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Hours, Wages, and Welfare in Industry.

OF all the problems which have been left to Great Britain as a legacy of the War, that of unemployment has proved to be the most tragic, most persistent, and most intractable. Ever since the short-lived boom of 1919 the nation has had to contemplate week by week the spectre of anything from 1 to 2 million workers unemployed. Although the anxiety arising from this fact has been alleviated in some degree by the knowledge of the relief arising from the operation of the Unemployment Insurance Act, it is to our credit as a nation that we have never ceased to concentrate attention on remedies for this evil as well as on palliatives of its worst defects. Private investigators have inquired carefully and scrupulously into the effects of unemployment, and official analyses of the unemployed have been made in order to get so far as possible to the tenacious, deep-seated roots of the trouble.

It was not, therefore, surprising that when the first Labour Government came into power it should follow the excellent British tradition of appointing a committee to inquire into the conditions and prospects of British industry and commerce, with special reference to the export trade. Accordingly, the Committee on Industry and Trade was set up by Mr. MacDonald on July 28, 1924, with a distinguished and impartial personnel ranging from members responsible for the conduct of large industrial undertakings, with economic experts and the chief economic adviser to the Government, to representatives of the wage-earners. As is the British custom also, the political colour of the Commission was blended in a judicious pattern. In a memorandum accompanying the terms of reference, the Committee was asked to direct its attention first to the position of British Overseas Trade and the prospect of British participation in the markets of the world. In pursuance of this request, the Committee issued in July 1925 a first volume entitled "Survey of Overseas Markets," in which it surveyed Overseas trade and brought together in a convenient and accessible form a mass of valuable data upon that subject.

Another of the three questions put up to the Committee in the memorandum referred to was that of the relations between those engaged in production. In the words of the memorandum, "This will involve inquiry into methods of industrial remuneration, the main causes of unrest and disputes, and the methods of avoidance or settlement of disputes, as, for example, co-partnership, co-operation, wages boards and voluntary arbitration, State regulation of wages, and compulsory arbitration and compulsory enforcement and extension of agreements."

Faithful to this term of reference, the Committee has now produced a second volume,[1] which covers the ground indicated by our quotation. The main part of the book consists of six chapters on population, wages, conditions of labour, unemployment, machinery for industrial negotiation, and statistical data respectively. As the terms of reference required the Committee to have special regard to the export trade, the investigations were limited to those industries which account for the major part of exports of British manufactures, namely, coal mining, iron and steel, engineering and shipbuilding, electrical manufacturing, cotton, woollens and worsted, chemicals, and clothing. The information in the six chapters referred to has, of course, been mainly supplied by the Government Departments concerned. Upon the Registrar-General fell the labour of providing statistics as to population; the rest of the burden was mainly carried by the Ministry of Labour, the Mines Department, the Board of Trade, and the Home Office. In what is termed an introduction, of 53 pages in length—practically a review of the mass of the information gathered—the Committee surveys the field of labour and brings out the principal facts and tendencies. The keynote of this survey is to be found in the statement that "the primary objects of this volume are descriptive throughout and no systematic attempt has been made therein to trace and co-ordinate the underlying causes of the phenomena described, still less to formulate conclusions as to remedial measures."

The publication of the volume rests upon the Committee's belief "that the impartial ascertainment and publication of authoritative data on certain essential aspects of industrial relations in Great Britain will not only be of value to a large number of persons who desire a trustworthy book of reference, but will also conduce towards the better understanding of present-day economic problems, both by limiting the field of controversy and by facilitating and clarifying discussion." To the constant student of economics, therefore, this volume brings little added knowledge. It is a praiseworthy book of reference, but little more. Nevertheless, on that account alone its value is not to be denied. We may therefore with advantage pick out some of the principal facts established in order the better to equip ourselves in our consideration of the industrial problems which Great Britain has yet to solve.

Although it is customary to speak of four agents of production, namely, land, capital, labour, and organising ability, in the ultimate analysis, all is seen to depend upon the productivity of human effort. Land is limited in quantity, and has its own degrees of fertility. Capital is itself the fruit of productivity, stored up in quasi-permanent form. The free gifts of Nature, the sunshine and the rain, are beyond human choice or control. Labour therefore, excluding for the present its small but important sub-class of organising ability, is of supreme importance to the Committee on Industry and Trade. The growth and distribution of the population thus naturally receives first attention in this report.

During the decade from 1911 to 1921, containing the War years, the increase of population in Great Britain was less than 2 millions, or scarcely more than half of that of the preceding decade from 1901 to 1911. This figure, of course, includes children, wives, and others who followed no industrial occupation, and omitting this, the War decade showed an increase in the number of occupied persons, whether employers or employees, of just over a million. But the War, with its heavy loss of adult male lives, left its mark in the altered distribution by ages of the occupied population. Practically the whole of the million increase referred to took place in the older-age groups, those above 45 years. This decline in the proportion of workers of the most efficient ages cannot be overlooked in weighing the degree of productivity available to industry, and the Committee, in noting this fact, points out also that future years are likely to show this factor of disadvantage in an increasing degree. Britain has thus two million more mouths to feed, with one million more workers, but the productive efficiency of the working population as a whole must be taken to have been diminished, though but slightly, by the heavier proportion of workers in the older-age groups. Here is one definite result of the War, which is not likely to be remedied by natural events for many years. To offset it, one must look largely to improvements in industrial organisation.

Another striking problem which has remained to us from the War is the mal-distribution of the workers among the industries. Statistics on a comparable basis for 1911 and 1921 are available for England and Wales only. Speaking in terms of percentages of the number of occupied persons, we notice that for agriculture the figure has fallen between 1911 and 1921 from 7·55 to 6·54 per cent., for the manufacture of clothing (including boots and shoes) from 6·45 to 4·74 per cent., and for building, decorating, and contracting from 5·29 to 4·42 per cent. To those who have followed the history in recent years of agricultural economics, the fall in this industry will come as no surprise. But the Committee on Trade and Industry

[1] "Committee on Industry and Trade. Survey of Industrial Relations Based on Material mainly derived from Official Sources, with regard to Industrial Remuneration, Conditions and Relationships in Great Britain and certain other Countries so far as available; together with Statistical Tables." With an Introduction by the Committee. Pp. v+497. (London: H.M. Stationery Office, 1926.) 5s. net.

is not concerned with this, and the absence of any comment is not surprising. We had, however, expected some comments on the two other decreases we have mentioned. Perhaps it is assumed, and rightly, that the public is already sufficiently aware of the difficulties in providing the additional labour in the building industry. But what is the reason for the fall in the number of persons occupied in manufacturing clothing? We have two million more to clothe, yet the percentage of workers engaged has decreased by more than 25 per cent.

It is not, however, so much the decreases as the increases in various industries which invite attention. Coal mining in 1921 occupied 6·59 per cent. of the occupied population, compared with 5·96 per cent. in 1911. Here, again, the Committee rightly assumes that little comment is needed. In the chemical and paint industry the percentage has risen from 0·81 to 1·15, a striking increase. In metals, machines, implements and conveyances, the increase is from 9·31 to 12·37 per cent. The Committee is content to record these facts. We should have welcomed some exploration of their causes, their effects, and the possibility of some amelioration of the economic disadvantages to which they have given rise. How far, for example, are the Rent Restriction Acts, with their paralysing effect on mobility, to be saddled with the responsibility for the persistence of these abnormalities? At a later stage in the introduction, the Committee discusses the relation between sheltered and unsheltered trades, but this important fact of supply is not brought into the arena. It is considered that the prime difference between sheltered and unsheltered trades depends on the element of time. From that we must dissent. As regards the relation of these facts also to unemployment, the Committee is content to state that it does not deal with the large problem of the mobility of labour, because there are no official data enabling its cumulative effect to be estimated.

After treating of population, the Committee turns to the kernel of this part of the terms of reference, and deals with wages and earnings. As is pointed out, on this subject there is the view of the employer and the view of the worker. To the former, the governing consideration is the amount of earnings per unit of output; to the latter, the primary consideration is the total quantity of necessary or desirable commodities which he can purchase with his weekly earnings. The necessity of distinguishing, so far as practicable, between wages as an item of cost and as a means of livelihood is therefore emphasised. Here again we are faced with the lamentable paucity of official statistics. There has been no comprehensive survey of wages since the partial inquiry of 1906; there has been no effective census of production since 1907; there has been no adequate inquiry into the household budgets of the workers since 1904. In the present year we may hope to have the results of official inquiries in the first two of these fields; as for the third, we must still possess ourselves in patience. The Committee records, therefore, that it is compelled to resort to imperfect methods of estimate.

From the slender information available, the Committee concludes that the net rise in money wages per week on the whole averages between 70 and 75 per cent., but that, first, the proportionate rise has been greater for the less skilled than for the more highly skilled workers; and secondly, the proportionate rise has been less for industries directly exposed to the blast of foreign competition than for those which are less exposed to that competition. As already mentioned, it is the real cost of labour with which the employer is concerned, and the Committee therefore proceeds to examine this aspect of the question. Since the index number of wholesale prices for 1924 was about 66 per cent. higher than its pre-War level, it follows that, *ceteris paribus*, there has been, on the average, a small increase in real wages, and therefore a small increase in the wages element in the real cost of production. But here again there is the same condition of unequal distribution between the sheltered and unsheltered industries, or unexposed and exposed industries, as the Committee prefers to call them.

The reliability of these conclusions is, however, somewhat weakened by the fact, pointed out by the Committee, that everything depends upon the *ceteris paribus*. If other factors have not remained constant, if the efficiency of labour or of industrial organisation, for example, has varied, then some of this reasoning must be revised. The Committee therefore postpones its final conclusions until the results of the evidence it is taking and of its own special investigations can be reviewed. When this point is reached we may hope the fallacy of averages will be borne in mind, and that the Committee will be content with recognised lines of statistical technique.

From the point of view of the worker, concentrating on the purchasing power of his weekly wages, the cost of living index must be substituted for the index of wholesale prices. As the mean of the monthly numbers for that index was 75 per cent. above the pre-War figure, the Committee notes that, again on the average, there was little if any change in real wages to the worker, but that the same disproportionate distribution appears between skilled and unskilled men, between sheltered and unsheltered trades. The validity of all these conclusions is, however, impaired by the limitations to which the evidence on which they are based is subject. It is stated, for example, that "the

information at the disposal of the Ministry of Labour is insufficient to enable the average percentage increase for all industries and occupations to be computed with precision, but it is estimated. . . ." Again, "No information is available, however, as to changes which have occurred in rates of wages in industries, or sections of industries, in which neither standard nor minimum rates, nor the general amount of increase or decrease in rates of wages, have been fixed by collective agreements, arbitration awards, Statutory Orders, etc." And finally, "No corresponding figures [of pre-War and 1925 wages] can be given as regards the earnings of piece-workers, who form a large proportion of the skilled work-people in many of the principal export trades."

We do not wish to dwell too strongly on these defects, but that there may be a substantial difference between estimates based on rates of wages and facts as to actual earnings is shown, on the one hand, by the inclusion of skilled engineers in a table under the heading of "Increases substantially below the general average," and on the other hand, by the definite statement, based on statistics furnished by the Engineering Employers' Federation, that for engineering workers, skilled and unskilled, the general average rise of money earnings was about 73 per cent. when working on piece, and 65 per cent. when working on time, or taking both together, and including the shift over from time to piece which has taken place since 1914, an increase of 73 per cent. This compares with the 75 per cent. increase in the cost of living. As we are also told that piece-work is widely prevalent in the textile, mining, iron and steel and clothing groups, but that time work is still much the more usual method in the engineering and kindred trades (despite the tendency to change from time to piece), we begin to have some doubts whether the difference between sheltered and unsheltered industries is so clean-cut and definite as the Committee's report suggests.

We have only space to mention some of the other topics of absorbing interest brought together in this survey. There are interesting tables of the movements of real wages in other countries, but the impossibility of relating different national standards of living, to say nothing of the incomparability of national methods of calculating the movements in the cost of living, robs them of much value. Comprehensive particulars are here brought together of changes in hours of labour, welfare work, unemployment, conciliation and arbitration machinery, all relevant to the problems of industry to-day. We notice, for example, that the time lost through sickness amounted in 1924 to more than 26 million weeks, or more than eighteen times the number of weeks (1·4 million) lost through trade disputes in the same year. Yet there are many who deem national expenditure on health and welfare work a waste of money.

Every thoughtful student of national well-being must be very grateful to the Committee on Trade and Industry for this publication. We may perhaps be permitted also to include in this recognition of work well done all the labour which fell upon the Government Departments concerned. Two-thirds of the Committee's task has been accomplished, but the greater part still remains. The productive capacity and organisation of British industry, the supply and efficiency of capital, labour and management, the present extent of large-scale production, its possibilities and limitations, the current methods of industrial and commercial finance, etc., have yet to be investigated. In this sphere, if anywhere, the Committee must come to real grips with its problem, namely, the root causes of the depression of the coal, iron and steel, textile and other industries, which have steadily lost ground in the last seven years. We look forward eagerly to the remaining volume, in which the Committee will deal with these baffling problems, and on which the justification for its appointment and labours will be almost entirely judged.

W. H. COATES.

Avian Migration.

Problems of Bird-Migration. By Dr. A. Landsborough Thomson. Pp. xv+350. (London: H. F. and G. Witherby, 1926.) 18*s*. net.

THE study of avian migration has been elevated to a higher scientific plane than heretofore by Dr. Landsborough Thomson in the book under review. The phenomenon of migration has at all times been a secret of absorbing interest and speculation not only among scientific men but also among those whose hobby has been of a scientific nature. As a means whereby evidence can be collected to assist the biologist and to help solve the larger biological problems, a valuable source can be found in avian migration, now that its importance has been recognised. "To study the migration of birds is to investigate the nature of animal behaviour, and to do this is to probe the inmost mysteries and to ask the very meaning of Life itself" (p. 327).

The book is unsatisfactory in the sense that it fails to satisfy, but at the same time it completes the picture in as thorough a manner as our present knowledge will permit. A creditable, over-cautious strain permeates the whole book, which is delightfully free from dogmatic or fanciful theories.

Part I. summarises all known facts bearing on the subject, serving as an excellent basis for further investi-

gations. Part II. specialises in individual migration with special reference to the results of bird-marking. Part III., which deals with the main complex problems of bird migration, stands out as the most important part of the book, giving much food for thought and many lines for further investigation. In the past, avian migration has been studied as a whole, theories being frequently built up to fit in with existing evidence, which, to say the least of it, has been fragmentary. In the first place, migration is not a phenomenon confined to birds alone, and, if the secret is to be probed, some knowledge must be gained of the migrations of fishes, insects, and mammals. The periodic transfer of residence is identical in many branches of life, though probably the stimuli and initial causes are widely different.

It appears to the writer that the correct study of the larger problems of migration is to examine in closest detail the movements not only of single species but also of individual communities among birds; and indeed, as one can now do with the aid of bird-marking, the movements of the individual bird itself.

Assuming for the moment that both the Darwinian and Mendelian principles express truths on evolution, and that the making of the species in some cases follows one, sometimes the other, and sometimes a combination or modification of both or either, can we not apply such doctrines to a problem such as migration? Avian migration as witnessed to-day, ranging, in the case of some high-level birds, from a simple altitudinal move from alpine meadows to sheltered valley, to the vast periodic movement of other species from the Arctic to the Antarctic, have every degree of intermediate form, and the one could easily, as argued by Dr. Landsborough Thomson, spring from the other. Then we have what Dr. Thomson terms irregular migration phenomena (Chapter vii.). Birds which adopt this habit, dispensing with the slower Darwinian principle, perform in one bound an act which in other birds may have taken countless ages to evolve in its perfect shape.

No simple explanation, however, fits every case; hence the difficulty. The stimulus which sets free the desire to migrate may have a hundred variations. That the desire is deep-seated is beyond question, and it is difficult to believe that such a desire is not as much a part of the germ plasm as is the ability of birds of a species to build nests of remarkable similarity. Dangerous as are analogies to logic, nest building is as regular, as true to type, and as accurate in heritable qualities as is migration, and is probably subject to precisely the same laws of evolution as the formation of a species or of a geographical race.

It may be found, and probably Dr. Thomson would agree, that a particular migration route, or a particular stimulus which sets free the desire to migrate, or the particular means by which birds find their way on migration, will apply to a particular species or even a community within that species, and will not be true of others apparently carrying out a similar migration. This can only be verified by an intensive study of the species or individual. When that is complete it will be time enough to generalise and find out what influences are common or general.

In his last few chapters Dr. Thomson seems wilfully to tantalise his reader by nibbling at many by-products of migration. He bites into the much-vexed question of the inheritance of acquired characters. Perhaps space, perhaps mental digestion (or indigestion), forbade more than a bite. But one would have welcomed his views, as migration seems to offer such valuable evidence.

The home of the bird. The original centre of dispersion. Where is it? In many cases, such as the Petchora pipit (*Anthus gustavi*), *Acrocephalus griseldis* breeding in Iraq and wintering almost entirely in east tropical Africa, and *Irania gutteralis*, we find a winter quarters almost as restricted as the breeding quarters. Why again should certain species (*Apus a. pekinensis*, *Falco naumanni pekinensis*, and *Falco vespertinus amurensis*) travel to restricted winter quarters in South Africa? It is most unlikely that the amenities of South Africa were accidentally discovered, or even that such amenities do not exist at nearer ranges in south Asia or Africa. Why do many species travel from north Europe to south-east Asia every year, and others from north-eastern Asia to South Africa? There must be a meaning, and if we knew more about the original home of the bird a clue would be supplied.

Again, why should birds sometimes select a different return route in spring from their autumn route? In addition to the cases cited by Dr. Thomson, two races of the Willow warbler (*Phylloscopus trochilus trochilus* and *eversmanni*) pass through Egypt in autumn in countless thousands, but in spring their occurrence is a great rarity, though in Palestine they occur in spring almost as commonly as they occur in autumn.

The ability of birds to find their way on dark nights and over great distances without the aid of landmarks is perhaps as complex a problem as exists in the whole story of migration, and no attempt will be made here to fathom such a fascinating subject beyond quoting a curious experiment undertaken by the writer near Karachi in 1913.

A night was spent on a sandy beach where the Loggerhead turtle was known to breed, and at a time of year when the young should be emerging from their sandy nests. Both sea and wind were dead calm. On the

south side of the beach was the open Indian Ocean. To the north was a deep, wide lagoon, only connected with the sea at high tide. Young turtles do not all emerge from their sandy nest in a bunch, but do so singly or in small parties, and a few early ones give one warning of the general hatching. Two active nests were located, and in each case the sloping beach was levelled and a sand parapet erected four feet from the nest in order to prevent slope of terrain or sight of sea acting as hints in direction to the babies. The first nest gave its young to the world with the earliest blush of dawn, the second nest after sunrise but before the sunlight bathed the beach, a tall belt of palms screening the rays. In eleven observed cases out of a total of nineteen, the babies scuttled towards the open sea, over our parapet, and into the ocean without a moment's hesitation. In the other eight cases there was slight hesitation, which seemed due more to daze than to uncertainty. The slight traces of those baby flippers on the sand were obliterated by our party as soon as they were formed. In this case the roar of the surf, the smell of the ocean, wind, sight, and slope of ground were eliminated so far as one could, and yet these babies, but a few minutes old, acted without undue hesitation and apparently certain knowledge. It is indeed difficult to deny the existence of inherited knowledge based on ages of experience.

The young cuckoo, and many other birds, set out every autumn at the appointed time on a definite journey with a definite object, without apparent guidance. Instinct is a lazy and meaningless explanation. Science requires something more exact, based on evidence. But it is to instinct we would address the question: Why?

There is one biological aspect of migration to which we had wished Dr. Thomson had addressed himself. He does not touch on the influence of migration on power of flight and evolution. Is there such an influence? Must we accept the old dogma that migratory birds have wings more suited to migration than others which are resident? Are we to believe that a mere incident in a bird's life (all-important though it be) will influence structure?

Dr. Thomson has taken us all up one rung of the ladder in a book where simplicity, logic, and science go hand in hand. As a book of educational value, or as a reference book, the work is unique. It has summarised, modernised, and, so far as existing evidence allows, helped to elucidate problems of immense scientific import. Migration has at last received the attention it has deserved at the hands of a trained scientific brain and has been lifted up from the plane of conjecture and spasmodic research to that of sound logic and scientific analysis.

Surveying.

(1) *Text-Book of Topographical and Geographical Surveying.* Edited by Col. Sir Charles Close and Col. H. St. J. L. Winterbotham. Third edition. Pp. iv+366. (London: H.M. Stationery Office, 1925.) 15*s.* net.

(2) *Surveying Instruments: their Design, Construction, Testing and Adjustment.* By R. M. Abraham. Pp. ix+309. (London: C. F. Casella and Co., Ltd., 1926.) 7*s.* 6*d.* net.

(3) *Surveying for Everyone.* By A. Francon Williams. Pp. 114. (London: The Sheldon Press; New York and Toronto: The Macmillan Co., 1925.) 3*s.* 6*d.* net.

(1) THE "Text-Book of Topographical and Geographical Surveying" embodies the experience of surveyors who have carried out surveys in most parts of the British Empire, and under very varied conditions. Each method, or process, included in the book has been tested and used with success, and is described by a writer who has employed it. The book has therefore gained the confidence of practical surveyors. The second edition having been out-of-print for some months, the appearance of the third edition has been eagerly awaited, and will be warmly welcomed.

The third edition is the same size as the second, but the type is a little smaller, so that more information is contained in the same space. The price has been doubled, but the book is still good value.

Much new information has been added, but few alterations or corrections have been found necessary in the original matter. There are three new chapters dealing with surveys in war, photographic surveying, and the prismatic astrolabe. The chapters on surveys in war and photographic surveying are necessarily little more than introductions to large subjects. The prismatic astrolabe is an instrument which is likely to be used, in conjunction with radio time signals, for the determination of astronomical longitudes. A clear account is given of the methods of using it, and reducing the observations. A new section dealing with the reception of radio time signals is a valuable addition to the book. Another new section is devoted to Prof. Jeffcolt's direct-reading tachymeter.

The most important change that has been made in the original matter is the substitution of the mid-latitude formula for computing geographical latitudes, longitudes and reverse azimuths for Puissant's method. The computations involved are simpler, and the results not less accurate.

In a book which contains so much information, it is perhaps unfair to search for omissions, but space might perhaps have been found for a description of the Transverse Mercator projection, which is recommended

for war maps, and may be adopted for the small scale maps of the Ordnance Survey. The elimination of distortion in field sheets, by pasting them on to a thin sheet of aluminium or zinc, before mounting them on a plane-table, might also have been mentioned, as this is likely to become the standard practice.

The book deals, in a clear and practical way, with every important problem that is likely to confront a surveyor. It is an excellent example of how a text-book should be written.

(2) In the past, surveyors have often been handicapped by a lack of knowledge of the first principles of optics and instrumental design, with the result that they have not been able to make the best use of their instruments, or competent to suggest improvements in the design of them. "Surveying Instruments" gives a clear and concise account of every instrument used by the surveyor, and an analysis of most of the instrumental errors which may be expected. It is a book which should be consulted by every surveyor who wishes to use his instruments to the best advantage, and it is to be hoped that it will establish a closer liaison between the surveyor and the instrument maker. On the other hand, the instrument designer should remember that the way to test his instruments is to observe with them on a cold, dark, windy day. If the instrument stands steady in the wind, if all the necessary adjustments can be made with frozen fingers, and the required observations made in dull light and without any uncertainty, the instrument will earn the surveyor's confidence. But if it fails in any of these respects, he will probably discard it for another, which, though less accurate, is better adapted to field work.

It is probable that in the most accurate modern instruments the errors of observation are largely due to varying and unequal illumination of the field of the micrometer microscopes. This is a point that deserves the attention of the instrument designer. The Wild theodolite, recently designed and manufactured in Switzerland, is arousing much interest amongst surveyors, and it is to be hoped that British instrument makers will study, and test, the new methods and principles incorporated in this instrument.

An account might perhaps have been given of the 'constant bubble' spirit level, and of the latest pattern of geodetic levelling staff as used on the Ordnance Survey.

(3) This is a small handbook designed for the instruction of those who have no knowledge of surveying, and whose mathematical knowledge is limited to simple arithmetic. It describes in simple language how a survey of a small area may be made with a chain, a plane-table, or a prismatic compass. The computation of areas, contouring, and scales are also dealt with.

The Manufacture of Sugar.

Sugar. By Geoffrey Fairrie. Pp. xiv + 233 + 62 plates. (Liverpool: Fairrie and Co., Ltd., 1925.) 12*s.* 6*d.* net.

SUGAR, the sucrose of the chemist, is very widely disseminated in the vegetable kingdom, where in many plants it forms the most important carbohydrate reserve substance. Originally consumed as a condiment, or even taken as a medicine, it has during the last few centuries become one of the most important articles of dietary among the nations of the world. Great Britain, which next to the United States is the largest sugar-consuming country in the world, consumes sugar in different forms at the rate of more than 90 lb. *per capita* per annum. The two chief sources of sugar are the sugar-cane, *Saccharum officinarum*, and the sugar-beet, *Beta vulgaris*, whilst sorghum, maple, and palm occupy subsidiary positions.

In view of the importance of sugar as a food material, a book on the subject of its manufacture, which enables the general public to understand how it is extracted from plants, and how it is refined into a product fit for consumption, should be welcomed. The author of the work before us states that his object has been to present general information on the subject of sugar in such a form that it can be understood by the laity. But far more than this has been done. The author has produced a book not only for the laity, but one which, in many parts, may also be studied with advantage by the intending technician. At the present time the technology of sugar manufacture has increased in importance in Great Britain, in view of the rapidly developing beet-sugar industry.

Pure science is touched on in this work to a slight extent, and most of the information given is of a 'scrappy' character. The object of the book is, however, to deal with the practical side of the subjects, and it contains a complete description of the manufacture of sugar from cane and beet, giving illustrations of the plant employed. The diagrams giving the general arrangement of plant in a cane-sugar and beet-sugar factory are particularly instructive. The separate plant employed, vacuum pans, centrifugal machines, etc., are clearly described both in the text and by illustrations. Some space is devoted to decolorising charcoal and carbons—their method of preparation and use. The physiology of sugar is dealt with, and finally the analysis of sugar by the polarimetric method is described.

We cordially commend this work, not only to the general public, but also to those scientific men, chemists, engineers, etc., who desire to obtain a succinct account of the manufacture and refining of sugar.

ARTHUR R. LING.

The Origin of European Civilisation.

The Ægean Civilisation. By Prof. Gustave Glotz. (The History of Civilisation Series.) Pp. xvi+422 +4 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1925.) 16*s.* net.

THE oldest European civilisation was born in Crete and spread thence throughout the Ægean basin. In the discovery and re-creation of this civilisation, Englishmen and Americans have taken the lead. Yet, curiously enough, no really complete and well-documented account of it has been available in English. The translation of Prof. Glotz's French work by Messrs. Dobie and Riley therefore fills a real gap. Glotz evokes a vivid picture of Minoan life in all its aspects—social, industrial, commercial, religious and æsthetic. Incidentally he shows how the Greeks, and so the whole western world, were indebted to their prehistoric forerunners: Cretan enterprise discovered the routes to the Euxine, to Asia Minor, to Sicily and to Italy that Hellenic traders and colonists followed; the olive and the fig were cultivated in the great island long before the northerners reached the Ægean; the athletic contests and dances which played such a prominent part in Hellenic life had roots in the Minoan age, and, long before Terpander and the Phrygians, the notes of the seven-stringed lyre and the flute had resounded in the halls of Hagia Triada.

Of course, were the work intended strictly as a text-book for students, the very qualities of vividness and symmetry which make it such fascinating reading might be reckoned as defects. Glotz gives us in lively and unitary form his own interpretation of the archæological material, without, as a rule, cumbering his pages with contrary views. But, since the interpretation of such material is always debatable, he is thereby committed to a series of assertions which will, to many, often seem questionable hypotheses. Let us, therefore, hasten to state that the unfortunate criticism of Sir Arthur Evans's chronological scheme in the first chapter is no fair sample of these hypotheses. In fact, despite his alleged preference for the clumsy system of Franchet, Glotz, like all practical workers in the field, is fain to adapt his exposition to Evans's nine periods, and elsewhere his views are backed by good authorities.

The rapid progress of Ægean archæology is conveniently revealed by two long sections of addenda (there will be room for a third when the English translation reaches a second edition), while the utility of the English text has been greatly enhanced by the translators' admirable index. Perhaps, however, for the benefit of the general public, forms like *Kirke* and *Kerkyra* might have been glossed.

V. GORDON CHILDE.

Evolution and Biology.

Evolution and Genetics. By Prof. Thomas Hunt Morgan. Pp. ix+211. (Princeton: Princeton University Press; London: Oxford University Press, 1925.) 9*s.* net.

THIS little book originally appeared in the form of four lectures given at Princeton University in 1916. After three reprintings a new edition has been called for. The author has responded by revising the book and giving it a new title, breaking the contents up into thirteen chapters, including a new chapter (previously published elsewhere) on the non-inheritance of acquired characters, and another short chapter on human inheritance. It is an excellent discussion of evolutionary theory on the basis of the more recent discoveries in genetics and mutation. The case against the inheritance of acquired characters is very cogently stated.

If one might criticise so lucid and well-documented a book, it would be to point out that mutation is considered almost entirely from the zoological point of view, but perhaps that is inevitable. A point on which biologists will probably not all agree with Prof. Morgan is in his interpretation of the biogenetic law. He says (p. 28): "I venture to think that these new ideas and this new evidence have played havoc with the biogenetic 'law.'" Citing the case of the gill slits in the embryos of the chick and of man, he agrees that they represent the same structures as the gills of a fish, but he goes on to suggest that "the mammal and bird possess this stage in their development simply because it has never been lost." This seems entirely unexplanatory. In the adult frog, as is well known, they have been lost, even though before metamorphosis the gills are fully functional. Is it not more reasonable to suppose that the tadpole represents a stage which is terminal in the fish but is not terminal in the amphibian, because the stages of lung development were added later in connexion with their transmigration to land? That mutational changes 'cut across' these developmental changes does not nullify the significance of either, because, as was pointed out a decade ago, a mutation is a change which is definitely represented in every cell of the mutated organism. However, the interpretation of recapitulation is a subject on which biologists may continue to disagree.

Prof. Morgan's book deserves to be widely read as a concise summary of several active fields of evolutionary investigation, by one who has contributed largely to the present point of view, and whose work on crossing-over, in particular, has been of immense significance.

R. RUGGLES GATES.

Our Bookshelf.

L'Industrie chimique des bois : leurs dérivés et extraits industriels. Par P. Dumesny et J. Noyer. Première partie : *La distillation du bois ;* Deuxième partie : *Fabrication d'extraits divers.* Deuxième édition refondue et considérablement augmentée. Pp. vi+432. (Paris : Gauthier-Villars et Cie ; n.d.) 50 francs.

Two distinct aspects of the technical chemistry of wood are dealt with in this book, namely, the working up of the volatile products from the thermal decomposition of wood and the preparation of tannin and other extracts from various classes of cellulosic materials. Unlike the majority of books of this nature, the authors have intentionally restricted theoretical descriptions and classification and have, so far as possible, concentrated on technical points and works' processes. In this way the maximum amount of information useful to the manufacturer has been secured, and general organic text-books can be consulted for the more theoretical underlying principles.

The utilisation of olive stones or grignons, which are available in enormous amounts as a waste product in Spain from the crushing and extraction of olives, receives special attention, as such material is suitable for wood distillation. In addition to full details regarding the working up of acetic and acetone and phenolic substances, the preparations of various acetates and other secondary products are described, with particulars of analytical examination.

The use of the wood of the chestnut tree for the preparation of a tannin extract receives very detailed treatment, and on the whole this is the most interesting and complete section of the book. The description of processes has been in most cases amplified by very clear diagrams and illustrations of plant. The extracts of the oak and various other woods are dealt with in less detail. Standard methods for the analysis of such extracts are also given. The economic side has not been neglected, and comparisons of present-day conditions with those before the War have been reviewed. The work as a whole, especially the second part, contains a considerable amount of general useful information, and those interested in this branch of applied chemistry will find it of particular value.

J. REILLY.

Les méthodes physiques appliquées à la chimie (*Collection de physique et chimie*). Par P. Job. Pp. viii+251. (Paris : Gaston Doin et Cie, 1926.) 30 francs.

PROF. JOB'S book is divided into two main sections dealing first with pure substances, then with mixtures, solutions and heterogeneous systems. There is also an appendix in which the principal properties are reviewed with special reference to units, definitions and experimental methods. In his preface the author emphasises the importance of physical methods in chemistry by referring to the advances which followed the use of the balance by Lavoisier, the introduction of the spectroscope by Kirchhoff and Bunsen, and of the electrometer by Curie. He begins by showing how physical methods can be used for the identification of pure substances, and for the determination of their purity, their molecular weight and their constitution. The physical methods used for the last determination include optical methods for the study of organic compounds, electrical methods for the study of complex ions, and X-ray methods for the study of crystals. Thus the last method is cited as having established the octahedral symmetry of the complex ions of a number of co-ordination compounds, and the tetrahedral symmetry of hexamethyltetramine $C_6H_{12}N_4$, a condensation product of ammonia and formaldehyde in which six bivalent methylene groups, occupying the six edges of a tetrahedron, are linked to four tervalent atoms of nitrogen occupying the four corners of the figure.

The section on mixtures begins by describing the use of physical methods for determining the percentage composition of a mixture, *e.g.* by thermal analysis ; but it then goes on to deal with the more difficult problem of determining the presence of definite compounds both in the solid and in the liquid and gaseous states, *e.g.* of the salt K_2CdI_4, or of the ion CdI_4'', in aqueous solutions, as established by studying the heats of mixing, the ultra-violet absorption coefficients, and the cryoscopic properties of a series of solutions. A few examples of the study of reaction velocities are also described. Attention may be directed to the number and clearness of the figures which are used to illustrate the text.

Ministry of Agriculture and Fisheries. Research Monograph No. 2 : *The Physiology of Animal Breeding, with special reference to the Problem of Fertility.* By Dr. F. H. A. Marshall and John Hammond. Pp. 45 +6 plates. (London : Ministry of Agriculture and Fisheries, 1926.) 2*s.* net.

BEFORE science can bring the much-needed reinforcement to the crafts of agriculture, two things at least are necessary. There must be research that shall provide accurate information concerning those aspects of agricultural practice that to-day present difficulties and are sources of embarrassment to the agriculturist, and the agricultural community must become aware that such information, having been secured, awaits evaluation. The Ministry, in a series of monographs written by members of the staffs of the different agricultural research institutes, seeks to place in the hands of the farmer an account of the work of these institutes and a demonstration of the bearing of the results of research conducted therein upon agricultural problems.

Whilst most research institutes would seem to need a chorus to interpret their functions and their fruits, the Animal Nutrition Institute at Cambridge is exceptionally fortunate in having Dr. Marshall and Mr. Hammond, who can not only discover fact but can also explain it in the language of everyday life. In this monograph on "The Physiology of Animal Breeding" they have succeeded in presenting a great mass of information in an eminently readable form. The earlier sections, dealing with the anatomy and physiology of the reproductive systems, puberty, rut, œstrus and the sexual cycle, form an adequate foundation to a general discussion of fertility in farm animals. There is nothing new in the subject matter, for the authors exhibit their characteristic caution in

communicating to those that seek their aid only such information as is based on accepted fact. The monograph may indeed be recommended as a model for those who seek to gain the sympathetic understanding of the community they serve and thus to secure for their science further opportunity.

Electrical Photometry and Illumination: a Treatise on Light and its Distribution, Photometric Apparatus and Illuminating Engineering. Pp. xvi+427. By Prof. Hermann Bohle. (London: Charles Griffin and Co., Ltd., 1925.) 25*s.* net.

THIS second edition of Prof. Bohle's work is considerably revised and extended and is much more complete than his original treatise, which was based on lectures delivered at the University of Cape Town. The opening chapters follow the now familiar order, and are well adapted for the use of students. Chap. i. deals with photometric quantities, Chap. ii. with radiation and its effects. Subsequent chapters deal with the eye, photometric apparatus, the testing of electric lamps, shades, globes and reflectors, and illuminating engineering in general. The sections on photometric apparatus and the testing of electric lamps and illumination are exceptionally full.

Throughout the book the author shows himself conversant with recent work in Great Britain and the United States, though the illumination-photometers described appear to be mainly German and American, and the most recent British models of the lumeter and luxometer type seem to have been overlooked. The final chapters deal with practical problems, such as the lighting of schools, libraries, churches, theatres, etc., and there is a special section on industrial lighting. We notice that a reference is made to the first report of the Home Office Departmental Committee on lighting in factories and workshops. In a further edition some account might be given of subsequent reports and of the contents of American codes.

The book contains some effective illustrations, including a number originally presented before the Illuminating Engineering Society in England. Whilst the title conveys that the work is devoted to *electric* lighting, it might be advisable to include some reference to natural lighting, as comparisons of conditions by natural and artificial light are helpful to the student. At the end of the book there is a useful bibliography and an adequate index.

Geology of India: for Students. By D. N. Wadia. Second edition. Pp. xx+400+20 plates. (London: Macmillan and Co., Ltd., 1926.) 18*s.* net.

THE second edition of this work follows closely on the lines of the first, and, by the use of small type for details and subsidiary matter, the bulk has not been increased, in spite of the additions needed to bring it up-to-date. In a book which, in less than 400 pages of text, covers the whole ground of the geology, both pure and applied, of a region so extensive as the Indian Empire, the information must at times be pemmicanised, but in any criticism it must be remembered that one purpose of the book is to provide students with answers to examination questions. For the rest, the judgment passed in our review of the first edition might be repeated almost word for word; the general commendation remains as true as the criticism of certain passages which remain almost unaltered.

An outsider may marvel at the confidence with which the unfossiliferous, presumably pre-Cambrian, rocks of widely separated regions are correlated, and it is surprising to find that the great valleys of the Himalayas are still unhesitatingly accepted as examples of antecedent drainage. At the outset stress is laid on the time-honoured distinction between the peninsular and extra-peninsular regions of India; in this the author follows earlier writers, and will doubtless be followed by later, though the advance of knowledge has shown that the distinction, true enough as regards existing geography, is, when applied to geology, merely a partial view of one aspect of a many-sided problem. Yet with all this the book remains a useful one, and the only one of its sort at present available.

A Treatise on Hydromechanics. By Dr. W. H. Besant and A. S. Ramsey. Part 1: Hydrostatics. Ninth edition (revised). Pp. viii+136. (London: G. Bell and Sons, Ltd., 1925.) 7*s.* 6*d.* net.

"BESANT and Ramsey" is a classic, and has been so for several generations of students. It is, therefore, of some considerable interest that this—the ninth—edition should be very appreciably modified on production. It is not stated in the preface that these alterations are the result of any changed outlook by the author on the scope of the work or on the manner of presentation. The abolition of the order of merit in the Tripos makes it no longer profitable for the average student to devote much of his time to hydrostatics or to the solution of elaborate problems. In conformity with this, a substantial amount of the book work in previous editions has been omitted, along with numerous examples. We do not think the book has suffered from this at all; on the contrary, it has probably become much more readable to a larger number of students, for whom the parts that are essential have been retained. It is, however, an interesting illustration of how the examination system practically decides the text-book, and the text-book the teaching.

Wire-Drawing and the Cold Working of Steel. By A. T. Adam. Pp. 212. (London: H. F. and G. Witherby, 1925.) 40*s.* net.

THE author of this work, being on the research staff of a manufacturer's laboratory, is in a position to put into book form much valuable information on the subject of the wire-drawing and cold working of steel. The main object of the book is to explain the nature of wire-drawing and other cold-worked processes, and little attention is given to actual manufacturing methods except in so far as they are relevant to the main purpose of the book. The various scientific aspects of the subject are treated from a practical viewpoint, and not the least interesting chapters are those devoted to theories of plastic flow in cold-worked metals and to what the author calls the "pathological aspect of cold-worked operations." Judging from the large number of references given at the ends of the various chapters, the author, in addition to giving the benefit of his own practical experience, has done a service to metallurgical science in having included so much scattered information in a book of this kind.

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 Distribution of Freshwater Fishes.

As a mere sciolist in geology it sometimes occurs to me to wonder whether enough attention has been given to the distribution of freshwater fauna in estimating the origin of British land contours and the course of rivers. It is generally accepted that until the North Sea was formed by an extensive subsidence of land in an age not geologically remote, all eastward-flowing rivers south of and including the Yorkshire Ouse were tributaries of the Rhine. The natural result of this should be that the fishes of the Rhine should continue to inhabit its ancient tributaries, as in fact they do in all rivers between and including the Ouse of Norfolk, the Ouse of Yorkshire, and the Trent system. But there is a notable absence from the Thames and the Medway of two species common to the aforesaid rivers and the Rhine—namely, the burbot or eel-pout (*Lota vulgaris*) and the grayling (*Thymallus vulgaris*).

It is true that within recent years grayling have been introduced into the upper waters of the Thames in the interest of anglers, just as in 1816 they were brought by the Houghton Fishing Club to the Test from the Itchen, where they had been established at some previous time. Izaak Walton, writing in the seventeenth century, mentions grayling in the Hampshire Avon; but had they been indigenous there, they would surely have been so in the other rivers of Hampshire also, as the brook trout (*Salmo fario*) undoubtedly is. During the nineteenth century grayling were transported to, and became naturalised in, very many English and Scottish streams in the interest of anglers; but there is no record of any attempt so to distribute the burbot, in which fish anglers take no interest, and in fact it exists only in Great Britain in the rivers between and including the Yorkshire Ouse and the Norfolk Ouse. The question seems to have some significance why these two prolific species should inhabit these rivers and be absent from the Thames.

The following passage in Leonard Mascall's "Fishing with Hooke and Line" (1590) has misled some writers into stating that burbot did inhabit the Thames three or four hundred years ago.

"There is a kind of fish in Holand [south-east Lincolnshire] in the fennes beside Peterborrow, which they call a poult; they be like in making and greatness to the whiting, but of the cullour of the loch [loach]; they come forth of the fennes brookes into the rivers nigh there about, as in the Wandsworth river there are many of them."

It is natural that in writing the "Wandsworth river" Mascall should have been understood to mean the Wandle, which flows into the Thames at Wandsworth. I was deceived in that way myself, until it occurred to me as strange that Mascall should leap suddenly from the Fen district, about which he was treating, to the Surrey side of the Thames. This led me to examine the topography of "the fennes beside Peterborrow," when it became clear that he was referring to the Nen at Wansford, near Peterborough. Probably a London printer familiar with the Wandle thought he was doing the author good service in changing the name.

If, as I think, it may be assumed that neither the burbot nor the grayling ever were natives of the Thames, Sir Andrew Ramsay, had his attention been directed to that fact, might have cited it in support of his theory that the Thames originally flowed westward into the lower Severn valley, which in his opinion was "one of the oldest in the lowlands of England" ("Physical Geology and Geography of Britain"). He considered that the Chalk and Oolite strata through which the Thames flows sloped originally towards the west, and that they received a tilt eastward in consequence of the extensive depression that formed the North Sea.

"When this slope of the Chalk and the overlying Eocene strata was established," he says, "the water that fell on the long inclined plain, east of the escarpment of the Chalk, necessarily flowed eastward, and the Thames, in its beginning, flowed from end to end entirely over Chalk and Eocene strata."

Later geologists have failed to reconcile Ramsay's theory with the formation of the Goring Gap and other clefts in the Chalk escarpment, and I certainly am not competent to call their decision in question. Nevertheless the question still remains (more puzzling to a field-naturalist than to geologists) why burbot and grayling, which are common to English tributaries of the Rhine system, are absent from the Thames and the Medway, and are not native to any westward or southward-flowing rivers in Great Britain.

HERBERT MAXWELL.

Monreith.

The Actinium Series and the Lead Ratios in Rocks.

PROF. JOLY in his beautiful work on pleochroic haloes in mica has stressed the importance of a small discrepancy in the observed position of the first halo ring. The discrepancy was shown to vary with the age of the rock. It was recognised that the influence of actinium in the formation of these uranium haloes had not been taken into account, but it did not seem possible that the actinium series could have any appreciable effect since it is regarded as only a 3 per cent. off-shoot from the main uranium series. Certainly it could not account for a *shifting* inner ring, and Prof. Joly suggested that the type of thing needed was a variable decay-constant for uranium—such as would arise if uranium had an isotope of considerably shorter life than uranium I. But it can be shown that more than one additional α-ray is needed to account for the observed shifts.

I hope in a more extended article to explain these discrepancies by assuming a different origin for actinium. Dr. A. S. Russell has proposed such a theory by placing AcU_I and AcU_{II} as parent isotopes in the actinium series. He assigned a half-period of 8×10^9 yr. to AcU_I—a period considerably longer than that of U_I. The theory here proposed would indicate a half-period of about $2{\cdot}5 \times 10^8$ yr. (only about $\frac{1}{20}$ that of U_I). The usual connexion between range and decay-constant would assign a range of 3·2 cm. to the α-ray. Such a quick rate of decay leads to some marked contrasts with the assumption of a longer rate of decay. The activity of AcU_I, once as great as that of U_I, is now but a few per cent. On this theory AcU_I would be of no assistance in explaining the departure of the atomic weight of uranium from an integral value, for while the activity of AcU_I is still a few per cent. of that of U_I, the relative mass of it is negligible. An explanation of the atomic weight would have to be sought elsewhere. AcU_{II} also turns out to be necessary, and apparently a range of about

3·4 cm. is prescribed, as will be shown. Equilibrium of AcU_1 and U_1 seems indicated about 10^9 years ago.

These assumptions have a very important bearing on the ages of rocks found from lead or helium ratios. A variable fraction of Ur-Pb would be AcD—the proportion varying from about 40 per cent. in Archaean rocks to 10 per cent. in Devonian. If this is so, a varying atomic weight of Ur-Pb should be found, and in very old rocks a 40 per cent. reduction in ages determined from Ur-Pb ratios would follow. Other interesting consequences and curves showing the shifting of the inner halo ring will be presented later.

An attempt to secure direct experimental evidence of these two α-rays is being made. T. R. WILKINS.

Cavendish Laboratory,
Cambridge, May 5.

Plastic Deformation of Single Metallic Crystals.

IT is a remarkable and characteristic feature of single metallic crystals that when loaded in tension the plastic deformation produced leads to the production of a wedge, the final fracture taking place along the thin edge formed. From the angle of this wedge it is possible to deduce valuable information regarding the actual nature of the mechanism of the plastic flow.

Goucher (*Phil. Mag.*, 48, p. 800, Nov. 1924) has considered the question in relation to his single crystals of tungsten, the relation given being :

$$\phi = 2 \tan^{-1}(\tfrac{1}{2} \tan \theta),$$

where ϕ is the included angle between the sides of the wedge and θ is the angle made by the planes on which slipping occurs and the axis of the test-piece.

Although this is given as a general solution, it does not appear to be so, since it is based on the assumption that the point of fracture is distant $D \cot \theta$ from the plane, normal to the axis of the wire, at which the wedge commences to form, D being the diameter of the wire. In the particular case examined by Goucher, however, the formula agreed well with about one-half of the results.

It is possible, however, to treat the problem more generally and, as the result may well become of considerable value, this has been done here. Let ACE and DF (Fig. 1) be successive planes on which

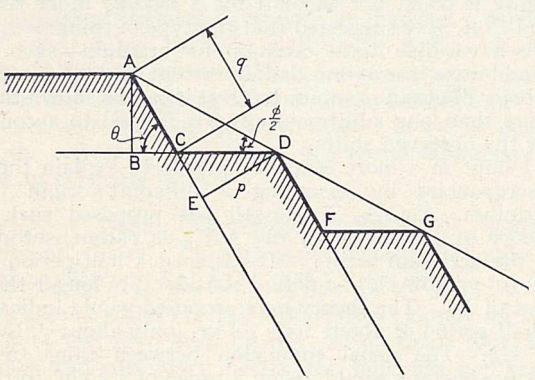

FIG. 1.

slip occurs and p be the perpendicular distance between them. For a uniform wedge the distance through which each plane of atoms moves, *i.e.* AC and DF, will be the same, say q. With ϕ and θ bearing the same meanings as above,

$$\cos \frac{2}{\phi} = \frac{q \cos \theta + \dfrac{p}{\sin \theta}}{\sqrt{(q + p \cot \theta)^2 + p^2}}.$$

This relation is now a perfectly general one applicable to any uniform wedge formed by the fracture in tension of a single crystal of any ductile metal. By its use it is possible to extract from the experimental results obtained on these single crystals of tungsten information with regard to the distance through which the atoms move and the number of planes involved which has hitherto remained unrealised.

Of the fractures dealt with in his paper, Goucher points out that they fall into two sharply defined groups with ' sharp ' and ' blunt ' wedges respectively. About half gave a wedge angle very near to 39°, while the remainder, though giving a mean angle of 54° 12′, varied from about 50° to 60°. For movement on the {112} plane, the one shown to be operative at any rate in the case of the sharp wedges, for the body-centred lattice of tungsten, and for an orientation such that the axis of the wire crystal is perpendicular to the {110} plane, θ is $35\frac{1}{4}°$ and $p = \frac{\sqrt{2}}{3} d$, where d is the atomic diameter, *i.e.* the distance between the centre of atoms in ' contact.' Putting $q = cd$, the following values of ϕ are obtained :—

c	2/3	1	2	3	10
$\phi/2$	15° 50′	19° 36′	25° 10′	28° 15′	32° 26′
ϕ	31° 40′	39° 12′	50° 20′	56° 30′	64° 52′

The significance of Goucher's wedge angle of 39° is now clear. It is almost exactly that which would be produced by slipping on every successive {112} plane through a distance exactly equal to that of the nearest approach of the atomic centres. It is true, of course, that the same wedge angle would result if slipping took place on alternate planes but through a distance of two atomic diameters, but it is certainly less likely that the latter are the conditions than that the movement is through one atomic distance on each plane.

With regard to the more variable blunt wedges, hitherto no very convincing explanation has been offered. Slipping on two symmetrical cube faces would give a wedge with an angle of about 53°, but the wedge itself, if this were the movement, would be at right angles to that actually found. Movement on the {223} plane would also give an angle very near to the mean value for all the tests in this group, but slipping on this plane cannot be regarded as likely. The obvious explanation, however, is seen from the values of ϕ just recorded. Among the values obtained by Goucher there is no angle between 41° and 50°, a fact which is of value in suggesting very strongly that movement takes place on every plane. A movement, for example, through three atomic distances on alternate planes would lead to a wedge angle of 46° 42′, and nothing within 5° of this is mentioned. Now if the explanation of these blunt wedges is to be found, not in a different plane of movement, but in varied degrees of movement on the same—the {112}—plane, and if the movement on every plane is through a multiple of the atomic distance so that the space lattice remains unaltered, the next wedge angle higher than 39° should be 50° and the next higher about 56°. Now 50° is, as we have seen, the minimum angle recorded by Goucher among his blunt wedges and there are six results within 1° of 56°. The largest angle of 60° corresponds with movement through five times the atomic distance.

The results thus suggest that the plastic deformation

has taken place by atomic movement on the {112} plane in all cases, on every one of these planes of atoms and by an amount which is in almost every case equal to, or a definite multiple of, the atomic distance, the space lattice thus remaining essentially unaltered and the atoms in their new positions slipping into the depressions left by the removal of other atoms just as would happen if the atoms behaved as hard spheres.

W. E. W. MILLINGTON.
F. C. THOMPSON.
The University, Manchester,
April 22.

On Imperfect Crystallisation in certain Long Chain Compounds.

A SMALL rectangular crystal flake of behenolic acid, $CH_3(CH_2)_7C:C(CH_2)_{11}COOH$, was mounted on an X-ray spectrometer in such a way that the long edge of the flake was parallel to the spectrometer axis. It was anticipated that this long edge should be parallel to the *b* axis of the crystal, in analogy to the previously investigated stearolic acid.[1] The revolving crystal photograph obtained with this setting was, indeed, almost identical with the corresponding photograph of stearolic acid. It gave, within the limits of experimental error, the same value for the *b* axis. One difference, however, was the extreme faintness of the long spacing. A second exposure obtained with a random setting gave an entirely unexpected picture. Most of the reflected spots on this second photograph were drawn out into arcs of circles. The picture was very similar to certain powder photographs which show orientation effects. It showed that the sample, in spite of its transparency, its smooth surface, and its straight edges, is not a single crystal. The first photograph leads to the conclusion that the small crystal elements from which the flake is built up cannot be orientated completely at random. The only possible orientation of these elements which is compatible with the observations is the following: All the elements have their *b* axes in common. The degree of freedom which is required to explain the powder effect consists in a rotation round the *b* axis (Fig. 1).

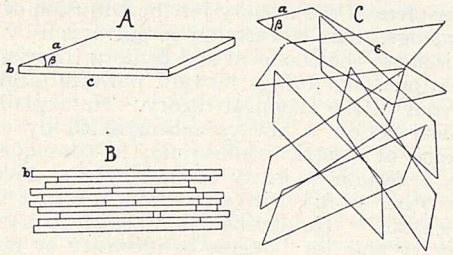

FIG. 1.—A: crystal element; B: arrangement of layers having *b* axis in the plane of the paper; C: another view of the same arrangement having the *a* and *c* axes in the plane of the paper.

An optical investigation of the crystal flake which was made afterwards confirmed the X-ray evidence of an anomalous structure. A true single crystal of either stearolic or behenolic acid shows in convergent polarised light the typical dark bands and coloured fringes. One of the dark bands which lies in the symmetry *b* plane persists in this anomalous crystal. The coloured fringes disappear. It was found later that some of the stearolic acid crystals showed the same phenomena.

An interesting fact is that very similar X-ray photographs to those described here can be obtained from crystals which have been bent. Rocksalt is a well-known example. Another example is maleic acid, the bending of which has been studied in this Laboratory. Supposing a crystal plate is bent in such a way that one of the crystal axes remains undistorted (Fig. 2). The crystal is fixed on an X-ray spectrometer with this axis parallel to the rotation axis. Both rocksalt and maleic acid give under these conditions perfectly normal rotation photographs. For any other setting they show powder effects. The explanation is obvious. The bending produces an internal breaking up of the crystal. The small crystal elements keep the undistorted axis in common — a rotation photograph round this axis shows no signs of this breaking up. The small elements have, after the bending, a random orientation round this axis—a random setting of the crystal gives rise to powder rings on the photographs.

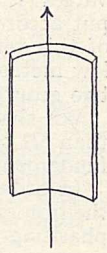

FIG. 2.—Crystal plate of maleic acid bent so that the axis is not distorted.

Behenolic and stearolic acid and most likely many of the long chain compounds grow from the solvent in this abnormal way. The crystallisation seems to go in two steps. The first step consists in an orientation of small crystal elements in parallel layers; the second step is an orientation of these elements parallel to a definite direction in the layer. The fact that these substances can exist in either the degenerate form or in the form of a true crystal illustrates again the instability of their crystals.

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The Fundamental Level of the Iron Atom.

IN a paper on the under-water spark spectrum of iron in *Phil. Mag.* (February 1926) and in a letter to NATURE (March 13, 1926, p. 380), Mr. N. K. Sur raises objections against the main result of the writer's classification of the iron spectrum (*Zeit. f. Phys.*, 23, 135, 1924; 26, 1, 1924), namely, the fact that a ^5D term is the lowest term in the energy diagram and that consequently ^5D corresponds to the normal state of the iron atom.

In spite of the fact that this conclusion was confirmed and independently arrived at by Angerer and Joos, as well as by Gieseler and Grotrian's absorption experiments (*Ann. d. Phys.*, 74, 746, 1924, and *Zeit. f. Phys.*, 22, 245, 1924), Mr. Sur maintains that a still lower term (X) must exist—the real normal state of iron—and that the alleged ground level ^5D is going to play only the rather subordinate rôle of a metastable state. Mr. Sur does not state clearly what the character and the quantum numbers of this hypothetical term X should be, although he intimates on p. 447 of his paper in the *Phil. Mag.* and in par. 2 of his letter to NATURE that he means a quintet or septet S term. But even these would be "at variance with the experiments of Stern and Gerlach on the directional quantisation of atoms." Only a $^1S_0$ would be in agreement with Gerlach's results, and obviously singlet terms cannot occur at all among the low terms of iron. (Comp. the last paragraph.)

A comment by Gerlach (*Ann. d. Phys.*, 76, 197, 1925) that some strong absorption lines around

[1] The samples of stearolic and behenolic acid investigated are monoclinic. Their space group is C^4_{2h}. A more detailed description of their crystal structure will be given shortly. In a note to NATURE, vol. 116, p. 45, July 11, 1925, it was suggested that stearolic acid was triclinic. This statement was made at a time when only very poor photographs were available. Photographs from very much better crystals have been obtained since. It was found that the preliminary conclusion with regard to the stearolic acid was erroneous.

2100 Å.U., which were not included in the writer's classification, probably involve this hypothetical low level, is also quoted by Mr. Sur. Unpublished observations of the under-water spark spectrum of iron made in this laboratory show, indeed, a conspicuous group of absorption lines in the region in question, the strongest being λ 2166·79. But these lines involve the differences of ^5D and form a multiplet with a new high $^5P_{1,2,3}$, which has the relative term values 13862·90; 13686·40; 13589·58 cm.$^{-1}$ (if we put according to general custom $^5D = 0$). The reality of this term is confirmed by combinations with the low metastable $^5P'$ and an (unpublished) $^3P'$ term in two groups at 3500 and 4200 Å.U. respectively.

We shall show at first that no other term lower than ^5D can exist, and then that *only* ^5D can be the fundamental lower level of the iron spectrum.

In order to illustrate his point, Mr. Sur compares the iron energy diagram with the neon diagram, emphasising that, although neon possesses a complete spectrum of more or less strong lines in the visible and near ultra-violet, it is entirely unjustified to draw any conclusions as to the *raies ultimes* of neon and its normal state; on the contrary, only the investigation of the Lyman region by Lyman and Saunders as well as by Hertz revealed the true normal state of neon. This conclusion, although correct for neon, does not apply to iron, for two reasons: (1) An upper limit of about 9 volts for the ionisation potential of iron is suggested by the general chemical similarity and by the ionisation potentials of the neighbouring elements, while from the behaviour of the iron lines in the sunspot spectrum we know that it must be larger than 6 volts (according to a letter of Prof. H. N. Russell to the writer). The difference $X - {}^5D$ must therefore be rather small, since we know that ^5D is already 8·15 volts = 66,000 cm.$^{-1}$ distant from the surface of the atom. Consequently, Mr. Sur's alleged ultimate lines arising from X should also lie in the near ultra-violet region, as do the strong lines involving ^5D; (2) the other reason for assuming the difference $X - {}^5D$ to be but small, is the appearance of the first iron lines in absorption at 1250°, and on the other hand the—at least approximate—absoluteness of King's scale in classifying the iron lines. If there were a much lower level than ^5D, King would not have assigned the designation "I" or "IA" to most of the lines which are found to be combinations of ^7P ^7D ^7F, ^5P ^5D ^5F with our ^5D. Their behaviour in the furnace would have been characteristic for Class II. or III., since a difference of about 10,000 cm.$^{-1}$ is equivalent to the interval between adjacent classes.

Assuming the difference $X - {}^5D$, or rather $S - {}^5D$, to be even so large as 14,000 cm.$^{-1}$, the combination with ^7P (π) should give a strong doublet or triplet not farther down than 2600 Å.U. We therefore reject Mr. Sur's point that in order to find this term "the spectrum in the Schumann region must be very thoroughly investigated, and then only can the point be settled." Such an investigation cannot possibly offer anything new concerning the low level of iron.

We are now going to show that *only* a ^5D term can be the lowest term in the iron atom, and for this proof we shall use the recent theory of spectra with several valence electrons, which was brought into final shape by Hund (*Zeit. f. Phys.* 33, 345, 1925). The iron atom with its eight valence electrons has for its low term set the choice between three more or less stable electron configurations, which furnish the following low terms:

Two 4_1, six 3_3 electrons:	^5D ^3H ^3F — — —
one 4_1, seven 3_3 ,,	^5F ^3F ^5P ^3P — — —
eight 3_3 ,,	^3F — — —.

The theory thus accounts for all the terms of the low metastable set up to a distance of about 20,000 cm.$^{-1}$. None of these three arrangements furnishes a ^7S or ^5S, and others are of course not possible. It furthermore seems entirely impossible to understand how any S term might arise from the normal state of $Fe^{+6}D$ (according to Russell, *Astr. Jour.*, 61, 223, 1925), since, according to a rule given by Kiess and the writer (*Science*, 63, 234, 1926), the transition from the higher to the lower stage of ionisation always amounts to a removal of the 4_1 electron. How this connexion of the arc and spark terms in iron can be traced is shown in a paper of the writer which is going to appear in *Journ. Opt. Soc. Am.*

The writer cannot agree with Mr. Sur that chromium and iron are comparable to any extent. The fact that in both spectra two prominent ^5D terms occur cannot warrant any conclusions of analogy between atoms of six and of eight valence electrons. The occurrence of S terms, only caused on account of five 3_3 electrons giving as a most prominent term (among others) a ^6S, is rather the exception than the rule in complex spectra. Only Cr^+, Mn^{++}, and consequently Cr, Mn^+, and Mn have S terms. If Mr. Sur doubts that ^5D is the low term of Fe, does he also question the low D and F terms of Sc, Ti, V, Co, Ni and their analogues in the next period?

O. LAPORTE.

United States Bureau of Standards,
Washington, D.C., April 6.

Peter Mark Roget and the Voltaic Cell.

THE transformation of energy from one form to another was realised in a general way before the middle of the nineteenth century, although it was not until the researches of Joule during the years 1838–1848 and the later work of Kelvin and of Helmholtz that the principle of the conservation of energy became an established doctrine of physical science. It is of interest, therefore, to find the principle of energy applied to the study of the voltaic cell by Peter Mark Roget (1779–1869) so early as 1829. This was before the experiments of Faraday on electrolysis, and nearly ten years before the work of Joule on the energetics of a voltaic cell.

In a work on natural philosophy published under the auspices of the Society for the Diffusion of Useful Knowledge, there is a section on galvanism by Roget. He discusses the chemical and contact theories of the voltaic pile, and brings forward powerful arguments in favour of the chemical theory. He explains that chemical action is always accompanied by a "disturbance of electric equilibrium, in consequence of which a certain quantity of electricity is developed, or, in other words, converted from a latent into an active state." He distinguishes between quantity of electricity and its "degree of intensity or tension," which we now call electro-motive force.

Roget then shows that certain conditions are necessary for galvanic action to take place. Denoting the three essential substances of a galvanic cell by A, Z, C, he explains that between A and Z some chemical affinity must exist and that the same action is not exerted between C and either A or Z. A must be a liquid, C a liquid or solid and Z a solid. If these conditions are satisfied he asserts that a continued stream of electricity will circulate in the direction CZA. If A, Z, C represent acid, zinc and copper, it is evident that Roget's conditions do apply to the ordinary voltaic cell. He goes on to say:

> "The absolute quantity of electricity which is thus developed and made to circulate, will depend

upon a variety of circumstances, such as the extent of the surfaces in chemical action, the facilities afforded to its transmission; . . . but its degree of intensity or *tension*, as it is often termed, will be regulated by other causes, and more especially by the *energy* of the chemical action . . . the energy of the galvanic power will depend altogether upon that of the chemical action, and can never be excited when the latter condition is wanting." [1]

Roget then discusses Volta's contact theory of the pile and says:

"There are several facts which appear so totally at variance with the immediate consequences of its fundamental hypothesis as to warrant us in rejecting it. Chemical action between some of the elements of a galvanic combination is so invariably connected with the production of electrical effect that it would be a violation of all just rules of philosophy not to consider these two classes of phenomena as standing to each other in the relation of cause and effect. . . . If there could exist a power having the property ascribed to it by the hypothesis, namely, that of giving continual impulse to a fluid in one constant direction, it would differ essentially from all other known powers of nature. All the powers and sources of motion with the operation of which we are acquainted, when producing their peculiar effects, are expended in the same proportion as those effects are produced; and hence arises the impossibility of obtaining by their agency a perpetual effect, or in other words a perpetual motion. But the electro-motive force ascribed by Volta to the metals when in contact . . . continues to be exerted with undiminished power in the production of a never-ceasing effect. Against the truth of such a supposition, the probabilities are all but infinite."

Thus Roget makes out a good case for the chemical theory. It was not until many years later, after the work of Arrhenius, Van't Hoff and Nernst, that the rival chemical and contact hypotheses were both included in a wider theory.

Roget is an interesting figure in nineteenth century medical science. He had a varied career and lived to a ripe old age. He was in France when hostilities with England broke out again after the Peace of Amiens and was among the unfortunate *détenus*. After a time he obtained his release, as his father had been a citizen of Geneva. After a period spent in private practice he held various official positions as a medical man. He was the first Fullerian professor of physiology at the Royal Institution and was for a time secretary to the Royal Society and editor of the "Proceedings." Among his publications besides his work on Galvanism we may note the following:—

Animal and Vegetable Physiology considered with reference to Natural Theology. Two vols. Bridgewater Treatises. Treatise 5. 1834, etc.

Third edition with additions, etc. Two vols. 1840.

Vol. 2 of the Library of Useful Knowledge. Natural Philosophy, 1829, etc., contains Treatises by P. M. Roget on Electricity—Magnetism—Electro-Magnetism.

An introductory Lecture on Human and Comparative Physiology, etc. 1826.

Tentamen physicum . . . de Chemicæ Affinitatis Legibus, etc. 1798.

Thesaurus of English Words and Phrases, etc. *First edition*. 1852.

D. M. TURNER.

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[1] P. M. Roget, "Natural Philosophy," London, 1829, Galvanism, §§ 70, 72.

An 'Eolith' Factory.

PROF. BOULE'S wash-mills are now rivalling the conjuror's hat—from which all sorts of strange things can be taken by an experienced hand. Years ago they produced what were declared to be typical Harrisonian eoliths; now they have given us "a collection of characteristic types, rostro-carinates, etc." (NATURE, April 24, 1926, p. 602), such as are found beneath the Red Crag of Suffolk, while, already, a crushing machine has "produced flakes, some of which . . . might have been taken for scrapers of an Upper Palæolithic or even Neolithic culture." From this it would appear that, with a little less stringent selection on Prof. Boule's and Mr. Etienne Patte's part, these wash-mills and crushing machines of France will soon be shown to be turning out 'typical' flint implements of all prehistoric periods, and the much-discussed Stone Age thus be made to disappear into the limbo of forgotten things.

Before, however, this dire result is brought about, it may perhaps be as well to consider for a moment or two the evidence upon which this latest wash-mill claim is based. Unfortunately, the illustrations accompanying Mr. Etienne Patte's paper in *L'Anthropologie* (Nos. 1, 2 of vol. 36) are of the indifferent order, but, even so, it appears reasonable to state that the specimens figured bear no real resemblance to those found below the Red Crag, and the claim that this resemblance does indeed exist is, it must seem, due to the fact that Prof. Boule and Mr. Patte have failed to distinguish between the type of flaking exhibited by their wash-mill flints and that of those from the Sub-Red Crag detritus-bed.

Such mistaken comparisons are by no means uncommon in prehistoric archæology, for there are still some observers who, for example, are unable to distinguish thermal flaking on a flint from that produced by human blows. That this conclusion is not unjustified is made clear by a letter which I have received recently from Prof. Henri Breuil, who has examined the actual specimens upon which Mr. Etienne Patte bases his case. It may be said that Prof. Breuil does not himself regard the Sub-Crag rostro-carinates with a favourable eye, yet he states that the cause of fracture of these wash-mill specimens is not the same as that exhibited by the Sub-Crag flints, and that the ensemble (of the wash-mill specimens) resembles in nothing the tertiary flints, or even those of the ancient palæolithic period.

History is repeating itself in this matter. In the days when the now accepted palæolithic flint implements were not universally regarded as examples of man's handiwork, a book was published in 1880 entitled "The Antiquity of Man," by Thomas Karr Callard and others, and I would ask those interested in this question to compare the statement published in NATURE (April 24, 1926, p. 602) with the following extracts from this book. On p. 33 we read: "We have said that these Palæolithic implements have a *certain* resemblance to the weapons of the modern savage; but instead of drawing the inference that because man made the latter therefore man made the former, *the resemblance we attribute to a natural cleavage in the flint which gives to it a tendency, however struck or crushed, to break into these particular forms . . .*" (my italics). Putting this thought to experiment, the writer has spent some hours in roughly breaking flints with a sledge-hammer, and the result has been that he has found amongst the broken flint forms sufficiently *resembling* the supposed arrow-heads, spear-heads, serrated edged saws, etc., to convince him that as many years spent in this way as M. Boucher de Perthes and Dr. Rigollot have occupied in their

research at Abbeville and St. Aucheul, would be likely to result in finding among the broken flints the choice specimens that they have treasured up: "*for it must be borne in mind that they simply made a selection*" (my italics).

Again, on p. 35 we find "Mr. Whitley has shown at the Victoria Institute *specimens of flint broken by Blake's patent stone-breaker, in which a cast-iron jaw is worked by a steam engine, which flints, selected from the broken mass, could not be well distinguished from those which, in the ossiferous caves, are the reputed knives and scrapers of Palæolithic man*" (my italics).

Further comment is unnecessary.

J. REID MOIR.

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Ipswich.

Frictional Forces in Liquid Surfaces.

WHILE working with a suspended system in which the bottom of the system consisted of a fine wire dipping into a solution of salt in water, it was found that frictional forces existed which resisted rotation of the wire. The suspending fibre was of phosphor-bronze, 0·0015 cm. in diameter and 1 m. long. On this was hung a disc, 4 cm. in diameter, and weighing 10 gm. Fastened to the bottom of the disc was a short piece of No. 30 copper wire dipping a few millimetres below the liquid surface. The liquid was 4 cm. deep.

It was found that often the top of the suspending wire could be turned two or three complete revolutions without any resulting motion of the disc, but when the disc once started to move it would move a considerable distance and with some rapidity.

CARL T. CHASE.

Norman Bridge Laboratory of Physics,
California Institute of Technology,
Pasadena, April 21.

The Disposal of Scientific Journals.

I EXPECT there are many people like myself who are embarrassed by the accumulation of scientific journals, which remain unbound and are so seldom referred to afterwards that they amount to little more than an incubus. I think many of us would be glad of some help towards getting this literature disposed of to the best advantage. I have myself a large accumulation of unbound issues of the *Proceedings of the Royal Society*, the *Journal of the Chemical Society*, *Chemistry and Industry*, etc. After inquiry in likely places I have found no trade market for these. I scarcely like to part with them as waste paper, yet it is difficult to find any better destination.

Perhaps some readers of NATURE may have found a solution of the difficulty, and could give others the advantage of their experience.

S.

Ultra-Violet Photometry.

THE use of optical wedges in photometry is so convenient and accurate that they are now being largely employed, but their use is, at present, mostly confined to the visible region. Dr. Toy (*Phil. Mag.*, 1920) showed that wedges of neutral grey gelatine between quartz plates could be used down to about 3000 Å.U., but the absorption coefficient, and hence the wedge-constant, was increasing so rapidly with decreasing wave-length, that they would probably become useless beyond about 2900 Å.U.

Having recently had facilities for measuring the constants of such wedges on an accurate spectrophotometer, using a sodium-in-quartz photo-electric cell, we found that the constants actually increased but slowly beyond 3000 Å.U. Messrs. Ilford, Ltd., kindly made another new wedge embodying certain suggestions indicated by previous work. The change of wedge-constant with wave-length for this new wedge is considerably smaller than that of a wedge of the standard type, and either type of wedge can easily be used down to 2380 Å.U. at least. (Beyond this there are no lines which we could use in the mercury spectrum, and the mercury arc is the only convenient source of illumination for this work.) The following table shows the change of wedge-constant with wave-length for both of Messrs. Ilford's standard wedges between quartz plates, and also for the special wedge they recently made for us—the wedge-constant for 3655 Å.U. being taken as unity in each case.

The change of wedge-constant with wave-length seems to be a gradual one, and is a very small disadvantage in practice, as it is easily allowed for. The writers have employed Ilford gelatine wedges between quartz plates for photometry of the ultra-violet end of the solar spectrum—*i.e.* to about 2950 Å.U.—for two years with excellent results.

λ.	Wedge-Constant.		λ.	Wedge-Constant.	
	Standard Type.	New Type.		Standard Type.	New Type.
Blue	0·7	0·7	2893 Å.U.	1·62	1·30
3655 Å.U.	1·00	1·00	2804	1·65	1·36
3342	1·28	1·10	2752	1·68	1·40
3131	1·50	1·19	2655	1·78	1·45
3022	1·57	1·23	2536	2·00	1·55
2967	1·58	1·26	2480	2·10	1·57
2925	1·60	1·28	2378	2·30	1·63

In the booklet on "Photographic Photometry" recently published, we have stated that neutral gelatine wedges cannot be used for wave-lengths shorter than about 2900 Å.U. as indicated by the earlier results. This now needs correction, since such wedges can be very conveniently used to 2380 Å.U. and probably somewhat further.

G. M. B. DOBSON.
D. N. HARRISON.

Clarendon Laboratory,
Oxford,
May 10.

A Substitute for Microscope Cross-Wires.

IF a microscope or other apparatus fitted with cross-wires is not available, a convenient substitute may be made by placing a coverslip carrying two filaments of seccotine at right-angles between the lenses of an eyepiece.

The coverslip is placed on the end of a cork, which makes a convenient 'bench.' A small quantity of seccotine is squeezed out of a tube; this is touched with a pin or match, and the fine filament produced when the pin is drawn away is manipulated on to the coverslip. The cork is rotated through 90° and the operation repeated. The degree of fineness to which a filament can be drawn depends on the consistency of the seccotine. At ordinary laboratory temperature in winter it was in a suitable condition almost as soon as it had left the tube.

FRANK W. JANE.

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(University of London), E.C.4,
April 26.

The Next Task of Astronomy.[1]

By Prof. R. A. SAMPSON, F.R.S.

A VERY large amount of work is in progress at present upon astronomical photometry. The older branches of astronomy, astrodynamics and measures of position, are far from being exhausted, and it is a matter for great regret that the former, especially, with its splendid traditions of great workers, of discovery and invention, should have fallen into relative neglect. The middle branch, astrophysics, has so far been based, almost exclusively, upon measures of position, namely, precise determination of spectral lines. Beyond that it has been little more than a descriptive branch—an avenue to science rather than a part of it. But lately from every direction it is being forced to address itself in earnest to the problems of photometry—that is, to face directly and with as much science as it can command, the question of measuring quantity of light-emission.

One is apt to forget that the estimation of stellar magnitudes is coeval with our earliest measures of position. It is found in Ptolemy's "Almagest," accompanied even by a few notes on colour. The six magnitudes into which we divide the naked-eye stars are a legacy from his sexagesimal arithmetic. The subsequent development of the two is in curious contrast. The edifice of positional astronomy is the most extensive and the best understood in all science, while light measurement is only beginning to emerge from a collection of meaningless schedules.

Measures of positional astronomy were originally nearly as meaningless as magnitudes. Successively the position of the observer, the phase of the earth's rotation, precession, the atmosphere, stellar aberration, nutation, the solar motion, stellar parallax, and finally relativity-shifts, required to be discovered, measured and eliminated, before we got down to clean results that referred to the stars and nothing else. To these may be added personality and the theory of instruments, or the allowances that are necessary before measures made by different persons in different circumstances can be combined. All this has been done with a success that is very nearly complete and permits one to remark, first on the extreme complexity and variety of unknown troubles by which simple geometric measures proved to be actually embarrassed, and secondly, on the enormous collateral advantages that accrued to knowledge in general by their solution, including unforeseen conquests of theory, necessity for invention of new methods, new instruments and new outlooks.

Now the place of a star is certainly the datum that matters least about it—except perhaps in statistical grouping. Its mass, its size, its surface temperature, the state of its atmosphere, its radiative emission—if we can get them—are all intrinsically a great deal more significant. All these are absolutely basic data or quæsita of physics. They relate to circumstances of Nature which we cannot imitate in any experiment of our own, owing to the quantities and the temperatures involved, and the isolation. These are Nature's experiments, in her own laboratory, and their variety is for our purposes endless and may be called complete. Our only access to them is by parcels of starlight, and our only treatment for these parcels, after a certain amount of general description, is to measure them, and to cast out from our measures what is irrelevant, personal to ourselves, our situation or our instruments. Difficult and laborious as the prospect may seem, it will falsify all experience if our labours do not yield us unexpected stores of gain, new and unforeseen relations, besides what we set out to master.

I would repeat that the measurement of radiation is a physical question of absolutely basic importance. Every step matters on the road to its elucidation. This is the question I refer to as "The Next Task of Astronomy," because a large part of it, and necessarily a critical part of it, falls in the astronomer's field. In spite of all the work that has been done upon it up to now, it is still, in the main, in a crude stage, much behind where we might, with proper effort, place it, and out of all comparison behind the position of measures of place. Therefore it offers a field which both astronomer and physicist can be sure they will not cultivate in vain.

Very few years ago there was but a single star for which a photometry that was physically significant was attempted. This was the sun. Here all the necessary allowances that were known were made, the first being a very elaborate and difficult determination of the effect of the earth's atmosphere, and the elimination of it. Then there was the measure of the sun's own radiation. This might be done in bulk, or separately for each wave-length. In either case the true measure is taken as a heat measure, an energy measure. As to that, there is more to say than used to appear. Questions of fundamental interest suggest themselves, and will certainly call for investigation hereafter. For the sun, the standard detecting instrument at present is the bolometer, which in principle is a Wheatstone's bridge, balanced upon a pair of exceedingly fine short strips of platinum, one of which receives the selected radiation and responds to it by an increase of resistance. Increase of telescopic power has made it possible to extend this method to certain stars, employing as detector either Nichol's radiometer or Coblentz's vacuum thermocouple. C. G. Abbot, with the 100-inch telescope at Mount Wilson, has been able to record the actual distribution of heat-radiation of nine stars, over the whole visible spectrum and far into the infra-red. Coblentz has obtained results nearly equal to these. Deflexions corresponding to integrated radiation for the whole spectrum are readily obtained by the same means for far fainter stars.

Interesting though this is, personally I regard it as a *tour de force*; like the interferometer measures of stellar diameters, it does not hold out any promise of general use, and gives measures which serve only to confirm results that are more conveniently and as certainly obtained otherwise.

Besides the interest attaching to a new feat, however, such measures are true physical photometry, as absolute as we can make them. The same cannot be said of our chief standard, the north polar sequence. Perhaps nothing speaks more clearly of the detached,

[1] From a paper read before the Optical Convention, 1926, on April 13.

inconclusive and essentially unscientific position of stellar photometry than the labour spent upon establishing and verifying this work, without reference to its subsequent physical interpretation. If my words are depreciatory, this does not mean that I undervalue those who worked at it, or what they have given us; it is to remind workers of to-day that we have got into a different era, in which astronomy has definitely and finally joined hands with physics, each serving and responsible to the other, for mutual profit.

The north polar sequence was devised by E. C. Pickering at Harvard, as his ultimate standard of photometric reference. It consists of a carefully graded series of stars within 4° of the north pole.

The accepted scale for magnitude is Pogson's, which he derived from J. Herschel, defining increment of magnitude as proportional to increment of log (intensity), so that an increment of magnitude, dm, varies as $-dI/I$, where I is the intensity. This is in accordance with Fechner's law, by which a physical intensity is translated into a sense-measure; its significance is the escape from introducing an arbitrary external unit to measure dI—the instantaneous value I serving for that purpose. To establish a standard sequence in accordance with this definition, Pickering deliberately employed a variety of instruments and methods, relying upon their mean to cancel the comparatively large discrepancies. Such a plan may have been the best to use at the time it was devised, but it is obvious that it may leave a residue of systematic error. It was ascertained to do so by F. H. Seares of Mount Wilson, and this was confirmed by H. Spencer Jones at Greenwich. But these are no more than the incidents in fixing a critical standard, and one can scarcely suppose equal results could have been better or more readily obtained.

What I criticise in the investigation of 'magnitudes,' of which the standard sequence is merely the best, and one of the least extensive, examples, is that the measure is a measure of a mixed phenomenon, which has never been analysed to its physical basis, and which it is usually impossible to complete afterwards. There are always and obviously three elements that contribute to the measure—the actual radiative emission of the source, losses in transit by dispersion, absorption and reflection in the instrument and the atmosphere, and finally the peculiar sensitivity characteristic of the receiving apparatus. One form of the latter is the eye, supposed reduced to a standard, and equivalent to a photovisually corrected lens used in conjunction with an isochromatic photographic plate and a rather ill-defined yellow filter. The result can be made sensibly the same and sensibly uniform.

The position is decidedly more unsatisfactory when we deal in photographic magnitudes. Apart from such investigations as I advocate below, which have not yet received a recognised place in astronomy, the basis of the adopted treatment is frankly empiric, and empiric in a way that holds out no promise of a better foundation. After numerous experiments a formula has been settled on, $m=a+b\sqrt{d}$, where d is the measured diameter of the photographed image, and a, b turn out to be sensibly constant over considerable ranges. It is a very convenient rule, and it has turned out a great deal of very useful work, but in a physical sense it is hopeless.

Now if we accept the heat radiation as standard, it is of course familiar that the estimate of intensity made by the eye, whether analysed or summed, is distorted. Abbot, for example, extended his bolometric measures beyond wave-length 2μ, to which the eye is perfectly blind. We require an equation of conversion and a different equation according to the partition of emissive energy along the spectrum. We can imagine then a reduced 'bolometric' magnitude, as introduced by Eddington, which corresponds to the true heat emission of the star, the correction that produces it being a function of the spectral class of the star. This correction is large, exceeding a magnitude at both ends of the scale. Equally a photographic magnitude, derived from an ordinary photographic plate, would require a different, similar correction, but it is more usual first to reduce the photographic magnitude to the photovisual, by estimating the difference between the two known as the 'colour correction,' and itself an index of the spectral class.

Thus, apart from instrumental and atmospheric difficulties, photometry is helpless without at least two measures, to give, between them, the total heat emission and the spectral class, or in other words the size and the shape of the Planck radiation curve. This statement assumes that the star radiates as a black body, which is sufficiently though not closely or invariably verified. So many ways are known for finding spectral class that it is sufficient merely to mention them. They are designed to apply to different cases, according as we want detail or collective summary, and can dispose of much light or little. The slit spectroscope, the prismatic camera, effective wave-lengths determined by the position of the secondary images formed by a very coarse grating, photographs with different colour screens interposed, and even eye estimates of colour.

To speak first of one of the desiderata, it has been verified beyond any doubt that the temperature indicated by the shape of the Planck emission curve of the star, which is taken as the 'effective temperature,' or the surface temperature of the star, implies quite strictly the spectral class, with its intricate detail of absorption lines. It remains only to confirm the fact by defining the relation more closely and better cleared from impurities, to examine how nearly the black body radiation actually applies to a star, and finally to search out exceptional cases.

As this branch of the research has been carried out with fair success and with general agreement in result for different methods of treatment, some detailed reference may be made to the questions it has evoked. The investigation proceeds from the evident fact that the balance of intensity of a star's radiation shifts from the blue to the red as we cross the spectral series. Presumably this is a temperature effect which may be interpreted by means of Planck's radiation curves. If we assume that the star's radiation is itself black-body radiation, it would suffice to use Wien's law and determine the summit or maximum of the curve, but it is preferable to make no assumption and attempt to determine the whole curve. In any case we require to calibrate our apparatus of reception by seeing what

it records when exposed to a standard source. It is possible to make such a source terrestrial. Wilsing employed as his standard an electric oven, constructed as a black body, against which he calibrated a glow lamp, which in turn was compared with the stellar spectrum. His work was visual. The method requires the subsequent elimination of instrumental and atmospheric losses. The latter vary rapidly and greatly. Accordingly Wilsing's measures show a rather wide dispersion, and there are some improbable results for individual stars. Besides, the general scale seems low, so that systematic error has not been avoided. But these are minor criticisms by which one tries to learn the lesson of the difficulties. The whole work, including that of his collaborators Scheiner and Münch, is a monument of skill and care.

To vary the method as Wilsing's experience suggests, I have photographed the spectra upon panchromatic plates sensitive up to Frauenhofer's (B), and in place of the terrestrial source as standard I have made comparison with a similar spectrum of Polaris, taken first and last on each plate, to guard so far as possible against atmospheric vagaries. Apart from altitude effect, it is assumed that both stars are equally affected by losses, so that there is no allowance to be made in the relative measures. We have then before us an interesting problem of interpreting the photographic deposit in terms of the active light. Different times of exposure and different wave-lengths enter with the changing sensitivity of the plate. It is in fact the basic problem of sensitometry. One might say that little can be said of it, except that it is enormously complicated. What the star contributes is merely a 'latent image' that cannot be examined, and the outcome depends on the chemicals used, their handling and temperature. The material employed is none too uniform. It is altogether a region that has hitherto been avoided, and that one would rather avoid if the gain were not so manifest of reducing it, even partially, to order. Besides, what is the alternative? There are exactly the same obscurities in using the eye, but it gives no permanent record that one can experiment on and cross-examine. Two other detectors of the same order of sensibility are offered—the selenium detector and the photo-electric cell. Whether photography may be more or less obscure than these, in a metric sense, it is certain we are more familiar with its troubles, and are in any case bound to use it for other purposes. Hence it appears to me, the sooner the discussion of the photographic deposit is reduced to a standard for scientific purposes, the better.

My own effort has been confined to reducing the complexity by defining the circumstances. If the temperature, chemicals and handling are kept the same, and if the photographic constants p and γ are separately determined in the laboratory for each batch of plates and for each wave-length used, then it would appear that the blackening of the plate can only depend on the intensity of the light and the time of exposure, or alternatively, the intensity is a function of the blackening and the time. The last two are measurable, so that to derive the former requires merely the establishment of a calibration curve in the laboratory as indicated above. Departures must be treated as accidental anomalies. It can be shown that a manageable theory may be built on this basis, applying at any rate to the case when the desideratum is the shape of the radiation curve, leading to an easy equation between the relative temperatures of two sources, as indicated from any wave-lengths at which their spectra are compared.

It will be noted that this method fails to provide an absolute standard temperature unit, as basis. This, however, may be supplied by taking the temperature of a 'Go' star the same as that of the sun; but in fact when a great many stars are used, the indeterminateness is distributed over them all, and it is found that a coherent treatment permits of very little latitude, without thrusting very improbable figures upon one or other of the extremities.

A parallel treatment of the area of the radiation curve, giving the total bolometric emission of the star, should not present any insuperable difficulty. We should then have by direct determination the two fundamental elements of the star's radiation, temperature and quantity.

. . . . . .

The measurement of the intensity of individual lines in the spectrum promises at least as much interest as a treatment of the whole. But in writing this summary directed to a special object, I have omitted many points which mean a great deal to those conversant with astronomical literature. If we want to pass from the 'magnitude' of a star to its radiative emission, we require to know the magnitude of the sun and the distance of the star. A few decades ago the number of stellar distances known was so insignificant that no general treatment was possible. It was the want of this knowledge that really accounts for some of the deficiencies of which I have spoken above. But that is now past. Some thousands are now determined, and their number is still rapidly increasing. Of stellar masses we still have only a very few determined directly; but a well-credited theory permits us to calculate these too, even for individual stars. These are necessary adjuncts if astronomy is to unite itself with physics, and the astronomer may be relied upon not to fail in supplying them.

The Active Principles of the Pituitary Gland.

SINCE the discovery by Oliver and Schafer of the blood-pressure raising or pressor effect of extracts of the posterior lobe of the pituitary gland, a number of other phenomena caused by injections of this material have been described; thus although in mammals the blood-pressure is raised, in birds it is reduced; in the former the extract also stimulates the uterus to contract, and produces an increased flow of milk and an increased secretion of urine, under certain conditions, but under others the urinary flow is markedly diminished. In frogs the extract stimulates the pigment-carrying cells or melanophores to dilate, producing thereby a darkening of the skin of the animal. It may be noted that these active principles are all obtained from the non-glandular posterior lobe of the organ, which is composed chiefly of neuroglial

tissue, although it has a partial investment of glandular cells from the *pars intermedia*. The glandular anterior lobe, which is essential for normal growth, has not yet yielded for certainty an active extract to the labours of the biochemist.

Are these various active principles, designated in the present state of our knowledge by an adjective descriptive of the effect produced, all different, or is there only one, or possibly only two or three? Subject to the isolation of one (or more) in a chemically pure condition, we can only attempt to reach an answer to this question by consideration of the indirect evidence which is available. Before reviewing some recent work on this subject, attention may be directed to one or two points. It is generally held at the present time that the diuresis observed after injection of a posterior lobe extract intravenously into an anæsthetised animal is caused by the rise of blood-pressure simultaneously produced, with perhaps a dilatation of the kidney blood-vessels, and that the galactogogue effect is due to the same principle stimulating the smooth muscle fibres in the walls of the ducts of the mammary gland, and so leading to an expression of the milk already secreted; in neither case is it considered that the extract stimulates the kidney or mammary gland cells to increased activity. It appears almost certain that some of the effects must be pharmacological rather than physiological; the usefulness of a principle which will produce a flow of milk and an expulsion of a fœtus from the uterus to a fish or frog is obscure.

Evidence as to the identity or otherwise of the active principles has been sought by an examination of the glands of different species for the presence of the various activities associated with gland extracts. According to a table given by L. T. Hogben and G. R. de Beer (*Quart. Journ. Exper. Physiol.*, 1925, vol. 15, p. 163), extracts of the pituitaries of elasmobranch and teleost fish, amphibia, reptiles, birds and mammals produce all the effects obtainable from such extracts, except that there is some doubt as to the presence of a pressor and diuretic principle in the gland of the skate. The authors have made quantitative comparisons of the contents of the skate's and cod's glands in the pressor and oxytocic (uterine-stimulating) principles, and have found that the latter contains twenty to thirty times as much oxytocic activity as the former, tested on the virgin guinea-pig's uterus, whilst the pressor activity of the cod's gland is at least five times more than the skate's, tested on the spinal cat. Unfortunately, the doses of skate's gland extract used failed to produce any rise of blood-pressure; it is possible that with larger doses some rise might have been obtained, seeing the great difference in their relative oxytocic activities. Hence the experiments are inconclusive, but afford no evidence that the two principles are separate chemical compounds.

Since the principles are so widely distributed throughout the animal kingdom, the differentiation between them must be made, if at all, by other means. Is there any difference in their distribution in the gland of a single species? That is, can differences be detected between their concentrations in the *pars nervosa* and in the *pars intermedia*, both of which structures are included in the posterior lobe? Hogben and de Beer have also investigated this question and find that in the pituitary gland of the ox the *pars intermedia*, although containing roughly only one-fifth of the amount of the principles in the *pars nervosa*, yet consistently contains more of the oxytocic principle than of the pressor, although usually the difference is not great. The authors favour the view that these two principles are probably different chemical substances.

Further light is shed on the problem by greater knowledge of the chemical properties of the active substances, and of their specific or non-specific nature. Thus Hogben (*ibid.* p. 155), investigating the depressor effect of injections of extracts of the posterior lobe in birds, finds that other tissue extracts fail to give this response; moreover, the chemical properties of the active principle are, so far as investigated, the same as those of the other principles and different from those of a non-specific depressor such as histamine. The compound is localised mainly in the *pars nervosa*.

The principle influencing the secretion of the urine has been investigated in some detail by N. S. Craig (*ibid.* p. 119). The *diuretic* action of posterior lobe extracts was the first to be discovered, and it was only later found that in the disease *diabetes insipidus*, characterised by great thirst and the passage of large volumes of urine, subcutaneous injections abolished temporarily both the thirst and the polyuria, thus exerting an *antidiuretic effect*. It appears, therefore, that one of the functions of the posterior lobe of the gland is to maintain the concentration of the urine; if this function is deficient, polyuria and thirst result. Craig finds that, injected subcutaneously into unanæsthetised cats, the extract delays the diuresis produced by giving water or saline solution by mouth, but has much less effect on that following the exhibition of a solution of urea. No evidence of a delayed absorption of the fluid from the gastro-intestinal tract was obtained, so that it must be retained in the body after absorption; certain observations on the hæmoglobin percentage in human blood after the administration of fluid by mouth and the injection of pituitary extract confirm this result. The author inclines to the view that the principle exerts its influence by an action on the cells of the kidney.

It is usually stated that extracts of the posterior lobe stimulate all forms of smooth muscle. A. D. Macdonald (*ibid.* p. 191), as the result of an investigation of their action upon isolated strips of smooth muscle from the mammalian ileum, disagrees with this statement. He finds that not all commercial extracts stimulate this preparation, that the stimulating substance can be preferentially extracted from laboratory-desiccated posterior lobe by alcohol, which extracts the non-specific depressor compound, and also to a certain extent by ether, which extracts neither the pressor nor the oxytocic principles, that it is present in other tissues, and hence is not a specific principle of the pituitary gland, and that it is not destroyed by boiling in dilute alkali, which treatment deleteriously affects both the pressor and oxytocic activities. It is probable, therefore, that the stimulating substance is histamine, which occurs in most tissue extracts, and that it is not quite completely removed from desiccated posterior lobe preparations by alcoholic extraction; although a preparation thus treated may show no depressor effect on injecting a second dose into a mammal, yet sufficient

histamine may have been left behind to stimulate the smooth muscle of the intestine, since the latter is about one hundred times more sensitive to histamine than it is to pituitary extract. It is possible, from some experiments on the heart of the dogfish, that small quantities of choline are also present in most posterior lobe extracts. Hence it must be concluded that any gut-stimulant action which pituitary extracts possess is very largely or entirely due to the presence therein of the non-specific stimulants histamine and choline.

Finally, reference must be made to the attempted chemical separation of the active principles. As W. Schlapp (*ibid.* p. 327) points out, the identical behaviour of the different principles through a large number of chemical manipulations is not sufficient evidence of their chemical identity, more especially as the non-specific histamine apparently accompanies them in many cases. On the other hand, a separation of two by a single chemical treatment would argue very strongly in favour of their non-identity. The author finds that the pressor, oxytocic and melanophore principles are all destroyed at the same rate by boiling in dilute acid, but that the pressor and melanophore activities are not extracted by butyl alcohol, whereas the oxytocic largely passes into this solvent; furthermore, lead sulphide adsorbs almost all the pressor and melanophore material present in a solution, but only about half of the oxytocic. He concludes that the pressor (and melanophore) and oxytocic activities are mediated by two separate and distinct substances, thus agreeing with Hogben and de Beer, who by a different method reached a similar conclusion. Now the melanophore principle appears to exist in greater concentration in the *pars intermedia* than in the *pars nervosa*, thus resembling the oxytocic but differing from the pressor principle. Hence it appears probable that these three activities of posterior lobe extracts are due to the presence in them of three different chemical compounds. Their relationship to the avine depressor and antidiuretic principles requires further research for its elucidation; whilst Macdonald's results throw doubt on the specificity of the galactogogue effect. The conclusions reached from a consideration of the work mentioned above agree in general with those which may be drawn from the experiments of other investigators.

Vital Statistics of Scientific Academies.[1]

A COMPARISON of the life statistics of such bodies as the Royal Society of London and the scientific academies in other countries is interesting, because the efficiency and influence of these institutions depend to some extent on the average age of their membership. Unless they contain a sufficient sprinkling of the younger generation and elections are not delayed until a man has done his best work, the institution will cease to command confidence and be hampered in the fulfilment of the object for which it was founded. We welcome the publication of the statistics collected by Prof. Raymond Pearl, and published by the National Academy of Sciences of Washington, because it allows us—so far as the limited material permits—to form a judgment of the effects of the conditions of election, which differ materially from those applying to the Royal Society. The latter, as is well known, has elected since 1848 fifteen members every year, while the leading scientific body in the United States has followed the practice of Continental academies and limited its total membership.

A statistical inquiry was first made in England by General Strachey (*Proc. Roy. Soc.*, vol. 51, 1892) in the latter part of the last century, primarily for the purpose of forecasting the ultimate membership of the Royal Society, which had fallen from 768 in 1848 to 427 in 1891 (not including 36 fellows elected under a special rule). There were then still 26 members alive who were fellows in 1848, when the statutes were changed.

In the United States the problem is reversed, the question being, what the number of elections per year should be so that the Academy might settle down at the maximum membership fixed by charter in 1863 at 250.

The National Academy started with a membership of 48, and, anxious no doubt to set a high standard, it was slow in making any substantial additions. During the first twenty years of its existence ninety-five new members—that is, less than five per year—were elected, and the number of elections diminished still further in the second period of twenty years, when the annual average of new members fell to a fraction more than three. Since 1905 the Academy increased more rapidly "under pressure of an arbitrary rule which virtually forced the election of 15 per annum." Reference to this rule occurs twice on the same page in Prof. Pearl's publication, but its exact terms are not stated.

The average age of members of the National Academy on May 1, 1925, was practically identical with that which I found for fellows of the Royal Society at the beginning of 1923, being 60·7 years in one case and 60·9 years in the other. But there is a great contrast in the admission of men below middle age. During the sixty years that have elapsed since the first nominations under the charter, Washington has elected only one man below the age of thirty, while the Royal Society has elected twenty-nine in the course of seventy-five years. The same tendency is shown in elections below the age of forty years. The percentage of elections under that age was 33·9 at the Royal Society and only 19·9 at Washington. The further fact emerges that the election of younger men to the National Academy has very markedly and steadily decreased since its foundation. On this point Prof. Pearl makes the following startling remarks:—

"It is easy to attribute the changing habits of the Academy relative to the election of young men to a growing conservatism of that body itself. That this is the sole cause I doubt. It is at least possible, and I incline personally to think it probable, that the increasing organization, standardization, mechanization, and constant striving for efficient mediocrity in all our academic life, which every thoughtful person has seen going on during the past 30 years, and which some have deplored and vainly endeavoured to stop, is showing as one of its most dreadful effects the curbing and fettering of the progress of the really brilliant student."

[1] Vital Statistics of the National Academy of Sciences: By Raymond Pearl. *Proceedings of the National Academy of Sciences* (vol. 11, No. 12, 1925).

It is not for us to comment on this formidable indictment.

At the Royal Society the decline in the number of elections of young men appears to a much smaller extent, and may be accounted for without assuming a decline in intellectual power. The statistician had better confine himself to his job; and if he ventures on explanations it is safest to assume that the general intelligence of a country is less likely to change than the state of science, which at different stages of its progress requires different types of intellectual activity.

One factor affecting the average age of admission is the greater competition due to the enormous increase in the scientific output of the British universities. This is strikingly illustrated by the increase in the number of men presenting themselves for election. The assistant secretary of the Royal Society has kindly supplied me with the relevant figures. I have collected these in the following table, in which the columns headed '*N*' give the five-year averages of the numbers of candidates.

Period.	*N*.	Period.	*N*.	Period.	*N*.
1848–1852	30	1873–1877	53	1898–1902	86
1853–1857	36	1878–1882	53	1903–1907	84
1858–1862	42	1883–1887	60	1908–1912	96
1863–1867	50	1888–1892	68	1913–1917	116
1868–1872	52	1893–1897	73	1918–1922	113

I have not ascertained the ages of the candidates, but am under the impression that they would show a slight increase in the last twenty years. Since 1922 the number has been 112 on the average.

ARTHUR SCHUSTER.

Obituary.

MR. JOSEPH LUCAS.

MR. JOSEPH LUCAS, who died on April 20 last at the age of seventy-nine years, was educated at Westminster School and in 1867 joined the Geological Survey of Great Britain. During his nine years in the service he was employed in mapping the Carboniferous rocks in the West Riding of Yorkshire, and, later, the area in north-east Yorkshire, within which the Cleveland ironstone occurs. While in the West Riding he was much impressed with the great amount of water yielded by the Lower Carboniferous sandstones, and this probably led to his taking up the study of water supply and the profession of water engineer on his retirement from the Geological Survey.

Although his investigations covered many parts of England, Mr. Lucas concentrated on the area of the Thames Valley, and all his more important publications dealt with this region. His work was marked by a distinct originality of thought and at once brought him into public notice. He was probably the first to publish a hydrogeological map with artesian contours, which he defines as a series of lines drawn through a number of points at which the water rises to the same height above Ordnance Datum. He gave much additional evidence of the steady fall of the underground water-level in the Chalk and suggested that such maps should be prepared at intervals, as by them this fall in the water-level would be more clearly shown.

A fairly full summary of Mr. Lucas's more important publications and conclusions are given by Whitaker in his comparatively recent work on the water supply of Surrey (*Mem. Geol. Survey of England and Wales*, "The Water Supply of Surrey," by W. Whitaker (1912), pp. 14-17. See also Bibliography (*ibid.*), pp. 328-330). A brief account is here given of Mr. Lucas's first paper, "Horizontal Wells" (published privately in 1874), and of his second and better-known "Artesian System of the Thames Valley," published in 1877 in the *Journal of the Society of Arts*, vol. 25, No. 1277, p. 597. The second work contained the original and valuable "Hydrogeological Map" showing the underground contours of the water-level in the Chalk, but referred only to the area south of the Thames. In 1878 he published privately a complete map of these underground water contours both north and south of the Thames. This proved so instructive that it was republished by the Geological Survey together with two other similar maps showing their position first in the period between 1890 and 1900 and later in 1911 (*Mem. Geol. Survey of England and Wales*, "Records of London Wells," by G. Barrow and L. J. Wills (1913), p. 19).

Later on, Mr. Lucas turned his attention to the water supply that could be obtained from the Lower Greensands of Hampshire and Surrey, and a short résumé of the work was published in 1880. Though he continued to practise as a water engineer for some years, he ceased, after this, to make any further publications of general scientific interest.

DR. B. P. GRENFELL.

THE death is announced of Dr. Bernard Pyle Grenfell, honorary professor of papyrology in the University of Oxford, which took place at Eley, Perth, on May 17. Dr. Grenfell was born in Birmingham in 1869, and was educated at Clifton College and Queen's College, Oxford. After taking his degree with first-class honours in both Moderations and *Lit. Hum.*, he was elected to the Craven fellowship and a fellowship at his own College.

In 1894 Grenfell began work as an excavator under Sir Flinders Petrie, who confided to him the editing of a Greek roll which proved to contain enactments of Ptolemy Philadelphus I. of the greatest importance for the currency and fiscal systems of Egypt. It was in this year that there began his long association with A. S. Hunt, which was to prove so fruitful in the study of the fragments of papyri which they discovered in the course of their excavations at Oxyrhynchus. From these were derived the "Sayings of Jesus" and the many other fragments published in the Oxyrhynchus series, which have thrown a flood of light on many aspects of the social and religious life of Egypt, as well as much matter of literary interest and of importance to the scholar. Grenfell himself was especially interested in the intricate problems of finance and currency in Egypt—a subject in which he had early shown his competence in a masterly account of the ratio of silver

to copper which had appeared as an appendix to his edition of the Ptolemy text referred to above.

In 1906, while excavating at Oxyrhynchus, Grenfell broke down through overwork. Though he recovered for a time, he broke down again in 1908, the year he was elected first professor of papyrology at Oxford, and it was only intermittently that he was able to resume work after that date. In 1913 he was appointed honorary professor of papyrology. He was an Hon. Litt.D. of the University of Dublin, and Hon.D.Jur. of Graz, corresponding fellow of the Munich Academy, member of the Academia dei Lincei, and Drexel medallist of the University of Pennsylvania.

THE death of the eminent French entomologist the Abbé J. J. Kieffer occurred on December 30 last. For many years he was on the teaching staff of the College of St. Augustin at Bitche in Lorraine, where he devoted himself largely to entomological research. His earlier work was concerned with the taxonomic study of gall-making Diptera and Hymenoptera, but latterly he turned his attention to the Chironomidæ and became the foremost European authority on the family. His most enduring contribution is his "Monographie des Cecidomyides d'Europe et d'Algérie" (1900), which contains a wealth of biological and anatomical information, and is profusely illustrated. His death leaves a gap in the ranks of the few students of the difficult and obscure groups of insects among which he laboured so assiduously.

WE regret to announce the following deaths:

Sir Harry Brookes Allen, emeritus professor of pathology in the University of Melbourne, and president in 1908 of the Australasian Medical Congress, aged seventy-one years.

Dr. J. T. Bottomley, F.R.S., for many years Arnott and Thomson demonstrator (experimental physics) in the University of Glasgow, and the author of elementary text-books on dynamics and hydrostatics and of papers on the thermal conductivity of water, permanent temperature of conductors, etc., on May 18, aged eighty-one years.

Prof. L. A. Herdt, professor of electrical engineering at McGill University, Montreal, and president of the Canadian National Committee of the International Electro-technical Commission, aged fifty-three years.

News and Views.

IT is gratifying to note that a serious effort is being made in the United States to assist the development of research in pure science, and in that land of dollars, concentrated energy, and munificent benefactors we have little doubt that the scheme adopted by the National Academy of Sciences will meet with the success it deserves. The general purpose of this scheme is "to increase and strengthen American contributions to the mathematical, physical, and biological sciences by the creation of a national fund to aid skilled investigators." Universities and other higher institutions will be expected to co-operate by assuring complete sympathy with research, by relieving the professoriate from the excessive demands of teaching and administration, and by providing all necessary laboratory accommodation and facilities. The endowment fund which has now been launched, and by means of which it is hoped to raise twenty-five million dollars, will be controlled and administered by a board of trustees consisting of Mr. Herbert Hoover, as chairman, and twenty-five well-known public men, including some of the foremost scientific workers. In a brochure recently issued by the National Academy of Sciences, the trustees declare their conviction that the funds at present available for the support of research in pure science are far below what the population, education, and material resources of the country demand. The United States already occupies a leading position in industrial research; it should rank with the most enlightened nations in the advancement of pure science.

RUSSIA affords a field for research in so many important branches of knowledge that any indication of a revival of interest in scientific matters among her people is of more than local moment. Under the Empire the study of the archæology, ethnology, and cultural history of the vast territory included within its boundaries was actively pursued, but unfortunately the results were not made widely known. Publication was much delayed, and comparatively little appeared in languages other than Russian. It is possible that under the Soviet Government conditions may be changed. It would appear at any rate that there is a strong desire to encourage the continuation of the scientific work which was carried on under the old regime and even to extend it. As an example, we may mention the development of the regional survey. The extent to which this form of activity has been encouraged and the proportions it has now assumed are described in a paper by Prof. P. D. Schmidt, of Leningrad, which was read at a meeting held in London in September last to celebrate the tercentenary of the Russian Academy of Sciences, and is now published in the *Sociological Review* for April. The movement began in 1921, when a Congress was held on the initiative of the Academy. A central bureau was organised in January 1922 at Leningrad with a branch at Moscow. By March 1923 there were 231 societies with 285 museums, 21 biological stations, and 16 natural reserves or parks, and in June 1925 it was estimated that there were more than a thousand institutions dealing with regional surveys. The museums have proved the most successful feature and are very popular among the peasantry; but a great deal of original work has been done in biology, geography, archæology, and the study of local history and culture, and most centres publish a periodical dealing with these activities.

MACHINE design has made during the last century enormous developments and shows no signs of having reached a standstill, but the designer as a rule considers primarily the work to be turned out by the

machine and gives relatively little attention to the operator of the machine. Nor do operators, as a rule, complain when the construction of the machine induces bad posture, inconvenience, or fatigue, for with habit they become acquiescent to an existent state of affairs. The Industrial Fatigue Research Board in a recent report (H.M.S.O., price 1*s.* 3*d.*, No. 36) by Legros and Weston directs attention to this neglect. Investigations have been made into machines used in laundries, leather factories, sheet-metal trades, textile trades, etc., from the point of view of the worker, and it is found that much fatigue and faulty posture might be eliminated by altering the designs somewhat. Suggestions are made for improvements. The Board points out that the work is in a preliminary stage and deals only with a few examples of industrial machines. It is, however, a very important aspect and the report is timely in its insistence that the unit is not the machine but the worker and the machine.

A REPORT on the administration of the Meteorological Department of the Government of India in 1924–25, and a general survey of half a century's work since the establishment of the department, has recently been issued by Mr. J. H. Field, Director-General of Observatories. This is the fiftieth administration report of the India Meteorological Department, and records the completion of the first half-century of systematic observations on weather in India by uniform methods. The retirement of Sir Gilbert Walker, who for some twenty-one years ably directed the policy and work of the department, is an especial feature. During the year the services of cyclone warning to ports and shipping, and of flood warnings to officers in the irrigation, railway, and other departments, were carried out. The period was marked by heavy localised rainfall, causing destructive floods from time to time in various parts of India, but the sea areas were unusually free from severe storms. Upper air work has been carried out in association with Army Headquarters for the needs of artillery and Royal Air Force, and telegraphic forecasts of bad weather were sent throughout the year to these authorities. The probability of closer co-operation with the Royal Air Force as the development of civil and military aviation progresses, is alluded to. Marine meteorology is being actively advanced, and wireless weather messages from ships at sea are used to supplement the coast observations in cyclone-warning work. Rainfall registration is carried out at nearly 3000 stations scattered well over India. The historical survey of half a century's work is of considerable interest.

A PUBLIC lecture on "The Ethnographic Approach to the Native Problem" was delivered by Capt. G. Pitt-Rivers at the London School of Economics, Houghton Street, Aldwych, on Tuesday, May 18. The subject is one on which Capt. Pitt-Rivers is especially competent to speak. His experience of native administration in the Papuan area has given him a clear insight into the difficulties of the native problem, to which he has also devoted close study from the special point of view of the anthropologist. Current events in the Union Parliament of South Africa serve as a reminder that the native problem is an insistent one in any widespread association of peoples such as the British Empire. Those who are most competent to judge and are most closely acquainted with the conditions in British tropical and sub-tropical dominions and dependencies are convinced that the ultimate prosperity of the State and the well-being of the individual are largely dependent upon a fair and sympathetic solution of the problem—a solution which will take account of the mentality and culture of the native populations as well as of the modifications in custom and outlook which have been forced upon them by contact with European civilisation.

BESIDES detailing the work carried out in the Museum itself during 1924, the Report of the Director of the Bernice P. Bishop Museum (Honolulu, 1925) gives an account of several expeditions by sea. A party on the mine-sweeper *Tanager* made a re-survey of Necker and Nihoa Islands, especially of the ancient building sites. The mine-sweeper *Whippoorwill* made two trips: the first to Fanning, Christmas, Jarvis, and Washington Islands, near the Equator in long. 157°-165° W.; the second to Baker and Howland Islands, long. 175° W. Some of the same islands, as well as Malden and Toagareva Islands and Tahiti, were visited by representatives of the Museum on board the *Kaimitoa*, a four-masted schooner with accessory oil-power, as guests of Mr. and Mrs. M. R. Kellum. On these expeditions many ethnological observations were made and large collections obtained for future study in the Museum. A botanical survey of Hawaii and the preparation of a Hawaiian dictionary are among the more important works being undertaken by this active Museum.

ON April 15, according to an announcement of the Smithsonian Institution, Mr. Henry B. Collins, assistant curator of the National Museum, left Washington to explore the tract of the Louisiana coast westward from New Orleans, which was the camping grounds of the Attacopa and Chitimacha Indians, about whom it is stated nothing has ever been written. The Attacopa were one of the few cannibal tribes of the American continent, though it is not known whether the practice was followed for ceremonial or other reasons. The Chitimacha were a people of much higher culture than the Attacopa, and seem to have been related to the Natchez. They had the same caste system, which descended through the mother, and their language was similar to that of the Natchez. Mr. Collins's work will be directed specially to the investigation of the mounds with the view of ascertaining whether they are true mounds or shell heaps. On completion of his work here he will proceed to the Mississippi Valley to continue the work of exploring the Choctaw mound which he began last year.

DURING the past few years there has been much discussion concerning the merits of the Spahlinger

treatment of tuberculosis. This treatment consists in the use of a vaccine, analogous to tuberculin, and of a serum consisting of a mixture of anti-serums prepared with various strains of the tubercle bacillus and other organisms. The Science Committee of the British Medical Association has summarised the known details of the preparation of the agents and of the effects of the anti-serums in the *British Medical Journal* (April 24, 1926, p. 755), and points out that the exact methods of preparation have never been fully published, and that, therefore, the remedy is of the nature of a "secret remedy." It is also pointed out that no investigations, carried out under strict experimental conditions which afford direct and convincing evidence of the curative action of the remedy, have been published.

THE inter-relationship of food, health, and strength is discussed by Sir Arbuthnot Lane in an article in the *Quarterly Review* for April. While fresh air is undoubtedly important, though animals and primitive natives disregard it, right food seems vastly more important to men and animals. Much of our food nowadays is soft, de-vitaminised, de-mineralised, chemically-coloured and preserved, and highly spiced. Failure to use our strong jaws, powerful jaw muscles, and teeth by the consumption of soft stuff, swallowed without chewing, results in the receding jaw, the narrow nose, weak throat, decaying teeth, toxic gums and tonsils. The capacity of the stomach and bowel clearly indicates that man was intended to live on bulky, not concentrated, food. A 'tablet' diet is an absurdity. Only a well-filled bowel readily empties itself; a sluggish bowel means stagnation and putrefaction of its contents and absorption of poisonous products. A far-reaching reform is necessary; we must go back to sound natural food; and this is one of the objects of the New Health Society founded by the writer.

THE extensive development of agricultural planting enterprises in Ceylon during the last hundred years has been accompanied by a voluminous literature, much of which is widely scattered and difficult to trace without undue expenditure of time. This has led to the publication by T. Petch of a "Bibliography of Books and Papers relating to Agriculture and Botany to the end of the Year 1915" (*Peradeniya Manuals*, 3, 1925), consisting of a list of more than five thousand references to the two subjects, exclusive of entomological work. Much care has been devoted to its compilation, and it is believed that the list is almost complete. The literature is classified under subjects, but there is no general alphabetical list of all the references. The bibliography should be of special value to all interested in tropical agriculture and botany, as it is stated that the literature of Ceylon on these subjects provides a mass of information rarely equalled in any tropical country.

MR. HENRY WOODS, of the Sedgwick Museum, Cambridge; Dr. Cyril Fox, Keeper of the Department of Archæology in the National Museum, Cardiff, and Ald. Edward Wooler of Darlington, have recently been elected honorary members of the Yorkshire Philosophical Society.

AN International Congress for Applied Mechanics will be held at the Federal Technical University, Zurich, on September 12-18. Prof. E. Meissner will be glad to receive the names of those who propose to attend. The titles and an abstract (not exceeding 300 words) of any paper offered for presentation at this Meeting should be forwarded to him at the University not later than June 1. Lectures have been promised by Prof. P. W. Bridgman of Harvard, Prof. P. Debye of Zurich, Prof. T. Levi-Civita of Rome, Prof. L. Prandtl of Göttingen, and Prof. G. I. Taylor of Cambridge, among others.

THE report of the National Baby Week Council for 1925, recently received, gives an account of the finance and activities of the Council and the results of the competitions for that year. "Baby week" in Great Britain is being organised this year on July 1-7, and a leaflet instructing how to organise a baby week celebration may be obtained from the Secretary of the Council, 117 Piccadilly, London, W.1.

THE Smithsonian Institution of Washington has in view the preparation of a descriptive account of the plants of all Central America. Dr. Paul C. Standley, botanist of the National Herbarium, has just returned from Costa Rica with a collection of nearly twelve thousand plants, including two thousand orchid specimens. He is now preparing a memoir on the flora of Costa Rica, whilst the Smithsonian Institution is seeking funds to prosecute botanical exploration in Honduras and Nicaragua, two regions as yet very inadequately worked.

THE next award of the Fondation George Montefiore, which is given triennially for the best original work bearing on scientific progress and on the advancement of technical applications of electricity, will be decided in 1927. The latest date for the receipt of competing works is April 30, 1927, and they should be addressed to the Secrétaire-archiviste de la Fondation George Montefiore, Association des Ingénieurs électriciens sortis de l'Institut électrotechnique Montefiore, rue Saint-Gilles, 31, Liége. The prize, which may be divided, will be worth 20,500 francs, and is awarded by an international jury of ten, five of whom are Belgian electrical engineers.

THE German Scientific and Medical Association met in 1924 at Innsbruck; last year there was no meeting. This year the Association meets at Düsseldorf on September 19-26. Preliminary announcements are dated April, and the detailed programme is expected in July. Invitations are extended to all scientific workers and doctors of German speech and to all who appreciate German character and learning. There is also to be an exhibition of hygiene, social welfare, and physical exercises. The general sessions and chief group sessions are already planned. The main topic is scientific research in relation to industry; other matters for discussion are vitamins, capillaries, goitre, non-ferrous metals, noxious animals,

quantitative spectrum analysis, luxury-poisons, synthetic anti-malaria drugs. There are fifteen scientific sections, including physical chemistry, pharmacy, genetics, eugenics, mathematical and scientific education, as well as other titles familiar at the British Association. The medical sections are nineteen in number. Correspondence should be addressed to Büro der 89 Versammlung der Gesellschaft Deutscher Naturforscher und Aerzte, Düsseldorf, Schliesfach, Nr. 66.

THE Italian Ministry of Aeronautics has issued a small *Annuario* for the use of aviators. It contains tables of the rising and setting of the sun and moon and other astronomical information, besides tidal, magnetical, and meteorological information likely to be of value in aviation. The latter half of the book gives the position of wireless stations, wave-length, call letters, and times of transmission of weather bulletins. The book is well arranged in a handy form suitable for ready reference.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A lecturer in philosophy in the University of Liverpool—The Registrar (June 1). An assistant lecturer in engineering at the Cardiff Technical College—The Principal (June 5). A lecturer in mechanical and structural engineering at the Regent Street Polytechnic—The Director of Education (June 7). A reader in mathematical analysis in the University of Leeds—The Registrar (June 9). Lecturers in palæontology, plant physiology, and comparative anatomy in the Egyptian University, Cairo—The Minister of Education, Cairo (June 14). A lecturer in tinctorial chemistry and dyestuffs, and a lecturer in bleaching, dyeing, printing, and finishing at the Manchester Municipal College of Technology—The Registrar (June 21). A lecturer in mathematics at the Northampton Polytechnic Institute, St. John Street, Clerkenwell, E.C.1—The Principal (June 26). A lecturer in biology at the Cheshire School of Agriculture, Reaseheath, Nantwich —The Principal (June 26). A principal of the L.C.C. School of Engineering and Navigation, High Street, Poplar—The Education Officer, (T.1.a.), The County Hall, Westminster Bridge, S.E.1 (June 30). An assistant in archæology in the National Museum of Wales, Cardiff—The Director (July 9). A professor of Indian economics in the University of Madras—The Registrar, Senate House, Chepauk, Madras (July 30). A full-time teacher of physics and electrical engineering at the Leicester College of Technology—The Registrar. A lecturer in geography and nature study at the Bedford Training College—The Principal.

Our Astronomical Column.

SUN'S ROTATION PERIOD AS DETERMINED FROM AURORÆ.—It has long been recognised that auroræ and magnetic storms tend to recur after a synodic rotation of the sun. Mr. G. J. Burns, director of the zodiacal light and auroræ section of the British Astronomical Association, contributes a paper to the March issue of the journal of the Association, in which he discusses the auroræ from 1860 to 1921. When these are grouped in ten-year periods and separated into the four quarters of the synodic period (assumed after Carrington as 27·275 days), the maximum and minimum values shift one quarter of a rotation each ten years, indicating that the rotation period should be increased by 0·02 day. This is quite a small amount, considering the large variations in rotation period in different latitudes. It could be explained by assuming either a slightly different level or a slightly different latitude for the regions of the sun that contribute most actively to visible spots and magnetic disturbances respectively.

THE ROTATION OF VENUS.—The rotation period of Venus is still one of the enigmas of the solar system. Prof. W. H. Pickering in 1921 was led to announce a period of 68 hours about a highly inclined axis. Mr. H. McEwen, director of the Mercury and Venus section of the British Astronomical Association, contributes a paper to the March issue of the journal of the Association, in which he describes some observations that support the Pickering period. Six drawings are reproduced, made between April 9 and 15, 1924; they show several light and dark streaks, which appear to turn about an axis near the centre of the disc. The periods deduced for the different markings varied from 66 to 77 hours. The definition was good on all the days. There is, of course, a large amount of evidence, notably that of Schiaparelli and Lowell, in favour of a longer period. The Mt. Wilson spectroscopic results were considered to indicate 15 days as a minimum. But the problem is such a difficult one to settle, that all evidence by skilled observers should be carefully considered.

MOTION OF SUNSPOTS IN LATITUDE.—A letter received from R. Sekiguti, Imperial Marine Observatory, Kobé, directs attention to a research on the motion of sunspots in latitude of which full details will be given in No. 2 of vol. 2 of the *Memoirs of the Imperial Marine Observatory*, now in press. An analysis of latitude motions of spots was recently published by the Royal Observatory, Greenwich, in *Mon. Not. R.A.S.*, Dec. 1924, in which no systematic drift so large as 0·1° per solar rotation was found, by considering long-lived spots during the period 1874–1923. Mr. Sekiguti, by limiting his analysis to spots of recent formation, considers that during the early phase of their life-history, spots in lower latitudes have an equatorward movement when their longitudinal drift (referred to the average motion of stable regular spots) is westward; *i.e.* in the direction of the sun's rotation. His conclusions are based on the following table from statistics of the last spot cycle:

Daily Motion in Latitude.	Frequency. Eastward.		Westward.	
≧ +0·5°	74		89	
+0·4	58		68	
+0·3	133	657	135	723
+0·2	162		180	
+0·1	230		251	
0·0	361		377	
−0·1	230		264	
−0·2	152		215	
−0·3	149	634	182	890
−0·4	39		89	
≦ −0·5	64		140	

Such motions in latitude, Mr. Sekiguti says, besides throwing light on the properties of a spot vortex, may explain the equatorial inclination of the axes of bipolar groups pointed out by Hale and others.

Research Items.

A TASMANIAN ABORIGINAL SKULL.—A skull of a young Tasmanian aboriginal female discovered on the north-east coast is described by Mr. H. H. Scott, Curator of the Launceston Museum, and Dr. R. McClinton in the *Papers and Proceedings of the Royal Society of Tasmania* for 1925. The skull, which is in sound condition but lacks the mandible, indicates the age by the non-erupted wisdom teeth and the condition of the sutures. The inion is slightly developed only. Of several wormian bones the most striking is a divided "Inca bone." Like some skulls of other lowly races it shows a last relic of the external plate of the old pre-frontal in the "orbital process of the sphenoidal turbinate bone." The palate is a perfect horse-shoe shaped cavity, the lingual aspect of the tooth-line slightly widening as it goes backward, in marked contrast to the straight tooth-line in the gorilla. There are seventeen teeth in the skull, of which fourteen had erupted during life. The third pair of molars was on the eve of eruption. The effect of coarse food has begun to be apparent. Except for an abnormal molar, all the teeth are physically perfect and without structural defect. There are large pulp canals and an absence of bone absorption. The palatal arch of this and four other female and six male skulls available to the authors more nearly resemble the Mousterian outline given by Dr. W. K. Gregory in his "Origin and Evolution of Human Dentition" than they resemble his Tasmanian palatal arch (Keith), though that of an eleventh skull, that of "Cobia," the lowest and most debased Tasmanian native, is more gorilla-like and generally conforms to Keith's figure.

THE JEWISH CALENDAR.—Mr. W. A. Heidel contributes to vol. 61 of the *Proceedings of the American Academy of Arts and Sciences* a study of the Jewish calendar in which he arrives, by different methods, at conclusions virtually in accord with the results of the well-known authority, Dr. Julian Morgenstern. Taking it as axiomatic that the calendar is connected with cultus, there would appear to be three calendars, or preferably three phases of the calendar, in Jewish history. A convenient starting-point is the reform of Josiah in 621 B.C., which aimed at a centralisation of the cultus at Jerusalem, superseding a number of local shrines of primitive usage, each doubtless with different calendars. The first indication of a change in the calendrical system after Josiah is in Ezekiel, who dates his vision of the Temple on New Year's day, the 10th day of the month. This obviously implies an equation between two calendars—almost certainly one solar, the other lunar—the latter being the pre-exilic Israelite or current Babylonian calendar. In like manner the 10th day of a month equated with a first day of some 'New Year,' links up with the Jubilee, the Day of Atonement, Sukkot and Pentecost. The calendar to which the 'first day' belongs is clearly the sacred calendar *par excellence*. The new system of numbering of the months, the neglect of lunation in the Torah, and the Bible, and other considerations also point to a solar year. In all probability it was introduced from Egypt somewhere between 610 and 605 B.C. After the Captivity there is evidence that proximity and similarity to the Babylonians led to the adoption of new festivals and of a luni-solar year, and the calendar of the Reformation was forgotten or misinterpreted. It would appear, therefore, especially in the light of the evidence afforded by the dating for the feast celebrating the Exodus before the Reformation of Josiah, that the Jewish calendar was essentially luni-solar, became solar for a short time after the Reformation of Josiah, and then reverted to luni-solar, although the calendrical arrangements adopted under the solar calendar for the Church year have persisted down to the present day.

HYDROGRAPHY AND PLANKTON AT MILLPORT.—The Annual Report (1924-25) of the Scottish Marine Biological Association on the work done at the Millport Laboratory on the Clyde, drawn up by the executive of the Council, shows a satisfactory progress in all directions. The research carried on by the permanent staff includes hydrography by Mr. A. P. Orr and plankton investigations by Miss S. M. Marshall. Mr. Orr is investigating the Clyde Sea area systematically with regard to the hydrogen-ion concentration and oxygen, nitrogen, phosphate and silicate content throughout the year. Miss Marshall has published elsewhere three papers on her plankton work, including the description of the interesting new dinoflagellate *Protoerythropsis vigilans*, and a systematic study of the food of the copepod, *Calanus finmarchicus*. In the present report she describes the feeding and reproduction of the aberrant silicoflagellate *Ebria tripartita*, which is holozoic, and also gives notes on other members of the microplankton collected in the lochs. She finds that when diatoms and certain small dinoflagellates occur in a loch to any extent, they increase in numbers towards its head, where they may be very numerous. This seems to fit in with the abundance of silicates found at the loch heads, a rapid growth probably taking place where the silicates are poured in from the streams. Mr. R. Macdonald, Carnegie research student, is working on the euphausiids of the Clyde area. A table of the food of *Meganyctiphanes norvegica* during several months includes copepods, diatoms and other algæ besides vegetable debris.

SILICEOUS AND HORNY SPONGES.—Prof. H. V. Wilson describes (*U.S. Nat. Mus., Bulletin* 100, 1925) the siliceous and horny sponges collected by the U. S. Fisheries steamer *Albatross* during the Philippine Expedition, 1907-10. His account is also "something of a guide to the contemporary taxonomy of sponges, more especially of the tetraxonid sponges." He directs attention to the bearing of variations on classification in such genera as Donatia and Tetilla—the problem which meets workers on groups of plastic organisms. In Donatia, for example, the various diagnostic features which have been picked out as characterising natural races all vary, and they vary apparently independently of one another, so that many kinds of combinations come into existence. Moreover, it is not a case of relatively unalterable characters (unit characters) which are present or absent, but any one feature varies so as to produce a series the extremes only of which contrast sharply; thus as the number of carefully studied individuals increases, the intergrading makes more and more difficult the customary method of classification, which is essentially a splitting method. He advocates the formation as sub-genera, not as groups into which all the species of a genus are divided, but rather as groups which are sufficiently homogeneous to be set off from a still heterogeneous remainder. If, therefore, a character or combination of characters is distinctly developed in a particular case the latter would find its place in a sub-genus in the sense proposed, but if such features are absent or not well marked, the specimen would be placed in the body of the genus (*e.g.* Tetilla).

MITOCHONDRIA IN OPALINA.—E. S. Horning (*Australian Journ. Exp. Biol.*, vol. 2, Dec. 1925) has

investigated the mitochondria which are present in large numbers in Opalina at all stages of the life cycle. In the asexual multiplicative phase of Opalina the mitochondria are bent, filamentous bodies and they multiply by longitudinal fission. Immediately before the Opalina encysts the mitochondria may divide transversely, giving rise to spherical bodies which persist in the cyst and in the gametes. In the zygote they appear to fuse into larger masses which later break up into small granules; these in turn elongate to form the filaments of the asexual stage. The author considers that his observations afford strong evidence for the view that the mitochondria are persistent, self-reproducing bodies, and not metabolic products of the cytoplasm, though the latter possibility has not been disproved. Further, he adds that synthesis of vegetative granules—storage products—appears to take place at the surface of the mitochondria, an observation which gives support to the speculation that the mitochondria are loci of protein and possibly of general protoplasmic synthesis within the body of the living cell.

ICE IN THE BALTIC.—The Havsforsknings Institutet of Finland has published the annual report on ice in the Gulf of Bothnia and Finland (*Isarna Vintern*, 1922–23). From about 120 stations, including several on the Finnish coasts of Lake Ladoga, detailed observations are given for the winter months. Not until January did ice become a serious menace. By early February all the Baltic coasts of Finland were blocked and the Gulf of Finland was very congested. By the end of the month pack-ice extended past the Åland Islands across to the Swedish coast, and the head of the Gulf of Bothnia was inaccessible. Conditions were even worse in March, and the spring break-up was very slow. In the beginning of May there was still ice in the north of the Gulf of Bothnia and at the head of the Gulf of Finland. It was June before the former entirely disappeared. These conditions, except the slow disappearance of the ice, did not show a marked departure from the normal, but the winter was on the whole a severe one.

THE PLANT AS A MEASURE OF THE HABITAT.—The discussion of the 'phytometer' method by Clements and Goldsmith was recently referred to in this journal (NATURE, Oct. 31, 1925, p. 656). Two recent papers record South African studies on these lines. Mr. J. F. V. Philips has been using the growth and structure of indigenous tree seedlings, both naturally sown and specially planted in selected quadrats, in order to obtain a quantitative expression of the effect of the habitat (*South African Journal of Science*, vol. 22, pp. 197-214, 1925. See also NATURE, January 2, p. 16). Prof. J. W. Bews and Dr. R. D. Aitken, with the collaboration of advanced students of Natal University College, have issued a second series of the researches on the vegetation of Natal (*Memoir No.* 8, the Botanical Survey of South Africa, Pretoria, 1925), which includes a study of the water requirement and transferation of a common Natal weed, *Bidens pilosa* L. These studies were undertaken with the view that the behaviour of this universally distributed Natal weed under carefully controlled habitat conditions is a necessary preliminary to its employment as a 'phytometer.'

SILVER LEAF DISEASE.—Mr. F. T. Brooks continues at Cambridge his investigations into this serious disease of fruit trees, especially apple and plum, and in association with Mr. W. C. Moore publishes a fifth paper upon the subject in the *Journal of Pomology and Horticultural Science* (vol. 5, No. 2, March 1926). One of the most striking results reported is the almost complete failure of inoculation with spores of *Stereum purpureum* upon freshly cut surfaces of healthy trees in the months of June and July, and sometimes in August. These results are in striking agreement with Mr. Swarbrick's investigations upon the natural processes of healing in such cut trees (NATURE, May 1, p. 635), recorded in the same journal. As Mr. Brooks finds that the disease makes little entry, if any, by old wounds, or through diseased tissues produced by other pathogenic organisms, these results seem to be of great practical significance. Indeed, in discussing treatment, the authors conclude that there is now ample evidence that the winter thinning and pruning of fruit trees is fundamentally wrong from the point of view of plant pathology. The authors report further trials with various protective dressings, applied immediately to cut surfaces. Gas tar and Stockholm tar seem to be ineffective; soft grafting wax is most highly recommended. Apparently its great value lies in the fact that it does not injure the tissues; apart from this danger certain anti-fouling paints appear to be very satisfactory. In view of the inoculation experiments reported in the same paper, it would seem that if the cut surfaces are exposed at a suitable season, natural healing processes themselves are usually an adequate protection against the entry of *Stereum purpureum*.

SUBSIDENCE OF CORAL REEFS.—In the *Proc. Nat. Acad. Sci.*, Washington, for February 1926, Prof. W. M. Davis brings forward additional evidence in favour of the strong subsidence of certain reef-encircled islands. It is argued that during intermediate stages of the submergence of a maturely dissected volcanic island, the distance from the island top to the outer spurs (spur-radius) should be two or three times the distance between the heads of bays and the outer spurs. Some of the embayed islands of the Fiji and Society groups, tested by this new criterion, appear to have subsided 1000 or 2000 feet. Similarly, where the width of the lagoon and the spur-radius are of the same order, the encircling reef must have been built up from a considerable depth. It is also ingeniously shown that the rate of island submergence in the open Pacific is frequently not faster than that of reef upgrowth. This implies that the rate of reef upgrowth is significantly slower than that of coral upgrowth, since the growing corals are the chief source of supply not only for the reef face itself, but also for the reef flat, much of the lagoon floor, and the outbuilding of the outer talus slope. The relation of island subsidence and reef upgrowth to changes of ocean level during and after the glacial period is also briefly considered.

THE AGE OF URANIUM MINERALS.—Analyses of pitchblende from Katanga, uraninite from the Black Hills of South Dakota, and asphaltite from Utah have been made by C. W. Davis, and they are recorded and discussed in the *Am. Journ. Sci.* for March 1926. The Katanga specimen is of particular interest in being quite free from thorium. It therefore helps to confirm the theory that thorium and uranium are not genetically related. The lead-ratio is 0·084, which is identical with that of polycrase from Brazil and with the higher ratios from Ceylon thorianites. The dolomite schists of the southern Belgian Congo are now known to be older than the age corresponding to this ratio, but unfortunately it is not yet certain whether that ratio characterises the older Palæozoic or the latest pre-Cambrian. Determinations on minerals of Keweenawan age now being carried out in the United States should definitely fill up this gap in our present knowledge. The Black Hills uraninite contains lead having an atomic weight of

206·07 (determined by Dr. A. L. Hall of Harvard). The geological age is pre-Cambrian, but the lead ratio, 0·24, is abnormally high. As the specimens are all somewhat altered to gummite and uranophane, the result is in accordance with the view advocated by Holmes, that altered uranium minerals tend to gain lead in greater proportion than they lose uranium (*Phil. Mag.*, May 1926). The asphaltite gives a low age and indicates, as deduced from geological evidence, that the deposit has been carried upwards and redeposited by thermal waters, during which most of the accumulated lead was dissolved and removed.

DIFFRACTION PHENOMENA WITH BIOLOGICAL STRUCTURES.—Adrianus Pijper has demonstrated (*South African Med. Record*, October 24, 1925) that surface growths of various bacteria act as diffraction gratings, and a study of the spectra obtained by means of such 'gratings' leads to the conclusion that bacilli in the culture probably stand on end perpendicular to the surface. By projecting the spectrum obtained into a dark chamber and focussing on a screen, measurements of the circular images may be made which, by the aid of a simple formula, give the size of the structures forming the grating. In this way the diameters of the microbes constituting the grating may be calculated. Blood smears also act as diffraction gratings, and the average size of the blood corpuscles can be calculated in a similar manner. In pernicious anæmia there is an increase in the average size which can be demonstrated by the method, which, therefore, may be employed for certain clinical investigations. Full details of the technique are given.

OPTICAL EFFECTS IN INVERTEBRATES DUE TO GUANIN.—The recently issued *Verhandlungen des Naturhistorischen Vereins der preussischen Rheinlande und Westfalens* (82 Jahrg.) is dedicated by his friends and pupils to Prof. Walter Voigt of Bonn, for many years secretary of the Verein, in honour of his seventieth birthday. It contains a score of zoological papers and three on geological subjects. Two of the zoological papers record the occurrence of guanin in reflecting structures in invertebrates. J. Schlicher describes the tapetum—using this term for the iridescent layer—in the eye of *Pecten jacobæus* as composed of crystalline quadratic plates, about 1·4μ in diameter, which are arranged in superimposed layers and in rows. These plates consist of guanin. He states that the layer contains from three to six cell nuclei of characteristic structure. W. J. Schmidt has examined the iridescent males of two Mediterranean species of Sapphirina, and shows that the iridescence is dependent on the epithelium of the dorsal surface, the cells of which attain a large area but are very thin. These cells secrete the cuticle, and they also produce in their cytoplasm the layer which gives rise to the iridescent effects. This consists of hexagonal plates about 1μ in diameter and 0·3μ thick, arranged in three systems, and they are either composed of guanin or contain a guanin component.

LIQUID VISCOSITY UNDER PRESSURE. — The February issue of the *Proceedings of the American Academy of Arts and Sciences* contains a paper by Prof. P. W. Bridgman of Harvard on the effect of pressures up to 12,000 atmospheres on the viscosities of forty-three liquids, mainly organic, at 30° C. and 75° C. The method used is that of the falling weight, which in this case is a short cylinder nearly filling a steel tube 0·6 cm. internal diameter and about 6 cm. long placed vertically. The time of fall, 5 to 50 seconds, is determined by means of electrical contacts at the top and bottom of the tube, which can be inverted between each fall. Except for water, the viscosity increases with the pressure, at first according to a linear law, but at higher pressures the increase becomes more rapid. The total increase at 12,000 atmospheres may be 10-fold or 10-million fold, the larger values being found for liquids with complicated molecules. The effect of temperature on the viscosity is several times as great at 12,000 atmospheres as it is at 1 atmosphere. The viscosity of water decreases a few per cent. as the pressure increases up to 1000 atmospheres, then increases, and at 12,000 atmospheres has about twice the value it has at 1 atmosphere.

THE LIGHTNING FLASH.—Some fifty years ago a lightning flash was supposed to take place along the path of minimum electric resistance. Afterwards Lodge gave reasons for supposing that it followed the path of minimum electric inductance, and this is the orthodox theory at the present time. In a paper communicated to the Washington Academy of Sciences (vol. 16, p. 87), N. E. Dorsey describes in detail the effects produced by a flash striking a tulip tree. He considers that these effects could have been produced by a great rush of 'carriers' analogous to the well-known cathode stream. If an electron attain a sufficiently high velocity it may generate a 'dart' of electrons, the leading electrons gaining energy at the expense of the trailing ones. A high-speed dart possesses a considerable amount of momentum, and can strike a correspondingly powerful blow. In the particular case studied, the molecules were so crowded that they could not pass transversely to the grain without actually punching out the fibres ahead of them. Along the grain, however, in the direction of the flow of the sap, they could pass much more easily, but in so doing the fibres were torn into shreds.

What happens during a lightning flash Dr. Dorsey describes as follows. There is at first a rush of electrons. These blaze a conducting path along which flows a more leisurely current of the ordinary type. Possibly this conducting current conveys a far larger quantity of electricity than is carried by the dart of electrons. The direction in which the dart flies is the direction in which the blow is delivered. The effects produced where the stroke starts differ characteristically from those produced where it ends.

ELECTRIC IGNITION OF FIREDAMP.—The Safety in Mines Research Board has issued a paper by Prof. R. V. Wheeler on the electric ignition of firedamp which is of considerable interest. The results do not agree with the researches of some other workers in this field, and further experiments are being undertaken in an attempt to reconcile them. It is proved that the igniting current for a given mixture of methane and air varies directly with the volatility of the metal at the spark-gap, being lower the lower the boiling point of the metal. The igniting current also is lower the more rapid the break in the circuit. It is also lower the less the area of the surfaces which touch one another and are pulled apart. Prof. Wheeler was unable to find any simple law connecting the value of the igniting current with the inductance of the circuit. In a particular case, a simple particular law was found which seemed to indicate that the electromagnetic energy stored in the circuit was approximately constant for the minimum igniting current. With highly self-inductive circuits the magnitude of the current is of far greater importance than the impressed voltage when the voltage is low. But with high voltages the igniting current decreases with the voltage. Finally, the experiments seem to prove that the incendivity of the break flashes does not depend on whether the current is direct or alternating.

A Problem in South African Geology.

THE Vredefort Mountain Land lies to the west of Vereeniging and some eighteen miles south-south-west of Johannesburg; it is cut through by the Vaal River, which forms the boundary between the Transvaal and the Orange River Free State. Its striking topography, in marked contrast to the monotonously flat country of the northern Orange River Free State, is determined by an enormous circular boss of granite with some gneiss and schists, about twenty-seven miles in diameter. This granite boss is surrounded by a belt of sediments ranging from the Lower Witwatersrand beds (nearest to the granite) up to the Pretoria beds—in all some 13,000 feet of total thickness. Although in apparently conformable succession, the beds dip towards the granite instead of away from it, as they should do if the succession were normal; so that there is here an inversion of the strata on a very large scale. Near the granite the sediments are highly metamorphosed, the shales and slates being charged with contact minerals. These phenomena constitute a fascinating problem, which has exercised the minds of South African geologists since the earliest days of the Rand.

The granite (a quartz-orthoclase-oligoclase-biotite rock) is generally accepted as identical with the old granite occurring north of Johannesburg and near Heidelberg, and as older than the Witwatersrand beds. It cannot therefore be intrusive in them, and the problem requiring solution is: What brought about the tilting and inversion of the sediments encircling the granite? And what is the cause of the contact-metamorphism shown by them?

The memoir under review [1] embodies the work done by Dr. Molengraaf, professor of geology in the Technical High School, Delft, and Dr. Hall, assistant director of the Geological Survey of the Union of South Africa, to elucidate this problem. The authors first review the various theories put forward in papers by Gibson, Molengraaf, Draper, Bunkell, Hatch, Sawyer, Jorissen, Kynaston, Mellor, and Penny, and then, after a detailed geological and petrographical description of the rocks and their tectonic history, they state their conclusions, which may be briefly summarised as follows:

(1) The granite is older than, and therefore non-intrusive into, the sediments.

(2) The over-tilting of the sediments is due to the up-doming of the central granite, which, it is suggested, was initiated by centripetal pressure. The relief of load resulting from this movement caused a younger magma below the granite to become active and to rise, thus assisting the upward movement of the heated but passive granite.

(3) This up-doming called into play exceptionally powerful pressure which manifested itself both in the metamorphism of the encircling sediments and in the production, by compression, trituration, and local fusion, of a flinty crush-rock (pseudo-tachylyte) which occurs in countless veins both in the granite and in the encircling sediments.

(4) In the contact-belt are dykes of enstatite-granophyre, which contain numerous xenoliths of crushed quartzite derived from the Lower Witwatersrand beds. It is suggested that this apparently igneous rock is a flinty crush-rock originating from ultra-trituration and partial fusion of the sediments.

(5) The metamorphism of the sediments was, in part, *regional* and due to static pressure, accompanied by heat, and, in part, *local* and due to the emplacement of a large younger intrusion.

(6) The regional metamorphism is characterised by the production of hornblende-granulite and garnet-amphibole-hornfels; the local metamorphism, by cordierite-biotite-hornfels and andalusite-biotite-hornfels. Where the two are concurrent the reinforced metamorphism is indicated by the increased size and abundance of the contact-minerals.

(7) The younger intrusion, referred to in (5), is, to a great extent, concealed, although exposed as three small bosses of alkali-granite (soda-granite) and accompanying nepheline-syenite dykes. Certain gabbroic marginal intrusions in the older granite and the nearest belt of sediments are regarded by the authors as the earliest basic differentiates of the younger magma.

(8) The extension of the nepheline-syenite dykes northward across the Magaliesberg into the Pilandsberg (also a region of alkali-rocks) indicates the existence of channels of communication between the two centres of alkali-rocks and some community of origin with the Bushveld complex.

The Vredefort Mountain Land has, according to the authors, remarkable analogies with the Black Hills dome in Dakota and the Ries Kessel in Bavaria. In the Vredefort area the up-doming movement originated at a greater depth than in the Black Hills dome; and this explains why the regional and contact metamorphism are so much more developed in the Vredefort area. Stress phenomena are much in evidence both in the Vredefort and the Ries domes; but in the former they attain a marvellous development, culminating in the genesis of flinty crush-rocks on a gigantic scale. In all three cases the observed facts lead to the surmise that a hidden mass of igneous magma must be present below the central core of granite.

F. H. HATCH.

[1] "The Vredefort Mountain Land in the Southern Transvaal and the Northern Orange Free State." By Dr. A. L. Hall and Prof. Dr. G. A. F. Molengraaff. Shaler Memorial Series. (Verhandelingen der Koninklijke Akademie van Wetenschappen te Amsterdam (Tweede sectie), Deel 24, No. 3.) Pp. xiv+183+39 plates. (Amsterdam: Koninklijke Akademie van Wetenschappen, 1925.) n.p.

Sunspots and Terrestrial Magnetism.[1]

FOR a long time it has been known that sunspot frequencies have had their counterpart on the earth in the disturbances exhibited by the magnetic elements on its surface. As the sunspot period is at least eleven years, and as the variations in sunspot phenomena in successive eleven-year periods are considerable, it follows that to get a comparison of normal means free from accidental effects, a large number of periods must be taken. The Kew magnetographs have been in almost continuous operation since 1858, and the connexion between sunspots and the absolute daily range of declination (the element most easily measured), for the first 42 years of their progress up to 1900 has already been discussed. The first of the memoirs under notice treats of the same phenomena and adds another 10 years to the comparison (1). The decade which is under discussion proved generally to be one of small magnetic disturbance and low sunspotted-

[1] Air Ministry, Meteorological Office, London. (1) Geophysical Memoirs, No. 29. *The Absolute Daily Range of Magnetic Declination at Kew Observatory, Richmond*, 1901–1910, by J. M. Stagg. 3s. net. (2) Geophysical Memoirs, No. 30. *Comparison of Magnetic Standards at British Observatories, with a Discussion of Various Instrumental Questions involved*, by Dr. C. Chree. 1s. 6d. net. (Published by the Authority of the Meteorological Committee.) H.M. Stationery Office, London.

ness. Anomalies were disclosed in 1903 and 1909, but were attributed to accidental magnetic disturbance enhancing what would otherwise have been normal years. The application of Wolf's formula, connecting magnetic range with sunspot numbers, also gives a small amplitude of the declination range corresponding to hypothetical zero sunspot numbers throughout the ten years.

Generally speaking, the results obtained are parallel with those for the previous longer series, especially in regard to the annual variation in daily range, and the incidence in the times of daily maxima and minima. The progressive change in time of the maximum daily value of declination was of the same sign, although not attaining the same order of magnitude as was suggested for the earlier periods. Confirmatory evidence is also shown of the 27-day period of recurrence of magnetic disturbance and calm, corresponding with the period of rotation of the sun.

The memoir concludes with a comparison between the inter-diurnal variability of sunspot areas and declination ranges, which does not remove the anomalies of 1903 and 1909. To facilitate examination, the numerous tables are represented diagrammatically. Mr. Stagg is to be commended on undertaking a task involving much tedious measurement of curves and a vast amount of laborious arithmetic.

(2) In order to get a correct idea of local variation and secular change in the components measured in terrestrial magnetism, one must be assured by careful comparison that the differences between individual standard measuring instruments do not confound the issues. Owing to his long experience in testing magnetic instruments, and his intimate knowledge of the standardisation of magnetographs, no one was better fitted than Dr. Chree for carrying out the comparison of the magnetic standards used at Kew, Greenwich, Eskdalemuir, Stonyhurst and Valencia, described in the second memoir. Taking the Kew instruments as ultimate standards, the instruments compared were Kew pattern unifilar magnetometers for measuring horizontal force and declination, and dip circles and inductors for the angle of dip.

Generally a travelling unifilar magnetometer and a dip circle served as intermediaries between Kew and the other stations. According to circumstances, the comparisons, extending in each case to about a week, were effected through direct simultaneous observations with two instruments, or indirectly through the medium of the magnetograph curves. Except at Stonyhurst, where the facilities for 'direct' comparison were rather limited, the differences obtained in declination and dip were trifling, and what might be expected of any two ordinary instruments over such a short period. The differences in the case of horizontal force measurements were more considerable, and no doubt had their origin in the variations of the 'constants' for which corrections have to be applied.

These 'constants' include (1) temperature, and (2) induction coefficients; (3) distribution of magnetism constants (P and Q), and (4) the moment of inertia of the collimator magnet. They have such an important bearing on the results, that the first part of the paper is devoted to a detailed discussion of the considerations which they involve. Temperature and induction coefficients are determined at the initial standardisation of the collimator magnet, and their variations are inappreciable. The 'constants' P and Q vary considerably with time, and the elimination of changes due to accidental causes is brought about by the use of means from large numbers of observations. Owing to attrition through constant use, the moment of inertia of the magnet is liable to decrease progressively, and fairly frequent determinations are desirable. The moment of inertia of the magnet is usually calculated from the mass and dimensions of its inertia bar (which should be a perfectly homogeneous right circular cylinder). Recent measurements of inertia bars at the National Physical Laboratory give the impression that modern methods of accurate measurement of length do not absolutely agree with those of the past, and the question should be investigated further.

After a perusal of the uncertainties liable to be introduced in the corrections applied, one is left with the idea that consistent true values of the horizontal force are hard to come by, but this idea is partly dispelled by an examination of the remarkably consistent base line values of the magnetograph curves obtained at Kew Observatory.

The memoir should prove of valuable assistance to all magneticians, and particularly to any one undertaking a similar investigation in the future.

R. E. WATSON.

The Fauna of the Chatham Islands.

THE Chatham Islands lie 536 miles east of the South Island of New Zealand and belong to that country both territorially and faunistically. They include three chief islands which are very fertile and are inhabited by a few hundred whites and natives. In *Records of the Canterbury Museum*, vol. II, No. 3, 1925, seven out of the ten papers contained in that issue are devoted to various groups of animals occurring in these islands, and chiefly collected by Messrs. Archer and Lindsay.

The Lepidoptera are dealt with by Mr. E. Meyrick, who mentions that forty-three species have now been recorded. Of these, three are domestic insects undoubtedly introduced by the direct agency of man; one species, *Agrotis ypsilon*, is cosmopolitan; six are common to both New Zealand and Australia, but probably are all of Australian origin; twenty-four are New Zealand species; and nine species so far as known are endemic. It is believed that few of the non-indigenous species have found their way to these remote little islands by being blown out to sea, and they have probably taken advantage of human agencies in some way in gaining their entry.

The Trichoptera are described by Dr. R. J. Tillyard, and only three specimens were obtained. Two of these belong to new species that are closely allied to existing New Zealand forms, while the third specimen is of a more interesting character. It is a very remarkable short-winged caddis-fly which is referred to a new genus Chathamia and to a new subfamily of the Rhyacophilidæ, the Chathamiinæ.

Mr. A. E. Brooks discusses the Coleoptera, and remarks that, of the 110 species of beetles previously known from the islands, only twenty-four are represented in the collection made by Messrs. Archer and Lindsay. More than half the species recorded are also common to New Zealand, and only two endemic genera have been brought to light, namely, Thotmus and Hadramphus, both of which belong to the Curculionidæ. The Orthoptera and Dermaptera are very few in number, only six species being recorded by Mr. A. M. Lysacht. These include three species of so-called sand-crickets (Stenopelmatinæ), one of which is endemic; a phasmid *Argosarchus horridus* (White); a cockroach *Zonioploca brunni* (Alfk.); and the earwig *Anisolabis littorea* (White).

Prof. C. Chilton enumerates the Amphipoda and Isopoda, and of the first-mentioned order eight species are now known to occur. Of the Isopoda eight species likewise are listed, and of these the most notable is *Paravireia typicus* gen. et sp. nov. This crustacean belongs to the family Sphæromidæ and is a fresh-water form. A remarkable fact concerning this type is that it is allied to the genus Vireia which occurs in underground waters in Europe. The spiders are discussed by M. Lucien Berland, who adds two species new to science, making a total of twenty species now recorded from the islands. The affinities of these spiders, he remarks, are entirely with New Zealand—they have no affinity with S. American forms.

Inheritance of Induced Melanism in Lepidoptera.

J. W. H. HARRISON and F. C. Garrett (*Proc. Roy. Soc.*, B, vol. 99, p. 241, Feb. 1926) record the results of some eight years' observation and experiment upon the inheritance of melanism induced in Geometrid moths by the addition of lead and manganese to their diet. The increase of melanism among various Lepidopteran species in industrial districts of England and the Continent has excited the attention of the field naturalist and the general biologist for some time, and in 1920 Dr. Harrison made the suggestion (*Journ. Genetics*, 9, 3, p. 195) that the increase in melanism was due to the modification of the body pigments through various salts deposited on the food plants in areas where the atmosphere is charged with smoke.

This suggestion was submitted to experimental verification, and the result is the most unequivocal proof which has yet been obtained of the inheritance of an experimentally induced modification. Individuals of three species, *Selenia bilunaria* and *Tephrosia bistortata* and *crepuscularia* were used. Normal (non-melanic) individuals were obtained from rural districts of the south of England. Some of them were kept as controls on normal food and, though bred for several generations, showed no melanism. Others were submitted to experimental conditions, the *S. bilunaria* individuals being fed on hawthorn treated with lead nitrate and manganese sulphate, the *T. bistortata* being fed on roadside hawthorn gathered in an industrial district (north Durham) where there is an abundance of wild melanic forms. In both cases melanism appeared in the experimental animals, and was inherited in *S. bilunaria* and *T. bistortata* as a Mendelian recessive, in *T. crepuscularia* (p. 245) as a dominant.

The technical procedure in these experiments seems to leave no room for criticism; though we would like to hear the author's views as to why in certain cases (pp. 245 and 246) the number of animals which are experimentally modified is so low (22 : 1, 26 : 1, and 29 : 2). Further experiments are contemplated with the view of discovering the active agent which produces the colour change, the authors expressing a doubt as to whether it may not be the acid radical of the compounds employed instead of the metal.

A Journal of Marine Investigations.

THE recent issue of the first number of the *Journal du Conseil* marks the start of a new and welcomed venture in publication by the Conseil permanent international pour l'exploration de la Mer. British readers in particular will find pleasure in the fact that Dr. E. S. Russell, the Director of Scientific Fishery Investigations of the Ministry of Agriculture and Fisheries, has undertaken the difficult task of editing this important work. The *Journal* will, it is hoped, appear quarterly, each number containing a general article on some aspect of the Council's work, one or two short scientific articles such as have hitherto been published in the *Publications de Circonstance* (which series will now be discontinued), notes on current work, reviews, and a current bibliography. The first number is a noteworthy commencement. The general article is written in English by Prof. Johan Hjort on "Fluctuations in the Year Classes of Important Food Fishes," and a résumé in French follows. The scientific article, also in English, on "The Relation between Cod-end Mesh and Size of Fish Caught" describes some preliminary experiments with the Trouser trawl, and should be of especial interest to the practical men of the trawling industry.

Thirteen papers in all are reviewed, the name of the reviewer in each case being given. It will probably be noticed that twelve of the thirteen papers reviewed were published in English, and of these nine were written by British investigators. Moreover, only two of the reviews were prepared by Continental writers. Many readers would be greatly assisted in their work if it could be found practical to include reviews of papers appearing in languages which are generally unfamiliar. If, also, the list of reviewers could be made to include representatives of the several nations interested in the work of the Council, a great store of experience and thought would become available to the readers of the *Journal*.

Part i. of a selected bibliography of marine bionomics and fishery investigation, compiled by Dr. E. J. Allen, will be generally welcomed. Part ii. is to appear in the second number of the *Journal*, and it is proposed to re-issue the bibliography, when complete, as a separate publication. Starting with No. 3 of the *Journal* the current bibliography will be issued to subscribers in the form of sheets printed on one side only, as well as being printed in the *Journal* in the ordinary way.

University and Educational Intelligence.

CAMBRIDGE.—The effects of the general strike were very marked. The Council of the Senate naturally made no recommendation as to the course which persons *in statu pupillari* should adopt. A tutors' committee dealt with instructions to those who wished to volunteer for service in various capacities; unfortunately, this committee gave instructions before an adequate organisation capable of dealing with masses of volunteers had been created. The result was semi-chaos, reminiscent of the early autumn of 1914.

The University ceased to give formal instructions between May 9 and 16. All triposes have been postponed, some for a week and some for a fortnight. As a result of this scheme the carefully devised plan on which the examinations are usually arranged in space and time has been dislocated, and the Board responsible for the organisation is faced with the prospect of providing for some 2000 candidates for university examinations on certain days (1600 is usually regarded as the maximum).

EDINBURGH.—At the meeting of the University Court on Monday, May 17, an intimation was received from Prof. B. P. Watson, professor of midwifery and diseases of women, of his intention to resign upon his appointment as professor of obstetrics and gynæcology in Columbia University, New York. The Court received his intimation with regret.

LEEDS.—It has been decided to confer the honorary degree of D.Sc. upon emeritus Prof. P. F. Kendall, following professor of geology in the University.

Dr. F. M. Rowe has been elected to the chair of colour chemistry and dyeing as from October 1 next, in succession to Prof. A. G. Perkin. Dr. Rowe entered the University of Leeds from the Marling School, Stroud, in 1908 with a Clothworkers' Company's scholarship. He graduated with first-class honours in colour chemistry and obtained the Diploma in Dyeing and the Leblanc Medal in 1911. He held the Clothworkers' Research Scholarship for one year and a University Research Fellowship in the following year. After three years' experience with Messrs. Joseph Crosfield and Sons, Ltd., Warrington, he was appointed lecturer in dyestuffs in the University and the College of Technology at Manchester, and in 1926 was appointed reader in tinctorial chemistry and dyeing. He was awarded the Dyers' Company's Gold Research Medal in 1925. He is the author of a number of papers on pure chemistry, coal tar, intermediate products, dyes, and dyeing published in scientific and technical journals, and of articles in Thorpe's "Dictionary of Applied Chemistry." He is also the editor and compiler of the "Colour Index" published by the Society of Dyers and Colourists, Bradford.

LONDON.—The University chair of physiology tenable at the London School of Medicine for Women, now held by Dr. Winifred C. Cullis, will henceforth be known as the Sophia Jex-Blake chair of physiology in the University of London.

Prof. J. A. Fleming, who occupies the University chair of electrical engineering at University College, will retire on July 31 next; the Senate has passed a resolution placing on record its sense of the importance of his achievements in this field of applied science.

A bequest by the late Sir John Rotton of books, bookcases, and bookshelves, and of 500*l.* for the creation of a fund to be known as "The Sir John Rotton Fund" in connexion with the Library of University College, has been accepted.

The following doctorates have been conferred:—*D.Sc.* (*Botany*) on Mr. E. J. Collins for a thesis entitled "Variegation and its Inheritance in *Chlorophytum Elatum* and *Chlorophytum Comosum*," and other papers; *D.Sc.* (*Mathematics*) on Mr. G. C. Steward for a thesis entitled "Aberration Diffraction Effects," and another paper.

In consequence of the general strike, many of the University examinations have been postponed.

Dr. T. F. Sibly, vice-chancellor of the University of Wales, has been appointed Principal Officer in succession to Sir Cooper Perry, who retires on August 31.

DR. W. E. H. BERWICK, reader in mathematics in the University of Leeds, has been appointed to the chair of mathematics at the University College of North Wales, Bangor.

APPLICATIONS for grants from the Chemical Society Research Fund are invited. They should be sent, on a prescribed form, to reach the assistant secretary of the Society, Burlington House, Piccadilly, W.1, by Tuesday, June 1.

THE London School of Hygiene and Tropical Medicine, 23 Endsleigh Gardens, W.C.1, is prepared to consider applications for two whole-time research studentships, one in the Department of Tropical Pathology and one in the Department of Helminthology. Each studentship is of the annual value of 250*l.* The latest date for the receipt of applications by the Secretary of the school is June 30.

Contemporary Birthdays.

May 24, 1855. Dr. Alfred Cort Haddon, F.R.S.
May 24, 1861. Sir Wyndham R. Dunstan, K.C.M.G., F.R.S.
May 24, 1860. Prof. A. Smithells, C.M.G., F.R.S.
May 25, 1858. Sir Henry Alexander Miers, F.R.S.
May 25, 1865. Prof. Pieter Zeeman, For.Mem R.S.
May 26, 1844. Sir Daniel Morris, K.C.M.G.
May 28, 1861. Dr. Hugh Robert Mill.
May 28, 1874. Sir Rowland Harry Biffen, F.R.S.

Dr. HADDON, reader in ethnology in the University of Cambridge, is a Londoner. He graduated at Christ's College, Cambridge. A former president of the Royal Anthropological Institute, he has received its Huxley medal for his services to anthropology.

Prof. SMITHELLS, emeritus professor of chemistry in the University of Leeds, a Lancashire man, was born at Bury. Educated at the University of Glasgow and Owens College, Manchester, he studied also at Munich and Heidelberg. Prof. Smithells' extended and valuable services to the University of Leeds, of which indeed he may claim to be one of the founders, have received special recognition.

SIR HENRY MIERS, vice-chancellor of the University of Manchester (an office from which he is retiring this year), was born at Rio de Janeiro. From Eton he graduated at Trinity College, Oxford. Waynflete professor of mineralogy in the University of Oxford from 1895 until 1908, he vacated this chair to become principal of the University of London. Recently Sir Henry has been elected a trustee of the British Museum.

Prof. PIETER ZEEMAN, foreign member of the Royal Society, was born at Zonnemaire, Holland. He is an alumnus of the University of Leyden, and formerly held there the chair of physics. Thirty years ago Zeeman communicated a paper of prime value to the Academy of Sciences, Amsterdam, entitled "On the Influence of Magnetism on the Nature of Light radiated from a Substance." Later, in its applications to celestial physics, this contribution provided astronomers with methods for tracing magnetic effects at the surface of the sun. In 1902 Prof. Zeeman was Nobel laureate in physics, with Prof. Lorentz; in 1922 he was awarded the Royal Society's Rumford medal for his researches in optics. A medallist last year of the Franklin Institute, Philadelphia, reference may be made to Prof. Zeeman's suggestive address there, "Magnetisation of Spectrum Lines: Reminiscences and Prospects."

Sir DANIEL MORRIS, economic botanist, was born at Loughor, Glamorgan, and was educated at Cheltenham and the Royal College of Science, London. From 1886 until 1898 he was assistant director of the Royal Botanic Gardens, Kew, and afterwards Imperial Commissioner of Agriculture, West Indies.

Dr. MILL, geographer and meteorologist, was born at Thurso. He is a graduate of the University of Edinburgh. Librarian of the Royal Geographical Society, 1892–1900, Dr. Mill is an authority on rainfall data and meteorological statistics in general. He is the author of valuable works on polar exploration.

Sir ROWLAND BIFFEN, professor of agricultural botany in the University of Cambridge, graduated there at Emmanuel College. He has actively pursued (notably in conjunction with the late Dr. W. Bateson) the general problems of heredity and variation in plants, particularly with reference to the breeding of new and valuable races of wheat. Sir Rowland was Darwin medallist of the Royal Society in 1920.

Societies and Academies.

LONDON.

Royal Microscopical Society (Industrial Application Section), April 28.—J. H. G. **Monypenny**: Some microstructural features of modern rustless steel. During the last few years several special types of stainless steel have been developed to meet special requirements. After referring briefly to the characteristic structures of ordinary stainless steel, the effects of raising still further the chromium content was described. The properties of low carbon material containing 16 to 20 per cent. chromium were discussed, particular attention being given to the solution of the carbide, the grain size, and the hardness and toughness of such material. Adding increasing amounts of nickel to such alloys restores to such high chromium steel the capacity for hardening by quenching from high temperatures and of producing tough ductile material when suitably treated. The austenitic steels produced by adding large amounts of nickel to high chromium steels were also described.

CAMBRIDGE.

Philosophical Society, May 3.—Sir Joseph **Larmor**: Insular gravity and oceanic isostasy.—W. A. D. **Rudge**: A mechanical model of the Rutherford-Bohr atom. An attempt is made to show that a rotating electron or electrons can map out a portion of space which represents the volume of the atom. This is effected by using for the electron a small electric lamp, which may be made to rotate about two axes simultaneously. Owing to persistence of vision, the track of the moving lamp appears as a continuous line, mapping out a spherical or ellipsoidal figure somewhat resembling a hollow globe with luminous lines for the meridian of longitude. A second lamp indicates the position of the nucleus. In another arrangement vacuum tubes are arranged in a plane, and by rotating about an axis parallel to the plane, the anode glows of the tubes are concentrated at the centre of a spherical space, and the cathode glows are distributed in the space surrounding the centre. This realises the usually accepted structure of the atom.—Miss C. A. **Scott**: On the higher singularities of plane algebraic curves. Expansions can be used to prove the numerical relations for singularities without any reference to small quantities. This is based on the theorem that if the lowest terms in $F_1(x, y)$ and $F_2(x, y)$ are of degrees r and s, then the conditions for $rs+q$ O-solutions of $F_1=0$, $F_2=0$, involve only the first q groups of terms in each, here proved by examination of the resultant of F_1, F_2. By means of this it is shown that for determining the number of O-solutions either F may be replaced by a factored form. This factored form is then applied to the proof of Plucker's equations; in particular, the number of intersections of a curve and its Hessian, at a higher singularity, is found by a direct process. No use is made of power-series and convergence.—J. A. **Ratcliffe** and M. A. F. **Barnett**: On the attenuation of wireless waves in short distance overland transmission. The attenuation of wireless waves of wavelengths 1600 m. and 360 m. has been measured over land up to distances of 70 miles. The results, on the whole, confirm the theory worked out by Sommerfeld, but departures from the theory are noticed at short distances. The value 10^{-8} E.S.U. is deduced for the resistivity of the ground.—Ž. **Marković**: Sur la non-existence simultanée de deux fonctions de Mathieu.—C. G. F. **James**: On the multiple tangents and multisecants of scrolls in higher space.—E. V. **Appleton**: On the diurnal variation of ultra-short-wave wireless transmission.—R. **Vaidyanathaswamy**: The (2, 1) correspondence.

DUBLIN.

Royal Irish Academy, May 10.—J. **Doyle**: Observations on the staminate cone of Larix. The vascular strand of the stamen of Larix becomes mesarch distally and develops such an arrangement of transfusion tissue as to support the claim that the tissue itself is, phylogenetically, a modification of centripetal xylem. Evidence from a study of the stamens of Larix and related forms supports the claim that the stamen is not a leaf, but that the primitive stamen of the Conifer and Ginkgo phyla was a radially symmetrical structure, carrying sporangia distally attached, and of a non-foliar, axile, or sporangiophoric nature. This conception allows an easy and direct homology to be drawn between the microstrobili and megastrobili of Conifers, a point of great importance; between the different megastrobilus types themselves; and between both strobili and primitive Palaeozoic forms such as Cordaianthus. Homologising thus directly, living structures with known structures in the Palaeozoic, it renders the brachyplast conception, in any but the most refined form, untenable.—D. R. **Pack-Beresford**: The harvest spiders of Ireland. One of a series of reports submitted by the Fauna and Flora Committee. Twelve species and one variety have so far been discovered in Ireland. Almost all these have a wide range in the country. Only *Nemastoma chrysomelas* seems to be confined to the south-east. The classification adopted is that proposed by Dr. Roewer.—A. W. **Conway**: The dynamics of the spinning electron. A spinning spherical electron rotates about a fixed nucleus. The six first integrals of the equations of motion are obtained without approximation, and the motion is described. The variables are quantised, leading to a type of series term.—A. W. **Conway** and G. **Keating**: Two-electron orbits. Two electrons rotate about a nucleus of charge $+2e$, the law of force between the electrons being that of the inverse cube. Symmetrical orbits of two types are considered and quantised, leading to enhanced series terms of Rydberg type. A supplementary field of force is obtained which will give the series terms of a selected Ritz type for the helium atom and also the proper value of the ionisation potential.

EDINBURGH.

Royal Society, May 10.—A. P. **Laurie**: Modern research on the methods of painting oil pictures as illustrated by the technique of the fifteenth century. The media used by artists are gum-arabic for water-colour painting, size principally for scene painting, the yolk of egg known as the tempera medium, and the three drying oils, linseed, poppy, and sometimes nut oil. The refractive indices of the drying oils are much higher than those of the other media. Brilliancy is largely due to reflection of white light, and as a pigment is immersed in media of higher and higher refractive index, the amount of white light reflected from the surface diminishes and the pigment is deeper and lower in tone. It is therefore impossible to paint in so high a key in linseed or poppy oil as in these other media. As the oil dries and the oil film gets older it turns a brownish yellow and its refractive index increases, causing a lowering of tone in the oil picture. It is therefore necessary for the painter to distinguish between the properties of the opaque and the transparent pigments and use them accordingly.

CAPE TOWN.

Royal Society of South Africa, March 17.—A. **Ogg**: X-rays and crystal structure (Presidential address).—H. O. **Monnig**: (1) On some strongylid nematodes of the African elephant. The specimens were collected

from elephants shot in the Addo Bush, Cape Province. Seven different species were found, of which four are new, namely, *Murshidia brachyscelis*; *Pteridopharynx brevicapsulatus*; *Bunostomum brevispiculum*, and *Bunostomum hæmatum*. (2) Three new helminths. These are (1) *Moniezia pallida* from the horse, (2) *Spirostrongylus australis* from the red kangaroo, and (3) *Cordophilus sagittus* from cattle, koodoo and bushbuck.—A. D. **Stammers**: (1) Some observations on certain pathological changes resulting from inanition. The changes, especially in the adrenals, resulting from vitamin deficiencies in the diet, are discussed. (2) Glycolysis in blood. A discussion of the fate of sugar in the blood after the removal of the latter from the body, and an account of experiments on normal and diabetic blood. (3) On the presence of α-hydroxy-acids in blood. Saccharic and mucic acids are formed by bacterial action in blood preserved *in vitro*; if the latter be inhibited, this oxidation process apparently does not occur.—F. G. **Cawston**: Variations in the shells of *Isidora africana* (Krauss) and closely allied species. It is difficult to divide this genus into species by the appearance of the shells, and the radulæ afford no better means of determining the species.—Sir Thomas **Muir**: Hadamard's approximation theorem since 1900.—Edith L. **Stephens**: A new sundew—*Drosera regia* (Stephens) from the Cape Province. This plant requires a moist and comparatively cool atmosphere such as is provided by the south-east cloud at the height of 3000 feet, where it flourishes. Possibly this may be connected with the very copious secretion of the tentacles, which is so viscid as to snare even grasshoppers and small beetles. It belongs to a section (Psycophila) hitherto unrepresented in South Africa. Its appearance is striking, a long peduncle, topped by a cluster of conspicuous pink flowers, being surrounded by linear leaves a foot or more in length.

WASHINGTON.

National Academy of Sciences (Proc. Vol. 12, No. 3, March 1926).—Carl **Barus**: Resonant acoustic and electric oscillations released by the relatively slow spring break.—William **Duane**: On the reflection by a crystal of its own characteristic radiation. Irregularities in the ionising current produced by the reflection of X-radiation (from a molybdenum target) by a crystal of potassium bromide have been observed which correspond to the bromine *K*-series lines. The increase, at any rate at the $K\alpha$ line of bromine (second order), seems to be due to an increase of fluorescent radiation at these points caused by slight imperfections of the crystal.—S. K. **Allison**: Note on the 'selective reflection' of X-rays by crystals of potassium bromide. The curve on which the preceding paper is based shows that a slight excess of radiation occurs only where reflection of the bromine $K\alpha$ line in the second order would be expected.—Robert S. **Mulliken**: (1) Systematic relations between electronic structure and band-spectrum structure in diatomic molecules (Part 1). The occurrence of features of band spectra can be explained on certain postulates. The first of these is that the electronic state of every molecule can be characterised by a term-designation associated with an electronic quantum number identical with Sommerfeld's atomic inner quantum number for the given term-type. (2) Part 2. The ZnH, CdH, and HgH molecules and their spectra. (3) The electronic states of the helium molecule.—Lee A. **DuBridge**: Variations in the photo-electric sensitivity of platinum. A platinum strip was heated for various periods in a vacuum and exposed to radiation from a quartz mercury arc lamp. For short or long heating periods, the photo-electric current decreases with temperature to a definite minimum which is not changed by prolonged heating or by further baking and out-gassing of the containing tube.—G. E. M. **Jauncey** and A. L. **Hughes**: Radiation and the disintegration and aggregation of atoms. A detailed statement of the arguments of a letter in NATURE of February 6, p. 193; $\lambda = 0{\cdot}0018$ Å.U. is corrected to $\lambda = 0{\cdot}00043$ Å.U.—Richard C. **Tolman** and Richard M. **Badger**: A new kind of test of the correspondence principle based on the prediction of the absolute intensities of spectral lines.—Roscoe G. **Dickinson** and Miles S. **Sherrill**: Formation of ozone by optically excited mercury vapour. Ozone is formed when oxygen at atmospheric pressure is passed over mercury and exposed to radiation from a water-cooled mercury lamp. Radiation of wavelength less than 2000 Å.U. was filtered out. Activated mercury atoms can give up energy to oxygen molecules as well as combining with it to form oxide.—George **Glockler**: Diffusion of electrons. The number of collisions which an electron makes in traversing a layer of gas, when the electron is not acted on by a field, is independent of its velocity and equal to $3a^2/2\lambda^2$, where a is the distance traversed and λ is the mean free path of the electron.—Lilian V. **Morgan**: Correlation between behaviour and shape of a chromosome.—Leonell C. **Strong**: The genetic basis of susceptibility to tissue transplants. Two relatively homozygous races of mice were used, in one of which a transplantable tumour showed progressive growth while the other race was resistant. The races were crossed and eventually synthetic races were selected which were susceptible and non-susceptible respectively, thus reproducing the original significant genetic constitution. Two factors seem to be concerned in producing susceptibility.—Joseph Miller **Thomas**: On various geometries giving a unified electric and gravitational theory. Einstein's new equations can be obtained by direct generalisation of his earlier equations of the gravitational field.—Sophia **Satina** and A. F. **Blakeslee**: (1) Studies on biochemical differences between (+) and (−) sexes in Mucors. (2) A preliminary report on the Manoilov reaction and other tests. Races of Mucor differ biochemically even when of the same sex; the (+) and (−) races show significant average biochemical differences, the (+) corresponding to the male of higher animals and the (−) to the female. (2) Biochemical differences between sexes in green plants. Average sex differences were found in respect to the Manoilov reaction, colour of leaf extract, presence of oxigenase, peroxigenase, and total acidity. (3) The Mucor parasite Parasitella in relation to sex. *Parasitella simplex* is a Mucor usually parasitic on other Mucors, when it forms galls. There may be some sex-relation between parasite and host.—Cecil D. **Murray**: The physiological principle of minimum work (1). The vascular system and the cost of blood volume. Calculations from the equations of flow through cylindrical tubes and the assumption of maximum economy of work, give values for the 'cost' of blood which accord well with the energy requirements of active tissues of the body. This 'cost' seems to be operative in determining conditions in the vascular system.—Curt P. **Richter**: The significance of changes in the electrical resistance of the body during sleep. Measurements were made of the resistance from hand to hand to an imperceptible electric current. During sleep the palm-to-palm resistance increases markedly, and this increase is some measure of the 'depth' of sleep, being very marked for heavy sleepers. On awakening gradually or suddenly, the resistance immediately becomes normal. Resistance measured between the backs of the hands increases a little where the sleep is tranquil and decreases with restless sleepers, possibly while dreaming. Patients in catatonic stupors resembling sleep do not show these characteristic changes of resistance.

Official Publications Received.

Svenska Linné-Sällskapets Årsskrift. Argång 9, 1926. Pp. vi+154. (Uppsala.)

Union of South Africa. Report of the South African Museum for the Year ended 31st December 1925. Pp. ii+15+2 plates. (Cape Town.)

The Physical Society of London. Proceedings. Vol. 38, Part 3, April 15. Pp. 169-275. (London: Fleetway Press, Ltd.) 6s. net.

The Peabody Museum of Natural History. Bulletin 1, No. 1: Addresses delivered on the Occasion of the Dedication of the new Museum Building, 29 December 1925. Pp. 38. (New Haven, Conn.: Yale University.) 25 cents.

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 14, Part 3: On the Differences of the Physico-chemical Properties of the Protein, Oryzenin, as found in Glutinous and in Common Rice. By Tetsutaro Tadokoro, Yukihiko Nakamura and Shukichi Watanabe. Pp. 129-169. Vol. 15, Part 5: Studies on the Apple Rust caused by *Gymnosporangium Yamadae* Miyabe. By Teikichi Fukushi. Pp. 269-307+plates 17-20. (Sapporo.)

Proceedings of the Cambridge Philosophical Society. Vol. 23, Part 2. Pp. 103-190. (Cambridge: At the University Press.) 7*s.* 6*d.* net.

Shirley Institute Memoirs. Vol. 4, 1925. Pp. vii+182+iv. (Didsbury, Manchester.)

Ingeniorsvetenskapsakademiens Handlingar Nr. 47: An Investigation of the Fatigue of Metals due to Locally Concentrated Stresses. By Ragnar Liljeblad. Pp. 17. (Stockholm.) 1.50 kr.

Seismological Report of the Apia Observatory, Samoa, 1923 July, to 1924 December. Pp. 9. (Apia.)

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 519: The Preparation of Levulose. By Richard F. Jackson, Clara Gillis Silsbee, Max J. Proffitt. Pp. 585-617. (Washington, D.C.: Government Printing Office.) 10 cents.

British Non-Ferrous Metals Research Association. Sixth Annual Report for the Year ending December 31st 1925. Pp. 36. (Birmingham.)

League of Nations: Health Organisation. Public Health Services in Australia. By Dr. J. H. L. Cumpston and Dr. Frank McCallum. (C.H. 404.) Pp. 65. 1*s.* 6*d.* Cerebro-spinal Meningitis in Prussia in 1923 and 1924. Third (and Final) Report. By Prof. Dr. E. Seligmann. (C.H. 405.) Pp. 43. 1*s.* (Geneva: League of Nations; London: Constable and Co., Ltd.)

Proceedings of the United States National Museum. Vol. 67, Art. 9: Unusual Forms of Fossil Crinoids. By Frank Springer. (No. 2581.) Pp. 137+26 plates. Vol. 67, Art. 21: Studies on the Cyclostomatous Bryozoa. By Ferdinand Canu and Ray S. Bassler. (No. 2593.) Pp. 124+31 plates. Vol. 68, Art. 11: New Fossil Fresh-water Mollusks from Florida. By William B. Marshall. (No. 2612.) Pp. 4+1 plate. (Washington, D.C.: Government Printing Office.)

Smithsonian Institution: United States National Museum. Bulletin 132: Revision of the North American Moths of the Subfamilies Lespeyresiinae and Olethreutinae. By Carl Heinrich. Pp. v+216+76 plates. 75 cents. Bulletin 133: Observations on the Birds of Argentina, Paraguay, Uruguay and Chile. By Alexander Wetmore. Pp. iv+448+20 plates. 65 cents. (Washington, D.C.: Government Printing Office.)

Cornell University Agricultural Experiment Station. Bulletin 443: The Marketing of Cabbage. By E. G. Misner. Pp. 137. Bulletin 444: The Climate of New York State. By R. A. Mordoff. Pp. 38. Bulletin 445: A Preliminary Survey of Milk Marketing in New York. By L. J. Norton and Leland Spencer. Pp. 51. Bulletin 446: Index Numbers of Freight Rates and their Relation to Agricultural Prices and Production. By Harry S. Gabriel. Pp. 37. Bulletin 448: Root and Crown Injury of Apple Trees. By H. E. Thomas. Pp. 9. Memoir 96: Interspecific Transmission of Mosaic Diseases of Plants. By Karl Hermann Fernow. Pp. 34. (Ithaca, N.Y.)

Aeronautical Research Committee. Reports and Memoranda, No. 991 (Ae. 202): Full Scale Determination of the Lift and Drag of an Avro Type 504 K at large Angles of Incidence and Comparison with Model Results. By Dr. R. G. Harris and C. Howarth. (A.4.a. Full Scale Work, Aeroplanes-general 122—T. 2067.) Pp. 7+7 plates. (London: H.M. Stationery Office.) 9*d.* net.

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 69: Seasonal Variation in Salinity of Nile Water at Rodah (Giza) with special reference to Alkaline Carbonates. By R. Aladjem. Pp. 11+1 plate. (Cairo: Government Publications Office.) 5 P.T.

United States Department of Agriculture. Department Circular 284: The Sterilization of American Foulbrood Combs. By A. P. Sturtevant. Pp. 29. 5 cents. Farmers' Bulletin No. 1374: Studies of the Pink Bollworm in Mexico. By W. Ohlendorf. Pp. 64. 15 cents. Farmers' Bulletin No. 1477: Preventing Damage by Lyctus Powderpost Beetles. By T. E. Snyder. Pp. ii+13. 5 cents. (Washington, D.C.: Government Printing Office.)

Memoirs of the Department of Agriculture in India. Chemical Series, Vol. 8, No. 2: Investigations on Indian Opium, No. 4. Further Experiments on the Influence of Manures on the Yield of Morphine Content of the Latex from the Opium Poppy. By Dr. Harold E. Annett and Har Dayal Singh. Pp. 23-51. (Calcutta: Government of India Central Publication Branch.) 8 annas; 10*d.*

Union of South Africa: Department of Agriculture. Science Bulletin No. 46 (Division of Chemistry Series No. 65): Co-operative Fertilizer Experiments with Potatoes. By Thos. D. Hall. Pp. 14. (Pretoria: Government Printing and Stationery Office.)

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, St. Kitts-Nevis, 1924-25. Pp. iv+41. (Trinidad, B.W.I.) 6*d.*

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, Antigua, 1924. Pp. iv+19. (Trinidad, B.W.I.) 6*d.*

Proceedings of the Edinburgh Mathematical Society. Edited by Dr. T. M. MacRobert and Prof. H. W. Turnbull. Vol. 44 (Session 1925-26), Part 1. Pp. ii+56. (London: G. Bell and Sons, Ltd.) 5*s.* net.

The Rockefeller Institute for Medical Research. Organization and Equipment. Pp. 24+2 plates. (New York City.)

Diary of Societies.

MONDAY, MAY 24.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Dr. M. Wilson and Miss Cadman: The Life History and Cytology of Reticularia Lycoperdon: One of the Mycetozoa.—Dr. H. W. Davies: A Simple Arrangement for Administering Carbon Dioxide to a Patient to Stimulate Breathing (Demonstration).—Dr. C. C. Miller: The Slow Oxidation of Phosphorus Trioxide. Pt. 2—The Production of Phosphorus Tetroxide by direct Oxidation of Phosphorus Trioxide.—*To be read by title only*:—Dr. A. C. Aitken: On Bernoulli's Numerical Solution of Algebraic Equations.

TUESDAY, MAY 25.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—E. Clark: Organic Theories of Oil Origin.

WEDNESDAY, MAY 26.

RADIO SOCIETY OF GREAT BRITAIN (at Institution of Electrical Engineers), at 6.—Capt. P. P. Eckersley: Broadcast Reception (Lecture).

THURSDAY, MAY 27.

LINNEAN SOCIETY OF LONDON, at 5.—Anniversary.

INSTITUTE OF PATHOLOGY AND RESEARCH (ST. MARY'S HOSPITAL), at 5.—Prof. D. P. D. Wilkie: The Functions of the Bile Passages in relation to their Pathology.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—N. R. Evans: Corrosion, Tarnishing, and Tinting of Metals (2).

ROYAL SOCIETY OF MEDICINE (General Meeting), at 5.30.—Sir Jagadis C. Bose: The Action of Alkaloids and Cobra Venom on the Pulse of the Plant and Animal (Lecture).

BRITISH PSYCHOLOGICAL SOCIETY (Joint Meeting of the General Society and the Æsthetics Section) (at Bedford College), at 5.30.—Prof. Alexander: The Creative Process in the Artist's Mind.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Annual General Meeting.

ROYAL AERONAUTICAL SOCIETY, at 6.30.—F. W. Lanchester: Sustentation in Flight (Wilbur Wright Lecture).

INSTITUTE OF CHEMISTRY STUDENTS' ASSOCIATION (London) (Annual General Meeting), at 8.—Presidential Address.

INSTITUTION OF MINING AND METALLURGY (at Geological Society).

FRIDAY, MAY 28.

ROYAL SOCIETY OF MEDICINE (Study of Disease in Children Section), at 5.—Annual General Meeting.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (Annual General Meeting), at 6.

SOCIETY OF CHEMICAL INDUSTRY AND INSTITUTE OF CHEMISTRY (Scottish Sections) (at St. Andrews University), at 6.30.—Principal Sir J. C. Irvine: Polysaccharides (Address).

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8.—Annual General Meeting.

WEST LONDON MEDICO-CHIRURGICAL SOCIETY (at Kensington Town Hall), at 8.30.—Prof. G. Elliot Smith: Vision and Evolution (Cavendish Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir Almroth Wright: Aims and Methods of Therapeutic Research.

SATURDAY, MAY 29.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. Moret: Une Révolution sociale en Égypte vers 2000 av. J.-C.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates and Students' Section) (Annual General Meeting), at 3.—Discussion on Paper by J. G. Taylor on Coal and its Banded Constituents.—Prof. J. Poole: Notes on the Tour in Belgium and Germany (Address).

PUBLIC LECTURES.

THURSDAY, MAY 27.

UNIVERSITY COLLEGE, at 5.30.—Prof. Niels Bjerrum: The New Aspect of Strong Electrolytes. (Succeeding Lectures on May 28 and 31.)

CONFERENCES.

MAY 22 TO 25.

ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS (at Regent Street Polytechnic).

MAY 22 TO JUNE 2.

ITALIAN NATIONAL CONGRESS OF PURE AND APPLIED CHEMISTRY (at Palermo).

MAY 24, ETC.

INTERNATIONAL GEOLOGICAL CONGRESS (at Madrid).

MAY 24 TO 29.

INTERNATIONAL ORNITHOLOGICAL CONGRESS (at Copenhagen).

MAY 25.

INTERNATIONAL SOCIETY FOR THE PROTECTION OF CHILDHOOD (at Rome).

SATURDAY, MAY 29.

ASSOCIATION OF WOMEN SCIENCE TEACHERS (at Northampton School for Girls), at 12.30.

INTERNATIONAL MEETING.

TUESDAY, MAY 25.

INTERNATIONAL SOCIETY FOR THE PROTECTION OF CHILDHOOD (at Rome).