12 per cent being of other European origin. In the prairie provinces the proportion of European stock other than British or French was three times greater than in Ontario, people of British stock representing about 60 per cent of the population of Alberta, nearly 53 per cent of that in Saskatchewan, and more than 57 per cent of that of Manitoba. In British Columbia nearly 74 per cent was of British origin, slightly more than 2 per cent of French origin, and nearly 12 per cent of other European origin, persons of Asiatic origin forming in this Province 7·57 per cent. The British and French stocks continue to predominate in the maritime provinces.

Discussing the urban and rural distribution of the Canadian population, it is of interest to note that approximately a quarter of the population is resident in cities of 25,000 and more, the cities being more predominantly British than the rural districts. Of the people of British stock, 28·17 per cent live in cities, the corresponding percentage for the French stock being 22·45 per cent.

## University and Educational Intelligence.

CAMBRIDGE.—Mr. F. L. Engledow, fellow of St. John's College, Cambridge, and University lecturer in agriculture, has been elected to the Drapers professorship of agriculture, vacant by the death on Nov. 6 of Prof. T. B. Wood.

The Vice-Chancellor announces that the Royal Society, in virtue of its reversionary interest in the residue of the estate of the late Mr. E. W. Smithson, holds a sum yielding about £1200 a year, and that the regulations now published have been adopted by the Royal Society after consultation with the Council of the Senate in order to give effect to the terms of the bequest. Accordingly, at the Congregation on Friday, Jan. 24, the Regent House will be asked to pass a Grace to the effect that Prof. A. C. Seward, Master of Downing, Mr. W. H. Mills, of Jesus College, and Mr. R. H. Fowler, of Trinity College, be appointed members of the committee for the administration of the Smithson Research Fund. The Royal Society will appoint four members of the committee. The income of the fund is to be devoted to the establishment of a fellowship for research in natural science with the view of the discovery of new laws and principles, to be called the Smithson Research Fellowship. The research must be carried out in the University of Cambridge provided that an appropriate laboratory is prepared to offer the accommodation needed. The fellow may not undertake any paid work outside the research without the written permission of the Committee. The Committee will normally not withhold such permission to the holding of a paid teaching appointment in the University of Cambridge, provided that this does not involve a total of more than forty-eight hours of actual teaching in any one academic year, but it will not permit the holding of an appointment for college teaching or supervision of students' work. The total emolument of a fellow will be made up to £800 a year during the first two years of his tenure.

LEEDS.—Dr. J. H. Richardson has been elected to the Montague Burton chair of industrial relations. Dr. Richardson is at present Assistant Chief of Section in the Research Division of the International Labour Office of the League of Nations at Geneva.

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A DISCUSSION was held on Jan. 3 at the annual meeting of the Science Masters' Association on School Certificate Biology. Mr. J. W. Stork (Charterhouse) was in the chair. Mr. E. H. Michael (Swindon) opened the discussion by reading a paper dealing with the gradual growth of biology in schools, and the general problems in connexion with fitting it into the school certificate curiculum. The programme of the meeting included a series of propositions which were set out in the leading article in NATURE of Jan. 11. These were next discussed in turn, the chairman making it clear that they were not to be regarded as representing a syllabus, but merely as points on which the discussion might be focused. Resolutions were passed recommending, among other things, that biology should be included as a separate subject in every school certificate examination syllabus, and should rank for matriculation; that school certificate biology, though intended primarily for general education purposes, must also provide preparation for specialised higher certificate work; that questions should be set in the examination which demand a practical acquaintance with experiments and types, but there should be no separate practical examination; that as few 'types' as possible should be included in the syllabus; and that the syllabus should include "An elementary knowledge of, at least, the evidences of Evolution".

UNDER Section 4 of the University of Durham Act, 1908, the Sunderland Technical College was entitled to be affiliated to the University of Durham in the Faculty of Science, as soon as it had satisfied certain conditions. During the past few years a considerable extension has been added to the College buildings containing a large engineering laboratory equipped with types of Diesel, steam, oil, gas, and petrol engines; air compressor; carbon dioxide refrigeration plant, and a large number of accessories, such as pyrometers, indicators, etc. The materials testing laboratory has also been remodelled and the equipment brought up to date, and hydraulic plant installed for experimental purposes. The electrical engineering laboratory has been enlarged and equipped with plant and instruments for tests on all types of electrical machinery, and the physics laboratory accommodation has been extended and much equipment has been added. Upon the completion of this work the local education authority in May of last year made formal application for affiliation to the University. The Statutory Committee appointed by the University of Durham reported favourably and invited the Chancellor of the University to declare the College to be affiliated to the University in the Faculty of Science as from the close of the present academical year. Students of the College, therefore, will now be entitled to be admitted as candidates for degrees in engineering and electrical engineering in the University of Durham without being required to attend lectures or instruction other than the teaching provided by the College, and the executive authority of the College will be entitled to nominate two persons to serve on the Senate as its representatives.

## Historic Natural Events.

Jan. 26, 1884. Great Storm.—The centre of a very deep barometric depression appeared off the west coast of Ireland on the morning of Jan. 26, and passed across Scotland to Aberdeen, which it reached at midnight. At Ochtertyre, Perthshire, the barometer fell to 27·359 inches (corrected for gravity), or 926·5 millibars at 8.30 P.M., the lowest known sea-level pressure in the British Isles. A severe gale was felt in north-east England, the velocity at Alnwick between 11.30 P.M. on Jan. 26 and 12.30 A.M. on Jan. 27 averaging 76 miles per hour. The Observatory on the summit of Ben Nevis was in operation at the time, and the storm there was exceedingly violent.

Jan. 27, 1889. Wind Storm.—During a thunderstorm at Sydney, New South Wales, some damage was done by a violent gust of wind. One house was completely shattered, the roof being lifted off and the walls blown outwards. At the Observatory three miles away, the highest gust recorded was 68 miles per hour.

Jan. 27, 1920. High Wind.—A severe gale on the west coast of Ireland was remarkable for a gust of wind at Quilty, County Clare, which reached the highest velocity known in the British Isles. The wind increased steadily in force until about 8 A.M., when it was 51 miles per hour. At 8.20 a violent gust occurred; the pen of the pressure-tube anemograph rushed up above the top of the chart, for it caught in the upper edge and spluttered as it came down. The indicated speed of the wind was at least 111 miles per hour. This isolated squall did not last much more than a minute, after which the general velocity fell again to 50 miles an hour.

Jan. 29, 1921. Storm in Washington and Oregon.—The severest storm experienced in 200 years. At the mouth of the Columbia River, the wind velocity recorded by an anemometer averaged 126 miles per hour over a period of five minutes, and reached 150 miles per hour in a gust. Trees four feet in diameter were broken off, the damage to standing timber being the greatest ever experienced in the United States. Billions of feet of the finest timber were uprooted and thrown down; much of it was a total loss, as the district is not readily accessible for salvage.

Jan. 30, 1766. Dust Storm.—A violent hailstorm at Gibraltar brought also enormous quantities of dust, which fell so thickly in the streets that in places it is said to have reached to the roofs of the houses, and afterwards one thousand labourers were required to remove it.

Jan. 30, 1911. Eruption of Taal Volcano.—A great eruption occurred in Taal Volcano in Luzon Island, 39 miles south of Manila. The chief feature was an explosion scattering scalding mud and ashes that ultimately formed a layer 2½ feet deep to a distance of 6 miles west of the crater. The sound was heard for at least 310 miles, and the resulting atmospheric depression was registered by barographs within 186 miles of the volcano. Though frequent earthquakes preceded the eruption for three days, no attempt was made to save the inhabitants, nearly all of whom (1335 in number) perished (see under heading Jan. 12).

Jan. 31, 1918. Fog.—With an anticyclone over western Europe, the three days Jan. 31–Feb. 1 were foggy at many places in Europe, and on Jan. 31 occurred the densest fog recorded in London for many years. It began to form in the City on the afternoon and evening of Jan. 30, but under the influence of light easterly airs it drifted up the Thames Valley, and at the same time increased in intensity. During the afternoon and early evening of Jan. 31 rail and road traffic was completely paralysed over all the low ground from Hammersmith to Twickenham, and in many places vision was limited to not more than a yard. It was a typical example of shallow radiation fog, ending against the slopes of the hills almost as abruptly as a sheet of water.

## Societies and Academies.

LONDON.

Royal Society, Jan. 16.—J. R. Marrack and F. C. Smith: The composition of diphtheria toxin—antitoxin floccules. The floccules formed by diphtheria toxin and antitoxin closely resemble serum pseudoglobulin. Their ultra-violet absorption curves are identical. The amount of precipitate obtained from a balanced mixture of a given toxin and antitoxin is to a large extent independent of the conditions under which flocculation takes place, particularly of the amount of non-specific protein present. Lipoid material forms a very small fraction of the floccules. The authors consider that the floccules consist mainly of antitoxin, and infer that antitoxin is not merely carried down in the pseudoglobulin fraction but actually is pseudoglobulin.—F. G. Spear: The delayed lethal effect of radium on tissue cultures *in vitro*. Cultures *in vitro* of the choroid and sclerotic of embryo chicks were exposed for varying periods to gamma rays from radium and were afterwards subcultivated every forty-eight hours. When a delayed lethal effect followed exposure to radium, it occurred sooner in those cultures which had been exposed to the greater intensity of irradiation for a shorter time than in those subjected to a lesser intensity for a longer time, the product of milligrams of radium and hours of exposure being the same in a given comparison.—Sir Frederick Keeble, M. G. Nelson, and R. Snow: The integration of plant behaviour. (1) Separate geotropic stimulations of tip and stump in roots. In seedlings of *Zea Mays*, a geotropic stimulus can be transmitted across a discontinuity from a coleoptile tip or root tip to an unstimulated root stump. Conversely, the sensitivity to gravity of a geotropically stimulated root stump is increased by an unstimulated coleoptile tip placed upon it, and probably also by an unstimulated root tip.—Charles Todd: Cellular individuality in the higher animals, with special reference to the individuality of the red blood corpuscle. It is possible in the fowl, by means of simple immunity reactions, to differentiate red blood corpuscles of any particular fowl from those of any other individual of the same species, except in certain cases where there is close blood-relationship. It appears probable that in the higher animals this individual specificity of the red blood corpuscle is only one example of a general rule applying to most cells of the body.—J. Ewles and J. B. Speakman: Examination of the fine structure of wool by X-ray analysis. Photographs have been obtained showing for the first time that wool has a definitely fibred structure. The three types of wool investigated in the unstretched state suggest an interesting transition in structure. Cotswold wool has definitely ordered structure and its strongly fibred pattern indicates an elongated cell. Geelong 80 merino wool, though fibred, is less so than that of Cotswold wool and suggests an ellipsoidal cell: 64 merino wool shows only a trace of ordered arrangement and fibring. The three types suggest the mode of development. The wool cell probably begins as a gelatinous spherical cell; by elongation in the direction of growth, strains may be set up which will give rise to ordered and preferential arrangement, tending to the crystalline state.

Mineralogical Society, Jan. 14.—Sir Douglas Mawson: On the occurrence of potassium nitrate

near Goyder's Pass, M'Donnell Ranges, Central Australia. The nitre occurs as encrustations on the walls and impregnations in the wall-rock in small caves in dolomitic limestone. The roof of the caves consists of a case-hardened crust formed by superficial silicification and ferruginisation of the limestone; and it is this impervious crust that has enabled the nitrates, probably of animal origin, to be preserved. Mention is made of some other occurrences of mineral nitrates in Australia.—**Louis T. Nel**: A new occurrence of zunyite near Postmasburg, South Africa. The mineral zunyite, previously known only from Colorado, has been found in some abundance in altered, highly aluminous, shales and flagstones in the vicinity of the deposits of manganese ore of the Postmasburg District in Cape Province. Minute perfectly developed tetrahedra are aggregated in clusters or are disseminated through the rock, which contains also diaspore, kaolin, and leverrierite. Most of the tetrahedra are simple, but a few are interpenetration twins with a triad axis as twin-axis. Analyses agree with the formula $Al_8(OH, F, Cl)_{12}(SiO_4)_3$.

PARIS.

**Academy of Sciences**, Dec. 23.—**A. Danjon**: Results obtained during the eclipse of May 9, 1929, by the expedition of the Strasbourg Observatory to Poulo Condore. The period of the eclipse was troubled by clouds, but the whole of the projected programme was carried out. Three photographs of the corona taken during totality are reproduced in the paper.—**A. Michel-Lévy** and **H. Muraour**: The microscopic examination of colloidal powders in polarised light. Contrary to the views hitherto held, it is shown that, with explosives of mixtures of nitroglycerine with guncotton, the examination in polarised light clearly differentiates the different types of powder, as regards the unequal distribution of the proportion of nitric nitrogen. The microscopic examination and the determination of the rapidity of combustion are always in agreement, the latter being invariably higher, for the same percentage composition, when the polarising microscope indicates the presence of strongly nitrated fibres of nitrocellulose.—**P. Mondain-Monval**: The spontaneous inflammation of mixtures of air and hydrocarbons. The influence of concentration. A summary, with diagram, of the results of preceding papers. Generally, even when there is no inflammation, a sudden spontaneous increase of pressure is observed in the bomb, an increase impossible to differentiate by external manifestations from a true combustion.—**Const. Kténas**: The limits of the mixed Ægean region. An attempt at a geological synthesis.—**Paul Wintrebert**: The equilibrium changes of the egg and the position of the blastopore in the course of the development of *Discoglossus pictus*.—**Jules Amar**. The respiratory adaptation of the heart.—**Brocq-Rousseu, Mme. Z. Gruzewska**, and **G. Roussel**: The relation of the hydrolysing power of the amylase of horse serum to the serum proteins.—**F. Vlès, A. de Coulon**, and **J. Nicod**: Experiments on the action of the amino acids towards tar tumours in mice. Treatment with amino acids, alone or mixed, showed several cases of cure of the cancerous tissue: in others the normal growth of the tumour was arrested.

CRACOW.

**Polish Academy of Arts and Letters**, Nov. 11.—**O. Nicodym**: The condition of Baire.—**K. Kordylewski**: The variable star Tauri. 41. 1929. The elements are calculated from 76 observations on 15 nights between 1925 and 1929. The time of eclipse is eight hours.—**W. Swietoslawski**: The heat of combustion of camphor, azobenzene, and hydrazobenzene. For the heat of combustion at constant volume for 1 gram weighed in vacuum the values obtained are, camphor, 9248·7 cal., azobenzene, 8477·0 cal.—**L. Marchlewski**: Phyllerythrin. This substance, when recrystallised from chloroform, forms a stable compound with the latter. This dissolved in pyridine, and precipitated by alcohol or by acetic acid, and this treatment repeated several times, yields pure phyllerythrin free from chloroform.—**K. Dziewonski, Mlle. A. Glasnerowna**, and **Mlle. J. Schoenowna**: Researches on the derivatives of α-bromoacenaphthene.—**K. Dziewonski, St. Lepiankiewicz, J. Moszew**, and **L. Sucheni**: 1, 4-Dibenzylnaphthalene and its ketonic derivatives.—**Z. Grodinski**: The lymphatic hearts of fossil reptiles.

WASHINGTON, D.C.

**National Academy of Sciences** (*Proc.*, Vol. 15, No. 11, Nov. 15).—**William Duane**: On the polarisation of X-radiation. A horizontal stream of high-speed electrons passes through a vertical stream of mercury atoms in the middle of the anode and the polarisation of radiation at right angles to the electron stream was investigated by means of the scattered radiation from a block of carbon. The weighted mean value for the degree of polarisation is 0·497.—**F. Zwicky**: On mosaic crystals. It is suggested that structure insensitive properties of crystals are determined by the primary lattice and structure sensitive properties by a secondary structure superposed on the primary structure.—**H. P. Robertson**: On the foundations of relativistic cosmology. A mathematical discussion leading to the view that the only possible cosmologies the intrinsic properties of which are independent of time are those of Einstein and de Sitter.—**G. I. Lavin** and **Francis B. Stewart**: Production of hydroxyl by the water vapour discharge. Excited hydroxyls are found in the discharge tube and destroyed in passing through the observation tube by some recombination reaction. Intensity of the hydroxyl lines is parallel to the quantity of hydrogen peroxide found in the water condensed in the outlet trap.—**Emma T. R. Williams**: A spectrophotometric study of class *A* stars.—**M. Demerec**: Genetic factors stimulating mutability of the miniature-gamma wing character of *Drosophila virilis*.—**Clyde E. Keeler**: (1) The occurrence of a heritable twisted nose in the house mouse, *Mus musculus*.—(2) On the amount of external mirror imagery in double monsters and identical twins. Mirrored features appear to be most frequent in laterally joined monsters.—**S. H. Yarnell**: Meiosis in a triploid *Fragaria*. There appears to be complete pairing of non-homologous chromosomes.—**Karl Sax**: Chromosome behaviour in *Sorbopyrus* and *Sorbaronia*. Both these hybrids fruit freely, but the former sets very few seeds; cytological studies were carried out to determine chromosome compatibility and behaviour.—**J. C. Walker, Karl Paul Link**, and **H. R. Angell**: Chemical aspects of disease resistance in the onion. *Colletotrichum circinans* (onion smudge) does not attack coloured varieties. Black spots appear at harvest on the outer scales near the neck and, during curing and storage, the fungus penetrates the fleshy scales causing shrinking and decay. A crude water extract from dry coloured scales is toxic to spores and also to thalli of the fungus. Free protocatechuic acid (3, 4-dihydroxybenzoic acid) occurs in this extract—this establishes the free existence of this acid—and is one at least of the toxic agents involved.—**Tracy Yerkes Thomas**: On the existence of integrals of the system of partial differential equations $A^i_{\alpha\beta i} = 0$ in $n$ variables.—**Marston Morse**: Closed extremals.—**G. A. Miller**: Non-Abelian groups of odd prime power order which admit a maximal number of inverse correspondences in an automorphism.

## Official Publications Received.

BRITISH.

The World's Sugar Industry. (Twelfth Streatfeild Memorial Lecture 1929.) By Lewis Eynon. Pp. 20. (London: The Institute of Chemistry.)

Ministry of Health. Treatment of Tuberculosis: Analysis of Work done during the Year 1928 under the Schemes of Local Authorities for the Treatment of Tuberculosis, as shown in the Returns furnished in accordance with Memorandum 37/T. (Memo. 131B/T.) Pp. 9. (London: Ministry of Health.)

University of Edinburgh: Animal Breeding Research Department. Report of the Director for the Period September 1st 1928 to August 31st 1929 (being the 9th Annual Report). Pp. 19. (Edinburgh.)

The Proceedings of the Physical Society. Vol. 42, Part 1, December 16, No. 231. Pp. viii+42. (London.) 7s. net.

Western Australia. Annual Progress Report of the Geological Survey for the Year 1928. Pp. 16+49 plates. (Perth: John Lee.)

Rubber Research Institute of Malaya. Bulletin No. 2: A Study of the Effect of Damp Storage on Raw Rubber. By B. J. Eaton and R. G. Fullerton. Pp. 26. (Kuala Lumpur.) 1 dollar.

Trinidad and Tobago. Minutes and Proceedings of the Froghopper Investigation Committee. Part 17. Pp. 343-423. (Trinidad: Government Printing Office, Port-of Spain.)

The Indian Lac Association for Research. Bulletin No. 3: Wax and Resin Secretion by the Lac Insect on Butea frondosa. By M. Venugopalan. Pp. 14. (Namkum.)

Transactions of the Hull Geological Society. Vol. 7, Part 2, 1928–1929. Edited by Thos. Sheppard. Pp. 41-76. (Hull.) 5s.

Report on the Zoological Survey of India for the Years 1926 to 1929. Pp. lviii+4 plates. (Calcutta: Government of India Central Publication Branch.) 1.10 rupees; 2s. 6d.

Proceedings of the Royal Irish Academy. Vol. 39, Section A, No. 3: The Ions produced by Discharges at Liquid Surfaces. By Prof. J. J. Nolan and J. G. O'Keeffe. Pp. 21-30. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6d.

The Indian Forest Records. Botany Series, Vol. 14, Part 3: Investigations on the Infestations of *Peridermium complanatum*, Barclay, on the Needles, and of *Peridermium himalayense* n. sp., on the Stem of *Pinus longifolia* Roxb. Part 1: Distribution, Pathological Study of the Infections, and Morphology of the Parasites. By Dr. K. D. Bagchee. Pp. iv+24+14 plates. (Calcutta: Government of India Central Publication Branch.) 2.12 rupees; 5s.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1254 (Ae. 403): Part 1, A Method of Calculating suitable Airscrew Characteristics to meet given Conditions—The Resulting Airscrew Performance; Part 2, A Comparison of the Observed Change of Performance consequent on a Change of Airscrew and the Change predicted by the Methods of Part 1. By R. S. Capon. (T. 2607 (revised); T. 2729; T. 2799.) Pp. 44+9 plates. (London: H.M. Stationery Office.) 2s. net.

Proceedings of the Royal Society. Series A, Vol. 126, No. A801, January 1, 1930. Pp. 184-365. (London: Harrison and Sons, Ltd.) 6s.

Air Ministry: Meteorological Office, London. Southport Auxiliary Observatory (the Fernley Observatory of the Corporation of Southport): Annual Report and Results of Meteorological Observations for the Year 1928. By Joseph Baxendell. Pp. 28. (Southport: Fernley Observatory; London: Air Ministry.)

Department of Scientific and Industrial Research. Building Science Abstracts. Compiled by the Building Research Station and published in conjunction with the Institute of Builders. Vol. 2 (New Series), No. 11, November 1929. Abstracts Nos. 2217-2443. Pp. v+387-424. (London: H.M. Stationery Office.) 9d. net.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1256 (Ae. 405): The Distribution of Pressure over a section of an Airscrew Blade in Flight, and the Variation of Lift Coefficient with the Speed of the Section. By E. T. Jones. (T. 2778.) Pp. 23+17 plates. 1s. 3d. net. No. 1259 (Ae. 408): Theoretical Relationship for a Wing with Unbalanced Ailerons. By A. S. Hartshorn. (T. 2794.) Pp. 16+4 plates. 9d. net. (London: H.M. Stationery Office.)

Department of Scientific and Industrial Research: Water Pollution Research. Summary of Current Literature. Vol. 3, No. 1, January 1930. Abstracts Nos. 1-119. Pp. iv+36. (London: H.M. Stationery Office.) 1s. 3d. net.

The Observer's Handbook for 1930. Edited by C. A. Chant. Twenty-second year of Publication. Pp. 72. (Toronto: Royal Astronomical Society of Canada.)

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, St. Vincent, for the Year 1928. Pp. v+30. (Trinidad, B.W.I.)

Development Commission. Nineteenth Report of the Development Commissioners for the Year ended the 31st March 1929. Pp. 232. (London: H.M. Stationery Office.) 4s. net.

Southern Rhodesia: Geological Survey. Bulletin No. 15: (i) The Geology of the Central Part of the Wankie Coalfield, by B. Lightfoot; (ii) The Fossil Flora of the Karroo System in the Wankie District, Southern Rhodesia, by John Walton. Pp. 83+13 plates. (Salisbury.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1264 (M. 65): The Elasticity of Pintsch Crystals of Tungsten. By S. J. Wright. Work performed for the Department of Scientific and Industrial Research. (E.F. 229.) Pp. 15+7 plates. (London: H.M. Stationery Office.) 9d. net.

FOREIGN.

Conseil Permanent International pour l'Exploration de la Mer. Journal du Conseil. Rédigé par E. S. Russell. Vol. 4, No. 3. Pp. 267. 375. (Copenhague: Andr. Fred. Høst et fils.)

Spisy lékařské Fakulty Masarykovy University. Svazek 7, Spis 61-69. Pp. 12+31+36+6+23+14+13+8+12. (Brno: A. Píša.) 30 Kč.

Biologické Spisy vysoké Školy zvěro lékařské. Svazek 7, Spis 96-110. Pp. 14+12+7+40+12+6+4+6+15+16+6+6+32+14+31. (Brno: A. Píša.) 40 Kc.

Sborník vysoké Školy Zemědělské. Sign. C15: Nomogram pro jednoduchou počítací desku bakteriální. Napsal Prof. Dr. Otakar Vodrážka. Pp. 15. Sign. D12: Doplňky k seznamu slovenského ptactva. Napsal Dr. Štěpán Soudek. Pp. 9. Sign. D13: Addenda ad floram Čechoslovakiae mycologicam, IV. Scripsit Dr. Richard Picbauer. Pp. 28. (Brno: A. Píša.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 60: Procès-verbaux (avril 1929). Pp. 144. 5.50 kr. Vol. 61: Untersuchungen an Salmoniden, mit besonderer Berücksichtigung der Art- und Rassefragen, Teil 1. Von Prof. Dr. H. Henking. Pp. 99+4 Tafeln. (Copenhague: Andr. Fred. Høst et fils.) 6.50 kr.

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 81. New and Little-known Madagascar Grouse-Locusts (Orthoptera, Acrididae Acrydiinae). By James A. G. Rehn. Pp. 477-519+plates 17-21. (Philadelphia, Pa.)

Ministerio da Agricultura, Industria e Commercio: Observatorio Nacional do Rio de Janeiro. Taboas das Marés para o Anno de 1930 nos Portos do Rio de Janeiro, Belém, S. Luiz, Amarração, Camocim, Fortaleza, Natal, Cabedello, Tambahú, Recife, Aracajú, Bahia, Ilhéos e Paranagua. Pp. 172. (Rio de Janeiro.)

Instytut Geofizyki i Meteorologji, Uniwersytetu Jana Kazimierza we Lwowie. Komunikaty, tom. 4, Nr. 43 do 56. Wyników prac Henryka Arctowskiego i jego współpracowników Pp. Jana Moniaka, Stanisława Myćki, Henryka Orkisza, Adama Schmucka, Henryka Stättnera, Edwarda Stenza, Adama Tabora, Zbyszka Juljusza Zielińskiego i Stanisława Zycha, przedłożonych Towarzystwu Przyrodników im. Kopernika i ogłoszonych w czasopiśmie *Kosmos*, t. 53 i 54. Pp. viii+831-886+188-583. (Lwów.)

Bulletin of the American Museum of Natural History. Vol. 58, Art. 12: Studies on the Evolution of the Pelvis of Man and other Primates. By Harriet Cutler Waterman. Pp. 585-642. (New York City.)

University of California Publications in American Archaeology and Ethnology. Vol. 24, No. 4: The Valley Nisenan. By A. L. Kroeber. Pp. 253-290. 50 cents. Vol. 24, No. 5: The Bear River Dialect of Athapascan. By Pliny Earle Goddard. Pp. 291-324. 40 cents. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.)

United States Department of Agriculture: Bureau of Biological Survey. North American Fauna, No. 52: Revision of the American Chipmunks (Genera Tamias and Eutamias). By Arthur H. Howell. Pp. 157+10 plates. (Washington, D.C.: Government Printing Office.) 35 cents.

Conseil Permanent International pour l'Exploration de la Mer. Faune ichthyologique de l'Atlantique Nord. Publiée sous la direction de Prof. Joubin. 24 planches. Rapports et procès-verbaux des réunions. Vol. 62: Rapport atlantique 1928. Publié avec l'aide de Dr. Ed. Le Danois et Rafaël De Buen. Pp. 103. 4.00 kr. Vol. 63: Die Reichsstatistik über das Fangergebnis der Deutschen Seefischerei. Von Eberhard Eichelbaum. Pp. 50. 2.50 kr. (Copenhague: Andr. Fred. Høst et fils.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 1, No. 12, Décembre. Pp. 627-668+xx. (Prague: Regia Societas Scientiarum Bohemica.)

Bernice P. Bishop Museum. Bulletin 66: Hawaiian Atyidae. By Charles Howard Edmondson. Pp. 36+1 plate. Memoirs of the Bernice P. Bishop Museum. Vol. 11, No. 1: Descendants of the Mutineers of the *Bounty*. By Harry L. Shapiro. Pp. 106+3 plates. (Honolulu.)

United States Department of Agriculture. Technical Bulletin No. 152: Life History of the Oriental Peach Moth in Georgia. By Oliver I. Snapp and H. S. Swingle. Pp. 16. 5 cents. Circular No. 82: Improved Reindeer Handling. By Lawrence J. Palmer. Pp. 18. 5 cents. (Washington, D.C.: Government Printing Office.)

Department of the Interior: Bureau of Education. Bulletin, 1929, No. 26: Commercial Education, 1926–1928. By J. A. Malott. Pp. 27. (Washington, D.C.: Government Printing Office.) 5 cents.

CATALOGUES.

Electro-Medical Apparatus. (Publication No. E29.) Pp. 16. (London Newton and Wright, Ltd.)

A Catalogue of Books on the Mathematics (Pure and Applied) and Astronomy. (No. 448.) Pp. 95. (Cambridge: Bowes and Bowes.)

## Diary of Societies.

*FRIDAY*, JANUARY 24.

ASSOCIATION OF ECONOMIC BIOLOGISTS (Annual General Meeting) (at Imperial College of Science and Technology), at 4.30.—Dr. Butler: Some Aspects of the Morbid Anatomy of Plants (Presidential Address).

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—J. M. Nuttall and E. J. Williams: A Method of Examining Stereoscopic Photographs.—S. E. Green: The Photography of Fabry and Perot Interferometer Fringes by the Use of a Simple Optical System.—Miss W. A. Leyshon: Characteristic of Discharge Tubes under 'Flashing' Conditions, as Determined by the Use of a Cathode Ray Oscillograph.—Demonstration by W. E. Doran of a pH Apparatus.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5.30.—J. H. Clarke: The Anderson Rotary Piston Engine.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—E. Watson Smyth: General Operating Experiences with the first 'Wood' Steam Generator.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Newcastle-upon-Tyne), at 6.—R. A. MacGregor: Failure of Steel Forgings and Castings through Fatigue.

INSTITUTION OF CHEMICAL ENGINEERS (at Institution of Civil Engineers), at 6.30.—Dr. H. Levinstein: Films and Fibres derived from Cellulose (Lecture).

INSTITUTION OF LOCOMOTIVE ENGINEERS (London) (Manchester Centre) (at Literary and Philosophical Society, Manchester), at 7.—J. R. Bazin: Presidential Address.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow), at 7.—F. Clerf: Notes on Continental Blast-furnace Practice.

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.—H. C. Lamb: The Electrical Distribution System of Manchester.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—W. J. Rees: Refractories for Steam-raising Furnaces.
LEICESTER TEXTILE SOCIETY (at Victoria Hall, Leicester), at 7.30.—F. Willis: Knitted Footwear.
TEXTILE INSTITUTE (Lancashire Section) (at Harris Technical Institute, Preston), at 7.30.—J. Starkie: The Weaving of Artificial Silk.
ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8.—Dr. G. P. Crowden: Industrial Efficiency and Fatigue.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir William Bragg: Cellulose in the Light of the X-Rays.

*SATURDAY*, JANUARY 25.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. R. W. Chambers: Sir Thomas More and His Friends (1).
BRITISH ASSOCIATION OF MANAGERS OF TEXTILE WORKS (at Manchester Athenæum), at 6.30.—F. H. Smith: Foreign Yarn Business.
INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Junior Section) (at College of Technology, Manchester), at 7.—J. O. Gray: Foundry Costing.

*MONDAY*, JANUARY 27.

INSTITUTE OF ACTUARIES, at 5.—C. H. Wickens: Australian Mortality.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. V. Bonney: The Surgical Treatment of Carcinoma of the Cervix.
NORTHAMPTON ENGINEERING COLLEGE ENGINEERING SOCIETY, at 5.30.—G. A. V. Sowter: Realism from Records.
INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—G. V. Twiss: High-Tension Distribution.
INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.—L. C. Grant: The Breaking Performance of High-Power Switchgear and of a New Form of Quenched-Arc Switch.
SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (at Great Northern Station Hotel, Leeds), at 7.15.—F. A. Mason: The Destruction of Materials by Micro-organisms.
KEIGHLEY TEXTILE SOCIETY (at Kiosk Café, Keighley), at 7.30.—A. Bennett: Modern Improvements in Worsted Machinery.
ROYAL SOCIETY OF ARTS, at 8.—H. J. L. Wright: Three Master Etchers: Rembrandt, Meryon, Whistler (Cantor Lectures) (2).
ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—Prof. W. Billington and H. Round: Bone-Grafting and the Mandible: Some Recent Results. A Two-stage Cleft Palate Operation.
ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—J. M. Wordie: The Cambridge East Greenland Expedition, 1929: Ascent of Petermann Peak.
MEDICAL SOCIETY OF LONDON.—Prof. D. P. D. Wilkie and others: Discussion on The Etiology of Gall-bladder Infections.
ROYAL IRISH ACADEMY (at Dublin).
INSTITUTION OF THE RUBBER INDUSTRY (London and District Section) (at Engineers' Club, Coventry Street, W.C.2).—Hon. F. A. Stockdale: Lecture.

*TUESDAY*, JANUARY 28.

ROYAL SOCIETY OF ARTS (Dominions and Colonies Meeting), at 4.30.—Sir Daniel Hall: Settlers' Problems in Kenya.
MANCHESTER UNIVERSITY CHEMICAL SOCIETY, at 5.—Dr. W. H. Mills: Some Stereochemical Problems.
ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5.—Dr. A. P. Thomson (with Bacteriological Reports by Dr. W. T. Hillier): Psittacosis.—Dr. O. Leyton: Nine Cases of Recovery from Diabetes Mellitus.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. F. W. Aston: Isotopes (2).
INSTITUTION OF CIVIL ENGINEERS, at 6.—G. Lacey: Stable Channels in Alluvium.
MANCHESTER ATHENÆUM TEXTILE SOCIETY (at Manchester Athenæum), at 7.—H. P. Curtis: The Automatic Loom.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. L. Thomson: The Technical Applications of X-Ray Stereoscopy.—R. B. Archey: Photographic Emulsion Spots of Biological Origin.
INSTITUTION OF AUTOMOBILE ENGINEERS (London Graduates' Informal Meeting) (at Watergate House, Adelphi), at 7.25.—S. C. Vince and others: Discussion on Tuning Motor Cycles for Speed.
SHEFFIELD METALLURGICAL ASSOCIATION, at 7.30.—B. S. Smith: Density of Molten Steel.
WEST KENT SCIENTIFIC SOCIETY (at Wesleyan Hall, Blackheath Village), at 8.30.
LONDON CLINICAL SOCIETY (at London Temperance Hospital), at 8.45.—Dr. A. Hurst, H. S. Souttar, and others: Discussion on The Treatment of Gastric Ulcer.

*WEDNESDAY*, JANUARY 29.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. G. E. Gask: A Contribution to the Treatment of Epithelioma of the Tongue by Radium.
EUGENICS SOCIETY (at Royal Society), at 5.15.—E. J. Lidbetter: Insanity: Legislation and Administration (Lecture).
INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.30.—A. H. Kennard: Highways, and a Survey of Future Developments.
INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (jointly with Midland Centres of Institutions of Civil and Mechanical Engineers) (at Midland Institute, Birmingham), at 7.—Capt. P. P. Eckersley: Broadcasting by Electric Waves (Faraday Lecture).
INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at Works of Austin Motor Co., Ltd., Northfield), at 7.30.—Prof. W. Morgan: The Value of the Institution to its Junior Members.
HALIFAX TEXTILE SOCIETY (at White Swan Hotel, Halifax), at 7.30.—J. P. O'Callaghan: Water Softening for Industrial Purposes.
ROYAL SOCIETY OF ARTS, at 8.—Sir Thomas H. Holland: International Movement of Mineral Products during Peace and War (Trueman Wood Lecture).
ROYAL PHILOSOPHICAL SOCIETY, GLASGOW (at 207 Bath Street, Glasgow), at 8.—Prof. W. E. S. Turner: Glass.

*THURSDAY*, JANUARY 30.

ROYAL SOCIETY, at 4.30.—R. H. Salaman: (*a*) Crinkle 'A'—an Infectious Disease of the Potato; (*b*) Paracrinkle—a Potato Disease of the Virus Group.—E. C. Smith and T. Moran: The Formation of Lactic Acid in Desiccated Amphibian Muscles.—H. G. Thornton: The Influence of the Host Plant in inducing Parasitism in Lucerne and Clover Nodules.—*To be read in title only*:—F. Kidd and C. West: Physiology of Fruit. I. Changes in the Respiratory Activity of Apples during their Senescence at Different Temperatures.—R. N. Mukerji: The 'Nucleal Reaction' in Apanteles sp., with Special Reference to the Secondary Nuclei and the Germ Cell Determinant of the Egg.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. H. A. Harris: The Growth of Children in Health and Disease (2).
BEDSON CLUB (at Armstrong College, Newcastle-upon-Tyne), at 6.15.—Prof. C. K. Ingold: Tautomerism and Conjugation (Bedson Lecture).
INSTITUTION OF WELDING ENGINEERS (at Chamber of Commerce, Birmingham), at 7.—C. A. Hadley: Modern Improvements in Electric Resistance Welding Machines.
ROYAL SOCIETY OF MEDICINE (at Wellcome Historical Medical Museum), at 8.30.—Dr. A. P. Cawadias: From Epidaurus to Galen: the Principal Currents of Greek Medical Thought.—Demonstration by L. W. G. Malcolm of Some Recent Acquisitions by the Museum.
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Newport).—R. D. Owen: Chemical Fires, Causes and Prevention.

*FRIDAY*, JANUARY 31.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 4.30.—Seismic Methods in Surveying: Prof. A. O. Rankine, Dr. H. Jeffreys, Capt. Shaw, R. S. Whipple, F. J. W. Whipple. Chairman, Prof. H. H. Turner.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. W. S. Handley: The Papilloma and its Menace.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (Joint Meeting) (at Newcastle-upon-Tyne), at 7.15.—W. G. Thompson: The Electrical Propulsion of Ships.
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—F. Onions: Superheating.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Lord Rayleigh: Iridescent Colour in Nature.
SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section, jointly with other Chemical Societies of Glasgow) (at Glasgow).—Prof. I. M. Heilbron: Lecture.
INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub-Centre).

*SATURDAY*, FEBRUARY 1.

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College for Women), at 3.—Annual Meeting.
ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. R. W. Chambers: Sir Thomas More and his Friends (2).
ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—The Westland Wapiti in Service.

## PUBLIC LECTURES.

*SATURDAY*, JANUARY 25.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. Harcourt: Things Old and New from India's Treasury.

*MONDAY*, JANUARY 27.

UNIVERSITY OF LEEDS, at 5.15.—Prof. R. V. Wheeler: Pyrolysis of Hydrocarbons.
UNIVERSITY COLLEGE, at 5.30.—Prof. J. Macmurray: The Philosophical Approach to Modern Social Problems. (Succeeding Lecture on Feb. 10.)
EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—J. G. Stewart: Farming Problems in East Anglia.

*WEDNESDAY*, JANUARY 29.

UNIVERSITY COLLEGE, at 5.30.—Miss A. S. Cooke: Recent County Library Developments.

*THURSDAY*, JANUARY 30.

KING'S COLLEGE, at 5.30.—Prof. R. J. S. McDowall: The Control of the Circulation. (Succeeding Lectures on Feb. 6, 13, and 20.)
UNIVERSITY COLLEGE, at 5.30.—A. D. Lindsay: The Relations between Ethics, Economics, and Politics (Jevons Memorial Lectures). (Succeeding Lectures on Feb. 6, 13, and 20.)

*SATURDAY*, FEBRUARY 1.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—D. Martin Roberts: London in the Tudor Age.

## CONVENTION AND EXHIBITION.

FRIDAY, JANUARY 31.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Northampton Institute, Clerkenwell).

At 2.—Convention, and Exhibition representative of Modern Scientific and Practical Advances in Electro-Deposition.

At 4.—Dr. W. Rosenhain: Research and Practice.

At 7.30.—Discussion on The Present Position of Chromium Plating.