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The Universities and International Relations.[1]

AT a meeting of the British Academy held on February 25, Lord Balfour, Dr. J. W. Mackail, Sir Henry Newbolt, and Sir Rennell Rodd spoke in support of the endowment fund appeal of the British Institute of Florence. The publication of reports of these speeches has attracted general attention to the enormous importance of cultural relations between civilised peoples in view of what is to-day the supreme interest of European civilisation—the establishment of conditions of genuine and enduring peace and goodwill between the nations. Universities are concerned with these relations, first as subjects of study and research, and secondly as responsive to influences which the universities can and do exert on them. It is mainly the latter aspect with which we are at present concerned, but limitations of space prevent more than a passing reference to the influence of vacation courses for foreigners.

Year by year visitors from nearly every civilised nation come to study in British universities. Since 1920 a census has been taken annually in October of students from other countries in the universities and university colleges of Great Britain and Ireland, and it has been ascertained that their total number at that season of the year is between four and five thousand. It has varied but little from year to year. Most of them come at an age at which, whatever its prejudices, the mind is receptive to new impressions. They come eager to learn, many of them hold scholarships awarded on the ground of exceptional capacity for learning, and many assume, after they have returned, leading positions in politics, administration, education, commerce, and industry in their own countries. The character of the impressions they receive is, therefore, a matter of no small importance. A very telling phrase, indicative of the importance of such impressions, was used by a professor of Harvard medical school when, speaking as exchange professor at Berlin in 1912, he described how, owing to his studying in a German university, he had become an "intellectual subject of Germany."

The universities of Great Britain and Ireland receive also from time to time university teachers from other countries. Such visits are generally for the purpose of delivering one or two lectures, and accordingly brief. In the few cases in which they extend over a whole term and the visitor has opportunities of entering fully into the life of the university, as in recent exchanges between

[1] *The Educational Record* (Quarterly Journal of the American Council on Education, Washington, D.C.), January 1925,—article on International Relations, by Dr. D. A. Robertson. "Syllabus on International Relations," by Dr. P. T. Moon (The Macmillan Co., 1925, pp. 276), issued by the Institute of International Education, and to be followed shortly by a companion volume designed to appeal to the general reader as well as the college student. *Documents concernant l'expansion scientifique et universitaire de la France* (Paris, Les Presses Universitaires de France, 1923).

Bâle and Cambridge, Bâle and Manchester, Cape Town and Liverpool, and Harvard and Oxford, they are capable of contributing substantially towards the promotion of good feeling between the countries which they represent.

The number of British students who resort to foreign universities for study and research has not been ascertained. Apart from attendance at summer vacation courses in language and literature, it is probably not large. During the past few years, however, a rapidly increasing flow of British students to the United States has been created by the institution of a number of fellowships and scholarships, notably those of the Commonwealth Fund, and the Laura Spelman Rockefeller, the Frances Riggs, the H. P. Davison, the Jane Eliza Procter, and the Clarence Graff foundations. When these are in full operation they will maintain some seventy British students in American universities.

During the War we were roused to a perception of the importance of fostering cultural relations with other countries. For a time "propaganda" was a word to conjure with, and the things for which it then stood were given a recognised place in our defensive armoury. Plans were worked out in detail for establishing a book distribution depot and a number of institutes in Continental countries, for encouraging the study of the English language and literature. These plans were about to be put into execution when the War came to an end, and, in the general retrenchment of establishments which ensued, they were hastily abandoned as being superfluous in time of peace. With the single exception of the British Institute at Florence, which is entirely independent of Government support, we have no establishments in European countries charged with the duty of diffusing knowledge of British civilisation.

Another war-time plan with similar objectives was devised by Lord Balfour in consultation with the universities of the United Kingdom in May 1918. This plan, for sending a Universities Mission to the United States, did not depend on the creation of any official machinery and was forthwith carried into effect. The missionaries sowed their seed and left it to thrive or perish as might be, bringing back with them a great store of knowledge of American universities, in the acquisition of which they had established many friendly personal relations. The precedent thus set was followed by missions, similar but on a smaller scale, to France and to Belgium in 1919, and a conference of British and Swiss universities at Bâle in 1922.

Although it was no part of the plan for the Mission to the United States to create any permanent organisation, Lord Balfour took the opportunity of pressing upon the universities the desirability of an "organ of expression" which should, among its other functions, represent them in their relations with the universities of other nations. The suggestion bore fruit in the constitution of a standing committee of the executive heads of the universities of Great Britain and Ireland, the existence of which facilitated the organisation of the later missions.

As a result of discussions arising out of the report of the Mission to the United States, a committee of the Universities Bureau was formed for the purpose of promoting interchange between teachers and students of the home universities and those of the universities of the United States and also of other parts of the world. With no funds at its disposal, and no prospect of obtaining any to meet the expenses incidental to such interchanges, the committee could not be expected to achieve much: nor, in fact, did it.

In matters of this kind, countries with autonomous universities are at a disadvantage compared with those in which the universities are controlled by the State, as in France and Italy. In March 1919 the Ministers of Public Instruction of these two countries concluded an agreement for the organisation of exchanges of professors and students "afin de rendre les relations intellectuelles des deux pays plus étroites et de mieux faire connaître de part et d'autre leur développement littéraire, scientifique et pédagogique." Later in the same year, agreements with the Ministers of Public Instruction in Rumania and Jugo-Slavia provided for seconding French professors for service in those countries. Agreements made by the French ministry in 1921–1923 with Belgium, Luxembourg, Poland, and Czecho-Slovakia provided not only for systematic interchange of professors and students and reciprocal recognition of studies, diplomas, and professorial service, but also for the setting up of permanent advisory commissions to ensure constant consultation and collaboration in the domains of scientific, literary, artistic, and pedagogic activity. Grants of money amounting to several millions of francs were obtained from the French treasury for bursaries and for remission of fees to enable foreign students to study in France.

It has been pointed out already that as soon as the War was over, the plans made for establishing British institutes in foreign countries were abandoned, on the ground that their expense was no longer justifiable. In France other counsels prevailed, a higher value being placed on such services. The Ministry of Foreign Affairs, through its Service des Œuvres françaises à l'étranger, and the Ministry of Public Instruction, through its Service de l'expansion universitaire et scientifique, have co-operated with professors and other savants, university councils, comités de patronage d'étudiants, and various associations, in a strenuous and sustained effort to make French culture appreciated by foreigners, an effort financed largely by the State.

Branches of the Office National des Universités et Écoles Françaises have been established in London and New York; the Instituts Français at London, Florence, and Madrid have been maintained, and new institutes opened at Naples, Barcelona, Prague, Warsaw, Sofia, and Buenos Aires; a university mission with 24 professors of lycées and eight professors or lecturers in universities has been established in Rumania.

These establishments have greatly facilitated the interchange of students in various ways. At Prague, for example, the Institute conducted special elementary courses in the French language which enabled lawyers, doctors, engineers, artists, and scientific workers to qualify for French government bursaries. The New York director of the Office National reported in November 1922 that he had placed in the universities, colleges, and schools of the United States as professors of French 115 former bursary holders. During the previous year the number of French bursary holders in American institutions was 62 and the number of American bursary holders in France 60, while 116 students were recruited by the Office for study and travel in France. In 1922 there were 1392 Americans studying at French institutions as compared with 407 at British. The total number of foreign students in French universities that year, excluding vacation courses, was about 6000.

(*To be continued.*)

Looking into Things.

Concerning the Nature of Things: Six Lectures delivered at the Royal Institution. By Sir William Bragg. Pp. xi+232+32 plates. (London: G. Bell and Sons, Ltd., 1925.) 7*s.* 6*d.* net.

TO deal with the "nature of things" as seen by modern physics in a course of six lectures to a juvenile audience is indeed a formidable task, and there are probably few besides Sir William Bragg who could have attempted it with any prospect of success. That success was achieved by the lectures there can be no manner of doubt to any one who had the good fortune to be present. The personal charm of manner of the lecturer and the beauty of his experimental illustrations was a great help, and no doubt many of his audience were carried smoothly along on the stream of his argument, in spite of the fact that the real inwardness of much of it must have been beyond their immediate understanding. The lectures cannot have failed to stimulate a vital curiosity as to the nature of things in some of the young hearers, and may perhaps have laid the foundation of more than one future career to be devoted to the successful deeper delving into that very "nature."

These same lectures, presented in the form of a book, are, however, a much more difficult matter. Cold print has to take the place of the living word, and illustrations, however well done, and descriptions, however clear, can never produce the same effect as actual experiment. To those who have heard the lectures the book must be most welcome as a permanent record in which they can study at greater leisure the facts and ideas put before them. To those reading the book by itself, however, we fear that its contents may prove a little difficult from the "juvenile" point of view. It is, of course, amazing to an older generation how much the more advanced juveniles of to-day are able to assimilate and understand, and possibly to a young mind coming fresh to such a field of ideas there may be less difficulty in following and adopting the writer's line of thought than to an older mind already burdened with many conceptions and some misconceptions. None the less, if one compares the book with the records of similar lectures by Tyndall or Faraday—and it fully deserves such a comparison—it seems to imply a much greater degree of scientific pre-education. To the more mature reader, on the other hand, it offers a delightful presentation of one of the latest developments of physical science in a most agreeable form. The scientific investigator who possesses the somewhat rare gift of lucid and attractive exposition owes a duty to the world to use that gift in order to open up the new fields of discovery to a wider circle, and that duty is beautifully performed in this book.

Broadly speaking, the book deals with the atoms and the ways in which they are arranged or grouped in gases, liquids, and solids. The first chapter deals with the structure and size of the atom, full use being made of the knowledge gained from radio-activity and the ionisation-track method of Wilson. The author takes care to state that the atom cannot be regarded as a hard sphere and describes its "astronomical" construction; afterwards, however, he follows the path of least resistance and speaks and evidently thinks of atoms in terms of spheres having definite sizes—a fiction which, though convenient, is apt to prove very misleading in detail. In the second chapter the nature of gases is discussed, with the aid of many beautiful experiments and analogies, while the third deals with the nature of liquids.

In the remaining three chapters the author comes to his own proper field of research, dealing with the nature of crystals, beginning with the diamond, studying ice and snow, and ending with the metals. Incidentally, however, many other things are touched upon, among them the simpler aspects of the author's own work on the measurement of organic molecules by means of X-rays, which is undoubtedly one of the

most remarkable achievements of that new weapon of physical research. It is not so very long since we still regarded the atom and the molecule as more or less theoretical conceptions the real size and weight of which could only be guessed at roughly. Here we see not only the dimensions and weights of the atoms accurately known, but also their exact arrangement in well-defined crystals as well as in thin layers of complex organic substances such as fats and waxes. The plane diagrams of stereo-chemistry are confirmed and supplemented until we have true three-dimensional models.

Perhaps the only ground for real criticism of Sir William Bragg's book relates to his treatment of the subject of metals and alloys; that particular chapter contains several perhaps minor but unfortunate errors, such as the statement that the addition of nickel to copper does not affect the lattice of copper and does not cause hardening, or that the path of fracture in gold is between the crystals at ordinary temperatures and across them at high temperatures, whereas in reality gold—and all pure metals—normally break across the crystals at all temperatures except within a few degrees of their melting point. A most interesting account is given of the behaviour of crystalline metals under plastic strain, but the reader is left to infer that this was discovered by X-ray methods, whereas it was discovered so long ago as 1899, and there is the further doubt whether it is justifiable to conclude that because X-ray reflections from a thin film of gold show reflections coming from regularly oriented crystals, the film of gold must be entirely or even mainly crystalline. When, however, an author undertakes to deal with "the nature of things" in general, we cannot blame him if he does not prove himself omniscient. The pleasure and profit of the reader—whether juvenile or not—of this book will scarcely be diminished by these things. These readers, and we hope there will be many of them, will share with the scientific world generally a sense of gratitude to Sir William Bragg for having, in this book, done good service in helping to spread the light on "things in general" as physical science now sees them.

British Earthquakes.

A History of British Earthquakes. By Dr. Charles Davison. Pp. xviii + 416. (Cambridge: At the University Press, 1924.) 25*s.* net.

FOR thirty-five years past Dr. C. Davison has made the subject of British earthquakes his own; he has written numerous studies of individual shocks and groups of shocks, and has now collected these, with much additional matter, into a volume which will always be of value to those who are interested in the phenomena which used to be called earthquakes, and will continue to be regarded as such by most of us, though the word has acquired a new meaning in modern seismology. By whatever name they may be called, they are a legitimate subject of study, and in this study Great Britain has taken a prominent place, in spite of the limited opportunities of observation; yet these opportunities are not so scanty as is often assumed, for Dr. Davison enumerates 1175 distinct shocks, of which he has found record, up to the end of 1912, nor are they by any means all feeble ones; in 1185 the "great church of Lincolne was rent from the top downwards," and in the Colchester earthquake of 1884, 1245 buildings of various kinds were damaged.

If any fault were to be found with the work, it is that the interpretation of the facts is, throughout, presented in terms of one particular theory of origin. This is openly acknowledged by the author at the outset, where he states that the methods of investigation made use of are based on the theory that earthquakes are the result of successive steps in the growth of faults. It is always unfortunate when a worker limits himself to one theory; theories, even the most strongly established, are ephemeral, and when their time is come, they pass away into the limbo of oblivion; or, to vary the metaphor, they are tools which the workman must use, but should always be ready to discard when they are no longer the best adapted for the job in hand. In some instances the facts seem to be as readily, if not more easily, explicable by a very different theory from that adopted by Dr. Davison, yet it must be acknowledged that, if he has allowed the theory to colour his interpretation, he has not let it distort his presentation of the facts, and some of these are curious. It is not commonly known that the first recorded observation of rotation, without overturning, of objects, was made in London itself, where two china figures in a cabinet, in Bloomsbury, facing westwards before the earthquake of March 19, 1750, were found turned round to north-east, after the shock had passed. In 1816 the octagonal spire of the county jail at Inverness was broken through at about five feet from the top, and the upper part twisted round so that the angles of the octagon stood nearly over the middle of the sides below. These are instances of vorticose shocks, first brought into prominent notice by the report on the Calabrian earthquake of 1783, observed in nearly every great earthquake since then, and for long a subject of controversy.

The most noteworthy impression produced by an examination of the book is that British earthquakes are characterised by the magnitude of the area over which the disturbance was sensible As in all earthquake catalogues, there are a large number of shocks which only affected areas of a few miles across,

but of the larger ones, in nearly every case, the extent of the disturbed area is markedly greater than is usual, in countries where earthquakes are frequent. To take the case of shocks which attained a maximum intensity of viii° of the Rossi-Forel scale, Dr. Davison enumerates 8 excluding those of early date and imperfect information; of these, in only one case was the disturbed area distinctly less than 50 miles across; the other 7 affected areas of more than 200 and up to nearly 400 miles in diameter. In the case of Italian earthquakes, attaining the same degree of maximum intensity, barely 1 in 20 would affect an area of 200 miles in diameter, and 9 would be limited to less than 50 miles across, the other 10 reaching limits between 50 and 200 miles. No method has yet been published which, in practice, enables the depth of origin to be determined with certainty, but the difference between Britain and Italy, in the extent of country affected by earthquakes of the same degree of maximum violence, shows that the origins of the British earthquakes are, on the average, markedly more deep-seated than those of the Italian.

Many other interesting observations recorded in the volume, which might easily escape notice in a work of its kind, are easy to find, as it is provided with an unusually detailed index. R. D. O.

Psycho-Analysis applied to Children.

Love in Children and its Aberrations: a Book for Parents and Teachers. By Oskar Pfister. Translated from the German by Eden and Cedar Paul. Pp. 576. (London: George Allen and Unwin, Ltd.; New York: Dodd, Mead and Co., 1924.) 24*s.* net.

IN his preface, Pfister, who is a Protestant pastor in Zurich, notes the difficulties inherent in the exposition of the analytical method to the ordinary reader, difficulties caused by the absence of generally accepted data and by the fact that the details of a single analysis would fill a volume. He claims that his vocation and studies have brought to his notice hundreds of mentally tormented persons in whom aberrations of the emotional life in childhood underlay the torment. Yet scientific psychologists have scandalously neglected this important topic, and "when a new and unfamiliar phenomenon like the activity of the unconscious makes its appearance they take to their heels—at least such has been the behaviour of most of the German psychologists."

After a survey of the handling of the problem by philosophers of different epochs, Pfister plunges into a psycho-analytical study of the manifold aspects of love aberrations in children. Freely illustrated by actual examples, this study shows Pfister as able to enter easily into an emotional *rapport* with his subjects, a *rapport* which undoubtedly aids him in obtaining their confidence and co-operation. His accounts of analyses are simply given, and in some cases it is possible clearly to distinguish between the associations of the analysand and the deductions of the analyst—a most important matter for the critical reader. Unless the reader dismisses these accounts as fantastic, they should carry conviction as to the reality of the mental processes concerned in the production of psycho-neurotic symptoms, the variety of which may surprise those unfamiliar with their ramifications: stammering, kleptomania, incontinence of urine, obsessive phantasies, inability to learn a particular subject or to settle down to a career, are a few of the problems that Pfister finds amenable to analytical treatment. Much of the book is devoted to individual cases, which serve to illustrate theoretical principles as they are developed, and the general application of these principles is summed up in the last six chapters, which are easily the most important and most interesting in the book.

Pfister is emphatic in declaring that in every school class there is a notable proportion of children with grave troubles and inhibitions, and that their teachers are in general quite ignorant of how to deal with them. Chapter xxvii. contains common-sense advice as to methods of handling such children, short of analysis, which should help teachers or parents who realise the need for help, but one fears that those who most need it will repudiate the need. The direct application of psycho-analysis to the individual is considered in the next chapter, where Pfister gives what is certainly one of the best popular accounts of psycho-analysis with its aims, difficulties, and limitations. Like most people familiar with unconscious processes, he realises the futility and even danger of "suggestion" when applied without knowledge, but he admits its applicability in certain instances. He shows how Dubois, the chief exponent of methods of persuasion, uses the emotional relationship of patient and physician as a means of alleviating symptoms even when he claims to work upon the intellectual plane. "Auto-suggestion" the author compares with asking a man to lift himself up by his own boot-straps.

There is a tendency to diffuseness and exhortation that may repel some readers, and the translators occasionally betray a lack of acquaintance with English idiom. Perhaps the author goes beyond the popular conception of "love" in making it the basis of the reaction of the individual to his human environment; but many difficulties of the nervous person of any age lie in the inability to come into satisfactory

emotional contact with his fellows, and it is possibly true that the emotion concerned is inseparable from that of love. The book is obviously written by a worker who relies upon his own experience for his deductions; it should be widely read. M. C.

A Mystic Poetess of Ancient Kashmir.

The Word of Lallâ the Prophetess: being the Sayings of Lal Ded or Lal Dîddî of Kashmîr (Granny Lal), known also as Lalêshwarî, Lallâ Yôgîshwâri and Lâlîshrî, between 1300 and 1400 A.D. Done into English Verse from the Lallâ-vâkyâni or Lal-Wakhi, and annotated by Sir Richard Carnac Temple. Pp. xiv+292. (Cambridge: At the University Press, 1924.) 16*s.* net.

KASHMIR, as the author of this erudite work remarks in his introduction, is the home of wise saws and proverbial sayings; and of the latter none are held in higher repute than the Lallâ-vâkyâni, the "Sayings of Lalla," mainly because those sayings, couched in the form of hymns or lyrics, illustrate the Shaiva Yoga form of the Hindu religion on its popular side, and depict by the medium of metaphor and simile drawn from everyday life the actual hopes and fears of the common folk who nominally followed that system of religion and philosophy. Lalla herself, or Lal Ded as she is commonly called, lived in the fourteenth century of the Christian era, and appears to have spent much of her life in wandering about in a nude state, dancing and singing ecstatically. She was, as her verses indicate, a *yôginî* or female exponent of the Yoga discipline associated with the worship of Shiva, one of the two great gods of neo-Brahmanic Hinduism: but while expressing in her life and poems the utmost devotion to this aspect of the Hindu religion, she was influenced to no small extent, as Sir Richard Temple points out, by the ideas and teaching of the Muhammadan saints of Kashmir, chief among whom was Sayyid 'Alî Hamadânî, leader of the Nakshbandî Order of Sûfîs. Though no authentic manuscripts of Lalla's poems now exist, the veteran scholar, Sir George Grierson, has succeeded in collating a tolerably complete text of her verses, which were originally composed in a now obsolete form of Kashmiri and were handed down orally from generation to generation, and it is this text which Sir Richard Temple has translated into English verse.

Apart from the actual songs and their rendering, this book is valuable by reason of the admirable survey of the sources of Lalla's religion and of the theory and doctrine of her faith, which the author has prefixed to his interpretation of her hymns. To those who desire a succinct and illuminating exposition of the growth and nature of the extraordinary medley of magic and metaphysics which we know as Hinduism, Part I. of this work can be confidently recommended, written as it is by one who has steeped himself for fifty years in the history, the antiquities, and the lore of India. Commencing with the Aryan religious instinct, which has a distinctly theistic trend in contrast with the atheistic tendencies of those Asiatic peoples who dwell farther to the East, the author expounds the gradual growth of the Aryan religion and of the old Brahmanic doctrines, which were a blend of "especially developed aboriginal ideas deriving from lands North and West of India with those of aboriginal India itself." He shows how the belief in sacred syllables, *mantras*, and riddles arose, comments lucidly upon the *Upanishads* and the Brahmanic schools of philosophy, and then describes the origin and nature of Buddhism, Jainism, and the Bhâgavat religion, with its great doctrine of *bhakti* or devotion to a personal God, and how the latter joined forces with Brahmanism in its struggle against the atheistic creed of the Buddhist, and so led directly to the identification of the Brahmanic Vishnu with the sole God, Bhagavân. It is observed that Sir Richard Temple dates the death of Buddha "with sufficient certainty" in 488 B.C. There is evidence, no doubt, to support this date; but it is by no means improbable that the date accepted in Ceylon, namely 543 B.C., is correct, particularly as this fits in with the chronology disclosed in the important Hatigumpha inscription of Khâravela, which at quite a recent date has been subjected to close scrutiny by two leading Indian scholars.

In one respect the author's estimate of the influence of Alexander's invasion upon India seems also open to comment. He attributes to the Macedonian conqueror "the teaching of state-craft on a large scale and generalship to the Indian Chiefs." Such Hellenistic elements as can be detected in Indian civilisation were certainly due indirectly to the invasion, but Indian polity and the caste-basis of society remained substantially unchanged, and even in military science Indians showed no disposition to learn the lessons taught by Alexander. The kings of India preferred to go on as before, trusting to their elephants and chariots, supported by hosts of inferior infantry. It was not until the sixteenth century that any leader appeared to repeat with success the shock tactics of the Macedonian cavalry. The date of the Kushân king, Kanishka, accepted by Sir Richard Temple, is likewise questionable, and it seems reasonable now to place that king's accession in the early years of the second century A.D. These, however, are minor criticisms and in no way detract from the value of the author's survey of the influences which moulded Lalla's religious belief. His account of the gradual permeation

of Hinduism by the Tantric doctrines and the often revolting worship of the *Shakti* or Female Energy, of the influence of Southern Indian Vaishnavism and of the great Hindu revival associated with the genius of Shankarâchârya, and lastly of Islam upon the minds of Lalla's age, is fully in keeping with the remainder of his careful explanatory essay, and must be read by those who desire to follow the author's detailed exposition of the Trika philosophy, which Lalla conveyed to the public in the guise of popular hymns.

As to the actual translation of the hymns, Sir Richard Temple has wisely refrained from adhering slavishly to the literal rendering of Lalla's words, but has endeavoured to convey her meaning in English metrical form, which, so far as possible, is modelled on the roughness and irregularity of the original. In order that the reader may lack no aid to understanding the inspired words of the prophetess, he has prefixed to each hymn or poem a brief and complete explanation of its inner meaning. Sir Richard Temple's work, which is printed and produced in a style worthy of the Cambridge University Press, is a valuable addition to the growing library of books dealing with the religious literature of India. S. M. EDWARDES.

Our Bookshelf.

Humanism and Technology and other Essays. By Principal C. Grant Robertson, Sir Thomas H. Holland, Prof. C. H. Desch, Sir Henry Fowler, Prof. F. W. Burstall, Prof. W. Cramp. Pp. 91. (London: Oxford University Press, 1924.) 3*s.* 6*d.* net.

THIS is a brilliant little book and as useful as it is brilliant. The title scarcely does it justice, for the book contains essays dealing with the relations of humanism and science generally and a great deal of admirable good sense on education. The occasion of their composition was a vacation school for engineering teachers held in the University of Birmingham and in Oriel College, Oxford, in the summer of 1923. Mr. Grant Robertson, the Principal of the University of Birmingham, fitly leads off with the most general paper and one of the best things in the book, on "Humanism and Science." The note which he strikes is sustained throughout the volume; both sides of education are needed for the adequate training even of the pure technician. If "humanism" means knowledge of the best that has been thought and felt, how can you omit from the best the finest achievements of the scientific intellect? Conversely, students of science who are to make the best use of their training should have at least such contact with the humanities as is implied in an acquaintance with general history, and in particular with the growth of science in relation to the evolution of human society.

Sir Thomas Holland has a humorous epigram on this point, which must not be pressed too far. "It is not," he says, "separate courses of history and science—a mechanical mixture—that are wanted, but the history of science itself, that is, a chemical compound. Giving two separate doses of two unrelated subjects to act as mutual correctives is equivalent to giving a man a metallic sodium pill with a sniff of chlorine gas, when what he wants is merely a pinch of common salt." Sir Thomas Holland lays great and well-deserved stress on the value of biography in historical teaching, and would like to try the experiment of covering a syllabus of chemistry or metallurgy by lectures on biography alone. Prof. Burstall is still more definite. He points out that physical science, as we know it, is a product of the last two hundred years, and its practical applications of the last century and a half. Hence he would have the student consider the historical aspect of the development of engineering since 1775, the starting-point of James Watt's work.

This would no doubt be excellent for the engineering student during his special training; but we should like to put in a plea for the earlier history of science as a part of his general education before he begins to specialise. F. S. M.

The Properties and Uses of Wood. Prepared in the Extension Division of the University of Wisconsin by Arthur Koehler. (University of Wisconsin Extension Texts: Industrial Education Series.) Pp. xiv+354. (London: McGraw-Hill Publishing Co., Ltd., 1924.) 17*s.* 6*d.* net.

THE author of this book is one of the chief workers in the Forests Products Laboratory at Madison in Wisconsin, which was established by the United States Forest Service in 1910. This laboratory is the largest and best equipped of its kind in the world, and during the fourteen years of its existence has accumulated a large mass of data concerning wood. The work is distributed amongst seven sections—timber mechanics, timber physics, wood preservatives, pulp and paper, derived products (turpentine, tar, charcoal, etc.), industrial investigation, and pathology. The results of the researches at Madison have already led in the United States to closer use of timber, to better manufacturing methods, and to prolongation of the life of wood in service. The enormous saving of material due to new methods will, it is believed, postpone the advent of the timber famine, which seemed a few years ago to be so near at hand.

We are fortunate, then, to have this elementary textbook produced at Madison, as it brings to our notice in a handy volume the more important facts about the properties of wood, and shows us how these properties affect the utilisation of timber. The chapters deal consecutively with the sections outlined above; and a detailed notice of the subjects treated is unnecessary. We may, however, signal some points of interest. The great drawback to the use of wood is its tendency to shrink and swell, from which result warping, checking, case-hardening, and honeycombing in timber, as is clearly shown in the third chapter. The practical devices against these defects are seen in aeroplane propellers, where the wood used retains its shape, although it is subjected to the most varying conditions of atmospheric moisture and temperature. The chapters on modern methods of testing timbers are well done. The U.S. Forest Service recommends, after many tests, the classification of each species of wood into four grades, according to the defects they

contain, and assigns definite working stresses for each grade, as shown in Table xv. of this book.

Air seasoning and kiln drying are dealt with in two chapters. The latter process is becoming more and more employed; and when done properly it shortens the time required and turns out a better product than ordinary air drying. We recommend this book to foresters and to all interested in improved methods of utilising timber and eliminating waste.

Ethnographie von Makedonien. Geschichtlich-nationaler, sprachlich-statischer Teil. Mit einem Trachtenbild. Von Prof. Dr. Gustav Weigand. Pp. iv + 104. (Leipzig: Brandstetter, 1924.) 3 marks.

PROF. WEIGAND is well qualified for his task, and has written an extremely interesting work. He brings out one theory which will be novel to most readers, that the Albanians are not the descendants of the ancient Illyrians, but of the Bessi, a tribe of Thracians referred to by several chroniclers. He considers the former a maritime people, whose centre was in the north and west of the Balkans, where they may be traced in the Morlacchi of Zara, Cici of Istria, where the Latin speech still lingers on, and Venetians, all of whom are connected with the authors of the Messapian inscriptions of southern Italy. He thus makes Albanian the modern representative of the old Thracian language, which occupied a position intermediate between the Slavonic and Iranian groups. He considers that the ancient Thracians became thoroughly Romanised, and, with the exception of the Bessi, forgot their tongue; the fact that Bulgarian, Rumanian, and Albanian, although in no way related, all have a postfixed definite article, unknown in any other Latin or Slavonic tongue, he attributes to the influence of the old Thracian language, and adduces a whole series of analogous occurrences; numerous names of places and of plants are explained as survivors of the old tongue. As an example, we may quote Plovdiv as a Bulgarian corruption of the Thracian Pulpidava.

When dealing with the relations between the Bulgarian, Macedonian, and Serbian languages we feel that the learned author has been influenced, in spite of his disclaimers, by his political sympathies. When, for example, on p. 73 he gives a list of Macedonian words which he states are *never* used in Serbian, he is certainly influenced by his greater familiarity with Bulgarian: all the words he quotes may be heard commonly in Yugoslavia, even in the north and west.

Electrical Design of Overhead Power Transmission Lines: a Systematic Treatment of Technical and Commercial Factors; with Special Reference to Pressures up to 60,000 Volts, and Distances up to 100 Miles. By William T. Taylor and R. E. Neale. Pp. vii + 266. (London: Chapman and Hall, Ltd., 1924.) 21*s.* net.

THE transmission of electric power in bulk over considerable distances has brought into prominence many almost purely mathematical and physical problems, the solution of which is necessary for economical design. Except in the case of abnormal working, the transmission lines are not traversed by high frequency currents or "surges" of electrical energy. It is necessary, however, to know how the resistance and inductance are affected in these cases, and there is a demand, therefore, for mathematical knowledge to simplify and evaluate the requisite formulæ. Considerations of economy also make it necessary to use a very high voltage. But at very high voltages the lines are surrounded with brush discharges which engineers dignify by the name of the "corona" effect. It is essential to know at what pressures these effects begin, and also the power expended in maintaining a corona on transmission lines. It is therefore necessary to know the physics of the phenomenon.

The authors have limited the scope of this volume to the consideration of lines up to 100 miles in length and to working pressures not exceeding 60,000 volts. The introduction of hyperbolic trigonometry is therefore rendered unnecessary. As power systems in Great Britain are included within these limits, at least at present, this book will prove of use in practice. The authors have wisely adopted international notation, and have laid stress on the standards adopted by the British Engineering Standards Association. They give references to practically all the useful literature of the subject.

Air Ministry: Meteorological Office. British Meteorological and Magnetic Year Book, 1916. Part 5: *Réseau Mondial, 1916. Monthly and Annual Summaries of Pressure, Temperature and Precipitation at Land Stations, generally Two for each Ten-degree Square of Latitude and Longitude.* (M.O. No. 227g, Tables.) Pp. xiii + 115. (London: H.M. Stationery Office, 1924.) 22*s.* 6*d.* net.

THESE results are now available for seven consecutive years, 1910–1916, and with the publication of each additional year the data are becoming of increased value for meteorological and physical inquiries. All the information refers to land stations, no data over the sea being as yet directly obtainable. Observations are given for 440 stations, and most of these are under the control of government meteorological services. The results show that the highest mean pressure for the year, at mean sea-level, is 30·19 in. at Barnaoul and Minousinsk in 53°-54° N. 83°-93° E., the lowest mean pressure 29·45 in. is at S. Georgia in 54° S. 37° W. The highest mean temperature was 85°·5 F. at Berbera, Somaliland, in 10° N. 45° E., the lowest 10°·6 F. at Markovo-sur-Anadyr in 65° N. 171° E. The largest rainfall for the year was 486 inches at Cherrapunji in 25° N. 92° E., which is 76·3 in. more than the average, followed by 269 inches at Akyab, 77·6 in. more than the average. No rain was measured during the year at Puerto de Arica or at Iquique, at both of which stations the average annual fall is 1 mm. The only rain expected at Puerto de Arica is 0·04 in. on the average in January, and at Iquique 0·04 in. in July. Notes are given for each month on the state of the ice in the Arctic Seas and in the North Atlantic.

Historical Atlas of the British Empire. Pp. 20. (London: Macmillan and Co., Ltd., 1924.) 1*s.*

A USEFUL cheap atlas with thirty-nine black and white maps of the British Empire. Most are only in outline, but a few show orographical features. The text consists solely of a chronological list of events bearing on the history of the British Empire from 55 B.C. to the present day. A great many facts have been crowded into twenty pages, but the maps are the best part of the book.

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.*]

Hydrography of the *Dana* Expedition.

IT may interest readers of NATURE to know the results of some of the hydrographical investigations carried out by the Danish *Dana* Expedition, under Dr. Johs. Schmidt, in the Atlantic in 1921–22.

These investigations were begun in the autumn of

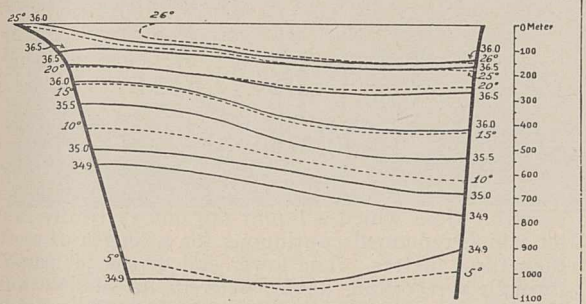

FIG. 1.[1]—Vertical section from Cape Yucatan to Cuba. The dotted curves are isotherms, and the unbroken curves, isohalines.

1921 from the Straits of Gibraltar via Madeira and the Cape Verde Islands to the north-east coast of Brazil; they are of great interest on account of their bearing upon the circulation in the Atlantic.

In the eastern part of the Atlantic, outflowing water from the Mediterranean was found as a characteristic stratum with relatively high temperature, and a salinity maximum at about 1000 to 1200 m., so far south as the Cape Verde Islands (see NATURE, January 12, 1922); in the western Atlantic, on the other hand, a colder water layer was found at a depth of 700-1000 m., with a minimum salinity, showing, indeed, values so low as 34·6 per mille, a stratum originating in the southern part of the Atlantic, and then forcing its way up into the western portion of the north Atlantic.

The section in question intersects the equatorial

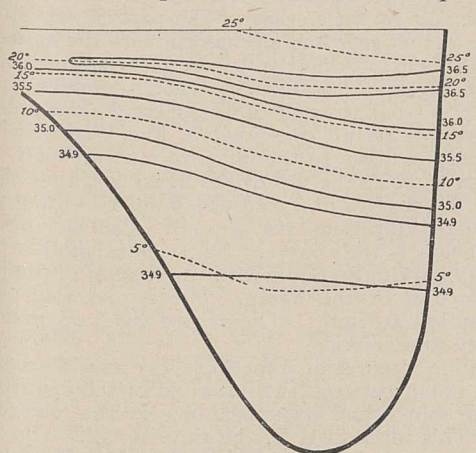

FIG. 2.[1]—Vertical section from Florida to Cuba.

current, which exhibits highly varying salinity at the surface (34-36 per mille); the temperature is high, but decreases rapidly with increasing depth, falling to 10° at a depth of 200-300 m.

[1] All the diagrams are drawn to the same scale.

Part of the equatorial current, with the subjacent south Atlantic water layer, flows into the Caribbean Sea, but the two are here separated by a stratum with high salinity (more than 36·5 per mille) from the Sargasso Sea, which edges in between them at a depth of about 200 m.

These three water layers of different origin flow through the Strait of Yucatan into the Gulf of Mexico, but, as is seen from the sections shown in Figs. 1, 2, and 3, they turn off at once to the eastward along the north coast of Cuba, continuing between Florida and the Bahama Bank. The deflexion due to the earth's rotation causes the isotherms and isohalines to incline to the eastward; the inclination is most pronounced in the Strait of Bemini between Florida and the Bahama Bank, showing that the current reaches its greatest velocity here.

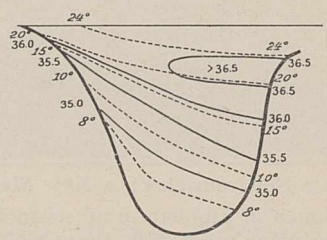

FIG. 3.[1]—Vertical section from Florida to Bahama Bank.

The south Atlantic substratum can still be discerned in the Strait of Bemini, but soon disappears altogether, whereas the two others, namely, the surface layer from the equatorial current and the salt intermediary layer from the Sargasso Sea, form the Gulf Stream or, more correctly, the Florida Current, which flows north-east along the east coast of the United States outside the coast shoal with a velocity probably varying considerably, like the breadth of the current itself, with the season. A value frequently found for the breadth is 60 miles, and the rate of speed may amount to more than three miles an hour.

In a section from Norfolk, Va., towards Bermuda (Fig. 4) the Florida current is sharply defined in the spring, but doubtless becomes somewhat effaced in the course of the summer. In the waters south of Newfoundland, the Florida Current meets the Labrador Current, giving rise to a mixed product with somewhat lower temperature and salinity than are found in the continuation of the Antille Current which

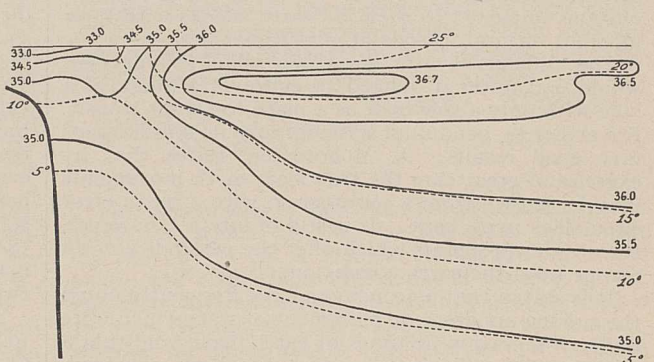

FIG. 4.[1]—Vertical section from Norfolk in a direction towards Bermuda.

runs on the right side of the Florida Current and consists of water masses which keep outside the islands of the Antilles.

Some of the cold water from the Labrador Current flows on toward the south-west, over the coast shoals, and is gradually warmed, but right to the southern

part of the coast shoal the polar origin of the water is still distinctly perceptible.

The mixed product arising from the Labrador and Florida Currents fills the considerable area of sea south of Iceland, while the warm and salt water washing the coasts of north-west Europe is undoubtedly mainly derived from the Antille Current. The term "Gulf Stream" generally employed in European parlance to denote the warm current in the north-eastern part of the Atlantic, must therefore be regarded as inappropriate, since it can only rightly apply to the current off the east coast of the United States, and even this would be better designated by the older name of "Florida Current," as the current in question does not originate in the Gulf of Mexico, but comes from the equatorial region, and covers only the shortest possible distance in the Gulf of Mexico.

A detailed report of the results here summarised will be published in the Journal of the Royal Danish Geographical Society for 1925.

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Absolute Seismometry: a New Method.

THE fundamental problem in all seismometers is to find or devise some observable thing which shall not partake of the earthquake motion. Such a thing is spoken of as a steady point, and the work of a seismograph is to record the position of the steady point relative to the neighbouring earth as a function of time. Unfortunately, most mechanical systems under our observation or control require terrestrial connexion through agencies which inevitably transmit forces, so that steady points are subject to acceleration when their connecting links are disturbed. That is to say, the steady point is steady until the arrival of the earthquake and not longer.

"If one could only be suspended in space near the earth's surface," Hobbs observes, "but without any attachment to it, the problem of registering the earth's motions would be a simple matter. . . .

"The universal and unsatisfactory substitute for the theoretical unattached observation station outside the earth is the inertia of rest inherent in a suspended mass—the bob of a pendulum. . . . All pendulums have natural periods of vibration which are dependent on their length, and except in the most improved and elaborate instruments they inevitably combine the motions imparted to them by earth shocks with their inherent natural periods of vibration."

The difficulties are like those which a surveyor would encounter if obliged to survey the shore of a lake with only a row-boat as a place to set his transit. Nevertheless, pendulum seismographs in skilful hands give good results. A. Mohorovicic states that by exercise of great care the true local earth movements may be known from a seismogram with a mean error so small as 10 per cent. It is still of interest, however, to consider proposals which offer the possibility of an escape from the earth connexion.

It is stated that astronomers have frequently noted the sudden apparent displacement of stars which were under observation at times of earthquake, and that a seismometer utilising this effect has been proposed. Such an instrument would have the advantage of a truly steady point, but, passing over other objections, would have the limitation of sensitiveness only to rotations and not to translations of the earth particle.

The writer has considered using a freely falling body as "steady point." Such an object is not steady in any sense of being stationary, but it is quite detached from local earth features and will not participate in any changes of earth motion that may originate within the period of its fall. It would be better to speak of it as an "independent point."

If a body be allowed to fall from a support which has at the instant of release a horizontal speed V, then after the lapse of time T the body will have departed a distance VT from the vertical containing its point of release. If this departure is recorded by a mechanism which shares the motion of the support, then the recorded departure, X, is given by

$$X = VT - D, \quad . \quad . \quad . \quad . \quad (1)$$

where D is the displacement of the recording mechanism during the interval T. Expressing D otherwise, we may write

$$X = VT - \int_0^T V dt. \quad . \quad . \quad . \quad (2)$$

If a continuous succession of falling bodies be observed, X is a known, continuous function of time and equation (2) suffices to determine V completely.

Rather than a succession of discrete bodies a continuous liquid jet may well be employed, as has been done in the experiments to be described. A table free to move in one horizontal direction carried a reservoir from which a liquid ran out vertically in a jet which remained continuous for a length of more than three metres. The lower end of the jet passed through a recording device wherein its shadow was cast through a horizontal slit upon vertically moving bromide paper. With the rate of motion of the paper known, the resulting trace gave a complete history of the excursions of the foot of the jet when a disturbance was imposed above.

In order to provide a correct record of the imposed disturbance (limited in this instance to linear horizontal oscillations) a metal pointer was arranged before the slit and mechanically coupled to the moving table so as to reproduce correctly its to-and-fro motions. The shadow of this pointer on the photographic paper left the desired record. Appropriate time-signal shadows were also provided.

These experimental conditions differ from those required by equation (2) in that the recording mechanism does not now partake of the motion of the reservoir. The equation of the trace would now be

$$X = s + T\, ds/dt, \quad . \quad . \quad . \quad . \quad (3)$$

where s is the displacement of the reservoir orifice at the instant of the release of the particle which is to arrive at the recording mechanism with the horizontal displacement X. For any series of motions of the source of liquid, two curves should appear on the record, related to each other as are X and s in (3). The sample record presented in Fig. 1 confirms this expectation down to the limits of measurement. The broken trace at the top of the figure is a time-signal, being the shadow of a reed which was executing 10·06 complete vibrations per second. The sinuous line next below is the s curve. Next comes another time-signal, marking seconds, with the shadow of the jet at the bottom of the figure. The sequence of events is from left to right. The record covers a period of twenty-four seconds.

A time interval of something less than a second is to be noted between the initiation of the disturbance at the source and its appearance at the foot of the jet. This interval is T, the time of fall. The slope of the s curve is, of course, ds/dt. Accordingly, if a line tangent to the s curve at any point be produced toward the right until it shall have progressed from the point of tangency a distance T in the direction of the time axis, the ordinate of its extremity should, according to (3), be X. It may be shown from the figure that such is the case.

It was not thought worth the additional trouble to perform a direct test of equation (2). It will be granted at once that a verification of (3) leaves no room to doubt the validity of (2).

Considered as a possible seismographic method, the device presents several interesting features. Two components of motion of a jet are readily registered on one paper through the use of an inclined plane mirror. The apparatus is extremely insensitive to tilts. Its response is to velocity rather than to displacement. The amplitude of the trace may be increased not only by optional magnification but by obtaining a longer time of fall, thus actually increasing the relative movement of the observed mass and its surroundings. As in pendulum instruments, we are dealing here with an inertia seismometer, but it is the inertia of motion rather than of rest which it is now proposed to employ.

When the motion of the source is quite rapid the trace does not obey equation (3), presumably because viscosity prevents the fall from being truly free. Viscosity operates at low speeds too, but without measurable effect on the trace. The traces now in hand were made several months ago. It is thought that the liquid used was unnecessarily viscous (some 300 poises) and the jet unnecessarily coarse. Further work is in progress.

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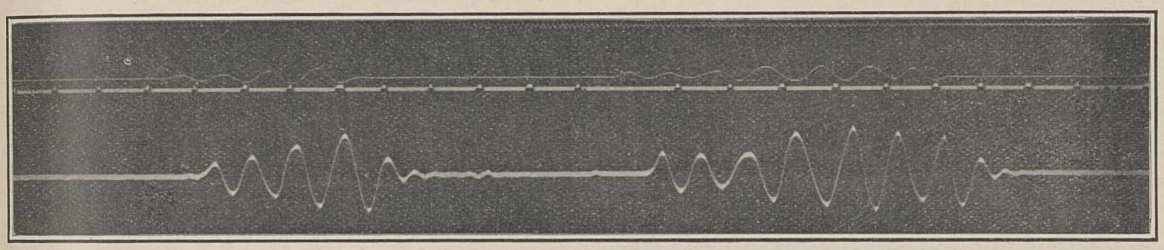

FIG. 1.

The Positive Electrical Drift in the Air.

IF electrostatic measurements are made in the air on a bridge over the permanent way near any railway station, extraordinarily large positive charges given off by steam locomotives will be observed, especially on starting up. These positive charges are carried by the wind for long distances. Under favourable conditions, that is, when the sky was clear and free from interference from clouds, and a stiff steady wind prevailed, I have noticed strong charges down wind a mile away, from a single engine working in a country siding. Scarcely any effect is noticeable in the opposite direction. Similar results, although on a much smaller scale, are observed near steam-driven road engines. They are not noticeable near petrol-driven or electric traction. These charges are presumably similar to those employed in Sir W. Armstrong's hydroelectric machine.

Under any of the large spans covering the railway termini in London, the potential gradient is zero when they are unoccupied. When locomotives are present high potentials are observed.

On some of the bridges over the Thames very high potentials may be observed according to the direction of the wind with respect to railway traffic. At Blackfriars, for example, very strong positive charges are carried by east winds from trains passing to and from Ludgate Hill and neighbouring stations.

With a westerly wind the Cannon Street traffic affects London Bridge, and that on Hungerford Bridge can be felt on Westminster or Waterloo Bridges, according to circumstances.

Of the two factors concerned in atmospheric potentials, that is, "the forces of Nature" and the activities of man, the latter appears to me to predominate in the majority of the daily readings in and near the metropolis. To what extent the former intervene can be deduced only from observations conducted many miles from the drift air from locomotives, steamers, road engines, and doubtless other forms of stationary engines. My own measurements point to the sun as the agent in this case.

The presence of these air-borne charges must necessarily affect the readings at Kew Observatory, surrounded as it is by a dozen stations within a radius of about two miles.

Many readers of NATURE will possess copies of the Royal Society's Handbook of the scientific exhibits at Wembley. In Dr. Chree's admirable article there —a model of popular exposition—curves of the potential gradient at Kew are shown. These curves, with their minima during the early hours of the morning, and their maxima at 8-10 A.M. and 7-9 P.M., would almost stand for traffic intensity curves. The gradient here at Upminster, 17 miles E.N.E. of Charing Cross, when the sky is clear and the wind does not set from the local station, appears to depend principally on London drift air, being very strong with W. to S.W. winds and very slight with easterly ones.

In any case, the distribution and influence of these positive charges deserves the careful attention of meteorologists. During hot weather they appear to be dispersed more rapidly than in cold, for a rising barometer and frost result in unusually high concentrations. These drifting positive charges constitute electric currents—in some circumstances these might give rise to compass irregularities. Their irregular distribution may conceivably be connected also with certain kinds of "atmospherics" in wireless.

WILLIAM C. REYNOLDS.

"Wharfedale," Upminster,
February 11.

THE phenomena of electrification in connexion with steam, to which Dr. W. C. Reynolds refers, are described by Mr. W. A. Douglas Rudge in a paper read before the Cambridge Philosophical Society (Proc., vol. 18, p. 127), and referred to in NATURE of November 18, 1915 (vol. 96, p. 332). The breaking up of water, whether the act of man or of Nature (as in waterfalls), is a powerful source of electrification, but I am unable to accept Dr. Reynolds's suggestion that railway steam may account to any large extent for the early morning minimum and evening maximum of potential gradient recorded at Kew Observatory. If this were the case, the change from steam to electric traction in the local trains should have had a profound influence, whereas the daily maximum and minimum

in question seem as marked now as thirty years ago. Richmond station, moreover, is ¾ mile from the Observatory, and is not in the direction from which the prevailing wind blows. It is not a station where much shunting is done. A minimum in the morning and a maximum in the evening have been observed at most places, town and country alike.

Dr. Reynolds is, however, I think, quite correct in believing that electrical phenomena in and near large towns are much influenced by the works of man. Steam no doubt may play an important part in some localities, but atmospheric pollution by smoke is, I think, a much more important factor. Reasons for this belief will be found in the Royal Society Handbook to which Dr. Reynolds refers.

Undoubtedly a continuous record of potential gradient and other electrical phenomena at some really country place, situated desirably to the south-west of London, is a somewhat urgent desideratum.

C. CHREE.

Experimental Study of the "Soaring" of Albatrosses.

A SERIES of experiments was made by me in Africa in 1920 in order to study the flight of the vulture. Kites were brought into the immediate vicinity of the soaring birds, and carried with them sensitive apparatus, making it possible to find, by means of electrical connexions with registering apparatus on the ground, the variations of internal energy of the air (temperature within 0·02° C., pressure within 0·1 millimetre ; speed, direction, and horizontality of wind variations).

The registrations so obtained showed that in all of the observed cases of flight, the birds used ascending air currents, the origin of which was almost always due to temperature variations ; the ascending air columns often shifting according to the temperature variations. The experiments enabled me to measure (by the relation of the horizontal and vertical speeds of the bird relative to the air) the lift/drag ratio of these birds, which is about eighteen.[1]

The soaring of albatrosses and other sea-birds seemed to be quite different. The French Government accordingly sent me on a mission to the South Seas, in the neighbourhood of South Georgia, to study the flight of these birds. Registering apparatus was made use of, either on board of the ship or at sea, by means of floaters left from the board (to avoid the possible perturbations due to the boat). The variations of the internal energy of the air were so studied, as in Africa, amongst birds. Films taken by an automatic cinematographic apparatus, moved by clockwork, enabled me to find out, by photographic reconstruction, the trajectory of albatrosses and their velocity. (The average speed, relatively to the air, was 22 metres.)

The experiments showed that the soaring of albatrosses always takes place when there is no ascending current over the waves and the wind is even ; but then it is always observed in the air strata where albatrosses fly, that the wind is *increasing according to the altitude* ; doubtless it is the friction of the sea on the wind in the low strata that decreases its velocity.[2] Albatrosses, then, are continually manœuvring up and down, turning from time to time, going up against the wind and going down with the wind, so that they alternately put themselves in strata of air of different speeds.

I took numerous measurements in the open sea in order to find out experimentally this variation in altitude of the wind speed that albatrosses use. These measures enabled me to calculate the energy gained by albatrosses.

The results are as follows :

(1) This sort of soaring is possible only for very swift birds. It needs a minimum wind of five metres, close to the water.

(2) The stronger the wind is, the higher (10-15 metres) the birds must do their upper turn.

(3) These trajectories of albatrosses are the most advantageous as regards gain of energy.

These theoretical conclusions are in agreement with the observations. Albatrosses consequently use the slackening of the wind speed due to friction on the surface of the sea.

P. IDRAC.

L'École Polytechnique, Paris.

[1] *C.R. Académie des Sciences*, February 21, July 5, 1920, May 9, 1921 ; "Études expérimentales sur le vol à voile," par P. Idrac. Thèse de la Faculté des Sciences de Paris 1921. Vivien éditeur, 48 rue des Écoles ; publiée aussi dans *L'Aérophile* (January, February and March 1922).

[2] *C.R. Académie des Sciences*, November 24, 1924, "Le Vol des albatross." Vivien, 48 rue des Écoles. *Bulletin de Recherches et Inventions*, March 1, 1925 : *Technique Aéronautique*, February 15, 1925.

Bio-Chemistry of Muscle Contraction.

THE films of long-chain organic compounds (*e.g.* the aliphatic mono- and dibasic acids) crystallised on glass surfaces possess a structure in which the molecules are orientated so that their terminal groups lie in a series of planes parallel to the surface on which they are deposited. This structure is similar to that postulated by Friedel for liquid crystals (*e.g.* soap curds) in the smectic state. In the lamellæ between the planes, the long chains are arranged with respect to the surface at an angle which depends on the nature of the terminal group. For the mono-basic fatty acids the inclination is about 55° and for the esters of these acids approximately 90°.

Films of aliphatic organic acids when crystallised on glass or on the surface of aqueous alcoholic solutions have been examined by convergent polarised light and found to show the biaxial interference fringes typical of crystal sections in which the acute bisectrix is not normal to the surface. The two optic axes may be accounted for by assuming that successive molecules of acid lie in different directions in space giving rise to a chain of molecules running in a "zig-zag" manner from the surface of the glass. The angle between the chain directions of two adjacent molecules will depend on the configuration of the terminal groups, being different for an acid and its ester and salt.

This type of crystal structure has a possible significance in physiology, for if it be present on the surface of a muscle fibre it would provide a mechanism by which contraction on stimulation could occur.

A striated muscle fibre shows alternate isotropic and anisotropic striæ along its length. On contraction, the width of the striæ decreases, the diameter of the fibre increases, and a tension is produced along the axis. According to Engelmann, the active constituent in producing the contractibility is the anisotropic part of the muscle. The anisotropy is conceivably due to the presence of orientated molecules, presumably of long-chain amino-acids, which are either present in the membrane of the muscle fibre or are distributed in fibrillæ throughout. Assuming for the moment that the membrane is anisotropic due to the presence of long chains of salts or esters of amino acids, and that these are orientated so as to give a zig-zag arrangement of the molecules in a direction parallel to the axis of the fibre, and further consider the effect of converting these salts into amino-acids. In the first place, the

inclination of successive molecules to one another would be altered just as is the case in the crystalline state when an ester is converted into an acid, and, in the second place, the length of the zig-zag composed of a finite number of molecules would be shortened. If the chains of the molecules commence at the interfaces between the isotropic and anisotropic regions, then the chemical change will produce a tension along the length of the fibre.

When a contraction wave passes along a muscle fibre the hydrogen ion concentration in the muscle increases, due to the production of lactic acid from glycogen, so that the chemical changes occurring during stimulation are sufficient to account for the conversion of a salt into an acid and of an expanded into a contracted molecular film, and hence for the tension along a muscle fibre.

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Ether and the Metaphysical Mind.

DR. JEANS states in his Kelvin Lecture to the Institution of Electrical Engineers, published as a Supplement to NATURE of March 7, that our own physicists have asked for a machine, while "the more metaphysical minds of the Continent have usually been content to accept action at a distance." He goes on to say "it is something more than a coincidence that Newton, Clerk-Maxwell, Kelvin, and Faraday are all British, while Boscovitch, Einstein, and Weyl are not."

Of the three men chosen as typical of the more metaphysical minds of the Continent, all are mathematicians primarily, while two at least of them are of eastern origin—Slavonic or Jewish. These men are therefore representative—if genius is representative of anything—of eastern rather than western Continental thought. Two natural philosophies are apparently now available—a natural philosophy based upon essentially British lines of thought as represented by Newton, Clerk-Maxwell, Kelvin and Faraday, and a natural philosophy based upon an eastern philosophical outlook. Does this not perhaps account for the difficulty that relativists are finding in getting this new plant of eastern origin to take root in British soil? Dr. Merz, in "A Fragment of the Human Mind," pp. 18, 24, 25, etc., has pointed out more than once that when an *impasse* is reached in a discussion of some philosophical question, as, for example, in "Hume's dilemma," it is characteristically British to appeal to common sense.

We appear to be witnessing not so much the birth of a new theory, for there are already half a dozen or more species of relativity theory — Einstein's, Eddington's, de Sitter's, Weyl's, Silberstein's, Whitehead's, Robb's, and so on—as the birth of a new branch of knowledge—*mathematical metaphysics*.

Just as there have always been minds that prefer physics to metaphysics, so there will always be minds that prefer mathematical physics to mathematical metaphysics. The former will draw their inspiration, meantime, from the Larmor-Thomson-Lodge School; the latter from the Einstein-Eddington-Jeans School. The essential distinction between them appears to be that one demands "a machine," *i.e.*, a mechanical (not necessarily Newtonian) model of the physical universe, built in normal space and time; whereas the other is content with describing it through the medium of a mathematical analogue or map. Many of us would be well enough pleased to possess either —the model or the map.

F. F. P. B.

The Migrations of the Painted Lady Butterfly.

ELSEWHERE in this issue (p. 535) is a short account of our present, very incomplete knowledge of the migrations of the Painted Lady butterfly (*Pyrameis cardui*). This article has been written with the sole object of obtaining co-operation in a problem which can only be solved by the combined efforts of a number of observers who know what to look for and are kept interested by knowing what relation their observations bear to the whole question.

As is stated in the article, only in Western Europe, North Africa, and Palestine is there any possibility of piecing together the hundred or so known records, and even in this area the conclusions will not be trustworthy until the records are ten times more numerous. In the rest of the world, and particularly just to the south of the Palæarctic Desert belt, in Nigeria, Senegal, and the Sudan, for example, every record is of the greatest value, and any one may help to give the clue to the mystery of the origin of the flights which reach the North African coast.

May I, therefore, ask any interested person in any part of the world to publish—or to send to me—notes on the seasonal abundance of *Vanessa cardui* in his district, and particularly on any sudden appearances or disappearances of large numbers, and in general any notes or observations relating to the migration of this or any other insect.

Records of actual migrations should include the locality, date, species, approximate numbers, sexes (if possible), direction of the flight and of the wind, and any other notes on the meteorological or biological conditions. If, in addition, specimens actually caught on migration could be sent to me for examination and dissection, I should be very much obliged.

All original notes and observations sent direct to me will be published, as in the past, with full acknowledgments if of sufficient interest.

C. B. WILLIAMS.
(Acting Chief Entomologist.)
Ministry of Agriculture,
Cairo, Egypt,
January 14.

The Spectrum of Potassium excited during its Spontaneous Combination with Chlorine.

THE spectrum of ionised potassium has been studied by many scientists by exciting the vapour with the condensed spark, electrodeless ring discharge, and electronic impacts. I have been recently studying the spectrum emitted by potassium burning in chlorine at normal pressure *spontaneously*, and have obtained the following interesting results.

The photographs taken with the quartz spectrograph show a very strong emission band in the red extending from about 7200 to 6150, corresponding to the emission and absorption bands obtained by McLennan and Ainslie in the fluorescence and absorption spectra respectively of dense potassium vapour. Besides this, many arc lines of moderate intensity and the following *enhanced lines* are seen:

4466, 4388, 4307, 4220 and 4115.

As the slit was kept fairly broad, some of the wavelengths given are the mean values for lines very close to each other.

These results show that the *electron affinity* of the chlorine atom, together with the temperature attained by the potassium vapour as a result of the chemical reaction, must account for the excitation of the *enhanced lines* in the absence of any external electrical forces. I am following up the work in connexion with the remaining alkali metals. A

detailed account of the results obtained hitherto, along with an explanation of the processes involved in the emission of the enhanced spectrum, will be published shortly. L. A. RAMDAS.

210 Bow-Bazar Street,
Calcutta, India,
February 19.

Heterogeneous Catalysis.

IN connexion with prevailing notions on heterogeneous catalysis, the following remarks of Graham, written in 1868 (Proc. Roy. Soc., 16, 422, 1868; "Chemical and Physical Researches," 1876, p. 286), would seem to be of interest. Referring to the adsorption of hydrogen by platinum, he says: "The hydrogen appears to be polarised, and to have its attraction for oxygen greatly heightened. I beg to offer the following representation of this phenomenon, with an apology for the purely speculative character of the explanation. The gaseous molecule of hydrogen being assumed to be an association of two atoms, a hydride of hydrogen, it would follow that it is the attraction of platinum for the negative or chlorylous atom of the hydrogen molecule which attaches the latter to the metal. The tendency, imperfectly satisfied, is to the formation of a hydride of platinum. The hydrogen molecule is accordingly polarised, *orienté*, with its positive or basylous side turned outwards, and having its affinity for oxygen greatly enlivened. It is true that the two atoms of a molecule of hydrogen are considered to be inseparable; but this may not be inconsistent with the replacement of such hydrogen atoms as are withdrawn, on combining with oxygen, by other hydrogen atoms from the adjoining molecules. It is only necessary to suppose that a pair of contiguous hydrogen molecules act together upon a single molecule of the external oxygen. They would form water, and still leave a pair of atoms, or a single molecule of hydrogen, attached to the platinum." (The formula of water is evidently considered to be HO.)

J. R. PARTINGTON.

East London College,
University of London.

Influence of Radiation on Ionisation Equilibrium.

IN a recent letter (NATURE, March 14, p. 377) Saha and Swe develop the theory of the stationary state of a medium traversed by radiation of a temperature different from that belonging to the medium. Their argument seems to follow thermodynamic lines; supposing this to be the case, it may be of interest to point out how the same results may be obtained starting from Einstein's classical paper on Planck's radiation law (*Phys. Zeit.*, 18, p. 121, 1917) and from Milne's extension to the photo-electric effect (*Phil. Mag.*, 47, p. 209). The principle of this alternative method, already well known (Milne in this way recently has derived a formula equivalent to formula (3) of Saha and Swe, in his investigation of the equilibrium of a Ca^+ chromosphere, Mon. Not. R.A.S. 85, p. 119), consists in formulating the conditions required for a stationary state by means of probability laws governing the elementary processes involved. These probability laws themselves have been derived from the consideration that in thermodynamic equilibrium the number of elementary processes in one direction ought to balance the number occurring in the opposite direction.

For example, consider a gas traversed by radiation of a different temperature. Milne's results allow us to compute the ratio of the number of photo-electric ionisations to the number of electron-captures accompanied by emission of radiation, in terms of the relative concentration of neutral and ionised atoms. Requiring this ratio to be equal to unity furnishes a value for the degree of ionisation identical with formula (4) of Saha and Swe.

J. WOLTJER, JR.

Observatory, Leyden,
March 23.

Bushmen Rock Figures.

THE comparisons made by Prof. Dart (NATURE, March 21, p. 425) between Bushman paintings and Asiatic figures will need much wider knowledge than we at present have on our side. The turn-over cap called "Phrygian" belonged to Phœnicians of Tyre and Sidon, and to men of Dabig between the Euphrates and Gulf of Alexandretta (see "Gates of Balawat"). It is seen about the Mediterranean now, and is much like the cap of the London draymen fifty years ago. The cap with the long tail is not only Babylonian, but is the typical head-dress of the Hittite and Syrian god Sutekh. Both of these forms may have a much wider spread, and the Bushman might have been figuring a liripipe hood of five centuries ago.

The Figure 13, quoted as Egyptian, is a man of Punt. The "figurino of an Egyptian courtier of the period of Thothmes III." I have handled. It is a well-known kind of moulded pottery figure, from Thebes, but more probably modern than ancient. There is, no doubt, a wide basis of African custom and culture below Egyptian civilisation, of which I have quoted dozens of examples, in *Ancient Egypt*, 1914, pp. 115, 159, and the indications are that these are due to a common basis, and not to importation from Egypt. General likenesses to Egyptian figures do not strike those who know them best; the women of Fig. 12 might be Somalis, but not Egyptians. Resemblances of names require an exhaustive inquiry as to possible meanings and origins among all the languages that may have intervened, before they can be accepted with caution. A name always means something; it is not a casual sound. FLINDERS PETRIE.

5 Cannon Place,
Hampstead, N.W.3.

On the Resonance Radiation from Thallium Vapour.

RECENTLY we have shown that the absorption spectrum of non-luminous thallium vapour exhibits lines corresponding to the sharp and the diffuse series, and that $1\pi_2$ is the ground orbit of the valence electron in the atom of this element. A further confirmation of this view is given by our latest experiments on resonance radiation. In these experiments the radiation emitted from the vapour in a lateral direction was examined when the vapour was illuminated with light obtained by using different colour-screens. It has been found that the vapour, subjected to radiation $\lambda 5350$ $(1\pi_1 - 1\sigma)$, does not emit any radiation, while when illuminated by radiation $\lambda 3775$ $(1\pi_2 - 1\sigma)$ it acquires the ability of emitting radiations $\lambda\lambda 5350$ and 3775, the fluorescent track in this latter case being of a beautiful green colour. These experiments, together with the experiments on absorption, strikingly confirm that $1\pi_2$ is the normal state of the atom. Further experiments in this direction are in progress.

A. L. NARAYAN.
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Research Laboratories,
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The Migrations of the Painted Lady Butterfly.

By C. B. WILLIAMS, Acting Chief Entomologist, Ministry of Agriculture, Egypt.

THE migrations of birds have been known for centuries, and have, particularly in recent years, been moderately well studied and understood. The migrations of fishes are also generally known, and within the last few years the remarkable journeys of the eel have been definitely determined. Most people know that locusts make huge migratory flights, invading countries in countless numbers and doing incalculable damage; but it is surprising how few are aware that such frail insects as butterflies make extended migratory flights, often in enormous numbers and over hundreds and even thousands of miles.

Scattered throughout literature there are references to nearly two hundred species of butterflies which have been seen in migratory flights. In most of these there

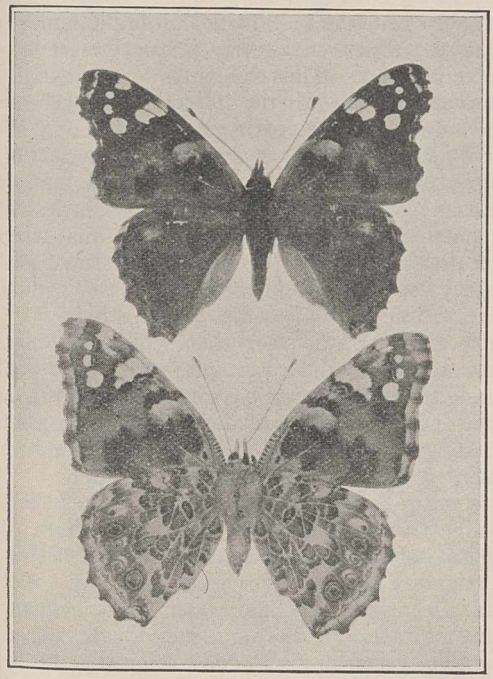

FIG. 1.—The Painted Lady or Thistle butterfly (*Pyrameis cardui*).

are unfortunately only one or two records for each species, and in only a very few cases do the records number more than a dozen. In two or three, however, we have sufficient evidence to get a general idea of the movement, and of these the most complete is that of the Painted Lady or Thistle butterfly, *Pyrameis cardui* (Fig. 1).

This butterfly, like many migrants, has a very wide range and is indeed known from every continent, and may be seen from the equatorial tropics to within a few degrees of the arctic circle. In Northern and Central Europe it is sometimes common, sometimes rare, and sometimes a summer will pass without a single specimen being seen. In England it is usually first seen at the end of May or beginning of June, and becomes again more common in August and September, but there is no evidence of an individual surviving the winter in any stage. The same seems to be true of all Europe north of a line through the middle of France and South Germany or Switzerland.

Observation has shown that north of this line the country is dependent for its Painted Lady butterflies entirely on migrations from the south. In the late spring, isolated individuals or huge swarms of this butterfly set their faces more or less to the north or north-west and, in Western Europe, cross France and England, and in some years may reach so far as Iceland. Farther east, similar migrating bands may fly from Italy or the Balkan peninsula, and cross Switzerland, Austria, Czecho-Slovakia, and Germany, and invade Scandinavia. Still farther east, in Russia, it is probable that the same movement occurs, but the records are few and far between.

Studying the movement in the south of Europe, we find that the majority of the migrating insects do not originate here, but cross the Mediterranean from North Africa, apparently finding but little difficulty in the long sea passage. Still more recently, evidence has been accumulating that even the north coast of Africa and Palestine do not represent the origin of the insect, and it appears that they reach the coastal regions of Africa from the south. They have been recorded entering Algeria from the south; they have been seen crossing the Nile Valley near Cairo in thousands, coming from the south-eastern desert; they have been recorded as entering Palestine from the east in countless numbers for days on end; and finally comes a record of the same butterfly flying towards the west in Mesopotamia. They have been seen massed in great numbers, apparently resting during migration, in the Egyptian Desert near the Sudan border; but south of the desert belt, there is no record except a doubtful hint from Nigeria.

The present state of our knowledge of their movements in Europe, North Africa, and Asia Minor can therefore be summarised as follows (see also Fig. 2):

From somewhere in, or south of, or south-east of the long line of desert stretching across North Africa and Asia Minor, the butterflies begin their north and north-westerly movement in the early spring and arrive at the southern shores of the Mediterranean usually about April. From Palestine they appear to fly through Syria and Turkey to the Balkan States, and from Egypt, Tripoli, and Algeria they cross the Mediterranean, arriving in southern Europe usually early in May. They pass on, probably leaving behind stragglers all the time, and arrive on the level of the southern shores of England at the end of May or beginning of June, reach the northern part of Scotland about the middle of June, and have been recorded in Iceland in July.

The dates given are those of the first main drift, but the movement appears to continue for many weeks or even months at irregular intervals. Thus the butterflies have been seen crossing the Mediterranean north of Egypt so late as July, and in some years they appear to reach England from the Continent so late as September. These presumably are the progeny of later broods than the first movement. Apparently there is a general tendency for all butterflies over the whole

area to drift to the north-west during a large part of the year.

In other parts of the world there are also migrations, but the records are at present too few to be capable of discussion. They fly into California from the south in the spring at irregular intervals and have also been seen migrating in Florida. It is, however, only in Europe, North Africa, and Asia Minor that we can bind together the evidence into the semblance of a whole. It is curious to note that in Ceylon, where migrations of many species of butterflies occur on a very large scale, one observer notes that *P. cardui*, although not uncommon, has not been noticed as entering into any of the flights.

As the migrations of birds are better understood than those of any other animal, it will be interesting to draw

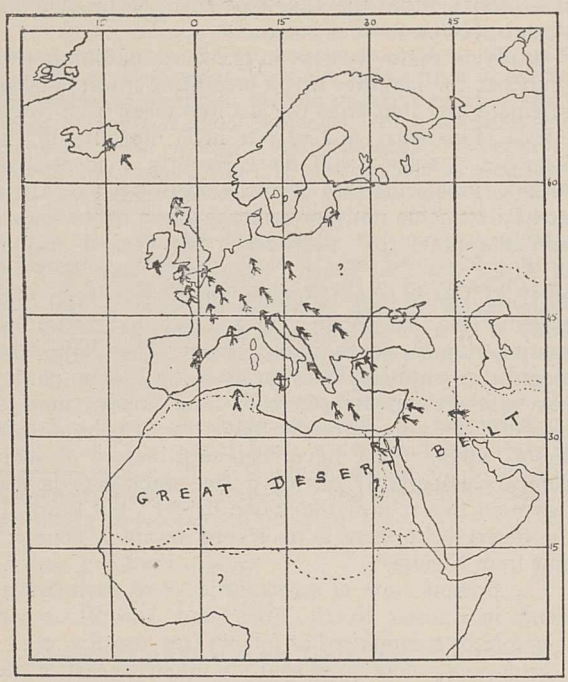

FIG. 2.—Sketch map indicating the known migrations of the Painted Lady butterfly.

a comparison and see to what extent the migrations of the Painted Lady butterfly resemble them.

In the first place, we have the remarkable fact that in the butterfly there is practically no evidence of any return from north to south in the autumn. So far as we can see, all those butterflies which fly to the north of the area in which they can breed throughout the year are lost completely to the species, as either they or their offspring perish during the winter. The butterfly does not seem to have developed the ability to hibernate in any stage; unless it can breed continuously it cannot survive. The statement seems so remarkable that some investigators believe that there is a return flight, but that it is performed individually and not in mass, and so escapes notice. While this may be so, it is at present unsupported by any direct evidence and must be classed as an hypothesis, as opposed to the known facts of the northward movement in the spring. One cannot help referring here to the remarkable contrast which is found in the case of the Monarch butterfly (*Anosia plexippus*) in North America. Here the southward autumn flight is known from dozens of observations, while the direct evidence for the northward flight in the spring is extremely scanty, although from the complete absence of any record of hibernation in the Northern United States and Canada, we presume that such a return flight must occur.

The possibility must also not be overlooked that considerable flights may take place at night. This may seem to be a rather unexpected statement to be applied to butterflies, but it is actually supported by direct observation and capture of Painted Lady butterflies at night at light-ships and on boats at sea. The same butterflies have also been seen flying to the north off the coast of Egypt between three and four in the afternoon, and to reach land in this direction they must fly all night or rest on the sea.

In the case of the Painted Lady, it follows that even if there is a return flight, it is in a later generation. No individual butterfly ever performs the same journey twice, even in opposite directions, thus differing from most birds, which make the journey twice a year for several years. This eliminates any possibility of memory being a factor in the determination of the route.

The next difference between the migration of the butterfly and most birds is that it is only a part of the butterfly population which migrates, while many stay behind to continue breeding in the countries where they hatched out. If it is really true that there is no return flight, this of course would be absolutely necessary, as otherwise the species would gradually move northwards and become exterminated.

Next we have the fact that while the migrants which reach England, for example, lay eggs and produce offspring there, those that have stayed behind in South Europe or North Africa are also breeding. In contrast to what is usually found in birds, breeding takes place throughout the whole range of the migration.

This raises the question as to whether it is the same individuals that perform the whole flight from Africa or Mesopotamia to Northern Europe, or whether the first migrants stop to lay eggs on the way and their offspring continue the flight later. The evidence at present indicates that the same individuals can, and in favourable years probably do, complete the whole flight, but that their progeny may also form a later migration, starting from where the eggs were laid by the original migrants, or may continue the migration alone if for any reason that of the previous generation has been brought to an end.

This in turn raises another question. How is it that the butterflies have time to perform their long journeys, and, having hatched from a pupa in Africa, can wait to lay their eggs in England? The answer to this is still obscure, except that we know that *P. cardui* usually hatches out from the chrysalis with the generative organs completely undeveloped, but with a very large reserve fat-body. Apparently the migration generally takes place before the genital organs are functional (thus resembling the locusts); but this is not an absolute rule, as butterflies have been known to lay eggs while apparently on migration. When we know what determines the original development of the fat-body at the expense of the ovaries, and what later circumstances cause the ovaries to develop at the

expense of the fat-body, we shall be nearer the solution of one of the problems of migration.

Finally, as the life of the butterfly is not dependent on migration, we get another important difference from birds in the great irregularity of the occurrence and extent of the movement. Sometimes, as in 1879, Western Europe is invaded by countless millions, while in other years the migration is at a minimum and scarcely a single individual reaches the British shores. This irregularity of flight is probably an indication of varying conditions in the countries of origin of the swarms, but as we are not yet certain where these are or if they are always the same, it is idle to speculate as to what are the conditions that determine the start of the flight. Once the migration is in progress, what little evidence we have indicates that the direction is influenced, but not entirely determined, by the wind. The butterflies have a tendency to fly into the wind rather than with it, and there are one or two records, from localities with a daily change in wind direction due to land and sea breeze, of a corresponding daily change in the direction of the flight.

This tendency to fly more or less into the wind would of itself partly account for the general trend of the migration to the north and north-west, as in the spring there are prevalent northerly winds over Southern Europe, the Mediterranean, and North Africa (see Fig. 3). However, one feels that this alone is not the explanation of the main trend of the flight, and further study and many more records are necessary before it will be possible even to guess at the real cause.

We are similarly in ignorance as to what are the conditions which cause the insects to cease migrating—if it is fatigue, low temperature, food, or the development of the sex organs and sex instinct, and if the latter, the problem is only put one stage further back to what is the cause of this change.

The final question, which is with so many the first to be asked, is: Why do the insects migrate?

FIG. 3.—Prevailing winds in Europe and North Africa. From Kendrew's "Climate of the Continents."

This is best perhaps at present left entirely alone. Whether, as some hold, a habit is explained when some advantage has been shown to accrue from it to the species, or whether, as I insist, there must be an immediate mechanistic cause for the migration of each individual, is a question the discussion of which would be out of place in the present article.

Further Evidence regarding the Correlation between Solar Activity and Atmospheric Electricity.[1]

By Dr. LOUIS A. BAUER,
Department of Terrestrial Magnetism, Carnegie Institution of Washington, Washington, D.C., U.S.A.

THE geophysical element which has thus far shown the most marked correlation between manifestations of solar activity, as, for example, sunspottedness and prominences, is some measure of activity of the earth's magnetism. The range of the magnetic diurnal variation, as shown by observations extending over nearly a century, is known to pass through a definite fluctuation to the extent of 50 per cent., or more, during a sunspot cycle. The synchronism between the solar curve and the magnetic curve is not exact, however, the times of maxima of the two curves differing not infrequently by one year or more. Thus, at the Kew Observatory the absolute daily range of the magnetic declination during the period 1858–1900, or approximately 4 sunspot cycles, passed through a maximum value, three times out of the four cases, one year *in advance* of the sunspot maximum. During the recent sunspot cycle (1913–1923) the maximum magnetic activity showed a lag of two years with reference to the solar curve. In 1893, when sunspottedness was a maximum, the earth's magnetic activity, after having been increasing for several years previous, was quite markedly lessened, and then rose to a maximum value in 1894.

Attention may also be directed to the fact that no index of the sun's activity, as given thus far by solar observations, is apparently a complete measure of the radiations or emanations which are responsible for the magnetic phenomena just described. Nor do the solar measures in themselves, or for that matter the magnetic measures, give us a definite indication of the *sign* of the electrically charged particles which may be shot out by the sun during periods of intense activity.

The desirability is thus seen of finding some other geophysical element which may be affected in such a manner by solar changes as to supplement effectively the knowledge gained from magnetic effects and polar lights. That element may be atmospheric electricity; some results concerning the correlation of this element with solar activity were presented before these societies [2] a year ago. The present communication is based on atmospheric-electric data accumulated during the past 7 sunspot cycles. Manifestly, it will not be possible here to attempt more than a summary of the entire

[1] Presented before the joint meeting of the American Physical Society, the American Astronomical Society, and Sections B (Physics) and D (Astronomy) of the American Association for the Advancement of Science, Washington, D.C., December 30, 1924.

[2] See footnote 1.

investigation; those interested may be referred to the fuller publication.[3] Since atmospheric electricity is so continuously subject to much greater fluctuations of all kinds, natural and artificial, it will be appreciated that the tracing of a definite connexion with solar activity is much more difficult than in terrestrial magnetism, and, accordingly, an allowance must be made in the critical examination of the results. *So far as possible, only data derived from so-called electrically undisturbed days,* i.e. *days of no negative potential and no pronounced disturbances, have been utilised.*

Atmospheric Potential Gradient and Variations.

In Table I., s represents the percentage change in the atmospheric element corresponding to a change of 1 in the Wolf-Wolfer observed sunspot numbers, and S_m the mean sunspottedness of a complete cycle beginning with the year of minimum.

Table I. summarises the average values of s, expressed in percentages of the respective electric quantity, for each of the 7 sunspot cycles beginning with 1843, derived from the observed values of the potential gradient, P, and some measure of its diurnal and annual variations.[4] The stations for which sufficiently long series are at present available for the various cycles are as follows: Brussels for Nos. 1, 2, and 3; St. Louis, Missouri, for portions of Nos. 2 and 3; Greenwich for No. 4; Perpignan, Lyons, Kew, and Greenwich for No. 5; Kew, Greenwich, Perpignan, and Kremsmünster for No. 6; and Ebro (Spain), Eskdalemuir, and Kew for No. 7. An attempt has been made in the last column to give some idea of the weight, w, to be attached to the tabulated s, according to the character of the available observations and number of stations utilised. Nos. 1 and 4 get the lowest weight (0·5), as they each depend on one station alone, no trustworthy observations at other stations for the corresponding period being at present available. No. 7, on the other hand, is given the largest weight (3), as it depends upon the most modern observations at three distant observatories; No. 6 ranks next in reliability. Though No. 5 depends on the data from several observatories, it is given a weight of but 1·5, as during the period covered the observations are all relative ones, the method of reduction to infinite plane not having as yet been introduced.

Table I.—Values of Sunspot Coefficient, s, for Atmospheric Electricity, 1843–1893.

No.	Sunspot Cycle.	S_m.	s (per Cent.).	w.
1	1843–1855	53·7	−0·70	0·5
2	1856–1866	49·6	+0·53	1·0
3	1867–1877	56·6	+0·22	1·0
4	1878–1888	34·6	+0·09	0·5
5	1889–1900	38·8	−0·24	1·5
6	1901–1912	31·1	+0·49	2·5
7	1913–1923	40·6	+0·24	3·0
Mean, Nos. 2, 3, 4, 6, 7 . .			+0·34	8·0
Mean, Nos. 1 and 5 . . .			−0·35	2·0

It will be observed that for five of the seven cycles the sign of s is plus, which means that increasing potential gradient and diurnal and annual ranges corresponded with increasing sunspottedness, the average value of s being +0·34. For two of the seven cycles, namely, Nos. 1 and 5, the sign of s is negative, implying that increased potential gradient and ranges corresponded with decreasing sunspottedness, the average value of s being −0·35.

He who wishes to regard the two cases (Nos. 1 and 5) as contradictions of a definite correlation between atmospheric electricity and solar activity, may take the algebraic weighted mean of all values of s for the 7 cycles and obtain +0·20, which corresponds approximately to the value for the period (No. 7) of most trustworthy observations. However, I am inclined to advise leaving open the possibility of a reversed relationship, especially as the indications afforded by No. 5 are of a character not lightly to be dismissed. For example, the most striking part of the reversal occurred during the year 1893, when, as has already been remarked, there was also a notable depression in the earth's magnetic activity, in spite of its being the year of sunspot maximum;[5] this is the first definite correlation between disturbances in atmospheric electricity and terrestrial magnetism.

Comparing the values of s for the past two sunspot cycles, it will be observed from Table I. that, while they are both plus, the value for the cycle (No. 7) of more intense solar activity, as indicated by the mean sunspottedness, S_m, was only about one-half of that for the preceding cycle (No. 6). The same fact is found to apply to the values of s derived from two different measures of the earth's magnetic activity obtained independently by Dr. Bartels, of the Potsdam Observatory, and myself. The ratio of s (No. 6 : No. 7) is 2·0 for atmospheric electricity and 1·7 for terrestrial magnetism.[6] Even the variation during the year of s follows essentially the same law for both geophysical phenomena. Thus the ratio of s (October to March: April to September), for the period 1911–1921, was found to be 2·4 for atmospheric electricity and 1·7 for terrestrial magnetism. If a definite correlation is to be ascribed between solar activity and terrestrial magnetism, the facts just cited point to the conclusion that there is likewise a definite correlation between solar activity and atmospheric electricity.

Fig. 1 shows the high degree of correlation between solar activity and atmospheric potential gradient and its diurnal and annual ranges for the two sunspot cycles, 1901–1923, during which the atmospheric-electric data are of highest reliability. For the first cycle (1901–1912) we have available electric data at Kew, Greenwich, and Perpignan (France). For the second cycle (1913–1923) the data were obtained from the observatories at Kew, Eskdalemuir (Scotland), and Ebro (Spain). I desire here to acknowledge my indebtedness for latest data at these observatories to the very cordial co-operation in this research given by the respective directors.

While in the fuller publication the data from each observatory have been treated independently and

[3] *Terr. Mag. and Atmos. Elec.*, vol. 29 (1924), pp. 23-32 and 161-186.

[4] Table I. was derived from the values of s given *in extenso* in the author's Table 7, p. 171, *Terr. Mag.*, vol. 29, p. 171.

[5] See Fig. 2, *Terr. Mag.*, vol. 29, p. 31.

[6] While s for cycle No. 7 was only about one-half of that for No. 6, the total electrical output during each cycle may have been about the same. Thus if R is the range or difference in sunspot number between minimum and maximum, then we have for No. 7, $Rs = 102 \times 0{\cdot}24 = 24$, and for No. 6, $Rs = 61 \times 0{\cdot}49 = 30$.

without the use of any smoothing process, it was thought desirable in the graphs, Nos. 3, 4, and 5 of Fig. 1, to group them together as indicated and take smoothed means according to the well-known formula $(a+2b+c)/4$. With the aid of overlapping data for about two years, a preliminary attempt was made to refer the mean results for the two cycles to the same base line; a more accurate reduction will be possible later. Curve 5 is a combination of the results shown

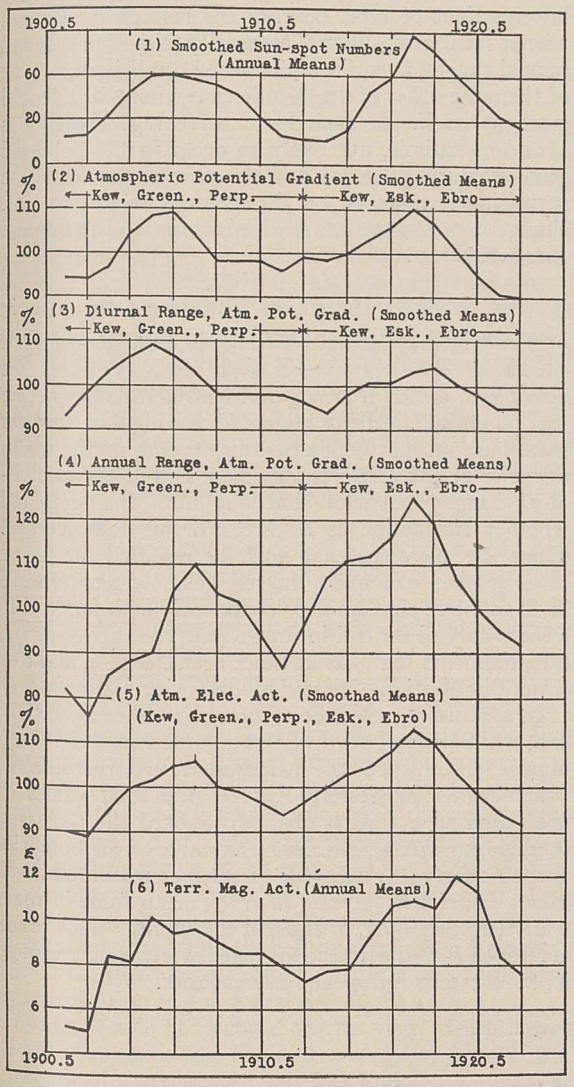

FIG. 1.—Showing degree of correlation between solar activity, atmospheric electricity, and terrestrial magnetism for the two sunspot cycles 1902–1923. (Dependent on atmospheric-electric data at Kew, Greenwich, Perpignan, Eskdalemuir, and Ebro, and on magnetic data at Potsdam, 1900–1905, and at Cheltenham, Maryland, 1905–1923.)

separately in Curves 2, 3, and 4. The smoothed sunspot numbers are those of Wolf and Wolfer with extensions according to latest data kindly supplied to me by Dr. Wolfer. Curve No. 6 of the measure of the earth's magnetic activity (ϵHR) has been derived by me with the aid of the absolute diurnal ranges (R) of the horizontal intensity (H) at the Potsdam Magnetic Observatory, 1900–1905, and at the Cheltenham Magnetic Observatory, Maryland, from 1905–1923; the data at the two observatories were reduced to the same basis and expressed in terms of the unit ϵ. For the most recent values of R at the Cheltenham Observatory, I am indebted to the Director of the United States Coast and Geodetic Survey. In the case of Curve No. 6 no smoothing was attempted, in order to obtain some idea how satisfactorily a measure of terrestrial magnetic activity might be obtained from one observatory alone, in view of the smaller effect of local disturbing influences in terrestrial magnetism than is the case for atmospheric electricity; however, since the atmospheric-electric data pertain to the electrically undisturbed days, only the magnetic ranges from the ten least disturbed days per month were used.

From Fig. 1 *the following conclusions may be drawn for the period 1901–1923*: (*a*) The atmospheric potential gradient and its diurnal and annual ranges show a high degree of correlation with the sunspot curve, increasing atmospheric-electric quantity in each case corresponding with increasing sunspottedness for both cycles; (*b*) the combined measure of activity as obtained from observations of the atmospheric potential gradient and its diurnal and annual variations at several stations may show as high a degree of correlation with sunspottedness as measures of terrestrial magnetic activity; (*c*) the annual means of the atmospheric potential gradient, of its diurnal range, and of its annual range follow closely parallel courses from year to year. (Conclusion (*c*) has been found to hold generally for the various cycles investigated.)

Table II. will give some idea of the general agreement in the values of s, as derived separately from the observed values of the potential gradient, the diurnal variations, and annual variation at the three observatories, Eskdalemuir, Kew, and Ebro, for the region from Scotland to Spain and for the period of most trustworthy data, 1911–1921. The values of the correlation coefficient, r, are also given for each observatory; it will be seen that, for the potential gradient, r varies from 0·76 to 0·95, according to the location of the observatory, the mean value being 0·85. The mean value of r is lowest for the annual variation, as this quantity cannot be determined entirely satisfactorily from single years of observation. The mean value of s, it will be seen, is practically the same for each atmospheric-electric quantity.

TABLE II.—COMPARISON OF VALUES OF SUNSPOT COEFFICIENT, s, FOR VARIOUS STATIONS AND ATMOSPHERIC-ELECTRIC QUANTITIES, 1911–1921. (s is expressed in Percentages of Mean Values of Atmospheric-Electric Quantity.)

No.	Observatory.	Pot. Grad.		Diur. Var'n.		Ann. Var'n.	
		s	r	s	r	s	r
1	Eskdalemuir .	+0·19	0·85	+0·20	0·53	+0·44	0·65
2	Kew. . .	+0·20	0·76	+0·17	0·58	+0·19	0·30
3	Ebro . .	+0·31	0·95	+0·33	0·78	+0·23	0·32
4	Means .	+0·23	0·85	+0·23	0·63	+0·29	0·42

VERTICAL CONDUCTION CURRENT AND ELECTRIC CONDUCTIVITY.

According to observations at Kew (1911–1921) and Ebro (1914–1923), the vertical conduction current of atmospheric electricity during the past sunspot cycle apparently increased with increasing sunspottedness,

at the average rate of 0·32 per cent. for a change of 1 in the sunspot number. As this is about the same average rate of change shown by the potential-gradient observations at the same two observatories, the present indications are that the average rate of change for several stations of the atmospheric-electric conductivity with sunspottedness, if not zero, is small. The continuous observations of negative electric conductivity at the Potsdam Observatory likewise indicate but little change with changing solar activity. (Since this paper was prepared it has been found, by a method[7] which minimises the effect of uncontrolled changes in the factor to reduce potential gradients to volts per metre over level ground, that the average value of s for the Potsdam observations from 1913–1923 was +0·27 per cent. of the mean value of the potential gradient, *i.e.* the potential gradient increased, on the average, with increasing sunspot activity. Accordingly, the vertical conduction current at Potsdam also increased during 1913–1923 at the average rate of about 0·27 per cent. for an increase of 1 in the sunspot number.)

Atmospheric Electricity and Terrestrial Magnetism.

The foregoing results indicate a close correspondence between such changes in atmospheric electricity and terrestrial magnetism as may be dependent upon the state of the sun's activity from cycle to cycle. However, the close correspondence between the two different geophysical phenomena also holds in other respects. For example, the so-called "earth-effect" on sunspottedness during circumminimum years, the diurnal range of the atmospheric potential gradient, the diurnal range of the potential gradient of earth currents, the aurora borealis frequency for latitudes 51° to 58° north, and terrestrial magnetic activity all pass through a double periodicity during the year; the maxima and minima occur near the equinoctial and solstitial months respectively. Furthermore, the retardation of the second maximum from September to October is common to all phenomena. For further explanation, reference must be made to the fuller publication.[8]

It would appear that terrestrial magnetism and fine weather atmospheric electricity are more closely associated than has heretofore been thought to be the case. Besides being subject to diurnal change, they both show similar fluctuations from year to year and from month to month. Whether atmospheric electricity, like terrestrial magnetism, is subject to a still longer cycle of changes than that of the sunspot cycle, seems not unlikely, and is the subject of further inquiry.

In a notable respect the changes of atmospheric electricity differ from those of terrestrial magnetism, namely, as regards relative magnitude. The periodic variations of the earth's magnetic elements are usually but fractions of 1 per cent. of the respective element, whereas in atmospheric electricity the diurnal and annual ranges, even for undisturbed conditions, may be of the same order of magnitude as the normal potential gradient itself. If such large percentage changes as 100, for example, are likely to occur in the potential gradient during the day and the year, it should not be surprising if there is, on the average, a 30 per cent. change between the years of minimum and maximum sunspottedness.

Is the Sunspot Influence Direct or Indirect?

While it may appear reasonable that atmospheric electricity does vary with solar activity, it is not possible to decide from *a priori* considerations whether the potential gradient ought to be high or low for maximum sunspottedness, as this depends on the *modus operandi* of the cause, the average sign of the electrically charged particles shot out from the sun, and whether the action is a direct or an indirect one. These are questions that must be reserved for future investigation. So much interest has now been aroused in the subject that we may confidently look forward to a more careful control in future of atmospheric-electric measurements than has at times been the case, and to a wider distribution of first-class observing stations.

In conclusion, it will be of interest to refer to the fact that while the present investigation has had to be based almost entirely on the atmospheric-electric data at observatories in western Europe, the final values of the potential gradients observed aboard the *Carnegie*, in all oceans, show that the mean value of the potential gradient for 1917, the year of sunspot maximum, was about 20 per cent. greater than the mean value in 1921, near the year, 1923, of sunspot minimum. This result corresponds well with the average corresponding change at the western European observatories.

[7] See *Terr. Mag.*, vol. 29 (1924), p. 181.
[8] *Terr. Mag.*, vol. 29 (1924), pp. 175-179.

Obituary.

Prof. A. Dendy, F.R.S.

PROF. ARTHUR DENDY, whose death occurred on March 24, in King's College Hospital, at the age of sixty years, was educated at the Manchester Grammar School. On leaving school he proceeded to the Owens College, where he became one of a small band of distinguished zoologists trained by the late Prof. A. Milnes Marshall. He was the first of the students of the old Victoria University to gain a place in the honours school of zoology. Soon after he took his degree in 1885, he went to the Biological Station at Millport, and as a result of the work he did there he published his first two papers, one on a twelve-armed specimen of Antedon and the other on the regeneration of the visceral mass of the same crinoid.

Although Dendy never lost his interest in the group of Echinodermata, it was for his wide knowledge and brilliant researches on sponges that he was destined to become a world-wide authority. He was called to London as an assistant in the British Museum (Natural History), and undertook to complete for publication the memoir on the monaxonid sponges of the *Challenger* expedition, which had been left unfinished owing to the serious illness of Mr. Stuart Ridley. He set to work with his characteristic energy and skill, and this "highly satisfactory" memoir was published in 1887.

In the following year Dendy was appointed lecturer in zoology in the University of Melbourne, a post he held until 1894, when he was promoted to the professorship in the same subject in the Canterbury College of New Zealand.

In the rich and extremely interesting fauna of Australasia, Dendy found full scope for his brilliant abilities in zoological research, and he published in rapid succession a long series of papers on the anatomy and development of some of the most interesting animals of that region. Apart from some excellent papers on sponges, he wrote on land planarians, on the land nemertine (Geonemertes), on the remarkable polyzoan Cryptozoon, on Holothurians, and on the Collembola. His valuable papers on the oviparous species of Peripatus greatly enriched our knowledge of this extremely interesting and archaic arthropod, and his study of the pineal eyes of the New Zealand lamprey Geotria threw important light on the history of these remarkable vestigial structures previously discovered in Sphenodon by his friend—also an old Owensian—Sir Walter Baldwin Spencer. On reaching New Zealand he lost no time in going in search of Sphenodon itself, and, on finding that there was serious danger that the enterprise of collectors would lead to its early extinction, he made urgent and successful appeals to the Government to pass measures for its protection. He was the first to write an account of the development of this reptile, and to record many important features of its anatomy and natural history.

In 1902 Dendy came back to England on a visit, and was given the hospitality of the Zoological Department of his old University in Manchester to enable him to pursue some investigations on which he was engaged. Here he completed his description of the aberrant floating hydroid Pelagohydra and examined sections through the brain of the Ammocoetes larva. In studying the anatomy of the Geotria in New Zealand, he had discovered a pair of ciliated grooves lying beneath the posterior commissure of the brain, and he found these grooves to be even better developed in the brain of the young Petromyzon. On these researches he published an interesting paper, which appeared in the Proceedings of the Royal Society in 1902. His studies on these brains led him to the investigation of another structure in the nervous system of vertebrates, namely, Reissner's fibre. On this subject, also, he made a very important communication to the Royal Society in 1910.

While he was in England on this visit, Dendy heard of the vacancy in the chair of zoology at Cape Town. He applied for the post and was appointed. But he remained in South Africa only two years, as he received the appointment to the professorship in King's College, London, in 1905, vacated by the retirement of the late Prof. F. J. Bell. He held this chair until his death. He was elected a fellow of the Royal Society in 1908.

In London Dendy carried on his teaching and researches with increasing energy and success, and under his guidance King's College soon became recognised as an active centre of research in his subject. He put together some of his teaching notes in the form of a book entitled "Outlines of Evolutionary Biology," which was published in 1912 and has already reached a third edition, and he also wrote an interesting little book entitled "The Biological Foundations of Society," which was published in 1924.

The last important work he wrote was the memoir on the Antarctic sponges reviewed in NATURE of March 7, p. 330, but a preliminary note published in these columns on February 7 showed that he had in hand a paper in which he was prepared to maintain the rather startling proposition that the spicules of siliceous sponges are formed by the skeleton-forming cells enveloping migratory symbiotic organisms resembling micrococci. Many of his friends looked forward with much interest to the fulfilment of his promise made last December to maintain this thesis at the next meeting of the British Association.

Dendy was a man with a very striking and impressive personality, a fine speaker, and a clear and sympathetic teacher. His father was a well-known Unitarian minister. One of his sisters, Miss Mary Dendy, is widely known for her philanthropic work, particularly in connexion with the care and education of feeble-minded children. Another sister married Dr. Bernard Bosanquet, and is herself a well-known writer.

S. J. H.

WITH the sudden and untimely death of Prof. Dendy, we have lost the only man in England with a catholic knowledge of sponges, and probably the leading authority of the two or three in the world who could be classed with him. He was a biologist with wide scope of learning and research as well as a spongologist, but it is of his work on sponges only that I am competent to write.

A catalogue of Dendy's papers on sponges would be long. They begin in 1886, when he was twenty-two, with Ridley and Dendy's "Preliminary Report on the Monaxonida . . . *Challenger*"; they end with a letter, unseen by me as I write this (March 26), which appears in NATURE for March 28, and shall remain in these columns unanswered. Ridley and Dendy's classic *Challenger* monograph (1887) was written as to some five-sixths by Dendy, a wonderful piece of work for so young a man. Then came careful anatomical and histological studies of single species (*Q.J.M.S.*, 1888 *et seqq.*). Beside them the "Monograph of the Victorian Sponges . . . Homocœla" (1891) described several important new forms, of some of which we have little added information—one is now recognised as of generic rank by the name Dendya, not conferred by its discoverer. But the contemporary importance of the "Monograph" was that it carried on Poléjaeff's revolt (*Challenger* "Calcarea," 1883), and struck loose from Haeckel's "Kalkschwämme," and in this it was followed by "Observations . . . and Classification of the Calcarea Heterocœla" (1893, *Q.J.M.S.*), which made a serious and valuable attempt at classification *de novo*.

It would be a long article which should follow Dendy from youth to maturity and from maturity to the admirable work of his last years; we may say briefly that Vosmaer's "Bibliography" to 1913 (in press) gives him thirty-five publications, mainly before 1898, and that his masterly "Reports" since 1913 on collections of sponges add up to 460 quarto pages of print. They are all good. As in other descriptive monographs, there is much which is only readable to the colleague whose interest has been aroused in the

organism described. But there is no slovenly work, and nothing written without purpose, responsibility, and accuracy.

Dendy was above all truthful in record. I have followed much of his work very closely in calcareous sponges, and I have never found the sign of anything described which I had reason to doubt had been seen. He was a beautiful draughtsman, and I have always considered that I could trust one of his drawings as if I had seen the specimen. Four or five years ago I questioned him as to certain details in his early illustrations (*a*) of the collar-cells of Halichondria, (*b*) of the pore-canals of *Leucosolenia stolonifer*. He showed me under the microscope the actual sections from which the drawings had been made, a third of a century earlier, and the fidelity was perfect.

Dendy's life's work as regards sponges was to accomplish a revised classification of the whole group and of their spicules. He was an evolutionist to the core, and believed in the evolutionary chain not only for all forms of sponges but also for all their spicules. His work, however, led him to the conclusion that it is impossible to consider the detailed form of spicules to be evolved for functional advantage to the sponge, and in the case of the two-disced spicule of Latrunculia he, in conjunction with Prof. J. W. Nicholson, gave a most important physical theory of the nodal position of the discs.

I have elsewhere expressed disagreement with his classification. But Dendy had investigated probably more forms of sponges than any one else has ever done, unless possibly Topsent, Hentschel, or Vosmaer. His works constitute a logical catalogue of their forms and of their spicules, illustrated almost entirely by himself with innumerable accurate drawings and accompanied by clear and careful description. He has made research on sponges easier for all who come after him; he has left order where there was much chaos.

Dendy enjoyed public discussion and hard hitting, given and received without disturbing private friendship. Veracity in record, swift work, accurate observation, clear description, untiring industry and enthusiasm for biological knowledge—these were his characters.

In ten years have died Minchin, Maas, Vosmaer, Dendy. The evening grows chilly.

GEO. P. BIDDER.

MR. THOMAS HUGH POWELL, who died in London on February 19, was a remarkable personality in the microscopical and photographic world. He devoted practically the whole of his life to the development and improvement of appliances in connexion with microscopes and photography, and, following in the footsteps of his father, Mr. Hugh Powell, was responsible for many progressive inventions. When Mr. Powell's father died in 1883, it was said of him in an obituary notice in the *Times* that he was the first optician in England to construct object glasses on Amici's "immersion" system. After making a considerable number of one-eighths, one-sixteenths, one-twenty-fifths, and one-fiftieths, he completed, with the assistance of his eldest son, who has just died, an object glass of this kind having a focal length of one-eightieth of an inch. The formula of the "homogeneous immersion" system was the subject of special attention on the part of Mr. Powell, sen., but failing health compelled him to rely on the efforts of his son, by whom object glasses on this formula, having the highest apertures on record, were constructed. Mr. Powell was within a month of his ninety-third birthday at his death, having been born in March 1832. He was believed to be the oldest member, both in age and in length of membership, of the Royal Microscopical Society and the Quekett Microscopical Club, and displayed an active interest in his life-work to within a short time of his death.

WE much regret to record the death of Mr. Robert Standen, Senior Assistant-keeper in the Manchester Museum, who died on March 15, aged seventy-one years. He was born at Goosnargh, near Preston, and spent his whole life in Lancashire, forming one of the band of first-rate field naturalists who have done so much work on the fauna and flora of the north-west of England. He had wide knowledge and experience, and would have something of interest to say about most of the live things met with on a country walk, and to this he added a skilful museum technique and a scholar's knowledge of his special group—mollusca—on which he wrote many papers both on the British and, in conjunction with Dr. Cosmo Melvill, on foreign forms. In recent years he was active in promoting interest in neglected groups and quickly made himself an authority on wood-lice: here and everywhere he never grudged time and trouble spent on helping any one who asked for assistance. His services to natural knowledge were recognised by the M.Sc. degree which was conferred upon him by the University of Manchester in 1924.

THE issue of the *Physikalische Zeitschrift* for February 15 contains an obituary notice of Gustave Jaumann, professor of physics in the Technical School of Brünn, from the pen of his colleague Dr. E. Lohr. Jaumann was born at Karansebes in South Hungary on April 18, 1863, and was educated in Prague and Vienna. In 1885 he became assistant to Mach at the University of Prague, in 1893 professor of physics there, and in 1901 at Brünn, where he died suddenly on July 21, 1924. He published a number of experimental investigations on electric discharges and cathode rays, but is probably best known by his theoretical work, which is in great measure co-ordinated in his 1918 paper on the physics of continuous media.

THE editors of the *Journal of Genetics* inform us that they have received, with great regret, news that Mr. V. Issayev, of the University of Leningrad, has been killed in the Caucasus. The last number of that Journal contained a remarkable memoir by Mr. Issayev, giving the results of novel and curious experiments on grafting different species of Hydra together (noticed in NATURE, March 21, p. 438).

WE regret to announce the following deaths:

Mr. W. W. Rouse Ball, fellow and formerly tutor of Trinity College, Cambridge, on April 4, aged seventy-four.

Prof. Burt G. Wilder, professor of neurology and vertebrate zoology in Cornell University from 1867 until 1910 and afterwards emeritus professor, and president in 1885 of the American Neurological Association and in 1898 of the American Association of Anatomists, on January 21, aged eighty-three.

Current Topics and Events.

A LETTER sent to us addressed from the Nanking Branch of the Science Society of China is of particular interest now that the China Indemnity (Application) Bill, having passed the Committee stage, is down for third reading in the House of Commons. It is satisfactory to learn from the writer, Mr. Co-Ching Chu, that this important Society is in full agreement with our editorials of August 30 and November 29 last, not only on the principles and the chief details of expenditure there enunciated, but also on the object underlying our proposals, namely, the promotion of mutual understanding and goodwill between England and China. At the same time our correspondent utters a word of warning to our legislators. Expenditure on purposes other than educational and cultural may, he says, help to prolong the political turmoil in China, and to increase the antagonism towards foreigners. Coming from a responsible Chinese, these are arresting words. It is, however, unfortunate that he credits the unfounded rumour that the change of personnel on the Advisory Committee indicates a reversal of policy, by turning from education to railways, and in particular to a line along the Yangtze Valley.

ALTHOUGH railway construction is not ruled out by the vague wording "educational or other" purposes which Mr. M'Neill has persistently retained in the China Indemnity (Application) Bill, such usage has been expressly disclaimed by him in recent debates. He specifically declared to the Standing Committee that, while the main object of this Government, as of the last, is educational, the Government refuses to pledge itself even to education, if some other ameliorative object urgently presents itself. While such an attitude is understandable in normal circumstances, it is not merely unstatesmanlike but futile now when an anti-foreign feeling is gathering head in China, and the Chinese are accepting the views pressed by nationalistic agitators that the remitted moneys are all of the nature of returned loot. In any event, the sums remitted are so small when the size and the needs of China are considered that if distributed in driblets, as seems contemplated, no appreciable result will ensue. Certain institutions will, of course, benefit, but so far as the goodwill behind our gift is masked by vagueness, our allocations, however carefully considered, will make no call on the goodwill of a responsive people, while the timid handling of co-operation, contrasting unfavourably with that of other remitting Powers, will do nothing to stem the tide that day by day runs more strongly against the foreigner and all his works.

A SMALL volume by Dr. Marie Stopes, entitled "The First Five Thousand," being the first report of the results achieved by the Birth Control Clinic established by Dr. Stopes and her husband at Marlborough Road, Holloway, has been published by Messrs. John Bale, Sons, and Danielsson, Ltd. That some form of birth-control is the only means of regulating the tendency of the population of Great Britain to increase beyond the limits of our food supply is a conclusion which has forced itself on more and more thinkers, both in the biological and economic spheres. But birth-control is a subject against which more emotional prejudice can be aroused, than against almost any other subject of discussion. In the volume before us Dr. Stopes gives a full, clear account of the foundation and organisation of the clinic, and of the care that is taken to prevent the knowledge imparted from being used for purely immoral purposes. The sound rule is adopted that full advice is given only to women who have already borne one child. Dr. Stopes is fully convinced (perhaps some of her critics think too fully convinced) that the method which she adopts is the only safe and innocuous one, but she certainly brings forward strong evidence in support of her contention, for out of 5000 cases she can only find evidence of 42 failures, whereas to judge from the figures which she gives, the percentages of *successes* when other methods have been employed has never risen above 25 per cent. Dr. Stopes would perhaps admit that the storm of criticism, of which she has been the target, has led her to perfect the means employed, so that these criticisms shall be deprived of their ground. After all, there is no getting away from the fact that the practice of birth-control is widely spread among the middle classes, and to deny the knowledge of the means to the poor, who need it far more than the middle-classes do, is a proceeding which no parliamentary language is strong enough adequately to criticise.

THE Chemistry Section at the British Empire Exhibition this year is again being organised by the Association of British Chemical Manufacturers. In a purely business exhibition, designed to bring buyers and sellers together, a chemical display necessarily consists of samples of products. This year's exhibit, however, will be designed mainly to interest the public and give the visitor some idea of the extraordinary part which chemistry plays in the national life. For example, instead of the individual dyestuff makers each having their own display, there will be a large combined exhibit which will show, not only the immense variety of articles into which colour enters, but also what beautiful effects can be obtained by the use of dyestuffs made in Great Britain. The Scientific Section, which created so much interest last year, will also be remodelled. The public has now some idea of the position of Great Britain as a leader in scientific research. It is proposed, therefore, to show how strikingly connected are the various stages in manufacturing processes, from basic materials to the finished product. This subject will be treated by taking as a basis coal, salt, and food. From the consideration of, for example, the raw coal, the visitor will be taken through the various stages of distillation of coal, the products of such distillation, such as tar and ammonia, the treatment of tar, and the resulting intermediate products which lead up to the manufacture of dyestuffs. The production of benzol, of disinfectants, of fine chemicals, of medical products,

and the numerous other chemicals obtained from coal will also be illustrated. In this way it is hoped to demonstrate the importance of chemistry and chemical research in our daily life.

"CHEMISTRY IN THE SERVICE OF THE STATE" is the title of a brochure, published by the Department of Chemistry of the University of Wisconsin, which sets out clearly and concisely the importance of chemistry in industry and in private life. Unlike some recent propaganda, this publication is practically free from overstatements, and within its limits it may be said to constitute an exceedingly able presentation of the case; it indicates in plain language the relations of chemistry to agriculture, to medicine, and to some important industries, and outlines briefly a few of the urgent problems that await solution. The value of chemistry as a handmaid to other sciences appears to be well appreciated in Wisconsin, for we read that 89 per cent. of the 1386 university students who took chemistry in 1923 were specialising in other subjects. Perhaps the weakest section of the pamphlet is that concerning the cultural value of chemistry, but the weakness resides largely in the subject itself, for chemistry is essentially a material science, and culture connotes much more than a knowledge of the transformations of matter. The authors therefore do well to emphasise the value of chemistry as a field for the exercise of the scientific method, but the implication that ability acquired in this sphere is transferable to everyday life would be strenuously resisted by many modern psychologists. Further, the artist and the moralist would demur to the statement that the main business of life is to adapt ourselves to our environment. Does not the chemist himself seek to make his environment subservient to his own ends?

THE Ministry of Agriculture has recently issued a brochure of eight pages entitled "Wasps." Information is sought by numerous inquirers every season as to the species of wasp that happens to have attracted notice, while queen wasps are frequently mistaken by the uninitiated for the larger species or hornet. These difficulties should be got over by the present publication, since all the seven species of British social wasps are clearly described in non-technical language, while identification is further aided by the remarkably well-executed coloured figures of all the species. The letterpress includes a short account of the habits, nest-building, methods of destroying nests, etc., together with some cautiously worded observations on the food of wasps. The reader will gather from the facts brought forward that, although wasps may prey upon a certain number of noxious insects they are, on the whole, not to be regarded as beneficial. The recent innovation of issuing pamphlets of a fuller nature than the usual leaflets of the Ministry, and illustrated by coloured plates, is to be commended. Various insects of economic significance require this fuller method of treatment, and it is to be hoped that the practice will be extended. Brochures of a similar character on the frit fly, wireworm, certain fruit pests and other subjects would probably meet with a wide demand. Characteristic damage to plants by pests is often made far more easily recognisable to the agriculturist and fruit-grower through the medium of accurate coloured illustrations than by detailed descriptions and black-and-white figures. The wasp pamphlet is priced at the low figure of 4*d*., post free, and can be obtained from the Ministry's Offices at 10 Whitehall Place, London, S.W.1.

THE output of mathematical research from the Masaryk University, founded in Brno in 1919, is already such as to show that an active school of post-graduate mathematics has been instituted there. A parcel of 46 recent memoirs, edited by M. Hostinský, and issued separately in Brno as "Publications de la Faculté des Sciences de l'Université Masaryk," contains research work, mainly on pure mathematics, carried out recently by some twenty authors in Czechoslovakia. Typical examples are Hostinský's "Notes sur l'équation de Fredholm," "Kolaček's "Les tremblements de terre Carpathiques sur le territoire de la République Tchécoslovaque," Kaucky's "Sur une équation singulière de Volterra de première espèce," Seifert's "Remarques sur une surface cubique à point uniplanaire," Borüvka's "Sur les racines imaginaires de l'équation $\Gamma(z)=a$," and Lerch's "Études sur la théorie des résidus quadratiques suivant un module premier." Most of the memoirs are printed in Chech, and followed by a French translation or abstract. Nearly all of them show that the authors are familiar with the literature of their subjects. As a whole they prove how seriously scientific research is being pursued in a new university, despite the economic conditions of eastern Europe. If this rate of progress is maintained we foresee that the world of science will soon reckon the Masaryk University to be on a par with universities supported by greater wealth and with more age and tradition behind them.

THE question of the seat of the mechanism of aural analysis was brought strongly into notice some years ago by the publication of Sir Thomas Wrightson's "Analytical Mechanism of the Internal Ear." In that book, Wrightson, supported by Sir Arthur Keith, gave reasons for the view that the internal ear does not contain any analysing mechanism, that the individual nerve fibres have no characteristic individual function and act only in mutual support as transmitters of influence to a cerebral centre of analysis. On that view the ear misses the opportunity of analysis which Helmholtz regarded the basilar membrane as furnishing. Holders of it scarcely give sufficient weight to the knowledge and scientific judgment of Helmholtz when they conclude that the membrane cannot act as he considered it to do. A recent publication, "The Mechanism of the Cochlea," by Drs. Wilkinson and Gray, gives strong support to Helmholtz's view by means of scaled models. In "Some Questions of Phonetic Theory," chap. vi. (separately published), Dr. W. Perrett criticises adversely Wilkinson's and Gray's discussion. Unfortunately, the sarcastic style in which a large part is written is scarcely appropriate in a scientific discussion.

IN the annual address to the Asiatic Society of Bengal, delivered on February 4, the president, Sir Rabindra Nath Mookerjee, exhorts the members of the Society to renewed activity and appeals for the support of Princes and Zamindars as well as commercial magnates to enable the Society to continue and extend its work. The present position of the Society is one of considerable moment to those in Great Britain who are interested in those researches in India with which the Society concerns itself, and it may be hoped that the exhortations of the president will bear fruit. The address, which is a summary of the history and achievement of the Society since its inception in 1784, provides much material for reflection on the social and political changes which have taken place in that period in their relation to Indian studies. It is noted that whereas at one time research was largely, indeed almost entirely, in the hands of Indian Civil Servants, officials have now almost ceased to take any part in the Society's work, and there has been a great falling off in the interest shown by Europeans generally. The Society has great traditions, and European students now look to the natives of India to carry on these traditions worthily.

IN the issue of *Science* for February 20, Prof. Richard Hamer, of the University of Pittsburgh, Pa., enters a plea for naming the missing element of atomic number 43 before it is discovered; in view of the work of Bosanquet and Keeley (*Phil. Mag.*, 1924 (6), 145-147) and of others, he thinks that the discovery cannot be long delayed, and also that by taking time by the forelock in this manner, subsequent controversy, like that which followed the discovery of hafnium, will not arise. Prof. Hamer appeals to the scientific world to name the element "Moseleyum," in honour of the young British physicist who fell in Gallipoli, and to give it the symbol "Ms." In our view it would be a fitting tribute to the brilliant work of Moseley to perpetuate his name in some such way. Hitherto, no chemical element has been named after an individual (we exclude mercury, tantalum, thorium, and titanium for an obvious reason), and opinion may be divided on the advisability of making the innovation. It is, however, a mistake to be bound by precedent in such a matter, and the only objection we can foresee to the adoption of Prof. Hamer's suggestion is that the word is not particularly euphonious, and is rather suggestive of certain sepulchral monuments; but it might be argued that even this suggestiveness is not inappropriate, inasmuch as mausoleums are erected, as a rule, to the memory of the illustrious dead.

PROF. F. SODDY, professor of chemistry in the University of Oxford, has been elected a corresponding member of the Russian Academy of Sciences.

THE period of Summer Time in Great Britain will begin this year at 2 o'clock Greenwich mean time on the morning of Sunday, April 19. Summer Time in France and Belgium began on the night of Saturday-Sunday, April 4-5.

PROF. W. WIEN, professor of experimental physics in the University of Munich, will deliver the tenth Guthrie Lecture of the Physical Society of London on Friday, April 24, at the Imperial College of Science, South Kensington. The subject of the lecture will be "Recent Researches on Positive Rays."

AT the meeting of the Royal Geographical Society on Monday, April 6, the president announced that His Majesty the King has been pleased to approve the award of the Royal Medals of the Society as follows:—the Founder's Medal to Brig.-Gen. the Hon. C. G. Bruce for his life-long geographical work in the exploration of the Himalaya culminating in his leadership of the Mount Everest Expeditions of 1922 and 1924; the Patron's Medal to Mr. A. F. R. Wollaston for his explorations and journeys in Dutch New Guinea, Central Africa, and many other parts of the world. The Council has made the following awards:—the Murchison Grant to Mr. Eric Teichman for his travels in China and Tibet; the Back Grant to Capt. Bernier for his work in the Canadian Arctic; the Cuthbert Peek Grant to Mr. Michael Terry in support of his proposed journey across Northern Australia; and the Gill Memorial to Major R. E. Cheesman for his journey to the deserts of Jafura and Jabrin.

IN order to preserve the fauna of the Southern Ocean the Government of France has issued a decree constituting a national Antarctic reserve in certain territories belonging to France. According to *La Geographie* for January, the reserve includes all the Crozet Islands, St. Paul and Amsterdam Islands, and on Kerguelen certain islets on the north coast and parts of the south coast to a depth of 1000 metres from the land. Within these areas it is forbidden to hunt whales, seals, or sea-birds. No special means are proposed for enforcing these prohibitions, which must naturally depend on the good faith of the hunters who frequent these seas.

DURING two months following the Japanese earthquake of 1923, Mr. H. M. Hadley examined several hundred buildings in Tokyo and Yokohama that were damaged by the earthquake as well as several hundred others that escaped injury (Bull. Seis. Soc. of America, vol. 14, 1924, pp. 6-8). His general conclusion is that, whatever the material used—whether the buildings were steel-framed, of reinforced concrete, of brick or of wood—those that escaped were so framed and braced that they moved as a whole when their foundations were shaken. Of the large steel-framed buildings in Tokyo, those undamaged owed their immunity to the extensive use of reinforced concrete wall construction. A small amount of properly distributed wall construction at the corners and elsewhere was sufficient to protect buildings from the slightest damage. But, though earthquake-proof construction can be secured with any material, the safest and most economical results can be obtained "with structural steel or reinforced concrete, both embodying an adequate amount of reinforced concrete wall construction."

A REPORT on the meteorological service of Australia for the year 1922–1923 has been submitted to the Parliament of the Commonwealth by Mr. H. A. Hunt, the Commonwealth Meteorologist. The report deals with the Central Weather Bureau at Melbourne and with the Weather Bureaux at Sydney, Brisbane, Adelaide, Perth, and Hobart. At the Central Weather Bureau at Melbourne, reports are received daily from a large number of stations, embracing the adjacent islands, and from stations in New Zealand. By the aid of these reports, the South Pacific Islands are warned when cyclonic conditions are developing. The data are also used for the ordinary storm-warning service for the protection of the Queensland and New South Wales coasts and of shipping traversing the waters eastwards from Australia. Rainfall maps showing the total rainfall for each month for several stations are published on the first day of the following month. Aviation forecasts are regularly issued, and the Aviation School at Point Cook is informed whenever easterly gales are expected; the latter seems an admirable precaution. Ocean forecasts and storm-warnings, in addition to being distributed to coast stations, are broadcasted to ships at sea. The prevailing conditions of the weather round the coast are also supplied to radio stations. A careful analysis is made of the forecasts; on the average of fourteen years, the official forecasts verified for the States and for the Commonwealth as a whole reaches 87 per cent. There are 484 climatological and 5912 rainfall stations distributed throughout the Commonwealth and the adjacent territories.

Our Astronomical Column.

NEW COMETS.—Still another comet, 1925 *c*, has to be added to the list of discoveries. It was discovered by Mr. Orkisz in Russia on April 4, and was observed by Mr. Möller, at Copenhagen, on April $5^d\ 2^h\ 52{\cdot}7^m$ G.M.T. in R.A. $22^h\ 26^m\ 45{\cdot}13^s$, N. Decl. 16° 37′ 19″. The motion in R.A. is small: that in declination is about 1° daily northward. The magnitude is 8. The comet is in Pegasus, and must be looked for in the east just before dawn.

Both Schain's and Reid's Comets were observed by Dr. Steavenson as follows:

Comet.	G.M.T.	R.A. 1925·0.	Decl. 1925·0.
Schain	Apr. 2d 1h 55·6m	11h 31m 26·1s	+ 2° 27′ 37″
,,	,, 3 22 42·8	11 28 11·0	+ 2 35 49
Reid	,, 2 1 6·4	13 21 47·7	−22 22 49
,,	,, 4 0 40·9	13 19 32·7	−22 53 54

The following orbit of Schain's Comet is by Dr. A. C. D. Crommelin. It is still subject to appreciable correction, but is much nearer the truth than Kobold's orbit, which made perihelion occur in November 1924.

T	1925 Nov. 2·58 G.M.T.	
ω	216° 35·5′	1925·0
Ω	357 30·6	
i	146 6·9	
log *q*	0·59512.	

The perihelion distance is the second greatest on record, being exceeded by that of the comet of 1729 alone.

EPHEMERIS FOR 0h GREENWICH.

	R.A.	N. Decl.	log *r*.	log Δ.
April 11	11h 16m 4s	3° 6′	0·6351	0·5355
,, 19	11 3 24	3 36	0·6323	0·5438
,, 27	10 51 56	3 59	0·6296	0·5546

The comet should be in sight for two years or more. It is at present not far from the orbit of Jupiter.

The following orbit of Reid's Comet is by Mr. Möller and Miss Vinter-Hansen, of Copenhagen Observatory. Almost identical elements were found by Mr. G. Merton.

T	=1925 July 22·951 G.M.T.	
ω	=244° 19·8′	1925·0
Ω	= 7 41·6	
i	= 30 14·8	
log *q*	=0·29608.	

EPHEMERIS FOR 0h GREENWICH.

	R.A.	S. Decl.	log *r*.	log Δ.
April 10	13h 12m 35s	24° 25′	0·3693	0·1345
,, 14	13 7 26	25 25		
,, 18	13 2 6	26 23	0·3601	0·1194
,, 22	12 56 39	27 19		
,, 26	12 51 12	28 12	0·3513	0·1099

The comet is fairly bright, with a distinct nucleus, but is too low down for convenient observation in England.

SPECTROSCOPIC PARALLAXES OF 520 STARS OF TYPES F TO M.—Mr. W. B. Rimmer in vol. 64 of the R.A.S. Memoirs gives a full discussion of the absolute magnitudes and parallaxes of 520 stars from observations at the Norman Lockyer Observatory, Sidmouth. The curves connecting strength of lines with absolute magnitude were deduced from (1) moving-cluster parallaxes, (2) parallactic motion, (3) trigonometrical data; the last fails for the distant stars of high luminosity.

Special attention was given to the exact spectral type of the stars, published results being revised in several cases. Comparison of results is made with those of the Dominion Observatory, Victoria, B.C., the agreement being satisfactory.

On the whole the new parallaxes slightly exceed the trigonometrical ones, but the mean difference is only about 0·002″. The parallax of Polaris is given as 0·014″, in good agreement with the value 0·016″ obtained from the law connecting luminosity with period in Cepheids. That of Betelgeuse is also 0·014″, which is near the mean of other determinations. For α Centauri and 61 Cygni the values found were 0·770″ and 0·300″, but these are more a check on the graduation of the curves than of the parallaxes themselves.

THE OLD BABYLONIAN VENUS TABLETS.—A note in these columns more than a year ago described Dr. Fotheringham's work in dating these tablets, which are an important source for early chronology. Father Kugler was the first to deal with the problem, and fixed on the dates −1800 to −1780 for the series of observations contained in the tablets. Dr. Fotheringham made the dates 120 years earlier (they must be shifted by multiples of 8 years, owing to the fact that both Venus and the moon nearly repeat their positions relatively to the sun after this period). Dr. C. Schoch has lately been visiting Dr. Fotheringham at Oxford, and has just published a pamphlet entitled "Ammizaduga," which makes a further alteration in the dates, making them −1856 to −1836. One difficulty in the research is the question of intercalary months, with regard to which Ammizaduga appears to have changed the system. Light is thrown on them by study of the tablets relating to the harvests of dates and barley, as these give an indication of the position reached by the sun. It is claimed that, taking all the circumstances into account, the dates now adopted are the only ones that satisfy all the data. The mean dates of Nisan 1 reduced to Julian reckoning are given as follows:

Year 0	Nisan 1 =	Apr. 7, 15 days after equinox.
,, −1000	,,	Mar. 30, 1 day before equinox.
,, −2000	,,	Mar. 29, 9 days ,, ,,
,, −3000	,,	Apr. 1, 14 ,, ,, ,,

Research Items.

Physical Characters of Serbian Gypsies.—Dr. Viktor Lebzelter has recorded in the Journal of the Gypsy Lore Society, Ser. 3, vol. 3, Pt. 4, the results of anthropometric observations made in 1916 on forty-five Serbian gypsies who were prisoners of war. Gjargjevič has classified the gypsies of Serbia into three strata, of which the first and third are Moslems and the second Christian—Rumanian gypsies who with the other Rumanian inhabitants of Serbia entered the country in the seventeenth century. The subjects of Dr. Lebzelter's observations belonged to the Christian stratum, though only seven called themselves Rumanian gypsies. They came from north-west Serbia and all were sedentary. They were remarkably homogeneous. Their hair was thick, and smooth like that of Hungarian and Bosnian gypsies. In the majority of cases it was black, but ranged to light brown. The colour of the iris in eighteen cases was dark brown, but black-brown, brown, greenish-grey, brownish-grey, and greenish-brown also occurred. The average height was 1627 mm.; 24 per cent. were tall or very tall. The cephalic index ranged from 72·49 to 88·76, the average being 78·3. From an analysis of published measurements of Balkan gypsies, 952 individuals, Dr. Lebzelter concludes that the original type is dark, smooth-haired, moderately short, mesocephalic, moderately hypsicephalic, leptorhine, and perhaps leptoproscopic. The Serbian gypsies show this original element more clearly than the Hungarian gypsies.

Tribes of the Grassland Area, Cameroon.—Capt. L. W. G. Malcolm has contributed to *Mitt. Anthrop. Gesellschaft in Wien*, Bd. 55, a detailed study of the physical anthropology of the Eγap tribe of the Central Cameroon. The observations were confined to males, forty-four measurements being taken on each of one hundred individuals between the ages of twenty and fifty years out of a total adult male population of not more than 700. Five albinos with eyes hazel to green in colour were seen, and *leucoderma* on hands and legs is common in both sexes. Deformations include elongation of the head, the infant's head being moulded by the mother soon after birth, moulding of the nose, piercing of ears, lower lip, and septum of the nose, chipping of the teeth, circumcision, cicatrisation, and tatooing. The ratio of males to females is 25·92 per cent. The rate of infant mortality is high, and the number of children in polygamous families low. The head-chief, with more than 100 wives and concubines, had twenty-five children, of whom only five were living. Other chiefs with wives numbering between twenty and fifty had even fewer, and in nearly all cases there are more children by monogamous marriages. The maximum head-length recorded is 205 mm., the minimum 180 mm., the mean cephalic index 79·37. While the Eγap are mesaticephalic, according to the usual classification, they show a strong tendency to brachycephaly.

The Relativity of Time.—An article in the February issue of *Scientia* by Prof. F. Severi of the University of Rome deserves the attention of all who are interested in the philosophical aspect of the principle of relativity. It is an examination of objections of a general kind to the relativity of time. The argument deals with three objections to Einstein's definition of simultaneity: "Two flashes produced at equal distances from me are simultaneous if I perceive them at the same instant." The first objection is that the definition depends on a concept of simultaneity which is spontaneous and intuitive, the very concept the definition seeks to get rid of. The second is that logically the definition is circular, for it presupposes that the light reaches me from the two places at which the flashes are produced in equal times, whilst I can only measure intervals of time if I already possess the notion of simultaneity. The third is that the hypothesis of the independence of the velocity of light of the motion of the source and of the observer is *a priori* untrustworthy, because it precludes our thinking of a light phenomenon in the concrete, that is, as a phenomenon arising, developing, and finishing within its own environment. Prof. Severi, in replying to these objections, concludes a very lucid argument with the opinion that, so far from the principle of relativity having, as some have claimed, removed the last anthropomorphic vestiges from science, absolute time is both egocentric and anthropomorphic; and, however we regard the universe, whether as a reality external to us or as the projection of a construction of our mind, the maxim of Protagoras remains profoundly true: man is the unity of the measure of the universe.

Differentiation of Breeds by Serological Methods.—The *Journal of Immunology* (vol. 9, No. 6, November 1924) contains a paper by W. Bialosuknia and B. Kaczkowski, of the Institute for Serological Research and the Animal Breeding Department of the Institute for Agricultural Research in Poland, on the problem of determining the descent of certain breeds of sheep by applying the methods previously adopted by Londsteiner and others in their researches on the isoagglutination of blood among races of men. The sheep employed in the investigation were Southdowns, a local Polish breed, a mountain breed from the Carpathians and Karaculs. It was definitely shown that whereas certain types of erythrocytes are agglutinated by all the sera having the capacity for agglutination, others are only agglutinated by certain sera, and that the sheep investigated fell readily into groups according to the results of the isoagglutination test. It was impossible, however, to distinguish the breed of sheep by this test, since the same groups were present within the various breeds. Nevertheless, evidence was obtained of the existence of serological characteristics which could be transmitted in accordance with Mendelian expectation. It was found, moreover, that external factors played no part in the phenomena of isoagglutination. The authors are pursuing the subject further.

Herring Investigations.—The report for 1923–24 of the Dove Marine Laboratory, Cullercoats, Northumberland, drawn up by Prof. Meek, contains an account of a large amount of work. Following up his researches on herrings Mr. B. Storrow, who for many years has made this his speciality, contributes a detailed paper on herring shoals in which he reports on more than 7000 examples from various localities. He finds that those from the Smalls and from St. Ives were of mixed growth and practically all mature, making it difficult to fix separate races. From examination of the scales of the various herrings he makes the suggestion that the larger growth variations, as indicated by these scales, are to be interpreted as representing periods of migration to or towards areas of greatest growth which are oceanic, and he concludes that in the case of the North Sea herrings, a northerly migration is necessary to bring about a more rapid increase in size. Mrs. Cowan adds a report on the size of the herrings showing that various shoals of different sizes and ages appear at different times.

Experiments on Echinoderms.—The report for 1924 of the Marine Biological Station at Port Erin,

Isle of Man, by Prof. Jas. Johnstone, states that most of the research done at that laboratory has been published elsewhere, the amount of this work showing abundant activity on the part of the staff. In the appendix, however, there are two interesting papers, one by Mr. J. Ronald Bruce, naturalist of the Port Erin Station, on the seasonal and tidal P_H variation in the waters of Port Erin Bay, and one by Mr. H. C. Chadwick, research zoologist, entitled "Natural History Notes," in which he gives some recent plankton observations and describes some very interesting experiments on the vitality of the spines and pedicellariæ of echinoderms from detached portions of the test. It is shown that these may still respond to stimuli after thirteen days, and pedicellariæ alone when detached from the test may retain their vitality almost as long as when *in situ*. With regard to the unnamed larva figured in these notes, there seems no doubt that it is the free-swimming cercaria of the trematode *Pharyngora bacillaris*, which is to be found fairly commonly in the Channel in the winter months and is conspicuous in having an annelid-like tail regularly provided with setæ. The intermediate host may be a medusa or a ctenophore, in which it lives freely without encystment, and the final host is the mackerel. The parasitic ciliate protozoon *Cryptochilum boreale* in *Echinus esculentus*, from the Shetland Islands, recently described by Mr. C. C. Hentschel, is found to be common in the Echini from Port Erin.

POLLEN DEVELOPMENT IN SWEET PEAS.—The extensive genetical studies of *Lathyrus odoratus* by Bateson, Punnett, and others make a critical investigation of the cytology of this species desirable. In a preliminary account of such a study (*Brit. Journ. Exptl. Biol.*, vol. 2, p. 199), Miss J. Latter describes some of the features of the pollen development. The haploid chromosome number is already known from the work of Winge to be seven. In the second contraction stage of meiosis, the spireme is thrown into seven radiating loops, and for this stage Prof. Gates suggests the term broxonema. Each loop consists of a pair of chromosomes end-to-end. When the thread is still very slender the arms of the loop are frequently twisted about each other near the base. This would provide a possible basis for crossing-over combined with telosynapsis. Hitherto crossing-over has only been described in connexion with parasynapsis or a side-by-side pairing of chromosome threads. The view is also expressed that the linin rather than chromatin is the probable basis of inheritance.

ANIMAL ATTACKS ON LEAD TUBING.—At the Linnean Society on March 5, Mr. Gerald Loder showed a piece of lead piping from Waterloo Station, London, gnawed by rats. "The general opinion was that the rodents gnawed the metal in order to wear down their teeth, and not to reach the water or to enlarge a passage-way." The destruction of lead tubes by animals is also discussed by Prof. R. Hesse of Bonn in the *Biologisches Zentralblatt*, Part I., for 1925. He here explains the action of the rats in gnawing through a tube of 4 mm. thick as due to their endeavour to penetrate from a cellar into a basement, an endeavour which a stream of water from the pierced pipe would presumably throw considerable cold water upon. Dr. Hesse describes other examples of metals being attacked; thus in Shanghai species of Xylocopa eat through the lead sheath on telephone cables, although it is 0·8 mm. thick. The correspondent of a cable company explains that these "wasps" mistake the cables for bamboos and bore the holes in order to deposit their eggs therein! As soon as a rough "twine braiding" is wrapped round the smooth cable, it no longer has attraction for them and they leave it alone. The same cable firm reports the penetration of a submarine cable, armouring, jute and lead sheath, by chitons, which had slowly penetrated even the lead tube presumably by the slow chemical action of acid substance excreted from the foot.

THE SARCOPT OF THE BUFFALO.—T. M. Timoney gives an account in Bull. 154, Agric. Res. Inst., Pusa, 1924, of the bionomics of this parasite as observed at Muktesar. The average number of eggs laid by a female under experimental conditions was 17 to 18, and ten days was the maximum duration of life of an egg-laying female. The incubation period of the eggs is 1 to 2 days at summer temperature, and 2 to 3 days in winter. The interval between hatching from the egg and attaining adolescence is 6 to 8 days. The ovigerous and pubescent females can withstand better than the other stages separation from their host. The author records tests with 10 per cent. creosote in olive oil, which suggests that it may be found effective in controlling this sarcoptid.

TEXTURE AND STRUCTURE.—In the *Geol. Fören. Forhandl.* Bd. 46, Dec. 1924, pp. 654-660, P. J. Holmquist summarises the different definitions and usages of the petrographic terms "texture" and "structure." There is more diversity of opinion with regard to the latter term than to the former. Iddings, for example, applies "structure" to features due to fracture, aggregation, or erosion; whereas many Continental petrologists have used the term in the Anglo-American sense of "texture": that is, to connote the manner in which the internal units of a rock are arranged. Holmquist suggests that the confusion be brought to an end by accepting the meanings given by Holmes in his recent "Nomenclature of Petrology," these being also the meanings that have long been adopted by Törnebohm and other Swedish petrologists. "Structure" is thus applied to the appearance of a composite aggregate which is itself made up of simple aggregates, and each of the latter has a "texture" due to the degree of crystallisation, the grain size, and the shapes and interrelations of the crystals or other constitutional units.

EQUIPMENT FOR ARCTIC EXPEDITIONS.—The plans of the *Terra Nova* and a detailed list of its equipment and stores during its employment with Captain Scott's expedition form one of the most recent publications of the British Antarctic Expedition (1910–13) (London: Harrison and Sons, London. 5*s*. net.). The publication, which is edited by Col. H. G. Lyons and is entitled "Miscellaneous Data," contains also some notes on equipment and transport animals which should prove useful to expeditions of the future. It is of interest to note that the mules used by the search party in 1912 seemed far better suited to the Antarctic conditions than the ponies which Captain Scott used in the earlier stages of his southern journey. They were Indian pack-mules trained for snow work in the Himalayas. The volume also includes a short note on the tidal observations.

MOVING RAINBOWS.—In NATURE of Dec. 13, 1924, p. 860, Mr. G. B. Deodhar described some interesting observations made by him of a double and mobile rainbow. Mr. G. Fergus Wood, of the Forest Research Institute, Dehra Dun, writes to say that he happened to witness a somewhat similar phenomenon a year or so ago. He says: "I had just taken some readings with a theodolite in the early morning when an incomplete rainbow appeared in the sky above the point which I had been observing. The sky was clear, with the exception of a few clouds in the neighbourhood of the shower responsible for the bow. I elevated the telescope to look at it; as I did so the bow began to move rapidly out of the field of view so that I had

to depress the instrument to follow it. The movement was about 3°. I could detect no change in colour sequence or in radius, though the final bow seemed brighter and was complete. The movement lasted less than thirty seconds." Mr. Wood does not agree with Mr. Deodhar's explanation of two bows appearing in the sky close together and with the same colour sequence. He remarks: "I am inclined to attribute both phenomena to either a reflection or refraction of the sun's rays before entering the rain, or to a reflection (unlikely) or refraction between bow and observer. The latter—in the nature of a mirage effect—seems to me the most probable, since the time was favourable and magnification is frequently the result of mirage."

THE THEORY OF STRIATED DISCHARGE.—An explanation of the mechanism of the striated discharge, based on recent investigations of collisions between electrons and atoms, is given by Prof. A. Günther-Schulze in the *Zeitschrift für Physik* for February 11. He shows that in many gases, even when the collisions are inelastic, the velocity of the electrons, which move irregularly in all directions, increases in an electric field up to a definite maximum value. He gives the law which governs the velocity at different distances from the cathode, where it is zero. If the velocity expressed in volts is less than the excitation voltage of the gas, the losses on collision with the atoms will be small, and there will be no luminosity; when, however, the velocity reaches this point, the energy of a colliding electron will be given up to the atom, which will emit light. This will take place at a definite distance from the cathode, and the first bright stria will be produced, the velocity of most of the electrons being reduced to zero. It is known that faster electrons are not so likely to produce excitation as those that have the excitation velocity, and most of the former will pass on into the succeeding dark space, where they will not produce luminosity. The same is true of the electrons which have been brought to rest in the first stria, which will gradually acquire velocity as they pass through the dark space, and will excite the atoms in a second narrow zone when they have acquired the correct velocity.

THE ABNORMALLY LOW VOLTAGE ELECTRIC ARC.—Dr. R. Bär describes experiments with mercury vapour, argon and helium in the *Zeitschrift für Physik*, February 19. With mercury the smallest excitation voltage ($1S - 2p_3$) is 4·7 volts, and the voltage corresponding to the resonance line 2537 Å.U. ($1S - 2p_2$) is 4·9 volts; but Hebb found that an arc would burn with 1·7 volts and Yao with 1·8 volts. The author's experiments were directed towards finding whether such low voltages would suffice when there were no oscillations in the current and voltage, and his result was that the lowest steady voltage which would give an arc was 2·25 volts. Previous experiments by Bär, v. Laue and Meyer have shown that the arc produced in helium, at 8 volts, by Compton, Lilly and Olmstead was due to oscillations in the voltage, the peak voltage rising above the critical value 19·8 volts. The author has now succeeded in producing an arc in helium with a steady voltage of 16·5 volts, using specially purified helium and a very hot cathode wire.

A SUGGESTED EXPLANATION OF THE QUANTUM THEORY.—M. L. de Broglie, in the *Annales de Physique* of January-February, assumes the existence of a periodic phenomenon, the exact nature of which has still to be determined, which is connected with every isolated "portion of energy," including electrons, protons, matter in general, and quanta of light and X- and γ rays. The fundamental idea of the theory of quanta is the impossibility of considering an isolated quantity of energy without associating with it a certain frequency, in accordance with the equation $E = h\nu$, which must be connected with the mass of the energy portion, or mobile, by the Planck-Einstein equation. Considering the question in the light of the relativity theory, it is found necessary to associate with uniform motion of a material point a certain wave propagated from it, the phase of which is displaced in space with a constant velocity greater than that of light. In the more general case of an electrically charged body, moving with variable velocity in an electromagnetic field, it appears that the principle of least action in the form given by Maupertuis, and Fermat's principle of concordance of phase, may be two aspects of a single law. The known laws of quantified trajectories can be interpreted as expressing the resonance of the phase wave along the length of closed or quasi-closed trajectories; this appears to the author to be the first physically plausible explanation proposed for the Bohr-Sommerfeld stability conditions. The theory leads to a real harmony between the views of Newton and of Fresnel; but it is shown that the electromagnetic theory requires revision, though as a statistical approximation the existing theory is perfectly satisfactory in a very large number of cases. The scattering of X- and γ rays, statistical mechanics, and the law of radiation of a black body are dealt with in accordance with the new theory.

HOLMIUM.—F. H. Driggs and B. S. Hopkins describe in the February number of the Journal of the American Chemical Society some work carried out on holmium. Holmium and yttrium were separated from erbium by fractional crystallisation of the bromates; yttrium was removed by thermal decomposition of its nitrate. The ratio of holmium chloride to silver was determined, the results giving a mean value of 163·47 for the atomic weight of holmium.

THE CALOMEL ELECTRODE.—A method of preparing calomel directly in saturated potassium chloride solution is described by W. W. Ewing in the Journal of the American Chemical Society for February. A current of 1·3 amp./dcm.^{2} at 35-40 volts was applied to the system Hg^+ KCl(sat.) *N* KCl $CuCl_2$(sat.) Cu^-. Calomel mixed with potassium chloride crystals and finely divided mercury collected on the mercury surface, which was continually scraped with a stirrer. This method is less tedious than the older one, and the product is shown to be a dependable standard for use in the calomel electrode.

THE HABER EQUILIBRIUM.—It has recently been found that the equilibrium constant of the Haber equilibrium (hydrogen, nitrogen and ammonia) is a function of pressure, and it follows that such data can be used, at least in principle, to test assumed forms of the mass action law. Existing data must be supplemented with hypotheses, however, enabling us to pass from the properties of pure gases to those of mixtures; and L. J. Gillespie, in the February number of the Journal of the American Chemical Society, points out that the rule of Lewis and Randall for calculating the fugacity of a gas in a mixture offers a suitable hypothesis, provided it is made exact by the addition of a certain supplementary term based on the assumption that at large volumes the equilibrium pressure is equal to the ideal-gas partial pressure. The author shows thermodynamically that the three propositions—exactness of the modified fugacity rule, additivity of volumes and additivity of heat content—all follow from any one of the three. An experimental method is outlined for testing the author's results.

Submarine Measurements of Gravity.

RECENT years have witnessed great advances in our knowledge of the gravitational field near the earth's surface on land, but in spite of many efforts the extension of these determinations to oceanic regions has until quite lately proved a very intractable problem. It would now seem that substantial success has at last been achieved, as the result of trials of a specially designed apparatus and method during a voyage of a submarine from Holland to Java in 1923. The apparatus used is a development of one which was devised to overcome difficulties experienced in ordinary pendulum determinations in Holland, where the unusual mobility of the soil had made it impracticable to eliminate slight movements of the supports. These motions were rendered innocuous by suspending from the same plate several pendulums, having very nearly equal periods of vibration, and causing them to vibrate in different phases. The success of this device led to its trial at sea also, on a steamer of 1200 tons, but the weather was bad and the pitching and rolling of the vessel spoilt the attempt. Prof. van Iterson, Director of the Netherlands State Mines, then suggested that these disturbances might perhaps be avoided, or sufficiently reduced, by making observations on a submerged submarine instead of on a floating vessel. Preliminary trials confirmed the value of this proposal and arrangements were then made for a more exhaustive test.

Dr. Vening Meinesz, who was responsible for the investigation, has recently published a provisional account of the work.[1] The apparatus (made by Stüchrath) consisted of two pairs of pendulums suspended from the same plate, oscillating in opposite phases, two by two in planes at right angles. Their oscillations were recorded photographically. The pendulums were of brass, which led to difficulties in connexion with their large temperature corrections, since the temperature in a submerged submarine quickly rises; invar pendulums could not be used because of their susceptibility to magnetic fields, which are scarcely avoidable in a submarine. Dr. Meinesz suggests that errors arising from this source should be reduced in future experiments, either by the use of quartz pendulums, or by shielding the instrument from changes of temperature. The apparatus was mounted on a large wooden stand, which was not so firmly fixed as not to require watchful guard against shocks. It was placed as near to the metacentre of the submarine as possible.

Successful experiments were made in the Mediterranean and in the Indian Ocean. The pendulums were swung for periods of fifteen to twenty minutes, but rather longer periods, up to thirty or forty minutes, are recommended in future work. The various sources of error are discussed by Dr. Meinesz, who concludes that the mean error of a determination of the time of oscillation of a pair of pendulums in calm weather was 2 to 3 units of 10^{-7} second, and in rough weather, with the submarine at a depth of 20 or 30 metres, about 10×10^{-7} second.

This work by Dr. Meinesz was recently described by Colonel Lyons at a Geophysical Meeting of the Royal Astronomical Society, and it was urged that similar work should be carried out by other countries. Sir Gerald Lenox Conyngham discussed the results obtained (in Dr. Meinesz's provisional report this is not done, nor is any chart or topographical description of the observation points given, except latitude, longitude, and the depth of the ocean). The observed values of gravity far out at sea differ sufficiently little from the computed normal values to indicate that there must be isostatic compensation. Near land the compensation seems to be less complete, and it was stated that Dr. Meinesz infers a greater extension of the compensating layer below the mainland than is required by the theory of isostasy.

[1] "Observations de Pendule sur la Mer pendant un Voyage en sous-marin de Hollande à Java, 1923." Publication Provisoire par Dr. F. A. V. Meinesz.

Factors influencing Growth in Trees and Plants.

THE Carnegie Institution of Washington has recently published the results of a further very interesting series of investigations on growth in trees and massive organs of plants.[1] Prof. D. T. MacDougal's dendrographic measurements provide considerable additional information on the behaviour of tree-trunks. The investigations, which were conducted chiefly on conifers, but also on broad-leaved species, cover the duration of the growing season, seasonal activity, the increase of wood and of roots, the path and rate of movement of liquids in stems and the general use of the dendrometer for measuring the yearly increase in the circumference of stems. In addition, auxographic records are obtained of the growth of Opuntia stems and flowers, Mesembryanthemum leaves, potato tubers, and the fruits of Cucurbita. The experiments were conducted principally on plants grown in the open and under the full influence of their habitual environment so that the normal activity of the plants was not disturbed. Amongst the interesting conclusions to which Prof. MacDougal directs attention in his summary the following may be noticed.

In the investigations on the Monterey pine (*Pinus radiata*), it is observed that the duration of seasonal growth is longest in young trees, whilst wide differences are exhibited by older trees. The thickness of the woody layer shows a general correlation to the length of the growing season but no constant relation to the total amount of rainfall; it is more likely to be due to the favourable conjunction of a number of factors in which seasonal relative humidity may be an important agent. The flow of solutions, as shown by the use of dyes, is found to be much greater late in the season than in the stage of rapid growth, and confirmation is obtained that the sap travels chiefly in the wood of the two previous years. Several other interesting associations of facts in connexion with the movement of liquids and variation in girth of stem are also recorded.

In general, it is found that practically all organs or members tested with the dendrograph show daily equalising variations in size and volume in direct relation to their water-balance, and that these daily equalising variations are characteristic of each species. Further, the results of these investigations show that the amplitude of the daily variation is not dependent upon the softness of the wood and the character of the bark.

The development of potato tubers, as recorded by auxographic apparatus, shows that the period of enlargement may be estimated at 90 to 100 days, and that their behaviour is comparable to that of nuts and fruits.

The second part of the bulletin contains Dr. Forrest Shreve's records on the growth of trees. A series of

[1] "Growth in Trees and Massive Organs of Plants. Dendrographic Measurements," by D. T. MacDougal "The Growth Record in Trees," by Forrest Shreve. (Publication 350.) Pp. 116. (Washington: Carnegie Institution, 1924.) 1.50 dollars.

detailed analyses of stems of different ages and a consideration of the results obtained of growth in relation to rainfall and temperature lead to some very interesting conclusions. Examination of trunks of pine and redwood shows that the annual rate of growth is not the same at the stump and at different heights in the trunk, and that it is greater toward the centre than towards the periphery. No definite correlation is found between growth and rainfall and growth and temperature, and the conclusion drawn is that the annual growth of the specimens examined is dependent on the general complex of environmental conditions and not on any one particular factor.

A further contribution to this study has recently been published in the Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan.[2] The experiments, which took place in the University Botanic Garden at Sapporo, were conducted to show the influence of meteorological factors on the growth of trees, or, more precisely, on the girth of the trunk. Prof. Hirokichi Nakashima was fortunate in being able to select a healthy young specimen of *Abies Mayriana*, about 50 years old, which was growing a convenient distance from a meteorological station.

Until recent years it was supposed that the girth of the stem increased continually from spring to autumn, and that in winter during the resting period the girth remained unaltered. The experiments, however, showed that even in winter appreciable increase and diminution in girth took place, depending chiefly on meteorological factors. In fact each cycle of development may be divided into four periods. During the vegetation period, from the end of April to the end of October, precipitations proved the most important factor. The relations between transpiration and absorption were the determinants through the autumnal transition period, the month of November, and the late spring period March and April. During the resting period, from mid-December to the beginning of March, the temperature of the air was the chief factor. Prof. Nakashima has been able to express these relations in formulæ. The conclusions drawn are that increase in girth depends either on growth or on the swelling of water-containing tissue; changes in girth are connected with transpiration and absorption; increased transpiration without corresponding water-absorption by the roots causes decrease in girth; prevention or reduction of transpiration during absorption causes swelling of the stem, and, generally, increase and decrease of girth are closely connected with meteorological conditions.

The article is accompanied by the daily meteorological observations and experimental records of the whole period of five years during which the experiment lasted. The apparatus used for measuring the varying size of the stem was Friedrichs Zuwachs-autograph.

[2] "Über den Einfluss meteorologischer Faktoren auf den Baumzuwachs, (1) Über den Einfluss auf den Stammumfang eines Tannenbaumes," by Prof. Hirokichi Nakashima, Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan, vol. 12, Part 2, p. 69. Published by the University, Sapporo, November 1924.

Haddock Biology.

THE first part of a paper on the biology of the haddock, by Mr. Harold Thompson, was referred to in NATURE, August 30, 1924, p. 333. The second part, on the frequency and distribution of the age classes in 1923, which has recently been issued,[1] gives an account of later investigations. In the first part it had been shown that the year 1920 had produced a remarkably large brood of young haddock, which in 1922 were beginning to show in the commercial catches as two-year-old fish. We now learn that in 1923, as Mr. Thompson had ventured to predict, these fish had become the mainstay of the North Sea haddock market, and that they constituted 70·5 per cent. of all the haddock captured, so far as these were sampled.

The years 1921 and 1922 were both failures so far as the young brood of haddock in the North Sea was concerned, but it is pleasing to note that 1923 was one of the best years on record. If all goes well with the brood, these fish should become prominent in the commercial catches in 1926 as three-year-old fish. Mr. Thompson was able during 1923, by a detailed study of the scales of this group of haddock, to establish still more closely the relation between the growth of the scale and the growth of the fish. He shows that the scales first formed on the fish are those which lie immediately below the third dorsal fin, and if scales from this position in older fishes are selected for examination, it will be found that the length of the fish at the end of each growth-year can be determined correctly on the assumption that the growth of the fish is directly proportional to the growth of the scale. On the other hand, scales from below the second dorsal fin will give a calculated result about half a centimetre short, and those from below the pectoral fin 2.75 cm. short. This is an important point to have established and will clear up many of the difficulties which those working at problems of the growth-rate of fishes have encountered.

Further observations are recorded on haddock from Iceland, the Faroes, and from the Norwegian coast. The rate of growth of Iceland and Faroe haddock appears to be much greater than that of North Sea fish, but in Iceland the rate decreases from the south coast, by west and north to the east coast, where it is smallest. Good survival years for the brood at Faroe, Iceland, and Norway differ from each other and rom those of the North Sea.

[1] Fishery Board for Scotland: Scientific Investigations, 1924. No. 1, Haddock Biology; No. 2, Frequency and Distribution of the Age Classes in 1923. By Harold Thompson. Pp. 48+4 plates. (Edinburgh and London: H.M. Stationery Office, 1924.) 5s. net.

University and Educational Intelligence.

ABERDEEN.—At the graduation ceremony held on April 1, the degree of D.D. was conferred on the Right Rev. E. W. Barnes, F.R.S., Bishop of Birmingham.

LONDON.—The two following courses of free public lectures at King's College are announced: "Problems of Modern Physics," Prof. W. Wien, on April 21, 22, and 23; and "Recent Advances in the Study of Living Cells," Prof. R. Chambers, on April 27, 28, and 29. The lecture hour in each case will be 5.30.

THE Council of the University College of Southampton is to award two open exhibitions in engineering to candidates who may or may not be now resident in the district. The awards will be made on the recommendation of the Engineering Faculty Board without formal examination, provided the candidates have matriculated and are prepared to read for a degree in engineering.

THREE open scholarships, each of the yearly value of 40*l.*, some bursaries of 20*l.*, and others covering the tuition fees in commerce are being offered in competition by University College, Leicester. The examination will be held at the College in June. Particulars may be had from the secretary.

IF industrial prospects in Great Britain are at present clouded, good progress can be recorded in

the direction of improved social service. The activities of the Carnegie United Kingdom Trust, as set forth in the eleventh annual report, may be summarised as an attempt to restore to the English people the amenities of life which their forefathers enjoyed, and of which they were deprived by an over-rapid development of the factory system. The library policy of the Trust has, as is well known, been directed to the provision of facilities for reading in the rural districts by the establishment of County Library schemes reinforced by Central Loan Collections. Grants for the establishment of County Libraries have now been made in eighty-six counties in the United Kingdom of Great Britain and Ireland, and in the course of a few years these will all be on an independent basis. The development, however, of the Central Loan Collections on self-supporting lines presents many difficulties. The cost of the administration of these national book stores is likely to increase more rapidly than the income from the contributory libraries, and it is clear that in the long run some assistance will have to be provided by the State. In the meantime the grant to the London Central Library has been increased from 1000*l.* to 3000*l.*, at which sum it will be maintained for the next four years. Other activities of the Trust in the direction of fostering the national talent in musical composition, the drama, and folk-dancing continue to show satisfactory results. The Margaret Carnegie Hostel for girls at Portree was officially opened last October, and a large grant has been made for the purchase of a building in East London to be used as a hostel for boys.

VISUAL Education Departments in Educational Institutions form the subject of a report published in Bulletin, 1924, No. 8 of the United States Bureau of Education. Of 78 State universities and State colleges, 20 have departments sufficiently well organised to employ special officials to handle visual aids. They are generally organised as parts of the university extension divisions of these institutions, but the work is not entirely extra-mural, and the departmental heads attend faculty meetings. The growth of these departments is described as a teacher movement and not a commercial development: on the contrary, it is a development in despite of the commercial exchanges, which have sided with the theatres in their opposition to supplying films to educational institutions. Five departments undertake the actual production of films. Columbia University has a course in moving-picture production, and the University of Nebraska is said to have built a 20,000-dollar moving-picture studio on its campus. The University of Wisconsin has purchased the negatives of a large group of educational films, and sells the prints direct to other institutions at about 60 dollars per reel of 1000 feet—considerably less than what commercial firms charge. The United States Department of Agriculture and the Bureau of Mines have done much to popularise instruction in agriculture and in mining and metallurgy by the use of films and slides. The Bureau of Mines contrives to produce films without any expense to the Government beyond the salary of an engineer, who assists in planning and directing the work to assure its being worthy of circulation, the whole of the rest of the cost of production and making the copies being borne by the industries filmed. Colleges, high-schools, and churches are the largest users of these films. Though films figure largely in the report, they are by no means universally considered the most useful of visual aids. The slide has a decisive majority vote for usefulness. Much use is also made of stereographs and exhibits of objects from museums.

Early Science at Oxford.

April 13, 1686. A discourse concerning Hydraulic Engines, drawn up by Mr. King of Dublin, was communicated by Mr. Ash: the Society ordered their thankes for this ingenious discourse, both to Mr. Ash, and Mr. King.

Mr. Caswel communicated a Mathematicall paper containing the Solutions of severall problemes, composed by Mr. Baker of Bishops Nymton in Devonshire.

April 14, 1685. Mr. President communicated a farther discourse concerning ye Air's Gravity observed in ye Baroscope, occasioned by that of Dr. Garden read ye last meeting. He also comunicated ye following observation; that at Dover, on March 19 last past, (which was two daies after the last quarter of ye Moon) there was observed this extraordinary in ye Tide: After it had flowed some time, it ebbed two foot; then flowed again, and then ebbed; and after flowed a third time, and so a fourth time: so that there were four flowings, and three ebbings in one Tide.

A Letter from Mr. Cony, dated Rochester March 27, was read concerning the raining of Fish, as it was supposed to have been in that countrie some time since.—Mr. Cole of Bristoll mentioned a substance proceeding from Calamy oar, which far exceeds, in colour and finenesse, all metalls, beside gold, and silver.

April 15, 1684. Mr. Pulleyn informed ye Society, that an Elm, split at Cumnor, during ye late frost, was observed to have Ice in it: It was affirmed that vines have been split this winter, more frequently towards ye South, than any other, point of ye compass; and that they split more in ye Thaw following ye great Frost, than in ye frost itself: ye reason of ye former may be, because vines lye most open to ye South, and partly also (as Mr. Walker imagins) because ye sap-vessells are largest, and ye quantity of ye sap greatest in ye south side of ye vine, as in other Trees. Dr. Smith did himself observe, that ye Cedars of ye Physick garden, raisd from seeds brought out of Syria, bore ye shock of ye frost, without being any way damaged. Mr. Crouch was desired to enquire, whether ye Cedars of Balliol College were any way injured. A Letter dated Aprill 10th, from Mr. Aston, Secretary to ye Royall Society, was read; which questioning whether a body, in shape like ye heel of a Shooe, presented by my Lord Bishop of Lincoln, to Dr. Plot, being esteemed as a Petrification of leather, be any thing more then a bare Incrustation. For ye satisfaction both of ourselves, and ye Royal Society, it was ordered, that this (supposed) Petrification should be examined, as to its make, and texture; more especially by boring it: Mr. Wm. Piggot tooke this charge on him.

Three papers of Dr. Lister's concerning thunder &c. proceeding from Pyrites; and a letter from Sir R. Southwell concerning ye compasses of a Ship being changed by lightning, were read.

A Peice of black Brittish Marble, spotted white, found in ye grounds of Mr. Wogan of Bolston in Pembrokeshire (who uses this sort of stone for ye makeing lime) was comunicated to ye Society, by Dr. John Floyd, Vice-chancellor of ye University. It was ordered to be put in the Ashmolean Museum. This led us to discourse of sawing marble. It was affirmed by Mr. Wheeler that Little Veins, called *pins* by ye stone-cutters, run up and down, and are sometimes so many and so hard, that they dull ye teeth of ye tooles, so that many times it is not worth ye while to worke ye stone.

Societies and Academies.

LONDON.

Royal Society, April 2.—H. E. **Armstrong**: Studies on enzyme action, xxiii. The oxidase effect and the phenomena of oxidation in general: carbonic oxide. —N. K. **Adam** and G. **Jessop**: An explanation of the so-called "intertraction phenomenon" between solutions and the molecular significance of negative surface tension. Solutions mix by sending out streamers into each other only (1) if they are superposed, and (2) if there is a difference in rate of diffusion between the dissolved substances. The streamers are due to the different rates of diffusion between the two liquids disturbing the hydrostatic equilibrium of the layers. Capillary forces are not concerned. The movements are entirely different if (1) the faster, (2) the slower, diffusing solution is superposed. With these restrictions the phenomenon seems to be general, but it involves no unknown forces. "Negative interfacial tension" means that the inward attractive forces which, when surface tension is positive, prevent molecules from escaping across the surface of the liquid, become negative. It is properly manifested in diffusion away from the body of the liquid.—Jane **Sands**: Investigation of oxidation in the blood of earthworms.—R. **Snow**: Conduction of excitation in the leaf of *Mimosa spegazzinii*. Simultaneous determinations were made of the velocities of the water current and of the excitatory conduction set up by cuts in the leaves. The latter is many times the more rapid. After the stimulus of a burn, conduction is much more rapid again. Excitation is conducted much more rapidly in the leaves of shoots totally submerged under water for several hours than in leaves attached to the plants in air. In very damp air the velocity of conduction in the leaf is increased to a less extent. Excitation is conducted down the leaf pinnæ with great acceleration, and this depends in part on the nature of the process of conduction itself. In the leaf of *M. spegazzinii*, excitation is regularly conducted by some mechanism that has nothing to do with the water current. Changes of pressure in the tube-cells play no part in conducting excitation, even in the leaf.—Dorothy **Adams**: Investigations on the crystalline lens. The lens resembles other tissues in possessing an autoxidation system made of two sulphur-containing components: (*a*) water-soluble glutathione; (*b*) a thermostable protein residue. Experiments were made on fresh ox lenses, and oxygen uptake was measured directly and indirectly. Fresh lens has a definite oxygen uptake, evidently used for maintenance of its autoxidation system, since any alteration in concentration of glutathione in the lens causes corresponding change in oxygen uptake. The average glutathione content is higher than that of other more vascular tissues. The thermostable protein residue has no oxygen uptake; but with a few milligrams of glutathione it gives an oxygen-uptake curve exactly similar to that of fresh lens. Exposure of fresh ox lens to ultraviolet light or to heat rays causes measurable decrease in its glutathione content.

Royal Microscopical Society, February 18.—W. Bernard **Crow**: Variation in the hormogones of *Lyngbya nigra* Ag. The hormogones of the blue-green alga, *Lyngbya nigra* Ag., arise by division from the parent filament, the separation being effected by separation discs. Secondary separation occurs in the free hormogones, leading to the formation of very short hormogones. Some of the latter consist of a single segment only, but do not show the characters of spores. The separation discs, which are special deposits in the protoplasm, sometimes occupy a single segment. Ordinary transverse walls are occasionally absent at certain points in the trichome. Conjugations of adjacent segments in other Cyanophyceæ are interpreted as special cases of failure of transverse wall development.—W. L. **Roche**: Notes on the microscopic anatomy of the tentacular sense organ of *Cardium edulis*. The siphonal tentacles of the common cockle are sensory structures, and some bear eyes and curious sense organs situated at the bases of ectodermal depressions. These "hair sense organs" occur on ocular tentacles, but may be on eyeless ones; in the former case the same nerve supplies both. These cells are club-shaped, but do not possess stiff hairs which project to the exterior. They give off fibrils which enclose the bases of the cells of the pit which themselves bear sensory hairs. This organ is probably connected with chemical sense.

Royal Microscopical Society (Industrial Applications Section), February 25.—The microscope in the textile industries. F. **Summers**: The microscope in cotton research. Two main lines of activity can be distinguished. (1) The morphological structure of the raw cotton hair itself is the object of investigation both in the natural condition and also after modification of its structure and properties by the action of chemical substances, as in various trade processes, such as mercerisation. (2) The search for the causes of the many defects—popularly known as faults—in cotton yarns and fabrics, which may be due to the presence of abnormal hairs in the raw material or to irregularities introduced during the various spinning, manufacturing, or finishing processes. The action of mildew upon cotton at every stage of manufacture is also productive of many defects, causing discolorations or, at times, actual decomposition. The study of methods for the prevention of mildew growth on cotton goods forms one of the main features of the botanical research.—T. B. **Bright**: Methods of examination of mildewed cotton material. In the majority of cases mildew is easily diagnosed, but occasionally, though the damage is considerable, there is very little fungus growth, and careful examination under the microscope is necessary.

Physical Society, February 27.—J. J. **Manley**: Notes concerning the Sprengel pump. The walls of the pump are freed from gas skins by electric means, and the shattering of the mercury pellets (which tends to liberate gas) is checked by a special construction of the fall tube.—J. **Young**: The Thomson effect in copper, iron, and carbon steels. The apparatus described by Nettleton in the Proceedings of the Physical Society, April 1922, has been employed. Different results were obtained according as the electric current in the wire under test flowed with or against the temperature gradient.—D. W. **Dye**: An improved cathode-ray tube method for the harmonic comparison of frequencies and for the delineation of their wave form. Convenient arrangements for the superposition of a telephonic and a radio-frequency displacement of the light spot of a cathode-ray tube are described. The arrangements include the following: (1) Circular or elliptical trace at a telephonic frequency to serve as a time axis; (2) radial, circular, and straight-line displacements at low radio or high audio-frequencies superposed on the circular or elliptical time trace; (3) the superposition of a long narrow elliptical time displacement and a straight-line high-frequency displacement in a direction at right angles to the major axis of the ellipse. By this means a considerable portion of the time ellipse is nearly a straight line representing a uniform time axis. The wave shape at the high

frequency then appears in normal form, and may be made of quite considerable size. When an oscillatory valve system is arranged with grid and anode circuits closely coupled and harmonically resonant to each other, wave forms consisting of a fundamental and a resonant single harmonic can be produced.

Linnean Society, March 5.—G. C. **Robson**: Seriation and asymmetry in the cephalopod radula. The central tooth of the radula of many Octopoda exhibits a peculiar growth-phenomenon unique among the Mollusca. In the radula of *Octopus vulgaris*, for example, the ectocones in successive teeth occupy a progressively more external position, the migration from an internal to an external position usually occupying five teeth, after which a fresh ectocone appears and migrates outwards. This seriation is regularly asymmetrical. The asymmetry is possibly adaptational.—K. H. **Barnard**: A revision of the family Anthuridæ (Crustacea, Isopoda), with remarks on certain morphological peculiarities. Twenty-four genera are recognised, of which seven are new. Sixty-six species are diagnosed, of which twenty-one are described for the first time. Particular attention is given to the occurrence of paired and unpaired statocysts and to the arrangement of the parts forming the tail-fan.—E. Marsden **Jones**: The pollination of *Primula vulgaris*. Fifteen species of insects were seen visiting the flowers. Of these, six have a proboscis long enough to pollinate satisfactorily and appear to be adequate to effect pollination. Bombylius especially was found visiting consistently and almost exclusively the primrose. No night visitors were seen. The plants examined showed a good record of seed production, while two plants under control, a long and a short styled form, failed to produce a single capsule. It therefore seems that insect agency is necessary to secure pollination.

EDINBURGH.

Royal Society, March 9.—A. H. R. **Goldie**: Discontinuities in the atmosphere. The origin of "inversions" of temperature and discontinuities of motion in the atmosphere, and the dynamics of waves at a surface of discontinuity, are discussed; events are supposed to take place under adiabatic conditions. It is suggested that continuous ground level records may provide a means of estimating upper air structure. The effects of rotation of the earth on the wave motions are dealt with mathematically, and the results are in fair agreement with actual values taken from autographic records.—A. P. **Laurie**: Stone decay and preservation of buildings. The principal cause of rapid decay of stone is the crystallisation of calcium sulphate within the stone. The pollution of air by sulphur dioxide extends to remote regions in the country, and in the case of silicious sandstones, pollution of the stone with lime dissolved out of the mortar or cement acts as a trap for the sulphur acids. Anything in the nature of a skin over the surface of the stone like cement or plaster of Paris acts like an osmotic diaphragm, allowing free evaporation of water but causing a crystallisation pressure within the stone. Thus the length of life of limestone buildings will probably be increased by periodical washing in the summer. Stones should be selected for their resistance to acid attack and the rapidity with which they absorb and lose water.—W. H. **Watson**: An investigation of the absorption of superposed X-radiations. Two beams of X-rays transmitted in different directions through aluminium do not suffer any change in absorption as a result of superposition. This holds when both beams experience the J transformation by transmission. No information could be obtained for the case where only one beam is so transformed. The incidence of a hard primary beam on silver which is absorbing a beam of the characteristic radiation of K series of that element does not influence the absorption of the latter beam in the manner expected in terms of C. T. R. Wilson's conclusions from β-ray photographs.—H. S. **Allen**: Note on Whittaker's quantum mechanism.—H. W. **Turnbull** and J. **Williamson**: The minimum system of two quadratic forms. A strictly irreducible system of projective invariants of two quadratics and any number of linear forms consists of $3n+1$ members, where n is the number of homogeneous variables involved. The number of algebraically independent invariants is $3n$.—Marion C. **Gray**: The equation of the conduction of heat. The problem of the conduction of heat depends on the solution of a second order partial differential equation of parabolic type. Various general solutions of this equation have been given, notably by Fourier, Forsyth, and Poincaré. The apparently different general solutions can be derived from one another.

PARIS.

Academy of Sciences, February 23.—Ch. **Moureu**: The destruction of the original calorimetric bomb of Berthelot. Its replacement by a bomb of a new type.—Georges **Giraud**: The generalised problem of Dirichlet; non-linear equations with m variables.—Gaston **Julia**: Series of rational fractions of iteration.—N. **Abramesco**: The curves of convergence of series proceeding according to the inverse of given polynomials.—Léon **Pomey**: The theorem of the existence of solutions of linear partial integro-differential equations.—Georges **Valiron**: An integral function of zero order which is a solution of an algebraical differential equation.—**Jarry-Desloges**: Contribution to the study of the phenomena of the surface of the moon.—**Ferrier** and L. **Besnerais**: A new law of electromagnetism. Admitting that two electrified particles exert on each other actions of equal and opposite magnitude $d\mathrm{W}/dr$ with $\mathrm{W}=e^2\mathrm{F}(u, \ldots)/r$, it is possible to conceive the existence of an electric ether constituted uniquely by particles of the same sign. This formula can interpret, not only the known phenomena of electromagnetism, but also certain hitherto unexplained facts in the field of radioactivity.—B. **Szilard**: A method of comparison permitting the measurement of extremely small currents. A detailed description, with diagram, of a method of measuring very small ionisation currents of the order of 1 U.E.S. with an absolute error of $1/10^5$ U.E.S. unit.—François **Liana**: The transparency of glasses in the infra-red. Fifteen kinds of glass have been studied in the infra-red spectrograph of Moll. For a thickness of 15 mm. and for radiations of wave-length higher than $3{\cdot}2\mu$, all the glasses were found to be practically opaque. The glass which has been found the best as regards transparency and dispersion is the flint D/262.—Nicolas **Perrakis**: Trouton's quotient at the absolute zero of temperature. Trouton's ratio tends to a finite limit as the temperature approaches the absolute zero.—Francis **Perrin**: The theory of polarised fluorescence. The influence of the viscosity.—Fred **Vlès**: The spectrophotometric measurement of $\mathrm{P_H}$. A formula is derived by means of which the hydrogen ion concentration can be obtained as a function of the ratio of the absorptions, independently of the concentration of the indicator and without a preliminary empirical standardisation.—G. **Athanasiu**: The sensibility of actinometers with mercury electrodes.—A. **Wahl** and Th. **Faivret**: The derivatives of methyl-7-isatin.—Jovan **Cvijic**: Morphological types of calcareous strata.—Jean **Lugeon**: The relations

between various meteorological discontinuities and the atmospherics in the neighbourhood of mountain chains. Atmospherics differ considerably on the plain, in valleys, and on high mountains. There appears to be a direct relation between the electrical state and the weather present over the whole of the Alps and the Jura.—L. **Petitjean**: A stationary discontinuity in the western Mediterranean.—H. **Colin** and A. **Grandsire**: The structure and chemical processes in the beet-root.—Henri Jean **Frossard**: The production of the voice.—H. **Violle** and L. de **Saint-Rat**: The hæmostatic properties of pectin.—Ed. **Bayle** and René **Fabre**: Study of the urinary elimination of alkaloids derived from isoquinoline and especially hydrastine. A small proportion, about 3 per cent., of the hydrastine absorbed is eliminated with the urine.—E. **Fauré-Fremiet** and Boris **Ephrussi**: The action of temperature on the movement of translation of *Arcella vulgaris*.—Robert **Weill**: The skeletonisation of the nematocysts of the Cœlenterata.—Maurice **Piettre**: A new process of metabolism of the reserve fats. Butyrisation outside the breast.—E. **Marchoux**: The action of arsenic on the malaria due to *P. vivax*: Stovarsol (acetylaminophenylarsenic acid) administered either by the mouth or by injection has a rapid action on *P. vivax*, causing its disappearance, but *P. malariæ* and *P. falciparum* are unaffected by this drug. This is evidence against the view that there is only a single parasite, capable of undergoing morphological and biological variations according to circumstances.

SYDNEY.

Royal Society of New South Wales, December 3.—Griffith **Taylor** and F. **Jardine**: Kamilaroi and white; a study of racial mixture in New South Wales. The work was carried out chiefly upon aboriginals of the Kamilaroi tribe and their hybrids with the whites. The tribe occupies the central-north New South Wales. Fifty individuals were measured and details of their castes, hair, eyes, skin colour, etc., were obtained. 19 full-bloods, 7 three-quarter-castes, and 6 half-castes are discussed among the adults, and about a dozen children. The variation of cephalic index with influx of white blood is not noteworthy and does not appear in the frequency curves. The face index, however, shows a broadening in this respect. The nasal index frequency curves indicate influx of white blood very clearly, the half-castes being much more leptorhine. The hair is wavy to curly among the full-bloods, *i.e.* not very different from the hair of white folk. True curly hair was only noticed once. The eyes are usually muddy brown, sometimes with a narrow, slate-blue margin. The skin colour (under arm) is rarely chocolate, usually red-brown in the full-blood men, and Indian red in the women. It changes fairly regularly through yellow-brown to ochre with larger proportions of white blood.—R. H. **Cambage**: Acacia seedlings, Pt. X. Seeds of *Acacia podalyriæfolia* and *A. melanoxylon* have germinated after having been immersed in sea-water for five and seven and a half years respectively, the latter case being regarded as a record for the experiment. Certain of the species of Acacia which flower in midsummer take about one year to ripen their pods, while those flowering in the very early spring commonly have mature pods in four or five months.—A. R. **Penfold**: The essential oil of *Boronia safrolifera*. This recently named species of pinnate leaf Boronia grows in the swampy portions of the heath country around Broadwater, Richmond River, N.S.W. The leaves and terminal branchlets yielded 1·45 per cent. of a pale yellow oil heavier than water, highly refracting, and possessing an odour of its principal constituent, safrol, which was present to the extent of 70-75 per cent. The other constituents are d-a-pinene, methyl eugenol, with minor quantities of a phenol and paraffin. The oil possessed the following constants: Specific gravity, 15/15° C., 1·034, optical rotation, +3·79°, refractive index, 20° C., 1·5180.—F. R. **Morrison**: A chemical examination of the seeds of the "Bunya Bunya" (*Araucaria Bidwilli*) Part I. The tree is one of the Queensland pines, and bears annually cones containing more than 100 seeds. The kernel constitutes 77 per cent. of the seed. The composition of the air-dried powdered kernel was determined as follows: Fat 2·6 per cent., dextrin 7·72 per cent., starch 65·83 per cent., crude fibre 7·93 per cent., moisture 13·82 per cent., ash 2·1 per cent. Microscopically, the starch resembles rice or maize starch.—M. B. **Welch**: A further contribution to the knowledge of the silky oaks. The anatomical structure of a number of timbers belonging to the natural order Proteaceæ, and often known as silky oaks, was described. The woods are characterised principally by their large multiseriate rays.—W. R. **Browne**: Notes on the petrology of the Prospect intrusion. The mode of occurrence of analcite and other zeolites in the intrusion as well as chlorite, serpentine, and calcite, is discussed, and reasons are given for regarding them as due to late-magmatic or deuteric processes. The rock composing the intrusion should be called an olivine-analcite-dolerite rather than an essexite.

MELBOURNE.

Royal Society of Victoria, December 11.—T. H. **Laby** and Miss **Nelson**: The thermal conductivity of gases: a contribution to the International Critical Tables. A description is given of the method by which the values of the conductivity contained in the tables are arrived at from the determinations available. A weighted mean is taken. For air the results of different observers are so weighted that equal weight is given to the methods—cooling thermometer, hot wire, and plate method—which have been used to determine the conductivity of gases. The temperature variation of conductivity of a number of gases is expressed by means of Sutherland's formula.—T. H. **Laby** and E. O. **Hercus**: Experiments on the mechanical equivalent of heat made with the apparatus described in NATURE, June 30, 1923. The value of the 20° C. calorie is higher than the usually accepted value 4·180 (or 4·181) $\times 10^7$ erg. A recalculation of the indirect electrical experiments of Callendar and Barnes, Griffiths, Jaeger and Steinwehr, allowing for the departure of the electrical units used by these observers from their probable C.G.S. values, gives a mean of 4·183 $\times 10^7$ erg. per 20° calorie.—W. J. **Young** and J. R. **Vickery**: The changes which take place during the freezing of beef for export. Alterations in the microscopic structure produced by freezing at three different rates were compared by cutting sections while the meat was still frozen, and examining under the microscope in a room well below the freezing point. The freezing methods used were liquid air, brine at −15° C., and air at −15° C., the times of freezing being almost instantaneous, 2·5 and 15 hours respectively. The section frozen in liquid air presented a homogeneous granular appearance; the other two contained large crystals of ice between the muscle fibres, many of the latter being twisted and broken in the process. The difference was much more marked in the sample frozen most slowly. The changes occurring in the refrigeration of beef occur in the actual freezing.—Miss **Kerr**: The symbiosis of Loranthus and Eucalyptus. For a time at least a

Eucalyptus stock which has no foliage of its own can be nourished by a parasitic Loranthus, *i.e.* that a relationship may be established analogous to that between the stock and scion in a grafted plant. The injurious effect upon the host plant is due to the excessive transpiration rate of the parasite, which causes the host plant to suffer from lack of water, particularly during dry periods.—G. F. **Hill**: Termites from the Australian region: descriptions of new species and hitherto undescribed castes. Eight species are proposed as new, including two species of Eutermes from W. Australia and one species each from N. Queensland and N. Territory, one species of Calotermes each from Victoria and N. Territory, and two from Lord Howe Island. The alate imagos of two species of W. Australian Eutermes, hitherto known in the sterile castes only, and the soldier caste of two species of Calotermes (from Victoria and W. Australia respectively), hitherto known in the alate form only, are described for the first time. One of the latter, *C. obscurus* (Walker), until recently known only from the badly-damaged type and a very inadequate description, has been re-discovered in the type locality and fully described. A new name (*C. rufinotum*) is proposed for the Victorian species previously described in detail and provisionally referred to the last-mentioned species by the writer.—J. A. **Smith**: The graduation of the circle. Early graduations by hand, and the ingenious steps in the evolution of the "graduating engine" were outlined. The design and construction of modern machines such as the Swasey were described. The attainable precision is of the order of a maximum deviation of one-tenth of an inch at one mile.

VIENNA.

Academy of Sciences, February 5.—Scientific results of the expedition to the Anglo-Egyptian Sudan (Kordofan) undertaken by F. Werner in the year 1914. XXI.—I. **Sjöstedt**: Isoptera, reporting two new kinds of termites, with an appendix by R. **Ebner** on termite buildings. XXII.—W. **Adensamer**: Mollusca, including those of the Blue Nile.—H. **Pettersson**: Communication from the Radium Institute, No. 176. Theory of the method of atomic disintegration. A simple arrangement is described which enables the H-particles and reflected α-particles from disintegrated elements to be observed when weak radium C or thorium C preparations are used. The use of this arrangement for observing the number of H-particles emitted simultaneously by a disintegrated nucleus is shown by a series of measurements with aluminium.—H. **Handel-Mazzetti**: Plantæ novæ Sinenses. Thirty-second contribution, including three new species of Lysimachia.—A. **Köhler**: The granulite and granulite-gneiss problem in the south-western forest quarter of Lower Austria near Säusenstein, Wieselburg and Melk.—O. **Wettstein**: A new species of mouse from Lower Austria.—R. **Andreasch**: On carbamide and guianidine derivatives of the sulpho-fatty acids.—O. **Lehmann**: The geographical results of Dr. H. Handel-Mazzetti's journey through Guidschau (Kweitschou) in South-Western China.

Official Publications Received.

Department of the Interior: Bureau of Education. Bulletin, 1924, No. 32: A Study of 260 School Consolidations. By J. F. Abel. Pp. iv+39. 10 cents. Bulletin, 1924, No. 29: Legislation on the Junior High School. By Paul W. Terry and William J. Marquis. Pp. iii+42. 10 cents. Bulletin, 1925, No. 1: Educational Directory, 1925. Pp. iii+201. 25 cents. Bulletin, 1924, No. 28: Fiscal Support of State Universities and State Colleges. By Dr. Clarence Howe Thurber. Pp. iv+164. 20 cents. Bulletin, 1924, No. 36: A Manual of Educational Legislation, for the Guidance of Committees on Education in the State Legislatures. Pp. iii+51. 10 cents. (Washington: Government Printing Office.)

Scientific Reports of the Agricultural Research Institute, Pusa (including the Reports of the Imperial Dairy Expert, the Physiological Chemist, and the Secretary, Sugar Bureau), 1923-24. Pp. iv+141. (Calcutta: Government of India Central Publication Branch.) 1 rupee; 1s. 8d.

Report of the Department of Mines for the Fiscal Year ending March 31, 1924. Pp. iii+71. (Ottawa: F. A. Acland.) 15 cents.

Canada. Department of Mines: Geological Survey. Memoir 142, No. 123 Geological Series: Preliminary Report on the Clay and Shale Deposits of Ontario. By J. Keele. Pp. iii+176+9 plates. 25 cents. Summary Report, 1923, Part B. Pp. 115B. Summary Report, 1923, Part C1. Pp. 168C1. Summary Report, 1923, Part C2. Pp. 44C2. (Ottawa: F. A. Acland.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 14: Spectroscopic Evidence of Isostopy. By H. Nagaoka, Y. Sugiura and T. Mishima. Pp. 112. 1 yen. No. 15: The Results of the Analyses of the Soils and the Ashes of some Sugar Cane. By I. Wada, S. Ato and S. Kato. Pp. 113-124. 20 sen. No. 16: Application of X-ray Diffraction to the Determination of the Transformation Temperature of Thallium. By G. Asahara. Pp. 125-137+2 plates. 40 sen. No. 17: Distribution of Electric Field in Metal Arcs and the Stark Effect observed in Arcs of Silver, Copper, Magnesium, Chromium, Nickel, Cobalt, Iron and ten other Metals. By H. Nagaoka and Y. Sugiura. Pp. 139-167+plates 3-17. 250 sen. No. 18: Spectrum of Mercury under heavy Current Excitation. By M. Fukuda. Pp. 169-183+plates 18-20. 60 sen. (Komagome, Hongo, Tokyo.)

Conseil Permanent International pour l'Exploration de la Mer. Publications de Circonstance, No. 85: Observations on the Witch (*Pleuronectes cynoglossus* L.) and its Growth. By Arvid R. Molander. Pp. 15. (Copenhague: Andr. Fred. Høst et fils.)

The National Physical Laboratory. Report for the Year 1924. (Published for the Department of Scientific and Industrial Research.) Pp. 221. (London: H.M. Stationery Office.) 8s. 6d. net.

British Research Association for the Woollen and Worsted Industries. Annual Report, 1924. Pp. 19. (Headingley, Leeds.)

Proceedings of the University of Durham Philosophical Society. Vol. 7, Part 1, 1923-1924. Pp. 58. (Newcastle-on-Tyne.) 5s.

University Ideals: the Presidential Address to the Yorkshire Natural Science Association, Session 1924-25. Genetics and Wool Production: an Address to the Pan-Pacific Science Congress held at Sydney University, August 1923. By Prof. Aldred F. Barker. Pp. iv+60. (Leeds.) 5s.

Diary of Societies.

TUESDAY, APRIL 14.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at Loughborough College, Loughborough), at 6.45—A. B. Mallinson and others: Discussion on Justifiable Small Power Plants.

WEDNESDAY, APRIL 15.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Graduates' Meeting) (at Chamber of Commerce, Birmingham), at 7.30.—A. Weatherstone: High-speed Motor-cycle Engine Valve Gears.

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—Dr. F. S. Goucher: The Strength of Metals at High Temperatures.

THURSDAY, APRIL 16.

INSTITUTE OF CHEMISTRY (Belfast Section) (at the Queen's University, Belfast), at 7.30.—Prof. Symmers: Address.

INSTITUTE OF METALS (London Local Section) (at Institute of Marine Engineers), at 7.30.—C. H. M. Jenkins: Metals in the Gaseous State.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—J. Guild: The Geometrical Solution of Colour Mixture Problems.—Peeling and Van Neck: Exhibition and Description of The Hahn-Goerz Workshop Microscope; The "Artisol" Mirror Arc Lamp.

FRIDAY, APRIL 17.

DIESEL ENGINE USERS' ASSOCIATION (at Engineers' Club, Coventry Street, W.1), at 3.30.—J. L. Chaloner: Recent Oil-engine Developments.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Dr. H. D'Arcy Power: The Reproduction of Colour and Tone.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—W. T. Dunn: Vertical Retorts.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Graduate Section) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—Question Night.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Sir Henry Gauvain: The Organisation and Work of a Light Department in a Surgical Tuberculosis Hospital.—Dr. G. Murray Levick: The Selection of Apparatus for the Production of Artificial Sunlight.—Prof. Russ and Dr. Peacock: Ultra-violet Radiation.

SATURDAY, APRIL 18.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Junior Section) (at Municipal College of Technology, Manchester), at 7.—A. Hill: Foundry Materials.

BOLTON AND DISTRICT MANAGERS' AND OVERLOOKERS' ASSOCIATION (at the Institute, Henry Street, Bolton), at 7.30.—B. Robinson: Education and Industry.