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Recruitment for Indian Services.

THE structure of dyarchy originated by the Government of India Act 1919 was carried up another story by Statutory Rules and Orders 1924, Nos. 354 and 355, issued by the India Office. By those Orders the control of the servants of a local government was put in the hands of the local government up to and including the power of dismissal "for good and sufficient reason." The local government was thus put in a position to secure due diligence on the part of its servants. At the same time, for the protection of the servant from victimisation, these Orders prescribed appropriate inquiry before the infliction of any punishment and set up a suitable system of appeal. The Government of India is the most usual appeal body, and it is interesting to note that special machinery for dealing with such appeals has recently come into being by the appointment of the chairman and other members of the Public Service Commission.

The control of existing servants being in the hands of the local government, it only remained to transfer to the local government the power of making new appointments. This is done by Statutory Rules and Orders 1926, Nos. 390 and 391, recently issued.

Within certain reasonable and necessary restrictions, these Orders give the local government a free hand as to method of recruitment. In this the Orders go beyond the recommendation of the Lee Commission, and rightly. The Lee Commission recommended that in any recruitment by a local government the Public Service Commission should determine "the standards of qualification and the methods of examination." In an article in our issue of July 12, 1924, entitled "Europeans in the Indian Services," we pointed out that that recommendation violated the principle of provincial autonomy, and it is very fortunate for the future of dyarchy that the new Orders make the local control of the transferred services effective by transferring also in full measure the power to appoint and control the government servants engaged in the administration of these services.

In one point only do the Orders show any distrust of dyarchy. The local government is prohibited from lowering the standard of admission without the previous sanction of the Governor-General in Council. It is not clear why it should be suggested that any local government would have a desire to lower the standard. It is true that in India, as in Great Britain, there are always 'people of influence' going about trying to thrust their incompetent relatives into 'soft jobs,' but surely the local government of a governor's province is sufficiently strong to deal with these people without this particular piece of support. This lack of trust is a universal characteristic of our nation; each

of us is perfectly convinced of his own impeccable honesty, but at the same time considers it necessary that his neighbour's honesty should be safeguarded.

This, however, is the only blemish, and it is a slight one. For the rest, the local government is given all the freedom a reasonable local government could ask. It is free to recruit in any manner it pleases, so long as it does so by means of a competitive examination or on the advice of a permanent board of selection set up by itself.

At the same time, the position of an existing servant is safeguarded by the condition that any appointment that would adversely affect him requires the previous sanction of the Governor-General in Council. This very effective safeguard, along with the Orders regulating dismissal, should completely allay the fears which the Indian civil servant has sometimes felt as to the security of his position.

These fears have never been shown by the young men at the British universities who furnish the recruits. The true state of affairs is masked by the fact that at the present time the London competition selects fewer Europeans and more Indians than in pre-War days. Because of this, people jump to the conclusion that our universities are no longer prepared to send their best to India. That is wrong. They send their best to the competition as much as ever they did. The study of the university records of the European Indian civil servants recruited now and before the War shows the standard of the present-day entrant to be fully as high as that of the pre-War entrant. The true explanation lies not in the deterioration of the European condidates, but in the improvement of the Indian candidates.

Scott's Polar Journey and the Weather.

Scott's Polar Journey and the Weather: being the Halley Lecture delivered on May 17, 1923. By Dr. G. C. Simpson. Pp. 31. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 2*s.* 6*d.* net.

IT was natural for Dr. Simpson to choose the subject of Antarctic weather for his Halley Lecture, 1923, in view of the important contributions he has himself made to our knowledge of Antarctic meteorology. Dr. Simpson commences with a lucid exposition of the chief meteorological features, with particular reference to the relation between radiation and air temperature, to the formation in the atmosphere of inverted temperature gradients when the sun is low or below the horizon, to the blizzards which disperse the inverted temperature gradients and thus raise the surface temperature, and to the effect of these on sledging conditions, including the friction on sledge runners. He then reviews the main vicissitudes experienced by Scott on his journey to and from the South Pole, and discusses the importance of the weather in contributing to the disaster which finally overtook the party.

The serious blizzard experienced by the outward-bound party in an unfavourable position at the foot of the Beardmore Glacier delayed them, not only during the time they were laid up, but also on the lower reaches of the glacier, the surface of which became covered with soft snow in which the sledges sank to the cross pieces. This delay was, however, partly offset by bridging of the crevasses with snow. Followed the ascent to the 9000 ft. plateau and the traverse to the Pole, the disappointment of finding that Amundsen had forestalled the party, and the return to the head of the glacier. The effort of sledge-hauling at this altitude in a mean temperature (January) of $-19°$ F. was undoubtedly tremendous, and the party naturally looked forward to a rise in temperature on descent of the glacier. The temperature did rise, only to fall again before the bottom was reached, and to fall still further as the party, now reduced to four, pushed northwards along the Ross Barrier. At this stage of the journey, Scott met generally light northerly winds, insufficient to blow away the softer surface snow, while the favouring southerly winds for which they prayed were infrequent and not of sufficient force to cause the thorough mixing of the air which would have raised the temperature and improved the surface. These conditions lasted until Oates made the supreme sacrifice, the party falling always further and further behind their time table. Finally, only eleven miles from One Ton Depôt and plenty, the blizzard came, but a blizzard of such strength as to render travel impossible and of such duration (at least ten days) as to cause the final catastrophe. These points are discussed by Simpson in detail and in graphic language.

Scott himself maintained that his arrangements were adequate, and that no one in the world would have expected such conditions so early in the autumn. In his message to the public, he says: "Our wreck is certainly due to this sudden advent of severe weather, which does not seem to have any satisfactory cause. I do not think human beings ever came through such a month as we have come through. . . ." Dr. Simpson makes it clear that conditions were unusual, not indeed in the occurrence of such low temperatures, but in the duration of the cold period unrelieved by blizzards. Herein lay the unforeseen element. Though the onset of the very severe blizzard on March 19 was the actual cause of the disaster, it was, tragically, the absence of blizzards and the consequent intense cold for some time previous to this date which rendered the disaster not only possible, but even probable.

Biology and Human Life.

(1) *Life and Evolution: an Introduction to General Biology.* By Prof. S. J. Holmes. Pp. v+449. (New York: Harcourt, Brace and Co., Inc., 1926.) 3.50 dollars.

(2) *I Believe in God and Evolution.* By Prof. William W. Keen. Fourth edition revised. Pp. 109. (Philadelphia and London: J. B. Lippincott Co., 1925.) 5*s.* net.

(3) *Plain Speaking.* By the Rev. T. R. R. Stebbing. Pp. 218. (London: T. Fisher Unwin, Ltd., 1926.) 7*s.* 6*d.* net.

(4) *Evolution and Creation.* By Sir Oliver Lodge. Pp. 164. (London: Hodder and Stoughton, Ltd., 1926.) 3*s.* 6*d.* net.

(5) *In Search of Reality.* 1: *Organic Evolution.* By J. E. Williams. Pp. 256. (London: Gerald Duckworth and Co., Ltd., 1925.) 7*s.* 6*d.* net.

(6) *The Growth of Biology: Zoology from Aristotle to Cuvier, Botany from Theophrastus to Hofmeister, Physiology from Harvey to Claude Bernard.* By the late William A. Locy. Pp. xiv+481. (New York: Henry Holt and Co., 1925.) 4 dollars.

(1) AS Prof. Holmes points out in the preface to his volume, biology has during the last half-century exerted a profound influence upon human thought and human action, particularly through the theory of evolution and through modern views on the relation between heredity and environment. No one can lay claim to a liberal education unless he has made himself acquainted with at least the rudiments of the science. Prof. Holmes has made a bold and, on the whole, a successful attempt to cover the whole field of modern biology in such a way that his book can be read with interest and profit not only by the elementary student but also by the general reader. The treatment is competent, comprehensive and clear, and the book is eminently readable. With an eye presumably on recent developments in the United States, the author has devoted a good deal of space to the evidence for organic evolution. The problems of development and heredity are dealt with clearly and skilfully, and the practical bearing of our modern knowledge is brought out in a final chapter entitled, somewhat grimly, "The Eugenic Predicament." Our only criticism of the book is that the illustrations are, on the whole, rather poor and imperfectly reproduced.

(2) Dr. Keen's little book is one of the most effective contributions we have seen to the Fundamentalist controversy, and it is not surprising that several editions of it have been called for during the last three years. Dr. Keen is a distinguished surgeon who has seen in his own lifetime the rise of the Darwinian theory and the final acceptance by men of science and by all intelligent laymen of the doctrine of evolution. Throughout it all he has retained a firm belief in Christianity, and he finds no difficulty in harmonising his religious beliefs with a full acceptance of the theory of descent. This gives special point to his judgment of the Fundamentalist outbreak.

"The recrudescence of the warfare over Evolution, which for many years had subsided and almost disappeared, except sporadically, is a strange and surely only a passing phenomenon. The illogical and futile attacks upon science by some of the miscalled Fundamentalists, and an illogical and even absurd attempt to prove that the Bible contains and anticipated the discoveries of modern science, are doing immense harm to religion. There is serious danger, if present tendencies triumph, that intelligent people—those who eventually mold the thought of the world—will be alienated from the Church and finally driven from it" (p. 18).

There is also a danger, as events have shown, that the transference of political power to a half-educated democracy may tend to repress clear and honest thinking. There is need, therefore, for the biologist to present the case for evolution in a simple and convincing way.

This Dr. Keen succeeds in doing, in an original and effective manner. Believing that facts carry more weight with ordinary people than arguments, however logical and clearly presented, he has given in a series of short and incisive chapters a plain statement of specific facts, most of them drawn from his own personal experience as a surgeon and anatomist, facts which, to his mind, "absolutely demonstrate the solidarity of animal life, more especially in the case of the vertebrates, such as fish, birds, other mammals and man, the highest mammal." He discusses, for example, the homologies of the vertebrate skeleton, the extraordinary similarity of the internal ear throughout the vertebrate series, the similar effects of the endocrine secretions, the analogies of development, and so on. The instances are not new, but they are vividly presented and rammed home with the weight of personal experience and conviction. There are three excellent little plates.

(3) In "Plain Speaking" we have a collection of essays, of very diverse dates, from the pen of another veteran, the Rev. T. R. R. Stebbing. In one he discourses delightfully on the group he has made peculiarly his own, the Crustacea; others deal with teleology, thaumaturgy in the Bible, miracles, the origin of language, wolves and wild boars in France. A mixed bag, certainly, but particularly well written and readable.

Of special interest in the present connexion are the autobiographical details which are vouchsafed in

"An Address on receiving the Medal of the Linnean Society." The author took holy orders in the year 1858 and was plunged straightway into the violent controversies that attended the birth of Darwinism. Being young and enthusiastic and fond of a scrap, he joined in the fray. What followed is best given in his own words:

"I approached the reading of Charles Darwin's 'Origin of Species' with an easy confidence that I should be able to smash up his heresy and others like it. Instead of which I became an ardent convert, and very soon went on to deliver lectures and preach sermons, harping continually on the new views. These expressions of opinion were, it appeared, very agreeable to those who agreed with them, but very annoying and distasteful to the others" (p. 10).

One or two papers of this kind written in the 'seventies are here reproduced. It required a good deal more courage then than now for a parson to come boldly out on the side of evolution.

(4) Sir Oliver Lodge's thesis is that "there is no essential opposition between Creation and Evolution. One is the method of the other." His book is frankly popular, and makes little demand on the reader's intelligence. Sir Oliver is, as one would expect, interesting and suggestive on cosmical evolution, but not quite so good on the evolution of living things, though his discussion of the essential characteristics of life (pp. 118-119) is sound and penetrating. The spirit of Victorian optimism permeates the book.

(5) Mr. Williams' essay in search of truth deserves more serious consideration. He also is concerned with the reconciliation of science and religion, and sets out to inquire how two cardinal beliefs of orthodox religion fare at the hands of science—the belief in human survival and the freedom of the will. Both are denied by the materialistic determinism which is orthodox in science. Mr. Williams justly claims that the decision in these matters is too important to be accepted second-hand, and has set himself the task of examining the evidence for himself in order to come to a personal and considered judgment. The present volume gives us only the first fruits of his inquiry. He writes:

"Although the real issues outlined above must, no doubt, be fought out in the psychological arena, since the basic problems—those of individual immortality and responsibility—relate to spiritual and psychic rather than to physical processes, the preliminary battle-ground undoubtedly lies in the realm of biology, in the theories of heredity and organic evolution. Before it is possible to consider the infinitely complex problems of human and animal behaviour in their relation to immortality and spiritual reality, it is necessary to come to some conclusion upon the much more simple, though still intensely difficult, problems of physiological development" (p. 22).

Accordingly, Mr. Williams states and discusses the modern views on development, heredity and evolution, and builds up from them an ingenious and highly speculative theory, based on Brailsford Robertson's autocatalyst theory, J. T. Cunningham's views on hormones and heredity, and the late William Bateson's suggestion in 1914 that perhaps after all differentiation has come about by the progressive unpacking of an original complexity. Mr. Williams has read and mastered his literature in a very competent manner, and his theory will be of interest to those who think that a mechanistic explanation of heredity and evolution is still a possibility.

It is not clear just how far Mr. Williams believes in his own theory, for he tells us at the end of his book that he has deliberately pushed some modern lines of thought far beyond the limits sanctioned by their authors, into the realms of pure speculation, in the effort to see how far physico-chemical explanations can possibly carry us. He concludes by asserting that the most important factor in change is the behaviour of the animal itself, and that "the true origin of physiological evolution appears to lie within the complex factors which determine animal behaviour." Having thus whetted our appetite, Mr. Williams refers us to a second volume, which we shall await with interest.

(6) Dr. William Locy's posthumous book takes us into the calmer realms of history, and shows us something of the way in which biological discoveries have been made and new theories evolved. Special attention is given to the human note, portraits and biographical details being supplied with a lavish hand. The illustrations throughout are interesting and well chosen, particularly those taken from the old Herbals and the works of the early anatomists and microscopists. Perhaps too much attention is paid to personalities and individual discoveries—one certainly gets no very clear view of the general growth of ideas. For this defect the author's method of arrangement is partly responsible, for he is too much inclined to follow up the various lines of research singly and in isolation from progress in other directions—hence a certain disjointedness in the treatment.

One might complain, too, that some periods are treated in far too great detail compared with others of greater importance, that in particular too much space is given to the late Middle Ages, while the nineteenth century is treated rather cursorily. But it is true that the book does not profess to bring the story in any detail past about the middle of last century, and one can see that Locy was keenly interested in the early workers; his elaboration of detail about them has been a labour of love. There are other points which lend themselves to criticism, particularly his very low estimate of Aristotle's theory of development as given

in the "De generatione animalium," but these need not obscure the real merit and interest of the book. Although interest in the history of biological science has of late years greatly increased in Great Britain, thanks in large measure to Dr. Charles Singer, more attention still should be paid to it for its educative value. For this reason Dr. Locy's book should find a place in every biological library. It is a pity he did not live to write the volume which he contemplated on the history of evolution-theory and genetics. E. S. R.

Sexual Physiology.

An Introduction to Sexual Physiology: for Biological, Medical and Agricultural Students. By F. H. A. Marshall. Pp. xii+167. (London: Longmans, Green and Co., Ltd., 1925.) 7*s.* 6*d.* net.

IT is a relatively simple matter to interpret a science in a popular way to an audience that is entirely ignorant of it: it is a far more difficult thing to simplify the complicated for those who, keenly interested, strain eagerly at the threshold of their professional careers, since if great care is necessary in the selection of one's subject matter, still greater must be taken in the method of its presentation. Whatever else may be taught, it is imperative that the student of science shall, from his initiation, be made aware of what science is and of the discipline that must be self-imposed by those who serve. We may be sure that not all those who insistently urged Dr. Marshall to write this book, knowing how great was the need for it, recognised that they were setting him so difficult a task. He was to take his standard work on "The Physiology of Reproduction," refine it, and make it palatable to such as possess but a rudimentary knowledge of biology, to students of agriculture, medicine, and of pure science.

This small and remarkably inexpensive book that Dr. Marshall has written adequately presents that essential minimum of information relating to the subject of sexual physiology which ought to be possessed in common by every biologist, be he pure biologist, agriculturist, medical, or sociologist. In our opinion, the apprentice of pure biology cannot read the author's larger work too early in his career and should not be encouraged to begin with the volume under review. Medical and agricultural students will be well advised to use this book as a supplement to the usual text-book of general physiology. Those who are, or who intend to be, active in the field of sociology should be compelled to read and digest it before being allowed to enunciate doctrines or remodel laws concerning the social aspects of human reproduction. The book will be largely used. We therefore submit to the author certain criticisms in order that he may consider them against the time when the call will come for the second edition.

Chapters i.-v., dealing briefly with the anatomy and physiology of the reproductive system, the sexual cycle, pregnancy, parturition, the puerperium, and lactation, adequately present the essentials of these subjects. Certain alterations can be suggested. In the illustration of the sperms of different species it is a mistake to show two figures from the frog and the boar, differing in size and form, unless some explanation of this difference is appended. The alert student will imagine that sperm dimorphism, of which he will read later, is of the magnitude suggested by this illustration. Instead of stating that in the bee the female "gives rise to two kinds of eggs, one kind developing without fertilisation and giving rise to drones or males while the eggs of the other kind, which are fertilised by stored-up sperm, develop into workers and queen, both of which are females," would it not be better to say that if an egg is fertilised it develops into a female, a queen or a worker; if it is not fertilised, it gives rise to a male, either sexually functional or else a drone? The statement that "in certain hermaphrodite species the two sorts of sex cells are produced simultaneously by the same individuals, but in these the spermatozoa and ova are found at different seasons, the individual animals sometimes functioning as males and sometimes as females," is an instance of simplification that ends in profound obscurity. Finally, we think that the author is mistaken in his occasional choice of the teleological form of presentation. Those of his fellow-teachers who rigorously avoid this all too simple method of teaching already find it sufficiently difficult to break the student of this habit of thought.

Chapter vi., on internal secretion, is clear, simple, and necessarily dogmatic. The author is misled by his authorities when he states that following ovariotomy in the hen the erectile structures about the head remain unaffected. In point of fact, following ovariotomy, if the right gonad does not become active, the head furnishings undergo a very marked diminution in size.

In Chapter vii., on heredity and sex, the author enters the less familiar field of the genetical aspects of sexual physiology. In order to make the survey of the subject complete, this was necessary; but the result is distinctly unfortunate, for this chapter is marked with inaccuracies and much of it is extremely obscure. The plea of simplification cannot excuse the repeated teaching that the gametes or the chromosomes carry the hereditary characters. The sex-chromosomes do not differ from the autosomes in their behaviour. It is incorrect to state that "the Y-chromosome may

seem to be wanting altogether so that it was thought formerly that the male had one fewer chromosome than the female." It is an established fact that in many forms there is in one sex one unpaired sex-chromosome. The attempt to explain in simple terms and briefly Goldschmidt's Time Law of Intersexuality is not successful.

Chapter viii., on fertility, will provoke the student to serious thought, being rich in philosophy and admirably written. The only statement which we think is unnecessarily obscure is that "in certain breeds of fowls Pearl has found further that one of the factors for increased egg production is sex-linked, being present in the cock only and transmitted by him to the next generation of hens." The chapter and the book ends with an apt quotation from Keynes' article on "Reconstruction in Europe," and the student reading this will not fail to realise how far he has travelled since first he opened this excellent work.

F. A. E. CREW.

A Woman of Science.

Hertha Ayrton, 1854–1923: a Memoir. By Evelyn Sharp. Pp. xv+304+5 plates. (London: Edward Arnold and Co., 1926.) 15*s.* net.

IN her memoir of Mrs. Ayrton, Miss Evelyn Sharp has given an excellent account of the life and work of a remarkable woman, and has appropriately dedicated the book to Madame Curie as a co-worker in science and democracy for whom Mrs. Ayrton had a high regard.

The volume of some 300 pages is divided into twenty chapters and has five illustrations. It is well printed and, so far as the reviewer has been able to check, its contents are very accurate. Only two slight errors have been noticed, namely, on pp. 140 and 303 where "Morley" appears instead of "Mordey," and on p. 229 (3 lines from bottom) where the word "After" should read "Before."

From the book it appears that in early childhood, Phoebe Sarah Marks (as she then was) showed marked intelligence and originality, and displayed unusual ability and resource. These facts were noticed by her well-to-do and talented relatives, the Hartogs, who, in consequence, gave her an education her parents were unable to afford. Miss Marks' girlhood was nevertheless a strenuous one, and when barely sixteen years of age she took a post as governess in a private family so that she might help to support her widowed mother and invalid sister. Through her relatives she was introduced to many persons of influence and repute, several of whom aided Miss Marks in her ambition to enter Girton College, which had then been recently founded for the higher education of women. Although her examination records at Girton were not brilliant, her supporters never lost confidence in their protégé, and this confidence was amply justified by her subsequent achievements.

Before proceeding to Girton, Miss Marks took great interest in physics and mechanics, and helped one of her boy pupils to make a model steam engine. Further evidence of the scientific bent of her mind was given by the invention of a "sphygnometer," whilst at Girton, and of a "line divider" shortly after she came down; the latter instrument was put on the market by Messrs. Stanley, of Great Turnstile, Holborn, and was described before the Physical Society of London.

Short accounts of Miss Marks' first meeting with Prof. Ayrton in 1882 and of their marriage in 1885 are given in Chapters vii. and ix., whilst Chapters x. and xi. describe Mrs. Ayrton's classical researches on the electric arc, and her admission to the Institution of Electrical Engineers. The origin and progress of Mrs. Ayrton's painstaking work on sand ripples are then described in some detail, and in a manner creditable to both worker and biographer. These researches led to the award of the Hughes Medal (for original discovery in physical science) by the Royal Society in 1906, thus giving further confirmation of her success in science, which had previously been acknowledged by her election as member of the Institution of Electrical Engineers.

A considerable portion of Miss Sharp's book is devoted to the part Mrs. Ayrton took in the Suffragist movement in Great Britain, in which both author and subject were keenly interested. Mrs. Ayrton's many activities in this campaign must have interfered seriously with her purely scientific work, but in spite of this, she managed to carry out several investigations. She extended her studies on sand ripples and associated phenomena, and developed a new type of carbon for producing steady arcs for cinemas and searchlights.

The closing chapters of the book deal mainly with the "Ayrton Anti-Gas Fan," invented shortly after the first gas attack in the War. This invention was a development of Mrs. Ayrton's sand ripple studies and of the vortices which accompany the production of ripples. Immense difficulties were experienced in getting the authorities to give the fan a fair trial; this was largely due, in the inventor's opinion, to its extreme simplicity. Even when the fan was adopted, it was sent to the front in insufficient numbers and without proper instructions for its use.

In conclusion, one may say that this book is an admirable record of the life and work of a woman distinguished alike as scientist, suffragist, and humanitarian.

T. M.

The Yorkshire and Nottinghamshire Coalfield.

Memoirs of the Geological Survey, England and Wales. The Concealed Coalfield of Yorkshire and Nottinghamshire. By G. V. Wilson. Second edition. Pp. vi+283+5 plates. (London: H.M. Stationery Office; Southampton: Ordnance Survey Office, 1926.) 8*s*. net.

THE second edition of the memoir on the Concealed Coalfield of Yorkshire and Nottinghamshire has just been issued by the Geological Survey of Great Britain. The first edition by Dr. Walcot Gibson was published so far back as 1913; at that date the development of this important coal area had only just commenced and our knowledge of it was relatively slight. Since that date numerous boreholes have been put down, a good many shafts sunk, and not a few important collieries have been developed and are now working and raising coal, and in consequence a vast number of data concerning the geology of this area has been accumulated. The present volume, more than double the size of the first one, embodies the results of the knowledge thus acquired.

The memoir appears at a very fortunate moment when this coalfield is undergoing intensive development, and, as may be gathered from the recent report of the Coal Commission, it is to-day one of the few remunerative coal-producing districts in Great Britain and bears every indication that its future will prove to be of great national importance. The present volume will be of the utmost use, and possibly no portion of the report will be more carefully studied than Chap. iv., which deals with the configuration, structure and limits of the coal basin. In this respect the eastern boundary of the basin is the one on which the greatest amount of discussion centres, and it is a point which will seriously affect the working of the entire coalfield. Thus the first report of the Royal Commission on Mining Subsidence, which dealt particularly with the area described in this memoir, which the Commission has spoken of as the Doncaster Area, points out that an effective scheme for dealing with the flooding due to colliery subsidence must be governed largely by the position of the eastern boundary of the coalfield, as to which geologists are still in doubt. The present report shows that this doubt still subsists. The first report issued in 1871 placed the boundary of the concealed coalfield 2 or 3 miles east of the Trent; the final report of the Royal Commission on Coal Supplies of 1905 adopts the view of Prof. P. F. Kendall, which places the boundary 20 to 30 miles east of the Trent. The present report shows that in all probability both views are right, and that in the neighbourhood of Newark the limit assigned in the older report is probably correct, whilst to the east of Lincoln the "line approximates more nearly to that suggested by Professor Kendall."

The volume before us contains a mass of information; it discusses the various formations in detail, then proceeds as stated to consider the configuration of the coal basin, and finally contains a large number of valuable records of sections derived from shaft sinkings and borings. The appearance of this volume at the present moment will be exceedingly welcome to all interested in this important coalfield.

Our Bookshelf.

Ergebnisse der Biologie. Herausgegeben von K. v. Frisch, R. Goldschmidt, W. Ruhland, H. Winterstein. Erster Band. Pp. viii+670. (Berlin: Julius Springer, 1926.) 36 gold marks.

THE vast and ever-increasing flood of indiscriminate publication—including observations of every degree of importance and trustworthiness—which at present constitutes a real menace to the ordered progress of biological science, brings in its train the need of organised publication of 'potted extracts' of contemporary biological literature. An admirable publication of this kind summarising modern advances in our knowledge of the functional as opposed to the anatomical side of zoological science was Winterstein's great handbook of comparative physiology, which, commencing to appear some fifteen years ago, has recently reached completion. The new "Ergebnisse der Biologie" may be regarded as a continuation of Winterstein's handbook, to deal with contemporary literature in the subject as it appears. The scope of the new periodical is, however, rather wider, as its purview will cover comparative physiology in the broadest sense, including such subjects as plant physiology, experimental embryology, animal psychology, and the study of heredity.

That the work will be well done is guaranteed by the names of the distinguished quartet of editors. The opening volume deals with the comparative physiology of the skin of vertebrates (Biedermann), the ascent of sap in plants (Bachmann), the relations of the plant-cell to chemical salts (Kaho), ammonia, nitrate and nitrite as sources of nitrogen for the higher plants (Prianischnikow), the social psychology of birds (Katz), and the migration of birds (Wachs). The contemplation of these titles indicates how wide is the field over which the subject matter is distributed, but it also indicates clearly what will be the future of the periodical—not a systematic survey of all the literature appearing within its boundaries, but rather a series of summaries of isolated and restricted portions of the subject by competent specialists. Such a system, although lacking completeness, is probably on the whole of greater real use to students. Thus in the volume under review the first article is in effect an excellent and well-illustrated text-book of 342 pages upon its subject.

The new periodical will have to be added to the libraries of all university schools of biology.

Practical Coal Production. Preliminaries of Coal Mining: Prospecting, Explosives, Development, Drainage, Ventilation. Compiled by Frank H. Kneeland. Pp. vii+419. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 15*s.* net.

THIS little work contains a brief description of American coal-mining practice in certain branches of the industry. There are six chapters, the contents of which are: (1) Prospecting, (2) explosives and blasting, (3) development operations, drifting, tunnelling, shaft sinking, (4) planning, projection, development, (5) drainage, (6) ventilation and ventilation equipment. When it is seen that the whole work only comprises 413 pages, it will be obvious enough that no one of these subjects can have received anything like adequate treatment, and a perusal of the work leaves on one's mind the impression that the information conveyed is of a decidedly 'scrappy' nature. To prevent misconception, it may be pointed out that Chap. iv., which is headed "Planning, Projection, Development," refers entirely to the lay-out of the surface and does not attempt to discuss the infinitely more important question of the lay-out of the underground workings.

The work deals entirely with American practice, and in that respect will afford little or no assistance to mining engineers in Great Britain. For example, in dealing with shaft sinking, the author states that circular, elliptical and other forms of shafts are used, but he practically confines his attention to the rectangular shaft; this is the only form that he considers when discussing the size of shafts, as indicated by the following statement: "Main hoisting shafts vary greatly in size, some being as small as 5 × 10 ft., whilst others are as large as 15 × 60 ft. in the clear." He makes no attempt at discussing the relative advantages or disadvantages of the two types of shaft, but, in conformity with general American practice, takes the rectangular type more or less for granted.

The book throughout contains many little bits of useful information, though occasionally we find a mass of detail which is scarcely necessary, as, for example, the elaborate instructions for priming and attaching the fuse to a blasting cartridge. Such information is quite unnecessary for the practical mining engineer, and is in any case out of place in a book, as it is always far better and more rapidly learnt by actual experience; it is, in fact, one of the weak points of the work that it appears in places to be addressed to the beginner at the very outset of his career, and in others to be written for the experienced mining engineer.

Telephone Communication Systems. By Prof. Royce Gerald Kloeffler. (Engineering Science Series.) Pp. vii+284. (New York: The Macmillan Co., 1925.) 17*s.* net.

THE author gives a brief account of the whole field of telephony, laying stress on the latest developments of the art. In the United States there are more than 15 millions of telephones in use and thousands of miles are bridged between many pairs of them. Sound waves would take four hours to travel through the air from New York to San Francisco. With the help of electricity, however, they go over the transcontinental line in about the fiftieth of a second. By General Squier's method the same wire can also, theoretically at least, carry twenty-four simultaneous telephone messages, although in practice arrangements are seldom made to carry more then five distinct messages simultaneously. The development of the thermionic valve repeater has placed long-distance telephony on a sound engineering basis. The invention of electric filters which only allow waves of definite frequencies to pass through them led to multiplex telephony.

Heaviside's and Pupin's loaded cables are still used for submarine work and in long-distance land lines. In the latter case, however, valve repeaters are now largely used. It is pointed out that appreciable reflection losses occur when two lines having different electric constants are joined together. These losses are quite distinct from attenuation losses. We are glad to see that a sharp distinction is made between electrostatic and electromagnetic interference. The former is particularly troublesome on telephone circuits. When there are high-tension circuits in the neighbourhood, the electrostatic induction sometimes makes the potential difference between the telephone wire and the earth so great that there is a risk of a serious shock. In the concluding chapter the elementary principles of radio telephony are clearly explained. The book can be recommended to electrical engineering students who desire to get a general insight into the theory and practice of telephony.

Elementary Electrical Engineering: a Lecture and Laboratory Course intended for Students preparing for the First National Certificate Examination in Electrical Engineering. By Prof. O. R. Randall. (Technical School Series.) Pp. vi+233. (London: Sir Isaac Pitman and Sons, Ltd., 1926.) 5*s.* net.

THE combination of lecture work with laboratory experiments given in this book is good, but we are doubtful as to the educational value of some of the mathematical demonstrations given. For example, after saying that the average and effective values of the ordinate of a sine wave are $2/\pi$ and $1/\sqrt{2}$ times its maximum value respectively, it is stated that these relations may easily be demonstrated by drawing the curves and finding their mean heights. The industrious student, therefore, is expected to draw the sine curve, and the curve the ordinates of which are the squares of the sine, and get their mean heights. He doubtless knows that the results will come out within one or two per cent. of the numerical values of the mathematical expressions given above, but he will probably prefer to take the easier course of accepting the author's word that they are correct. We are told that if the three vectors representing the currents in a three-phase system are added together they form a closed triangle and their resultant is therefore zero. We think that this is looking at the matter the wrong way round. Since the algebraical sum of the three currents is by Kirchhoff's law always zero, their resultant, that is, the effective value of their sum, must of necessity be zero, and therefore the three vectors form a triangle. This is true whatever the shape of the current waves may be. We fully recognise that the mathematical knowledge of many of the candidates preparing for the national certificate is limited, but we think that some of the proofs given are too sketchy.

Handbuch der biologischen Arbeitsmethoden. Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 182. Abt. 9: *Methoden zur Erforschung der Leistungen des tierischen Organismus*, Teil 1, 2 Hälfte, Heft 1. *Spezielle Methoden: Tierhaltung und Tierzüchtung. Züchtung von wirbellosen Tieren.* Pp. 214. (Berlin und Wien: Urban und Schwarzenberg, 1925.) 9·60 gold marks.

THE present instalment of the encyclopædic work edited by Prof. Abderhalden is concerned with the keeping and rearing of animals for scientific observations. Dr. Kammerer discusses the subject in so far as Reptilia and Amphibia are concerned, and his experimental researches are familiar to all zoologists. This article is followed by one by Dr. Heitkertinger on the general apparatus and technique used in rearing insects. There are also separate articles by different specialists dealing with particular methods applicable to the Apterygota, the "Amphibiotica," Orthoptera, Corrodentia and Rhynchota. These different sections are something more than guides to the technique concerned, since the life-histories and behaviour of representatives of the various orders are discussed in detail, with numerous bibliographic references. The most extensive contribution is that by Dr. F. Zacher on the Orthoptera: this might almost be regarded as a complete synopsis of the biology and economy of that group. The remainder of the Insecta is to be dealt with in future issues. A. D. I.

Cellulose Ester Varnishes. By F. Sproxton. (Oil and Colour Chemistry Monographs.) Pp. 178. (London: Ernest Benn, Ltd., 1925.) 15*s.* net.

THIS volume of the series of oil and colour chemistry monographs is an excellent statement of the properties of the cellulose esters used for varnishes and of the finished products prepared therefrom. Particular attention has been given to those physical properties, viscosity, solubility, swelling, dispersion, and so on, which are important for the practical utilisation of cellulose esters in varnish making. In fact, pp. 58-92 constitute one of the best and most readable accounts of physical behaviour of cellulose esters available in so short a space. The nature and properties of the solvents of cellulose esters and the reasons for using them are adequately dealt with. Chapters dealing with the manufacture, application, and examination of cellulose ester varnishes furnish all the information which can reasonably be expected in a volume of this character. The subject matter is presented clearly throughout, and the work may be recommended to all those who desire an accurate statement of the present position of a growing branch of industry.

The Birds of the Riviera: being an Account of the Avifauna of the Côte d'Azur from the Esterel Mountains to the Italian Frontier. By Collingwood Ingram. Pp. xv+155+6 plates. (London: H. F. and G. Witherby, 1926.) 12*s.* 6*d.* net.

MR. COLLINGWOOD INGRAM has produced a book on the birds of the Riviera which will be useful to ornithologists among the many English-speaking visitors to that region. The scope of the work excludes the Italian portion of the littoral, but, on the other hand, it includes the whole of the French department of Alpes Maritimes, a fact which brings many strictly alpine species within its purview. The arrangement is systematic, and the text is not burdened by descriptions of those species which will be familiar to British readers at home and are dealt with in the ordinary text-books upon British birds. In addition to English and scientific names, the French and Niçois equivalents are conveniently given. The illustrations include numerous sketches by the author and a number of plates by well-known artists.

Flora of the Presidency of Madras. By J. S. Gamble. (Published under the Authority of the Secretary of State for India in Council.) Part 7: *Nyctaginaceæ to Euphorbiaceæ.* Pp. 1161-1346. (London: Adlard and Son and West Newman, Ltd., 1925.) 10*s.* net.

A MELANCHOLY interest is attached to this review, since the author of the work under notice died while it was still in the press, though he was able to correct all but the last few sheets of the proofs. It is greatly to be regretted that Mr. Gamble did not live to complete the flora, for he had an unrivalled knowledge of the region and its flora.

Part 7 now issued begins the Monochlamydeæ, and comprises the families according to the Genera Plantarum sequence from Nyctaginaceæ to Euphorbiaceæ with some minor deviations, *e.g.* the Hernandiæ are separated from the Lauraceæ forming the family Hernandiaceæ to include Gyrocarpus. Four new genera, twenty-five new species (mostly first described in the *Kew Bulletin*), and eleven new combinations are included. C. E. C. F.

Die gasanalytische Methodik des dynamischen Stoffwechsels. Von Dr. Wilhelm Klein und Maria Steuber. Pp. 99. (Leipzig: Georg Thieme, 1925.) 5·40 gold marks.

THE authors bring together certain well-known methods of determining metabolism by means of the respiratory exchange. The most space is devoted to a description of the Zwetz-Geppert method, which has not been used in England or America for a good many years. With the exception of the student apparatus of Benedict, which does not give the respiratory quotient, and an inadequate account of Krogh's latest apparatus, no description of any of the numerous variants of portable metabolism apparatus is given. The book contains nothing useful which is not already available in convenient form to English and German readers. The few references to the literature are given with little care. E. K. R.

Qualitative Inorganic Analysis. By Dr. D. R. Snellgrove and Dr. J. L. White. Pp. xi+281. (London: Methuen and Co., Ltd., 1926.) 7*s.* 6*d.*

THE explanations and practical hints given in this book are more detailed than is usual and will be found of value. The standard is that required in B.Sc. honours examinations. The authors appear to dislike tabular presentation in group separations, but there can be little doubt that this form is more convenient in laboratory work and in recording the results obtained in practical examinations. The book is printed on thick paper and does not remain open easily, both disadvantages in laboratory use.

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.*]

Dutch Pendulum Observations in the Atlantic and the Pacific.

I AM able to give the following particulars of the proposed pendulum observations in the Atlantic and the Pacific. In compliance with the request of the Geodetic Committee, the Minister of Marine has resolved that H.M. Submarine K XIII, appointed for service in the Dutch East Indies, will make the voyage to Java via the Panama Canal, in order to enable Dr. Vening Meinesz to make pendulum observations in the Atlantic and the Pacific. The main object of this voyage being scientific, the route has been fixed in accordance with the wishes of Dr. Vening Meinesz.

On May 26 the submarine will start from Helder; it will be at Fayal (Azores) July 4-6, and at Las Palmas (Canaries) June 12-16. From there it proceeds to the Porto Rico deep, crossing for the second time the middle Atlantic ridge, and thence by the Mona Passage to Curaçao, where it remains from July 5 until 17. It will be at Colon, July 20-22, and at Panama, July 22-26. In the Pacific it will at first sail westward to reach the deep sea, and then return to the coast; on August 6-12 it will be in Mazatlan and will reach San Francisco, August 20. It starts from there for the crossing of the Pacific on September 2; it will be at Honolulu on September 14-27, at Guam on October 16-28, and at Yap on October 30-November 2. Before reaching Guam it passes the Nero deep (5268 fathoms). From Yap it sails to Manila by the Straits of Surigao, crossing the Manila deep, where the greatest known sea depth (5350 fathoms) has been sounded. It remains at Manila from November 11 until November 17 and sails then for Ambon, where it stays from November 24 until November 29. Via the Banda deep it reaches Bima (Sumbawa), where it remains from December 5 until December 8, and will arrive at Surabaya on December 10 after a voyage of 195 days, 109 of which are sailing days. The whole length of the track is nearly 20,000 miles.

In the light of the experience which Dr. Vening Meinesz has gained of the new pendulum apparatus on his voyage to Port Said (NATURE, April 10, p. 531), some improvements have been made in the workshop of the Meteorological Institute of de Bilt. The suspension apparatus with one axis, to be placed parallel to the keel of the ship, has been replaced by a support with double gimbals in order to avoid the sliding of the pendulums caused by the pitching of the vessel. Probably by this means it will be possible to make observations at a lesser depth below the surface of the sea, and perhaps in favourable circumstances at the surface itself. This modification necessitated the connexion of the recording apparatus with the support; the former is now placed with the slit in a horizontal position above the former. For the guidance of the rays of light a system of prisms has been added.

The accuracy of the observed time signals during this voyage will be increased by the loan from the U.S. Coast and Geodetic Survey, with the consent of the Secretary of Commerce of the United States, of a wireless recording set. Special thanks are due to the Director, Mr. E. Lester Jones; the Assistant Director, Mr. R. L. Faris, and the Chief, Division of Geodesy, Dr. W. Bowie, for their valuable co-operation in this matter.

The time signals to be used will be first those of Bordeaux, then those of Annapolis, and afterwards those of Balboa. The co-operation of the U.S. Naval Observatory at Washington has been obtained for the control of these signals. During the voyage in the Pacific rhythmic time signals will be given by the powerful radio station of Malabar (Java), controlled by the Observatory at Lembang. This will control also the time signals of Manila, which may be used in the western part of the Pacific

At the request of Commander J. H. L. Luymes, Hydrographer of the Dutch Marine and member of the Geodetic Committee, the Hydrographer of the U.S. Navy sent a set of charts of the Pacific where the most recently obtained sea depths are noted. For the determination of the sea depth during the voyage the submarine will be provided with a sonic depth-finder of the type of the British Admiralty, constructed by Messrs. Hughes and Sons of London, with regard to which the Hydrographer of the British Navy, Captain Douglas, has rendered much valued assistance. With regard to deep soundings, the voyage of the submarine may also give valuable contributions.

I will not digress into a discussion of the advantages that may be derived for science from the observations of Dr. Vening Meinesz. I will but mention that as the track runs for a great part of the length not far from and nearly parallel to the equator, the question whether this is elliptic or not will probably be solved. The observations in general, and especially those near the coasts, as well as those near the edges of and above the great deeps, will be of much interest for the study of isostasy and other geophysical problems concerning the constitution of the earth's crust.

I may perhaps be allowed to express the hope that the example given by the Dutch Navy in the investigation of purely scientific questions will soon be followed by other nations. J. J. A. MULLER.

Zeist, May 1.

Optical Rotatory Dispersion.

SINCE the publication of Prof. T. M. Lowry's article in NATURE of February 20, 1926, p. 271—an article which, I observed, drew a gentle remonstrance from Prof. Armstrong in the issue of April 17—I have felt that some rejoinder was desirable, but was held back by the fact that adequately to criticise Prof. Lowry's views would require considerably more space than the article itself, since almost every statement made, far from possessing the definiteness which Prof. Lowry attributes to it, is highly controversial, and it usually requires less space to make an assertion than convincingly to refute it. But perhaps I may be allowed to point out that so far back as 1916 (*J.C.S.*, 109, 1211-1216, 1222-1224) I offered a reasoned criticism of most of the views which Prof. Lowry has so industriously advocated in the last few years, and that hitherto Prof. Lowry has not attempted any reply to these criticisms. Incidentally it may be suggested that Prof. Lowry does his thesis some disservice by a policy of aloofness from valid criticism directed against it. It may, of course, be that the criticisms are unanswerable, in which case Prof. Lowry's views require modification.

In addition to the criticisms already made, I would add here one or two more. In the first place, Prof. Lowry's views depend entirely upon some observations of Biot, made many years ago, according to which he found that the rotation dispersion of a mixed solution of oil of terebenthene and oil of lemon was identical with the sum of the dispersions of the same

substances separately (*Compt. rend.*, 1836, **2**, 543; see also *Ann. Chim. Phys.*, 1852 [iii.], **36**, 430). Now the accuracy with which Biot could carry out his observations was very much less than that possible at the present time, which may perhaps be illustrated by the fact that whereas Biot thought that quartz conformed to his simplest law of rotation dispersion, Prof. Lowry himself has shown that a Drude expression of no less than three terms is necessary to represent its behaviour. Further, it has not been shown with modern accuracy, either that the rotation dispersions of terebenthene and oil of lemon conform to Prof. Lowry's definition of simple dispersion, or that when mixed together they conform accurately to his definition of anomalous dispersion. Practically all modern work has demonstrated very clearly the fact, of which Biot was aware, that only in exceedingly few cases, if indeed in any, can one obtain, by mixing together two optically active liquids, purely additive results. It is doubtful, therefore, whether it is even worth while to repeat Biot's experiment.

Again, Prof. Lowry seems to be unduly partial towards the evidence which he adduces in favour of his views. Thus, for example, he says: "Tschugaeff has shown that anomalous rotatory dispersion can be produced by superposing the opposite partial rotations of two radicals in the same molecule, as in *l*-menthyl *d*-camphorsulphonate." This statement is utterly misleading. Tschugaeff found the dispersion of *l*-menthyl *d*-camphorsulphonate to be anomalous, and he *suggested* that this might be due to the superposition of two opposite partial rotations, but he certainly did not *show* that this is actually the case. It suits Prof. Lowry's view, however, to regard Tschugaeff's assumption as equivalent to a demonstration, but he makes no reference to the fact that in *l*-menthyl *d*-camphorsulphonate there are not two asymmetric centres in the molecule, but actually five—and even six if Prof. Lowry's idea of the asymmetry of the carbonyl group be adopted—so that the rotation dispersion of menthyl camphorsulphonate should be a very complex affair if superposition of asymmetric centres in the molecule plays a part in it.

It would easily be possible to extend these remarks.

T. S. PATTERSON.

Organic Chemistry Department,
University of Glasgow,
April 26.

I FIND it difficult to discover what reply Prof. Patterson expects to his courteous letter of April 26. From the two experiments which he cites I gather that he wishes to call in question the general proposition that *anomalous rotatory dispersion in transparent media is due to the superposition of two normal rotations*[1] *of opposite sign*. He has, however, described these two experiments in such a way that it is difficult to believe that either Biot's or Tschugaeff's paper was before him when he wrote his letter. In particular, Biot's synthesis of an anomalous rotatory dispersion, by superposing two normal dispersions of opposite sign (*C.R.*, 1836, **2**, 540), does not depend, as he suggests, on the existence of an additive law of optical rotatory power in mixed liquids, since in the first instance the liquids were not mixed but were contained in two separate tubes, the superposition of rotations being purely optical. A precisely similar result was obtained when the two liquids were mixed, but there are no numerical data in the paper which would justify the assertion that Biot "found that the rotation dispersion of a mixed solution . . . was identical with the sum of the dispersions of the same substances separately"; nor does my acceptance of the general proposition set out above depend on any such assumption.

In the same way, Tschugaeff's experiment (*Ber.*, 1911, 44, 2023) was not a mere numerical exercise in the summation of optical rotations, but a definite test to find out whether anomalous rotatory dispersion could be produced by "intramolecular superposition" as well as by Biot's process of "extramolecular" superposition. His experiment showed that an alcohol and acid, the opposite rotations of which would have given rise to anomalous dispersion if superposed by either of Biot's methods, also gave rise to anomalous rotatory dispersion when united into a single molecule by the elimination of a molecule of water. This successful synthesis has been generally accepted as evidence of the continued existence of the opposite partial rotations of the two radicals after esterification;[2] and its success does not depend, as Prof. Patterson appears to think, on the accuracy of the law of optical superposition, which Tschugaeff himself regarded as only a "first approximation." Nor is it necessary that the component "normal" rotations in any of these syntheses should conform to the law of "simple rotatory dispersion."

Since, as I have shown (*J.C.S.*, 1925, **127**, 606), there are at least six different ways (mathematical, physical or chemical) in which normal rotatory dispersions may be superposed to produce anomalous rotatory dispersion, there is plenty of room for diverse opinions as to the particular form of superposition which gives rise to this effect in any given case; but I do not think that any useful purpose would be served by a discussion in the columns of NATURE of these applications of a general principle which was established once for all by Biot in 1836.

T. M. LOWRY.

University Chemical Laboratory,
Cambridge, May 1.

[1] A 'normal' rotatory dispersion is defined as one in which α, $d\alpha/d\lambda$, and $d^2\alpha/d\lambda^2$ remain constant in sign throughout the region of transparency. In an 'anomalous' dispersion, changes of sign may occur in all these quantities, giving rise respectively to a reversal of sign, a maximum and an inflexion in the dispersion curve.

[2] The statement which Patterson describes as "utterly misleading" is a close paraphrase of the words used by Tschugaeff himself in describing his experiments in the Faraday Society's general discussion on "Optical Rotatory Power," when he claimed that he had shown "that anomalous dispersion may be produced by the *superposition of the partial rotations produced by two asymmetric complexes within the molecule of an active body*" (*Trans. Faraday Soc.*, 1914, **10**, p. 73).

Hardness of Copper-Tin Alloys.

IN NATURE of January 23 I described some experiments on the hardness of various materials, the hardness being measured by the pressure which the material can withstand.

Since that time the same test has been applied to many of the metallic elements, and it is intended to form as complete a table as possible of the hardness of those to which this method is applicable.

Some experiments have also been made on the hardness of alloys, and its variation with the relative proportions of the constituent metals.

An example for copper-tin alloys is given in the accompanying diagram (Fig. 1). These alloys exhibit an extraordinary range of hardness passing from 48 tons/inch^2 (pure copper) to about 6 tons/inch^2 (pure tin), but rising to 220 tons/inch^2 when one-third of the volume is tin (speculum metal). The hardness of the latter is about that of rather a low temper spring steel, though the other physical properties of the two are very different.

I found that small quantities (a gram or less) of the required alloys could be conveniently made by melting the proper proportions of the constituents under borax in the closed end of a hard glass tube, using a

gas blowpipe with a little oxygen added. If the process is properly carried out, the fused metal becomes embedded in a solid glass globe hanging by a narrow neck to the end of the glass tube. On breaking the

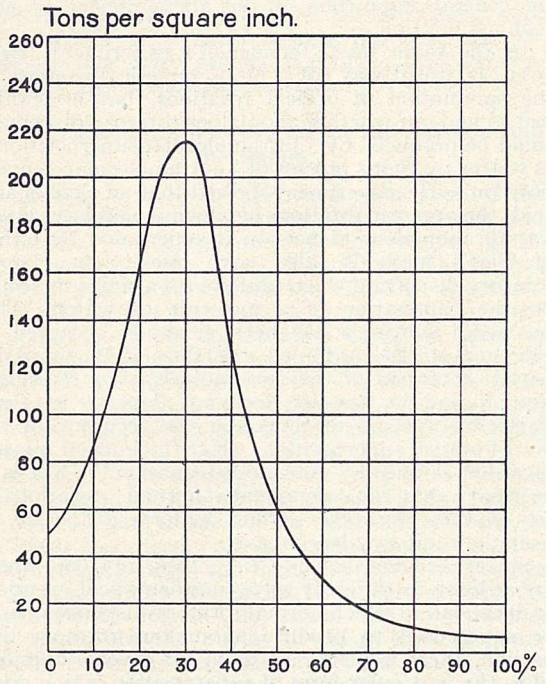

FIG. 1.—Diagram showing the hardness of copper-tin alloy in terms of the volume-percentage of tin. The ordinates give the hardness of the alloy in tons per square inch; the abscissæ are the percentages of tin by volume.

globe when cold, the alloy is found as a bright and nearly spherical bead.

The glass remains clear and uncoloured, and it may be assumed, therefore, that there has been no loss by oxidisation.

A. MALLOCK.

9 Baring Crescent,
Exeter.

Egyptology in Victorian Dress.

As the reviewer of "Descriptive Sociology" (NATURE, April 24, p. 578) accuses me of misrepresenting the divergent views of chronology, while making an *ex parte* statement himself of the 'demolition' of a view which he dislikes, I trust I may be permitted to outline the facts.

All scholars agreed in accepting what the Egyptians recorded as to the beginning of the history by the first dynasty about 5500 B.C., until Bunsen in 1845 started a truncation of this to 3600 B.C., rejecting the records because of our ignorance of the monuments. Yet the Egyptian view was maintained in Germany until 1884 or later. Since then, most important discoveries of monumental material have led Berlin scholars to go back to 4186 B.C., which is still the date accepted by officials of the Berlin Museum. Further, museum authorities in England, France and Belgium consider that some centuries earlier is a more likely date, but I did not quote them, as they vary. Behind all this shortening there is still the Egyptian statement of 5500 B.C. There is no general acceptance of any one view, much to the confounding of European pre-history which hangs on the debate. To attempt to give here the reasons for any of these views would be far too extensive a matter; but impartiality requires that all of them should be stated, as I have done without expressing a preference.

However repugnant the compulsory livery of Herbert Spencer may be, to myself or others, I hope readers of NATURE will find in the "Descriptive Sociology" a fuller statement of Egyptian science than has yet been issued, beside the linking of the prehistoric ages with the later conditions which has not been written before.

FLINDERS PETRIE.

By "the Egyptian statement of 5500 B.C." Sir Flinders Petrie means the *modern* calculations based on the fragments preserved by ecclesiastical copyists of the Egyptian priest Manetho's "History of Egypt," written under one of the Ptolemies. His book contained a general review of the Pharaohs "with the lengths of their reigns, and the total duration of each dynasty" (H. Brugsch, "A History of Egypt under the Pharaohs" (trans.), London, 1879, I. 13). In the first place, a chronological series of such a purely relative nature obviously cannot contain an objective date such as 5500 B.C. for the first dynasty; nor, on the other hand, can a modern calculation—even if it only amounts to the sum of the lengths of the dynasties added to a given date B.C.—be legitimately considered an "Egyptian statement." In the second place, the evidence from the monuments has shown the "absolute necessity of supposing in the list of Manetho contemporary and collateral dynasties, and thus of diminishing considerably the total duration of the thirty dynasties" (*op. cit.* 32). Precisely the same thing happened in Babylonia, where the scribes made lists of the lengths of the dynasties and of their sums, and even of the sums of the total lengths of contemporary dynasties in different cities. Moreover, the necessity of making allowance on this account in dealing with Manetho's records was already appreciated by Brugsch in 1877, as is shown by the quotation above from the English translation of his "Geschichte Ägyptens unter den Pharaonen."

In 1917, Dr. Ludwig Borchardt published a reconstruction of the Palermo Stone and its then newly discovered fragment in the Cairo Museum (which he—unlike Gauthier, Gardiner and Petrie himself—considers to be part of a separate, though similar tablet), and by calculations based on this reconstruction convinced himself that the first dynasty must have begun at about 4186 B.C. This was accepted by certain German scholars at the time, *e.g.* Schaefer, the Director of the Berlin Museum: but not by Eduard Meyer, who was not impressed, and maintained his own chronology, published some years earlier, and from that time until this generally adopted (with slight differences) in Great Britain, in America, and on the Continent. One of the most important of these "slight differences" is Hall's addition of 200 years to the Second Intermediate Period, which brings the date for Menes back to 3500 B.C., instead of 3300 B.C. It is to this modification, proposed not only by a museum curator but an historian as well, that Sir Flinders refers when he says, "museum authorities in England, France and Belgium [not historians] consider that some centuries earlier is a more likely date." As the last date mentioned by him has been "4186 B.C.," the reader naturally assumes that he means "some centuries earlier" than that, instead of Meyer's 3300 which he really has in mind.

Borchardt's 4186 B.C. was "demolished" by Peet in the *Journal of Egyptian Archæology* for 1920, pp. 149 ff. Recently the process has been repeated by Eduard Meyer in his "Die ältere Chronologie des Ägyptens und Babyloniens." The reader has only to pick up half-a-dozen books written in the last three years in Germany to see how unanimously the 'shorter' dating has been accepted.

THE REVIEWER.

Relative Intensities of Band Lines in the Infra-red Spectrum of a Diatomic Gas.

IN a previous theoretical discussion of the relative intensities of band lines in the infra-red vibration-rotation spectrum of a diatomic gas by one of us (E. C. Kemble, *Proc. Nat. Acad. Sci.*, 10, 274, 1924, and *Phys. Rev.* 25, 1, 1925) the formula

$$\alpha = \text{Const.}\ \frac{\bar{p}}{\nu^3} e^{-E''/kT} \quad . \quad . \quad . \quad . \quad (1)$$

was derived. Here α denotes the area under the absorption coefficient curve for the line in question when plotted on a frequency scale, and $\bar{p}$ is the mean statistical weight of the two states involved in the transition; E'' is the energy of the lower energy level or initial state for absorption; ν denotes the frequency of the line. Comparison of this formula with the experimental absorption curves then available for the HCl band at 3·5μ indicated fair agreement between theory and observation, provided that $\bar{p}$ was calculated from the statistical weight formula

$$p = 2m + 1 \qquad m = \tfrac{1}{2}, \tfrac{3}{2}, \tfrac{5}{2}, \ldots\ldots \quad . \quad (2)$$

in which m denotes the nuclear rotational quantum number.

Fowler (R. H. Fowler, *Phil. Mag.* 49, 1272, 1925) and Dieke (G. H. Dieke, *Zeit. f. Phys.* 33, 161, 1925; cf. also E. C. Kemble, *Zeit. f. Phys.*, 35, 286, 1925) have shown that the summation rule leads to the above formula, but with the restriction that the statistical weight formula must be

$$p = 2m \qquad m = \tfrac{1}{2}, \tfrac{3}{2}, \tfrac{5}{2}, \ldots\ldots \quad . \quad (3)$$

thus giving $\bar{p}$ the series of values 2, 3, 6, 8, ...

In order to obtain a decisive test of the statistical weight formula, and also to verify the asymmetry of intensity of the two branches implied in formula (1) (the R branch should be more intense than the P branch in absorption), the writers have just completed a series of observations on the HCl band mentioned above, using very short absorption tubes. The data permit the determination of the integral absorption coefficients α for the lines observed, and the values thus obtained are in complete harmony with the summation rule.

Using a quartz prism spectrometer we have measured the absorption curves for six absorption paths ranging in length from 0·1 cm. to 3 cm. Curves were drawn of the areas of individual absorption lines plotted against tube length. The initial slopes of these curves give the desired values of α. The accompanying table shows the relative values of α deduced from the experiment, taking the value for the third line of the positive branch arbitrarily as unity. The absolute value of α for this line is 49×10^{10} sec.$^{-1}$. With the exception of the line – 6, which is doubtful on account of the strong absorption in the quartz prism, the agreement between the experimental values of α and those computed from the theoretical formulæ (1) and (3) is within 4 per cent. of the absorption of the line +3. For all but two of the lines it is within 3 per cent. The maximum error becomes 10 per cent. if we use formulæ (1) and (2), and we are convinced that (2) is incorrect.

TABLE.

Line	+1	+2	+3	+4	+5	+6	+7
	0·500	0·853	1·000	0·959	0·774	0·542	0·333

Line	+8	+9	+10	−1	−2	−3	−4	−5	−6
	0·185	0·094	0·048	0·485	0·765	0·842	0·768	0·605	0·460

One surprising result of the investigation was the magnitude of the absorption with very short tube-lengths. The maximum observed absorption with a 1 mm. absorption path and a relatively broad slit was 16 per cent. From the shape of the area—tube length curves we can obtain at least a rough idea of the shapes of the lines, which are clearly very much narrower and deeper than previously supposed. Calculation indicates that radiation of wave-length corresponding to the centre of the strongest line is almost completely wiped out by the absorption in the first few millimetres of gas. The variation in shape of the area—tube length curves from line to line gives clear evidence of isotopic doubling and of the change in the doublet spacing due to the rotational isotope effect.

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Examination of Dead Sea Water for Eka-Cæsium and Eka-Iodine.

SEVERAL years ago it occurred to me that if eka-cæsium (element 87) is capable of permanent existence, it ought to be found in the Dead Sea. For ages rivers, streams, and rain, all charged with various salts, have poured into that sea, with practically no outlet save evaporation, so that an exceptionally high concentration of salts has resulted. It was not until July 1925 that I was able to visit Palestine and the Dead Sea. Summer is a particularly suitable time to obtain the water, as the enormous evaporation of surface water under the blazing sun causes a marked depression in the level of the Dead Sea, the water evaporating more rapidly than it is replenished by the Jordan, the rate of evaporation being thus estimated as exceeding six million tons of water per diem. Hence the accessible surface waters are more highly charged with dissolved salts than at other periods. This is reflected in their density, for which published data give values round about 1·1546 during the cooler months (Stutzer and Reich, March 1907). My sample was collected at the northern end of the Sea, at a depth of 2 feet, about 50 yards from the shore, and several miles west of the mouth of the Jordan. Its density at 18° C. was 1·2089, and thus more nearly approached the value given by Bernays for a depth of 300 metres, namely, 1·253.

Numerous analyses of Dead Sea water have been published from time to time and the presence recorded of the following ions: Na, K, Mg, Ca, Fe, Al, Cl, Br, I, SO_4, CO_3 and NO_3. My sample contained small but appreciable quantities of strontium, which does not appear to have been observed before. The amount of iron in the waters near the northern shore may now be expected to increase, in view of the erection of a number of crude dwellings on the beach, constructed of wood and flattened-out petrol tins. Many such tins lie also in pools and ditches hard by, imparting a deep ochreous stain to the salt that has crystallised out.

Assuming eka-cæsium to manifest in its salts the same gradation in properties as the other alkali metals, the chloride should be more soluble than the corresponding potassium salt and the chlorplatinate less soluble. After removal of all metals save those of the alkali group from a portion of the sea water, sodium chloride was fractionally crystallised out and potassium chlorplatinate precipitated from the concentrate. Gravimetric analyses showed that if any eka-cæsium were present, its amount was too small to be detected in this way with my limited supply of material. A sample of the chlorplatinate was accordingly sent to Messrs. Adam Hilger, Ltd., who submitted it to X-ray analysis in their laboratory. Several photographs were taken and good lines obtained in the region where eka-cæsium L radiations

would fall. A line of wave-length 1·037 was recorded, and it was at first thought that this might correspond to the $L\alpha$ radiations of eka-cæsium; but this was apparently not the case, since no corresponding $L\beta$ line could be detected.

The optical spectrum of a sample of potassium chloride, reduced from some of the chlorplatinate, was also photographed by Messrs. Hilger, but the only impurities we were able to identify were traces of sodium and calcium. It would appear, therefore, that eka-cæsium does not exist in the waters of the Dead Sea. Consideration of its position in the Periodic Table, between radon and radium, would suggest that eka-cæsium may itself be radio-active and short-lived, which latter property might render its detection extremely difficult.

A search was likewise made for the presence of eka-iodine (element 85) on the assumption that its silver salt would more be insoluble in water than silver chloride. The latter was fractionally precipitated and exposed to X-ray examination, but without result.

J. NEWTON FRIEND.

Municipal Technical School,
Birmingham,
May 1.

Influence of Electrical Field on the Adsorption of Neutral Molecules.

NOT only the adsorption of ions, but also the adsorption of undissociated molecules, depends on the direction and strength of the electrical field at the interface between the adsorbing body and the solution. This circumstance is illustrated by the electrocapillary curves which are obtained if a solution in contact with mercury contains organic substances.

According to Gouy, at a sufficient distance from the maximum the lowering of the interfacial tension by the organic substance vanishes, which means that

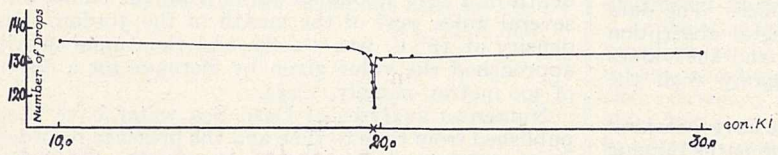


FIG. 1.

an intense electrical field prevents the adsorption of organic molecules. The reason for it is that such a field, as it has been recently shown by one of the present writers (*Zeitschr. f. Phys.* 35, 792, 1926), tends to expel organic molecules having a lower dielectric constant and to attract water molecules. The adsorbing action should therefore reach a maximum in the absence of the ionic double layer, *i.e.* at the maximum point of the electrocapillary curve. As a matter of fact, if a molecule being adsorbed charges the mercury surface positively, the maximum of adsorption is somewhat displaced with respect to the maximum of the electrocapillary curve towards the region of negative charge (the case of aliphatic acids and alcohols) and vice versa.

Starting from this consideration it was natural to look for similar phenomena in the case of solid adsorbing substances. Silver iodide proved a very suitable object in this respect. Investigations of Lottermoser and Fajans have shown that silver iodide precipitated from a solution containing an excess of silver ions is charged by these ions positively, whereas in the presence of an excess of iodine ions it is charged negatively. The potential difference between the solution and solid silver iodide varying with the concentration of silver ions in the same way as in the case of a silver electrode, the point at which concentrations of iodine ions and silver ions are equal corresponds for silver iodide to the maximum point of the electrocapillary curve, and near to it a maximum of adsorption for neutral molecules should be expected.

The method adopted for the measurements was the following: to 20 c.c. of an acidified 0·5 *N* solution of silver nitrate containing a definite quantity of caprylic acid, a similar solution of potassium iodide was added in small portions. After each addition the concentration of caprylic acid in the solution was determined by its surface tension, measured with a stalagmometer. The data obtained in one series of experiments are plotted on Fig. 1. In the proximity to the point of neutralisation a sharp minimum in the number of drops is observed, which corresponds to a minimum value of caprylic acid concentration in the solution, *i.e.* to its maximum adsorption by the precipitate. The maximum point is somewhat displaced in the direction of an excess of potassium iodide, just as in the case of the adsorption on a mercury surface.

We intend to apply this method to the study of electrocapillary curves of solid metals.

A. FRUMKIN.
A. OBRUTSHEWA.

Karpow Chemical Institute,
Moscow, March 18.

Infra-red Emission from Gaseous Explosions.

THE catalytic effect of water and other substances on the speed of explosions of mixtures of carbon monoxide and oxygen has been studied from the point of view of infra-red emission. This has been rendered possible by the use of a Downing galvanometer kindly loaned to us by Prof. A. V. Hill. With this galvanometer and a Hilger infra-red spectrometer, it is a comparatively easy matter to survey the infra-red spectra of gaseous explosions. The explosion spectrum of carbon monoxide and oxygen is qualitatively the same as that of the flame, but the ratios of the intensities of the 2·8μ and the 4·4μ bands are widely different in the two cases. For the explosion of the gases dried over P_2O_5 this ratio is nearly 1 : 1 for a 35 cm. tube, and for the flame 1 : 11. When the gases are saturated with water vapour the ratios are 2 : 1 and 1 : 10 respectively. The intensity of infra-red emission is markedly greater for the dry than for the wet gases, although the speed of explosion in the former is slower. The ratios of the deflexions obtained for the dry and wet gases were about 3 : 2 for the 2·8μ band, and 3 : 1 for the 4·4μ band. The absorption of infra-red radiation by the water vapour in front of the explosion wave is negligible (cf. Hettner, *Ann. Phys.*, 1918, 55, 496). This we have checked by absorption measurements on the wet and dry explosive mixtures. Thus the decrease in the infra-red emission which occurs when water is added to the explosion of carbon monoxide must be ascribed to some cause operating on the hot gases themselves.

Two mechanisms may be put forward to explain the catalytic action of water which take into account the bearing of the decrease in the emission of infra-red radiation on the increase in the speed of reaction. The reduction in the intensity of the radiation may be due either to its absorption or to the prevention of its emission by the water molecules. In the latter case, the internal energy of those activated molecules

which emit the 2·8 and 4·4μ bands may be converted by collision with the water molecules into kinetic energy. It is difficult to decide between the two possibilities, but in view of the high transparency of flames to their own radiation, the collision mechanism would appear to be the more probable of the two explanations.

Ethyl iodide and ethyl nitrate are still more powerful catalysts for the carbon monoxide and oxygen explosions than water, and the addition of a few per cent. of these substances reduces the intensity of emission of 2·8 and 4·4μ bands to about one per cent. of that emitted by the pure dry mixture. Here again the absorption in front of the wave is insufficient to account for the results.

W. E. GARNER.
C. H. JOHNSON.
S. W. SAUNDERS.
University College, London, April 29.

A Very Rare Halo.

ON Sunday, May 16, at 16.25 I noticed a double halo round the sun. There was much cumulus and fracto-cumulus at the time, but this cleared off later, and at about 17.30 the sky was clear except for some clouds near the horizon; at this time both halos were well seen, each extending to well over a semicircle. Except for the cumulus near the horizon the sky seemed at first sight to be absolutely blue and cloudless, but by looking carefully in the neighbourhood of the halos very faint strands of cirro stratus were seen. Both halos had a tinge of red on the side nearest the sun, but otherwise were white; they were equal in brightness except for a short time when the inner halo brightened on the right-hand side of the sun for some 30° or so, the colour at the same time becoming rather more marked. Before sunset both halos faded, the inner one disappearing first. The radius of the inner halo to the middle of the band was from 18° 30′ to 18° 40′ as measured with a sextant. Better measurements, perhaps, were obtained from a photograph taken on a panchromatic plate through a Wratten A (deep red) filter; this gave the radii for the inner halo of 17½° to the inner edge and 21° to the outer edge, for the outer halo 22½° and 26½° respectively. The photograph was taken with a wide angle lens, and allowance was made for distortion away from the centre of the plate in making the above measurements.

Three halos are known inside the halo of 22°; the first has a radius of 7½° to 10°, the second 17° to 18°, the third 18½° to 20°. The halo seen here was obviously the second, or Rankin's halo. Besson (*Comptes rendus*, 1920, **170**, 334) mentions this halo as having been recorded six times. There is some uncertainty as to the exact radius, and the matter is of some importance in connexion with the theory of these abnormal halos (see Besson and Humphreys, *Monthly Weather Review*, 1923, pp. 254, 255); for this reason, and also because Rankin's halo is excessively rare, I have gone into the matter rather fully. Halos are difficult to measure accurately, and the above measurement of 17½° is probably as accurate as any previously made; on several occasions when this halo has been observed the measurements were admittedly not very accurate. So far as I know it has never been photographed before.

On May 16 the two halos were seen over a wide area, reports having come from the counties of Suffolk, Essex, Kent, London, Surrey, Sussex, and Hampshire. As seen here in a nearly clear sky, they formed the most striking meteorological phenomenon that it has ever been my good fortune to witness.

C. J. P. CAVE.
Stoner Hill, Petersfield, May 23.

The Transmission of Signals from a Horizontal Antenna.

IN the course of a mathematical investigation of the propagation round the earth of electromagnetic waves from a horizontal antenna, the result has emerged that, when the earth is regarded as a perfect conductor, the components of electric and magnetic force are zero both when the earth is regarded as surrounded by a conducting Heaviside layer and when no layer is present. Finite conductivity of the earth must thus be assumed in order to account for the propagation, and it is then found that the resulting forces are a small vertical electric force and a much larger horizontal magnetic one. The electric force is due to the 'space waves,' the magnetic force to the 'surface waves' described by Sommerfeld (*Annalen der Physik*, vol. 28 (1909), p. 665); the result of the analysis is in remarkable agreement with the conclusions he there expresses. The magnetic force may be analysed into perpendicular components, each of which consists of two simple harmonic oscillations differing in amplitude and phase, results of the same general type being obtained both with and without the Heaviside layer.

Numerical investigations of the magnitudes of the forces and their variation with distance from the source are in progress.

MARY TAYLOR.
Mathematical Institute,
The University, Göttingen,
March 31.

Rustless Steel and Flexible Glass 5000 Years Ago?

WHILST looking up the literature connected with ancient glass, in which I am interested, I came across a book by M. A. Wallace-Dunlop, published in 1883, entitled "Glass in the Old World."

An account is there given of the alleged opening of the first and second pyramids of Gizeh.

As these pyramids are known with tolerable certainty to have been built between 3969 and 3845 B.C., we may conclude that the things found in them when first opened must have been made at least five thousand years ago.

It is stated, on the authority of one Ben-Abd-er-Rahman, that in the year A.D. 829 El-Mamoum, son of Haroun-al-Rasched, was the first who succeeded in penetrating the tomb of Cheops, and found there the mummy of the king, and that he also entered the west pyramid (second pyramid?), and that there was found "thirty treasures filled with store of riches, and utensils, and with signatures made of precious stones (signet rings?) and instruments of iron and vessels of earth, and with *arms which rust not*, and with *glass that might be bended and not broken*." The italics are mine.

Those ancients have a most exasperating way of anticipating our new ideas.

JAMES H. GARDINER.
Harrow.

Transmission of Stimuli in Plants: A Correction.

IN a communication dated May 22, Prof. Ricca asks me to point out that there is an error in his letter as printed in NATURE of May 8, p. 655. There it is stated that the closing of the pinnules from base to apex of a pinna indicated times of transmission of the stimulating substance from the base to the apex of the pinna of 5, 4, 3½, 2½, 2 min. This of course should read, 5, 4, 3½, 2½, 2 sec.

HENRY H. DIXON.
Trinity College, Dublin,
May 28.

The Element of Atomic Number 61; Illinium.

By J. A. HARRIS, L. F. YNTEMA, and Prof. B. S. HOPKINS, University of Illinois.

AN important result of the development of Moseley's atomic number rule has been the impetus it has given to the search for missing elements. It is true that later arrangements of the Periodic Table indicated that eka-cæsium, eka- and dwi-manganese, and eka-iodine were missing, but there were no theoretical grounds for supposing that eka-neodymium might exist until Moseley's rule showed that element number 61 was still to be identified. Moseley's work was of inestimable value to one engaged in completing the list of chemical elements for several reasons—first, it gave definite information as to the existence and location of gaps in the Periodic Table; secondly, it gave a basis for the calculation, prior to its discovery, of the X-ray spectrum of an element and indicated a technique by which lines in that spectrum might be identified; and, finally, it originated a method of examination so searching that a mixture of two elements, so closely similar in chemical properties as to be almost inseparable, could be definitely analysed. Were it not for the work of Coster and Hevesy on the X-ray examination of zirconiferous minerals, the presence in them of element number 72 would probably be still unsuspected and hafnium (or celtium) would still be listed among the rare earths. Chemical tests made on zirconium ores had frequently indicated the non-homogeneity of zirconium, but they could not give the definite proof afforded by an X-ray analysis.

The proof that a rare earth element was missing, the atomic number of which would place it between neodymium and samarium, explained the sharp break in the sequence of properties that comes in the rare earth group between those two elements. The differences in solubilities of the double salts formed by rare earth nitrates with magnesium nitrate appear to be quite uniform, excepting in the case of neodymium and samarium, since fractional recrystallisation of that double salt will accomplish a strikingly sharp separation of those two elements. There is the same break in the sequence of solubilities of other salts, in basicity, as indicated by the rate of hydrolysis, etc. It also appears that the absorption spectra show the same general variation, and, as will be shown later, the absorption bands of element number 61 seem to fit into the regular sequence.

Because element number 61 might be expected to share the striking similarity in properties and the common occurrence in minerals of the other members in the rare earth group, it seemed logical to institute a search for it in monazite sands, a mineral in which the first members of that family, the so-called cerium earths, predominate. Since that mineral is rich in neodymium, 60, and in samarium, 62, it would be surprising to learn of the absence of 61 there and its presence in a mineral containing little or none of 60 and 62.

The original material used in the investigation was the rare earth residue remaining from monazite sands after the extraction of thorium and part of the cerium for use in the manufacture of Welsbach mantles. It was given to this laboratory by the Lindsay Light Company of Chicago. After the remaining cerium was removed by the usual methods, the other rare earths were fractionally recrystallised as double magnesium nitrates. Very pure neodymium and samarium, the latter subjected to further purification by other methods, were sent to the Bureau of Standards at Washington for use in an extensive investigation being pursued on the infra-red arc spectra of the rare earths. It was found that a number of identical new lines were present in both samples, and the suggestion was made that they might be due to the presence of a small amount of a new element. Eder had noted the same phenomenon. Later, when the ultra-violet arc spectra of neodymium, samarium, and of intermediate fractions containing both were examined, lines common to all three were found. However, X-ray analysis of those same samples showed no indication of the presence of an element with atomic number 61. Prandtl and Grimm had subjected rare earth material to separation by the same method and then to a fractional precipitation with ammonia, and could find no evidence of the missing element by X-ray analysis.

It seemed that the solubility of the double magnesium salt of element number 61 is very similar to that of neodymium, and its separation by recrystallisation of that salt offered little hope of success. The order of solubility of the bromates of the cerium group earths is the reverse of the order obtaining with the double magnesium nitrates, and that suggested a means of separating neodymium and thus concentrating element number 61. It is easier to separate a small amount of one element from a larger amount of a second if the former is in the less soluble end of the series of recrystallisations. Accordingly the neodymium-rich material thought to contain element number 61 was converted to bromate and again recrystallised.

A marked change in the absorption spectra of the solutions that began to appear after repeated recrystallisation indicated the probable concentration of the missing element. Two bands, one at 5816 Å.U. and another at 5123 Å.U., that had shown very faintly in supposedly pure neodymium, became stronger in some fractions as the other neodymium bands disappeared. Because these two bands, if assigned to element number 61, find their places in a more or less regular sequence shown by bands of neighbouring elements, it was thought they might belong to that element.

X-ray analysis confirmed the theory and showed the presence of element number 61 in those fractions. A mean value of five determinations of 2·2781 Å.U. was found for the La_1 line and one determination of 2·0770 Å.U. for the $L\beta_1$ line. A faint indication of the $L\beta_3$ line was also noted. It is assumed that these results prove the presence of element number 61.

The name assigned to the element is Illinium (Il).

There are several reasons that may be advanced to explain why the element escaped detection by means other than X-ray analysis. It must be extremely rare. Its solubility in a series of fractional recrystallisation is next to that of the very abundant neodymium, which tends to spread into the illinium-rich members of a series. The large number of absorption bands exhibited by both neodymium and samarium would tend to mask

its absorption spectrum. Finally, the solubility of its double magnesium nitrate, which salt is commonly used for the separation of closely related elements, is close to that of neodymium. Evidence supporting this latter is found in the fact that the absorption bands at 5816 Å.U. and 5123 Å.U. found in supposedly pure neodymium purified by that method are shown to belong to illinium.

The identification of illinium as the missing rare earth completes the list of rare earth elements. Work has been instituted involving the extraction of several hundred pounds of the crude material with the purpose in view of obtaining enough of the element in pure enough state to study its properties, its relationship to other members of the group, and its atomic weight.

The Periodic System, Chemical Bonds, and Crystal Structure.[1]

By Prof. A. SOMMERFELD, For. Mem. R.S., University of Munich.

A GREAT advance was made in the Bohr theory of the Periodic System by the discovery of Stoner and of Main Smith that the numbers of electrons in the different subdivisions of the L, M, N, . . . shells are not equal, as Bohr originally assumed, but unequal. The details of the new scheme are given in the following table, which shows the sub-groups of the shells, with the numbers of electrons in each :

TABLE OF X-RAY LEVELS.

	n_{11}	n_{21}	n_{22}	n_{32}	n_{33}	n_{43}	n_{44}
K	2	..	..	..	..	..	..
L	2	2	4	..	..	..	..
M	2	2	4	4	6	..	..
N	2	2	4	4	6	6	8
	n_1		n_2		n_3		n_4

It will be noticed that the K-shell is single, the L-shell triple, the M-shell fivefold, and so on, in agreement with X-ray data (three L absorption edges, etc.). For the principal quantum numbers we still have of course $n=1$ in the K levels, 2 in the L levels, and so on.

At the top of the table is the quantum number notation which we find necessary for classifying X-ray spectra. There are, besides the principal quantum number n, two subordinate ones which we write as suffixes. They are denoted either by k_1 and k_2, or by k and j, and it is understood that while $k_1=k$, $k_2=j+\frac{1}{2}$; j is the so-called inner quantum number, and is, according to our scheme (developed in a previous lecture), half-integral, in the same way as in the alkali spectra. The two types of spectra are analogous, as is emphasised especially by Landé. We increase the magnitude of j, merely for typographical reasons, by $\frac{1}{2}$, so as to obtain a whole number k_2, in agreement with our practice in the case of the alkalis.

The numbers in the body of the table are now throughout equal to $2k_2=2j+1$. But $2j+1$ is the quantum weight, or number of orientations of the angular momentum j in a magnetic field, so that Main Smith and Stoner make the number of electrons in a given energy level equal to the quantum weight, $2j+1$, of that level.

At the foot of the table the numbers n_k describing the orbital types are given. We must direct special attention to the fact that any two shells that form a 'relativity doublet' in the X-ray spectra belong to the *same* orbital type n_k, which is in complete opposition to the original view from which the relativity formula was derived.

In replacing n_k by n_{kj}, we are introducing the same problem as has arisen in the case of the visible spectra. The characteristics of the orbit of a single electron ought to be fully determined by two quantum numbers, n and k, together with a third, m, to give the orientation of the orbit in space; that is to say, corresponding to the three degrees of freedom of the rotating electron, we should have altogether three quantum numbers. But we have already seen (in the earlier lectures) that even with hydrogen we require a j in addition to n and k, or three quantum numbers merely for the characteristics of the orbit, which is thus not fully described without four numbers. We need not be surprised then when the same problem arises with X-ray spectra, so that here also a single orbit must be described not as an n_k orbit but as an n_{kj} orbit. May we hope that the solution of the difficulty will be found along the lines of the new quantum mechanics introduced by Heisenberg and developed, for example, by Dirac? It is true we are confident that this will dispose of the old difficulties as to half-quantum numbers, and so on, that arise especially in the anomalous Zeeman effect; but it seems unlikely that it will succeed in providing a new degree of freedom for the orbital electron. Most probably we shall be compelled to make a new hypothesis that will introduce this into the Hamiltonian function of the system. In this connexion we may recall the striking suggestion of S. Goudsmit of the 'spinning electron' (proposed, in some respects, by Porson previously, though Porson gave no definite relations to quantum numbers); it may be that here we shall find the explanation of the missing degree of freedom.[2]

The j of the individual electron must not be confused with the j of the whole atom, the outermost shell of which is composed, in general, of several orbits of the type in question. This latter j we will distinguish by a bar, so that $\bar{j}$ refers to the atom as a whole; moreover, it refers to the atom in its fundamental or unexcited state. In other words, $\bar{j}$ is the inner quantum number of the fundamental term. In 1925 I enunciated two theorems in the *Physikalische Zeitschrift*, about this $\bar{j}$ of the fundamental term and its relation to the position of the element in the periodic table :

1. Every completed sub-group is distinguished by $\bar{j}=0$.

[1] From a series of University of London lectures on "Atomistic Physics," delivered at the Royal College of Science during March 1926.

[2] Indeed, from a paper of Heisenberg and Jordan, now in print in the *Zeits. f. Phys.*, it appears that both new mechanics and 'spinning electron' are needed in order to account for the relativity doublet arising between two levels that differ by j and not, as in the original theory, by k.

2. The element immediately following or preceding the one that completes a sub-group has a value of $\bar{j}$ that is identical with the j of the sub-group to which the element belongs.

The following scheme will give examples of these theorems :

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XVII.	XVIII.
$j=$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	....	$\frac{3}{2}$	$\frac{3}{2}$
$\bar{j}=$	$\frac{1}{2}$	0	$\frac{1}{2}$	0	$\frac{3}{2}$	..	$\frac{3}{2}$	0	$\frac{3}{2}$	..	..	0 ?	....	$\frac{3}{2}$	0

The Roman figures give the number of electrons in the outermost shell (whichever that is) in the various cases. The numbering is from the beginning of that shell, and applies equally well to the N shell as to the M, and also to the L shell in so far as it has enough electrons.

I can only touch very briefly on the spectroscopic evidence for this scheme, and must omit all details: $\bar{j}=0$ is found for column II. in helium and the alkaline earths, and for column IV. in tin and lead, and probably also in ionised nitrogen (N^+). For column VIII. it is established by neon (we considered in our second lecture the neon $^1S_0$ term); for column XII. it is doubtful, and XVIII. (nickel, palladium, platinum) will have to be considered further below. $\bar{j}=\frac{1}{2}$ denotes, in column I., the s term of the alkalis, and in column III. the $^2P_1$ term of aluminium, gallium, indium, and thallium; and so on for the others.

Of course we may expect in addition that the azimuthal quantum number of the last-bound electron will be the same as the k of the Periodic System, *i.e.* as the first suffix in n_{kj}. This is indeed the foundation, on its spectroscopic side, of Bohr's theory of the Periodic System. However, this k is different, in the case of atoms having several valency electrons, from the 'group quantum number' l, introduced (though their notation is different) by the work of Russell and Saunders on the alkaline earths. The exceptions to the Bohr scheme which iron and titanium, for example, appear to provide are founded on a confusion between k and l which Russell and Saunders were the first to avoid.

We come now to chemical applications. We may state the basic principle of chemical binding as a tendency towards the formation of complete sub-groups. The complete group of eight electrons has been familiar for some time, and it is well known how the simplest binary compounds approach this inert-gas configuration from both sides. The next in importance is the 'two-shell,' typified especially by helium, in which two electrons rotate in opposite directions, so that their moments cancel out. As an example of this we may cite $LiH=Li^+H^-=He_3He_1$.[3] However, the elements zinc, cadmium, mercury, belong to this class too, having a pair of outer electrons bound in a similar manner, and we know of many very stable compounds which are approaching this configuration. I will mention only a few, such as PbO (or PbS), in which the lead is divalent or, in other words, is reduced to the two-shell of mercury, having given two electrons to the oxygen or sulphur. PbO is actually more stable than PbO_2, although in the latter compound the lead has what used to be regarded as its 'correct' valency. We may note also the compounds of monovalent thallium and of trivalent arsenic, antimony, and bismuth, all of which are aiming at the two-shell or helium type. Main Smith and Stoner have thus left no room for doubt that in future chemists, in their speculations about affinity, will have to take into account as equally authenticated, not only the eight-shell of the inert gases, but also the two-shell.

We come now to the so-called eighteen-shell which is, one supposes, completed at the ends of the triads by nickel, palladium, and platinum. There is no doubt that the following elements—copper, zinc, silver, cadmium, gold, mercury—in their chemical compounds are often reduced to the eighteen-shell. But is this shell in fact complete, like the inert-gas shell? What are the conclusions of spectroscopy as to the fundamental states? With palladium the position is clear and unambiguous: the fundamental term is here a $^1S_0$ term lying well below the other levels. Palladium has thus a completed shell. This does not hold for nickel or platinum. In nickel the fundamental term is a ^3F term, with a $^3D'$ level slightly higher, and in platinum a $^3D'$ term. This is reflected in the chemical and spectroscopic behaviour of the following elements—copper, silver, and gold. Silver is without exception monovalent; on the removal of its single valency electron it goes over into the stable palladium configuration. Copper is mono- and divalent; gold mono- and trivalent. Here then, in addition to the valency electron, one or more of the electrons of the core of the atom may be detached. The core in the case of copper and gold is not completed, which agrees with what we have found for nickel and platinum.

The same impression is gained from their spectroscopic behaviours. Silver has a simple spectrum resembling that of the alkalis, while the spectra of copper and gold show in addition to the alkali doublet system a large number of foreign lines. It is very characteristic that Fräulein Stücklen[4] has found for the most stable state of copper not the s term of the doublets, but one which probably belongs to a quartet system. That corresponds exactly to the uncompleted shell of nickel. The position of an element in the periodic table thus gives us very decided clues for unravelling its spectrum.

The behaviour of nickel and platinum and, what is intimately bound up with them, the behaviour of copper and gold, must be regarded as a partial exception to our rule about resultant moments of momentum $\bar{j}$; $\bar{j}=0$ is indeed the mark of a completed sub-group, but in some cases the last electron, which might have performed this rôle, is, from considerations of energy, more easily accommodated elsewhere.

We come now to the final members of those sub-groups which are distinguished from the following sub-group by a different value, not of k but of j, so that they belong to the same orbital type, n_k, as the

[3] He_3 denotes a He-configuration with nuclear charge 3, $=Li^+$, and similarly for He_1.

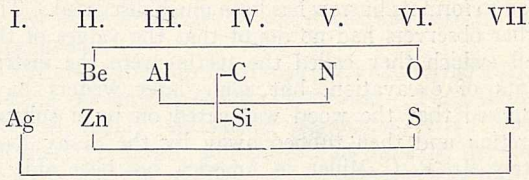
[4] *Zeits. f. Phys.* **34**, 562, 1925.

following elements. It appears that this division is less well marked, and makes itself less noticeable chemically than the close of the sub-groups already considered. If we take first the division between n_{43} and n_{44} (for $n=4$) in table I., we find that this occurs in the rare earths; and corresponding to it is the difference between cerium earths and ytterbium earths, which is especially noticeable magnetically. The curve for the paramagnetism of the ions rises, according to Cabrera and Stefan Meyer, to a maximum, then falls off almost to zero at the end of the cerium earths, reaches a higher maximum with the ytterbium earths, didymium, and holmium, and falls finally to zero at cassiopeium ($Z=71$).

The close of the sub-group n_{32} appears, as we have already said, not to be noticeable spectroscopically; in contrast to this we have found that the close of n_{21} is marked by $j=0$ in tin and lead, and probably also in carbon and silicon. But how about the chemical effects of the close? Are there compounds which are aiming at the four-shell as there are for the eight-, two-, and eighteen-shells? The answer will be of great interest for the understanding of chemical compounds, and towards it I can make the following contribution, based on an observation of H. G. Grimm relating to the crystal structure of certain diamond-like compounds. The subject is treated in a paper by Grimm and myself in the *Zeitschrift für Physik* (1926), where also the above remarks about copper, silver, and gold may be found.

The characteristic structure of diamond is known from the work of Sir William Bragg. Diamond is built up simply of tetrahedra in such a way that every carbon atom is surrounded by a tetrahedron of other carbon atoms. Zinc sulphide crystallises in the same arrangement, as zincblende, with each zinc atom surrounded by a tetrahedron of sulphur atoms and vice versa, but it also crystallises in another way, as 'wurtzite'; in this, while we still have interpenetrating tetrahedral systems, the structure is not cubical but hexagonal; the tetrahedra are merely disposed in a different way, in relation to one another, from that which occurs in the diamond. We will classify both together as tetrahedral structures. The crystal carborundum (CSi), so important technically, is likewise tetrahedral, with different modifications, which are distinguished by the way in which diamond- and wurtzite-structures alternate with one another in the hexagonal *c*-axis. As a result of this alternation the repetition-distance is here extraordinarily large—almost 40 Å.U., indeed, in one of the modifications.

Now, however, we have this to consider: this tetrahedral structure occurs not only in the fourth column of the periodic table (*e.g.* in carbon, silicon, carborundum, germanium, tin), but also in compounds of neighbouring elements, those neighbours being equally distant on opposite sides from the fourth column. We may in fact state as a definite theorem that tetrahedral symmetry occurs *only* in such binary compounds as have both components at most three places from a four-shell, and both equally distant.



It is very natural to assume that in all these compounds the mechanism of the bonds is the same as in the diamond. This is quite obviously a non-polar bond, since it unites two similar atoms, and we conclude that in zinc sulphide it is also non-polar; *i.e.* the compound is not $Zn^{++}S^{--}$. This is confirmed by X-ray intensity measurements, which, according to H. Ott, certainly do not correspond to Zn^{++} and S^{--}, but probably to neutral Zn and S. The idea of a four-shell would have suggested even the reverse picture, Zn^{--} and S^{++}, since the sulphur atom must give up two electrons if it is to be reduced to the four-shell of silicon, and zinc must acquire two to reach that of germanium; however, the intensity relations seem rather to indicate neutral Zn and S. Similarly, beryllium oxide, in contrast to magnesium oxide and calcium oxide, is at least not the polar salt $Be^{++}O^{--}$. In calcium oxide and calcium carbonate tetrahedral structure is not observed, nor is it to be expected theoretically, since calcium is not two places before a four-shell.

I prefer not to go further at present into the mechanism of the reciprocal binding of such four-shells; even in the simplest case of the diamond we know nothing certain about it. It is most probable that the binding is performed by pairs of electrons, each of which goes round two carbon atoms, as in G. N. Lewis's theory of the sharing of electron pairs.

In conclusion, then, we have found that the theory of the Periodic System shows at what elements we are to expect completed sub-groups. In addition to the inert-gas eight-shell, the shell of eighteen, and even more that of two electrons, is a goal at which the elements in a stable compound are aiming. The four-shell, on the other hand, is evidenced by a tetrahedral crystal structure, which points to the same kind of binding together of the atoms as we have in the diamond; this binding is not performed by the electrostatic attractions of polar ions of the usual sign, but is probably a matter of neutral atoms. It seems reasonable to hope that the great chemical problem of the non-polar bond will be brought nearer its solution by a close study of tetrahedral crystal structures.

The Shipworm.[1]

By Dr. W. T. CALMAN, F.R.S.

ALTHOUGH nowadays iron ships no longer fear the *calamitas navium*, as Linnæus called it, the shipworm still remains a constant source of anxiety to harbour engineers in many parts of the world. For example, the damage caused by it to wharves and jetties on the shores of San Francisco Bay, during the years 1919 and 1920, was estimated at no less than 15,000,000 dollars.

Within the last few years a good deal of attention has been paid to the shipworms by investigators in

[1] Substance of two lectures delivered at the Royal Institution on April 17 and 24.

Great Britain and, more especially, in America, and noteworthy additions have been made to our knowledge. Only a few of the more striking results can be touched on here.

The question of how the shipworm excavates the wood to form its burrow has been much discussed. The earlier observers had no doubt that the valves of the shell—which they called the teeth—were the instruments of excavation, but some later writers have supposed that the wood was acted on by a solvent secretion and then rubbed away by the fleshy foot. Lately Mr. R. C. Miller, in America, has been able to watch the animal at work, by laying bare the inner end of the burrow and cementing a cover-glass over the opening. He found that the sucker-like foot adheres now to one part and now to another of the inside of the burrow, and the animal is wedged firmly in position by the swelling up of a fleshy lobe lying over the back of the shell. A rocking movement of the valves produced by alternate contractions of the two adductor muscles causes the rows of minute teeth on the surface of the valves to rasp away the wood, and, as the foot shifts its position after each stroke, the boring proceeds evenly and the circular form of the burrow is preserved. In hard and fine-grained wood, microscopic parallel scratches can be observed which are the tool-marks of the excavator.

Most bivalved molluscs feed on minute living organisms and organic particles suspended in the water, and the food-collecting function of the so-called gills is at least as important as their respiratory function. It is possible that the shipworm obtains a part of its food in this way, but it also swallows the fine sawdust produced by the rasping movements of its valves, and the stomach and intestine are found on dissection to be crammed with wood-pulp. This does not prove that the wood is actually a source of food, for some related molluscs (Pholadidæ) that bore into rock, similarly swallow the innutritious mud produced by their boring operations. As compared with the Pholadidæ, which burrow only to get shelter, the elongated worm-like shape of the shipworms (some of which are six feet long) suggests the need for continued boring to obtain food while keeping in touch with the surrounding water at the mouth of the burrow. Recent work, however, shows that the wood is actually digested. Potts has observed phagocytic ingestion of wood-particles in the 'liver,' while Harrington found that an extract from the same gland acted on sawdust to produce glucose. Dore and Miller, in America, have analysed the borings after passing through the alimentary canal of the shipworms and compared the composition with that of the wood itself. They found that while the amount of lignin remained unchanged, the cellulose was reduced by 80 per cent. and the hemicelluloses by 15-56 per cent.

This, however, is not the whole story. It seems to be well attested that, in certain circumstances, the shipworm ceases to bore and shuts itself completely off from the wood by continuing the shelly lining over the end of its burrow. Where this has been done, the only source of food-supply will be the suspended particles drawn in by the respiratory current. The same is probably true of the somewhat mysterious giant shipworm, *Kuphus arenarius*, which does not bore into wood but lives vertically embedded in the mud of mangrove swamps with only its siphons projecting from the surface.

The practical man, when confronted with problems such as those presented by the shipworm, is sometimes apt to pay too little heed to the history of the subject and to waste time in finding out for himself facts that were discovered and recorded long ago. The learned Sellius, two hundred years ago, was at pains to confute the suggestion that the shipworm could emerge from its burrow and swim away to bore into a fresh piece of timber. Such a supposition was natural enough when nothing was known of the microscopic free-swimming larvæ, but it is surprising to find it revived in an official report issued only three years ago by the Department of Scientific and Industrial Research.

It is characteristic of the shipworm that it may appear suddenly in places that have previously been free from its depredations. Thus we find records of great outbreaks of shipworm in Holland in 1730, 1770, 1825 and 1858, at San Francisco in 1917, and so on. In most of these cases the damage is severe for two or three years, then the attack dies away and little or nothing is heard of the pest in the intervening periods. When one of these outbreaks occurs, the practical men generally begin by attributing it to importation of infection from abroad. In Drake's time the shipworm was commonly regarded as having been brought from the New World. In the eighteenth century the East Indies were supposed to be its place of origin. Linnæus concisely says of it, "ex Indiis in Europam propagata." In the recent San Francisco outbreak something was said of importation from Europe.

It is possible that some truth may underlie these beliefs. The commonest species of shipworm in northern Europe, *Teredo navalis*, has been found in places so widely separated as the Cape of Good Hope, Australia and San Francisco, and there is every probability that this wide range, unusual in a marine invertebrate, is due to the species having been carried to these distant parts in the timbers of ships. But it is unlikely that the individual outbreaks can often be due to this cause. It is certain that in most cases the shipworms have lurked unnoticed in odd corners until rapid multiplication owing to favourable conditions has directed attention to them. It becomes of importance, therefore, to determine what these favourable conditions are.

Individual outbreaks have sometimes followed years of deficient rainfall, leading to increased salinity in the waters of bays and harbours, and attempts have been made to find out the degree of salinity which is most favourable. It was found at San Francisco that *Teredo navalis* was active and apparently thriving at a salinity of 15 per thousand, that is to say, in water containing rather less than half the amount of salt usually found in ocean water. As the water was diluted the animals became less active until at 4 per thousand they withdrew into their burrows. While enclosed in the wood, however, they remained alive, though inactive, for three weeks in fresh water, ready to resume operations when replaced in salter water. It would be interesting to know how the free-swimming

larvæ are affected by changes of salinity, but there appear to be no detailed observations on this point.

All these observations, however, have been made on a single species, *Teredo navalis*. There are many other kinds of shipworms and, although we know little of their habits, we do know that they differ greatly in the degree to which they can adapt themselves to water of reduced salinity. *Teredo navalis*, which can flourish in water only half as salt as that of the oceans, probably owes its evil reputation to the fact that its tolerance for brackish water enables it to invade estuaries and harbours where the water is commonly less salt than that of the sea outside. It is the common species in the North Sea and comes up the Thames as far as Greenwich. At Plymouth, another species, *Teredo norvagica*, appears to be the commonest, and it will probably be found to prefer salter water. On the other hand, various tropical species ascend rivers, such as the Ganges and the Zambezi, to places where the water is quite fresh. There is even a report that a shipworm occurs in Lake Tanganyika, although no specimens have yet been seen by naturalists.

It should be clear, then, that an accurate determination of the existing species of shipworms and of their conditions of life is of great importance from a strictly practical point of view. How far we are from having this knowledge is perhaps only realised by those who have tried to determine collections of shipworms from different parts of the world. But that is no reason why such knowledge as we have should be neglected. In some recent investigations on the efficiency of certain poisons when used to protect wood against attack by shipworms, the authors do not even trouble to tell us what species of shipworm was used in their experiments.

A study of the shipworm suggests some considerations bearing on current biological theories. For example, like all highly specialised organisms living under peculiar conditions, the shipworms raise in the most striking way the problem of adaptation. The form of the body, the shape of the shell-valves with their file-like rows of teeth and the pivots on which they rock, the disposition of the muscles, the sucker-like foot, the alimentary canal—all these and many other details of structure co-operate to form a mechanism which is unintelligible except as a device for boring into and feeding on wood. The mutation theory of evolution teaches that organisms have evolved by sudden changes of structure which had no relation to the needs of the organism and only an accidental fitness for its mode of life. It is scarcely exaggeration to say that according to this school the shipworm bores into wood and feeds on it because it happens to find itself provided with suitable implements for doing so. If that were all the help to be got from the theory of evolution, it would be better to go back to the doctrine of special creation.

Obituary.

DR. H. B. GUPPY, F.R.S.

HENRY BROUGHAM GUPPY, who died at Martinique on April 23 on the voyage home from Tahiti, began work at a time when a medical training was the usual method of approach to a scientific career. Like other eminent naturalists, he started that career as a surgeon in Her Majesty's Navy. But the inspiration of the islands of the great oceans remained throughout his life as the directing force of his painstaking investigations of the problems relating especially to geographical distribution which they suggested.

In 1878 Dr. Guppy visited the China Seas; but his great opportunity came in 1881, when he was appointed surgeon to H.M.S. *Lark*, which was commissioned for survey work in the western Pacific. Two volumes on the Solomon Islands, published in 1887, contain the results of three years' study on the ethnology, natural history, and geology of this somewhat difficult group, where it was necessary to 'dare a little' in order to learn. The problem of coral-reef formation especially attracted him, and in 1888 he was able to continue his study of the problem on the Keeling-Cocos Islands, a classic locality, as the subsidence-theory held by Darwin was the result of a brief visit to the Islands during the voyage of the *Beagle*. Guppy, who examined all the islands and islets, more than twenty in number, concluded that these small atolls and horse-shoe islands only assume their characteristic form after the island has been thrown up by the waves (see NATURE, 39, 236, 1889). Later, in his physical and geological monograph of Vanua Levu, Fiji (1903), he describes as "one long story of emergence" the building up of the island by reef-formation on a submarine basaltic plateau.

The problem of the stocking of coral islands had interested Dr. Guppy from the first, and between 1890 and 1896 he made a careful study of British plants from the point of view of dispersal by water—a paper on "The River Thames as an Agent in Plant Dispersal" was read at the Linnean Society in 1892. This prepared him for three years' intensive work in Fiji and Hawaii (1896–99), and later on the west coast of South America (1903–4). The fruit of these observations was "Plant Dispersal" ("Observations of a Naturalist in the Pacific," vol. 2, 1906), an eminently suggestive work and a mine of information on the floras, especially littoral, of the islands and eastern shores of the Pacific, and the means of dispersal which have been effective in their formation. General problems are also discussed; and the hypothesis of a great Pacific land-area is dismissed: "We have much to learn before it would be safe to look to hypothetical changes of sea and land to explain difficulties in distribution." The problem of fruit and seed became the *motif* of his work, and his "Studies in Seeds and Fruits; an Investigation with the Balance" (1912) is a study of mechanical and physiological problems bearing on means of dispersal. These were preparatory to his second book on this subject, "Plants, Seeds, and Currents in the West Indies and the Azores" (1917), a record of his personal observations during visits to the Islands, and a valuable contribution to the study of Island floras. The award of the Linnean Medal of the Linnean Society in the same year, and his

election shortly after to a fellowship of the Royal Society, were a well-earned recognition of long years of quiet, steady, fruitful work carried out with remarkable singleness of purpose. A. B. R.

REV. W. A. B. COOLIDGE.

BY the passing away, in his seventy-sixth year, of the Rev. William Augustus Brevoort Coolidge, at the Swiss home which he had built for himself, Châlet Montana, Grindelwald, another famous mountaineer, who carried on the great traditions of the pioneers of the Alps, is removed from our midst. Not merely was he a climber of the very front rank, but the most erudite of the band, possessing a wonderfully complete personal knowledge of the Central European Alps—of their topography and physical geography, their history, and that of the countries in which they are situated. Familiarly and equally conversant with English, French, and German, he was a prolific writer in all three languages, conveying his exceptional knowledge with conciseness yet with fascinating interest. He wrote, for example, the articles on Switzerland in all the three later editions of the "Encyclopædia Britannica," those portions on the geography and history of the country being not only of great value and meticulous accuracy but also of eminent literary merit. Besides his well-known guide-books (to the Dauphiny Alps, Lepontine Alps, Adula Alps, Mountains of Cogne, and the Bernese Oberland), and his editions of Ball's "Alpine Guide" and Murray's "Handbook of Switzerland," he wrote a most charming book, "The Alps in Nature and History," in which his wide knowledge of the history, antiquities, folk-lore, religious and political development of the playground of Europe is used for our instruction in a truly delightful manner.

Coolidge was a singular combination. An American citizen throughout his life, born near New York and at school in the United States, he became an undergraduate of Exeter College, Oxford, where he took a first in modern history and won the Taylorian scholarship for French. He was afterwards elected to, and retained to the last, a fellowship at Magdalen. Moreover, from 1883 until 1895 he acted as curate at South Hinksey, having taken holy orders. In 1909, however, he removed permanently to Grindelwald, where he had built the Châlet Montana as a home for himself and his priceless library of Alpine literature.

For thirty-five years Coolidge spent the long vacations and some winter ones in climbing and exploration, in his best days accompanied by that wonderful guide, Christian Almer; during this time he climbed practically every peak in the whole of the Swiss, French, and Italian Alps. Elected a member of the Alpine Club in 1870, and an honorary member in 1904, he edited the journal of the Club for the ten years 1880–1889. His greatest claim to fame, however, is in the realm of topographical and physical geography, the whole of his writings on these subjects being characterised by a degree of accuracy which renders them pre-eminently trustworthy and of high permanent value.

A. E. H. TUTTON.

MR. F. S. SPIERS.

BY the death of Mr. Frederick S. Spiers, science loses one who was well known for his ability as an organiser, particularly of affairs related to physical chemistry. Mr. Spiers was born on October 21, 1875. His father was a Dayan or Judge of the Jewish Court. He was educated at the Central Foundation School, Finsbury Technical College, and at the Central Technical College, South Kensington, and obtained the degree of Bachelor of Science (London). He was an associate-member of the Institute of Electrical Engineers and a fellow of the Institute of Physics.

Mr. Spiers was best known for his work as secretary of the Faraday Society, which he assisted to found in 1902. He was an indefatigable organiser. With his help the Society has become one of the most important organisers of scientific discussions in the country. These are noted for the way in which they have brought American, Continental, and British workers together. His ardour was so keen that sometimes it had to be checked owing to the exiguous character of society finances. In 1920 he added to his work that of secretary to the newly founded Institute of Physics, and in this post has shown a like activity and alertness in bringing to the attention of the Board every possible way of amplifying its work. For both of these societies he has proved himself a man whom it will be difficult to replace.

During the War, Mr. Spiers stimulated the formation of a nitrogen products committee of the Faraday Society. As a result of the reports of this committee, in part drafted by him, important researches were carried out by the Munitions Inventions Department. He also organised for the British Science Guild the successful exhibitions of British Scientific Products held in 1917 and 1918. For his work in connexion with the War he received the Order of the British Empire.

Mr. Spiers was well-read in all branches of physical chemistry, but his daily work gave him no opportunity for research. Two papers only appear in his name; one on the electromotive force of Clark cells (*Phil. Mag.*, 1896), and one on contact electricity (*Phil. Mag.*, 1899). His outlook was, however, much wider than his scientific work. He was a Hebrew and Talmudical scholar, and his love for music amounted to a passion. He was keenly interested in all forms of applied art, and at one time was engaged in the production of decorative metal work by electrodeposition. The gold medal and diploma of the Franco-British Exhibition (1908) was awarded for some of this work. The attendance at his funeral was a testimony to the large amount of work that he had done for Jewish education. He was a member of the Jewish Board of Deputies.

His slight body was unable to stand the physical strain of all his activities. On several occasions he had been obliged to rest. For a couple of days before his death he took holiday, but returned on the Friday feeling rather worse than better. In the afternoon (May 21) he was found by one of his office staff leaning back in his chair. He had passed peacefully away.

News and Views.

LIMITATIONS of space forbade more than reference in our issue of May 29 to the recent birthdays of Sir Edward A. Sharpey-Schafer, F.R.S., and Sir W. M. Flinders Petrie, F.R.S. Sir Edward Sharpey-Schafer was born in London on June 2, 1850. Assistant professor of physiology in University College, London, from 1874 until 1883, he afterwards became Jodrell professor there, leaving in 1899 to occupy the chair of physiology in the University of Edinburgh. Sir Edward is especially distinguished for the great variety of his work in physiology, for his series of brilliant investigations into the nervous system, for his fruitful exploitation of histological methods, for his valuable discovery of the function of the supra-renal glands, and for the success with which he has applied physiological research to results of practical importance. A leader in physiological and histological inquiries, he has stimulated the prosecution of research, with noteworthy issues, through large numbers of student disciples. Sir Edward's earliest communication to the Royal Society was made so far back as April 3, 1873. The paper, printed in abstract in the *Proceedings*, was entitled "On the Structure of Striped Muscular Fibre"; afterwards the paper appeared in full in the *Philosophical Transactions*, but the title was changed to "On the Minute Structure of the Leg-muscles of the Water-beetle." As general secretary of the British Association from 1895 until 1900, Sir Edward rendered distinct service to science. He was president of that body at the Dundee meeting, held in 1912, delivering an address on the nature, origin, and maintenance of life. At the Oxford gathering of 1894 he was president of the physiological section. Awarded a Royal medal by the Royal Society in 1902, he was Copley medallist in 1924. Sir Edward is a foreign member of the Reale Accademia Nazionale dei Lincei, Rome.

SIR W. M. FLINDERS PETRIE, probably the foremost of living Egyptologists, was born on June 3, 1853, at Charlton, a descendant, on his mother's side, of Capt. Matthew Flinders, R.N., hydrographer and geographer, who is credited with having first suggested the name 'Australia' for the island continent. Sir Flinders, who was educated privately, began archæological survey and research work more than fifty years ago. He was then specially interested in ancient British remains. In 1881 he took up research work in connexion with the pyramids at Gizeh, and thence onwards down to recent days he conducted surveys and excavations in Egypt, exhibiting results which his countrymen have regarded with gratitude and admiration. Between 1888 and 1890 he was at work in the Fayum. In 1894 Sir Flinders founded the Egyptian Research Account, which ultimately became, in reconstruction, the British School of Archæology in Egypt. In 1906 he was awarded the Huxley medal of the Royal Anthropological Institute. Among his numerous publications may be cited "A History of Egypt," "Ten Years' Digging in Egypt," "Religious Life in Ancient Egypt" (1924).

A MOVEMENT to stimulate the study of pre-Roman Italy, which may be expected to have far-reaching effects on our knowledge of the early cultures of the whole Mediterranean area, has been inaugurated by the National Etruscan Congress, which was held at Florence at the end of April and the beginning of May, when, according to the report of the Milan correspondent which appears in the *Times* of May 25, a number of papers dealing with the language, culture, religion, and antiquities of the Etruscans were read. Prof. Luigi Pareti, professor of ancient history in the University of Florence, supported the theory that the Etruscans arrived in Italy by land and not by sea, traces having been left of their passage across the Alps; and further, that they were descendants of the lake-dwellers of the Emilian region. The problem of the Etruscan language was discussed by Prof. Bartolomeo Nogara and Prof. Trombetti. The latter distinguished three linguistic strata in the Mediterranean basin, of which the Basque is the oldest. The Etruscan he assigned to the second group with the languages of Anatolia. A paper by Prof. Sogliano, which is said to have attracted much attention, supported the view that Pompeii was probably Etruscan and that the Temple of Jove in that city was the Roman substitute for a true tripartite Etruscan temple. Details of Prof. Sogliano's argument will be awaited with much interest in the hope that they will throw further light on the question of the extent of the Etruscan element in Roman culture, and particularly in Roman religion. Committees were appointed to supervise the publication of two series of volumes, one dealing with the culture and institutions of the Etruscans, the other containing monographs on Etruscan centres. At the conclusion of the Congress, visits were paid to the tumulus of Montecalvario at Castellina del Chianti, Vetulonia, Populonia, and Volterra.

THE sixth annual report of the British Non-Ferrous Metals Research Association, which has just been received, is a remarkable record of progress. The expenditure on research during the coming year, including certain investigations the direction of which is shared with other bodies, will amount to about 20,000*l*. We are glad to see that the list of new members who have joined the Association during the year includes many large users of non-ferrous metals, such as railway companies and electrical firms, and also manufacturers of scientific instruments, as well as smelters and manufacturers of metals and alloys. The Association owes much to the energy and knowledge of its Director of Research, Dr. R. S. Hutton, while its policy of encouraging research work in the universities and other public institutions, by appointing salaried workers under the direction of scientific men of standing, has proved beneficial to all parties. It has now been found necessary to establish a small central laboratory, accommodation for which has been provided by the University of Birmingham. The report contains an account of the position of the

investigations already in progress, and also of the new investigations which have been begun, the latter including work on annealing furnace practice, the working properties of zinc, plumbers' joints, and alloys suitable for use at high temperatures. In the last-mentioned field interesting results have been obtained and published. The report is obtainable from the offices of the Association, 71 Temple Row, Birmingham.

A JOINT committee representing the Royal Society of Edinburgh, the Royal Physical Society, and the Royal Scottish Geographical Society, has made the first award of the Bruce Memorial Prize to Mr. James Mann Wordie, of St. John's College, Cambridge, for his geological and oceanographical work in Arctic and Antarctic regions. Mr. Wordie accompanied the ill-fated Shackleton expedition of 1914–1916 to the Antarctic, and was present with Dr. Bruce in Spitsbergen in 1919 and 1920. Later he led an expedition to Jan Mayen, while in 1923 his attempt to reach the east coast of Greenland was frustrated by heavy pack ice. As a result of his visits to polar regions he has made several valuable contributions to the knowledge of ice-formation at sea, of bottom deposits of Antarctic seas, and of Arctic geology. The Bruce Prize, founded to commemorate the work of Dr. W. S. Bruce, is awarded biennially for notable contributions to science, the outcome of personal visits to polar regions, its object being to stimulate further exploration. The medal (Fig. 1), which forms part of the award, is slightly modified from that designed by Dr. Bruce to commemorate the Scottish National Antarctic Expedition of 1902–1904.

FIG. 1.

THE *Journal of Geophysics and Meteorology*, vol. 1, No. 2, issued under the editorship of the late Dr. Friedmann, former Director of the Central Physical Observatory at Leningrad, contains twelve papers, all of which are in Russian, save one, which is in German (with a Russian summary); but short summaries of the Russian papers are given, six in English, one in French, and four in German. The contents relate mainly to meteorology, but a useful summary of magnetic results obtained at Pavlovsk (now to be known as Slutzk) is included; these are for the years 1912–1923, for which Pavlovsk data have not hitherto been published, the Annales of the Central Physical Observatory being temporarily suspended. The diurnal inequalities of each of the three elements of magnetic force are given in the mean for each of the twelve years: the seasonal variations of the diurnal inequalities are not indicated. An interesting article by Kurt Wegener (Hamburg) deals with the artificial production of rain, describing an attempt in this direction and the reasons why failure in this and all such attempts must be expected.

DURING the present century there have been several great volcanic eruptions in Japan, especially those of the Usu-san (Hokkaido) in 1910, the Asama-yama (central Japan) in 1908–14, and the Sakura-jima (southern Japan) in 1914. These are all well-known active volcanoes. The great eruption of Tokachi in Hokkaido that began on May 24 took place, however, from a volcano that was supposed to be extinct, and from a crater that has been occupied by a lake within historical times. The first explosion ejected the water from this lake. Later in the day there were two other explosions, accompanied or followed by an outflow of lava. By the last explosion part of the wall of the crater was blown away. Several hamlets and the greater part of the town of Furyono have been destroyed, and 900 persons are reported to have been killed by floods and lava-streams.

ON his return from a tour of British West Africa, Mr. Ormsby-Gore, Under-Secretary for the Colonies, gave some of his impressions to a representative of the *Times*. The Gold Coast Colony has made remarkable progress during the last five years, due largely to the great development of motor roads and transport facilities. Work is also proceeding on the construction of a modern deep-water harbour at Takoradi, which will be of great value in the two staple trades, cocoa and manganese-ore. Nigeria shows great prosperity and, with a large surplus balance in the past year, is justified in proceeding with the development of its transport. The present road system is entirely inadequate and a serious hindrance to the development of cotton growing. Mr. Ormsby-Gore will outline in his report a continuous programme of railway construction of anything from 100 to 150 miles a year for the next five years. The provinces of Sikaso, Zaria, and Kano alone may be expected to increase their annual cotton output to 250,000,000 bales of 400 lb. each of a fine type of American cotton. When a new type of cotton, on which the Agricultural Department is now experimenting, is produced, the middle belt of Nigeria will yield also an important crop of export cotton. In conclusion, Mr. Ormsby-Gore expresses himself as strongly opposed to any extension of the length of residence of European officials in West

Africa. The leading commercial firms are tending to reduce rather than to extend the period of stay of their officials.

THE key idea of Prof. J. McLean Thompson's lecture before the Royal Society of Arts upon "The Sea Transport and Storage of Fruit," published in the Society's journal for February 26, appears to be that the fruit carried to Great Britain has to be regarded as a 'living passenger.' Thus regarded, it is desirable to harvest and keep it under such conditions before shipping, that the fruit has ripened normally, and then in transit, if conditions are suitably adjusted, it may be possible, without the expense of cold storage methods, to keep it at that condition of restful dormancy which often seems to follow in living fruit and seed upon the attainment of maturity. Prof. McLean Thompson was apparently not in a position to discuss methods by which, under commercial conditions of storage, ripe fruit, of apples and oranges, has thus been kept in good condition for several months without resort to cold storage. He makes, however, a plea for further endowment of research at the great ports of Britain at which our imported food supplies enter, in order to enable a more thorough exploration of the methods, individual to every fruit, by which he hopes that ultimately we may succeed in transporting and storing suitably mature fruit by a treatment which will be based on a recognition of its needs as a living organism at a certain stage of existence. The chairman, Sir Halford John Mackinder, endorsed Prof. McLean Thompson's plea for research, but added the advice to the commercial interests involved that they should recruit from universities and colleges scientific practitioners prepared to apply scientific knowledge under commercial conditions to the workaday problems presented by the 'rough and tumble of trade' conditions under which shipping, transport and storage of fruit must take place.

IN the annual report of the Rockefeller Foundation for 1924 Dr. George Vincent, the president, surveys the activities of the Foundation for that year. These include a contribution of 350,000 dollars towards the publishing of an international journal for abstracts of the biological sciences, reports on the progress of medical education in various countries, and contributions for travelling fellowships. Grants were made to various medical schools in Great Britain, Canada, the United States, and China, funds provided for nursing education at Yale University and other schools and hospitals, campaigns organised against yellow fever, malaria, and hookworm disease, contributions made to the Health Section of the League of Nations towards epidemiological intelligence and study tours arranged for health officers, and assistance given to mental hygiene projects in the United States and Canada. The income of the Foundation in 1924 amounted to 8,191,506 dollars, and the disbursements to 7,288,822 dollars. The report also contains reports of the directors of sections, summaries of the work being carried out in various lands, and lists of publications of members and others directly associated with projects in which the Board participated.

IT is reported that archæological and historical discoveries of considerable importance have been made by Sir Aurel Stein, who has been engaged during the last two months on a tour of investigation in the Upper Swat on the Indian frontier. This area abounds in stupas, rock-carved reliefs, and other Buddhist remains, and for many years it had been anticipated that, given settled conditions, it would prove a profitable field for archæological exploration. That its strategic importance has long been recognised is indicated by the strongholds of old-time chieftains which abound, and it is an examination of the topographical features in this connexion that has led Sir Aurel Stein to a conclusion of very considerable historical interest. According to a dispatch from the Simla correspondent of the *Times* which appears in the issue of May 27, Sir Aurel believes that he has succeeded in identifying in a part of the Swat hills known as Torwal the site of Aornos, the fortress described by Arrian which Alexander captured in 327 B.C. This is usually considered to be the greatest achievement of his remarkable march on India. The topographical features of this suggested site appear to correspond with the description given by Arrian. Sir Aurel Stein himself showed some years ago that the suggested identification of Aornos with Mahaban was untenable on the ground that the summit of that mountain did not correspond with the extensive plateau which figures in the Greek account. The probability that Alexander's march to India led him to Bajaur and the Swat valley has now been greatly strengthened. It is further reported that Sir Aurel Stein has discovered two Buddhist shrines mentioned by Chinese pilgrims, a stone bearing the miraculous footprints of Buddha and a boulder with an impression of Buddha's drying clothes, which shows signs of continued local worship.

PROF. G. H. HARDY, Savilian professor of geometry in the University of Oxford, has been elected a corresponding member of the Vienna Academy of Sciences.

THE following have been elected foreign associates of the National Academy of Sciences of the United States of America: Prof. Jacques Hadamard, professor of analysis at the Ecole Polytechnique, Paris; Prof. Richard Willstätter, formerly professor of chemistry at the University of Munich; Sir Frank Dyson, Astronomer Royal, Great Britain; Prof. Max Planck, director of the Institute of Theoretical Physics at the University of Berlin.

THE thirty-first annual congress of the South-Eastern Union of Scientific Societies will be held at Colchester on June 9–12 under the presidency of Mr. Reginald A. Smith, of the Department of British and Medieval Antiquities, British Museum. The presidential address, "Essex in Pre-Saxon Times," will be delivered on June 9; other papers promised include "The Plant Communities of the Seashore," by Dr. E. J. Salisbury, "Dr. Wm. Gilberd, of Colchester, Author of 'De Magnete,'" by Mr. C. E.

Benham, "Some Curious Aspects of Evolution," by Mr. E. C. Stuart Baker, and "The Correlation of the Lower Palæolithic," by Mr. S. Hazzledine Warren.

WE much regret that, by an oversight, the name of Ives Delage was included in the column of Contemporary Birthdays in our issue of May 8. Prof. Delage died on October 8, 1920.

ERRATUM. NATURE of May 22, p. 720, col. 1. In formula at bottom of column, for "cos $2/\phi$" read "cos $\phi/2$."

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A lecturer in mechanical and civil engineering at Loughborough College—The Registrar (June 7). An assistant lecturer and demonstrator in chemistry and an assistant lecturer and demonstrator in engineering at the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (June 14). A reader in mechanical engineering at King's College, Strand—The Academic Registrar, University of London, South Kensington, S.W.7 (June 17). A professor of botany at the University College of Wales, Aberystwyth—The Secretary (June 19). A professor of Arabic, Persian, and Hindustani at Trinity College, Dublin—The Secretary (June 21). A professor of chemistry and assaying at the Indian School of Mines, Dhanbad—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (June 21). A junior technical officer for development work in connexion with instruments and small precision apparatus—The Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (June 26, quoting references No. A. 95). A curator of the Colchester and Essex Museum, Colchester—The Town Clerk, Town Hall, Colchester (June 28). A librarian for the University of Aberdeen—The Secretary, The University, Aberdeen (June 30). An assistant in the industrial engineering division and an assistant in the science library of the Science Museum, South Kensington—The Director and Secretary, Science Museum, South Kensington, S.W.7 (June 30). A lecturer in zoology, with special reference to the comparative anatomy and embryology of vertebrates, in the University of Edinburgh—The Secretary to the University (July 23). A temporary junior assistant (metallurgist) under the directorate of metallurgical research, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18. Instructor lieutenants in the Royal Navy—The Adviser on Education, Admiralty, Whitehall, S.W.1. A lecturer in botany at the Birmingham Municipal Technical School—The Principal.

Our Astronomical Column.

COMETS.—Ensor's Comet maintained the anomalous position of its tail for a full month. On March 16 the tail was 80° from the prolongation of the radius vector from the sun ; on April 3, nearly 70° ; and on April 13, about 60°. Since matter expelled from the head under solar repulsion would initially proceed along the radius vector, it would seem that the tail was not due to such repulsion : it is not easy to explain its direction, for there was no definite nucleus that could be regarded as a centre of repulsion. On April 13 the comet had sunk to magnitude 17 and was not followed for longer.

Finlay's periodic comet is due to return to perihelion about June 23. It will not be very well placed for observation at this return, being low in the morning sky just before dawn.

The following ephemeris for 0^h is from the B.A.A. Handbook :

	R.A.	N. Decl.
June 11.	$2^h\ 11{\cdot}5^m$	11° 6′
19.	2 46·8	14 18
27.	3 21·9	17 4

It will be better placed in July, owing to its northward motion. It was last seen in 1919.

Comet Pons-Winnecke will return to perihelion in June 1927. An ephemeris by Mr. F. E. Seagrave indicates that it will approach the earth within $4\frac{1}{3}$ million miles on June 26, when its horizontal parallax will be 190″. A well-defined object at that distance would serve admirably for deducing the solar parallax, but it is rather too much to expect that the comet will have a sufficiently definite nucleus for this purpose.

MINOR PLANETS.—A note by B. Asplind in *Astr. Nach.* No. 5442 demonstrates that the hitherto unidentified planets Simeis 59 and Simeis 60, discovered in 1916, are identical respectively with 1029 (discovered last year and named La Plata) and with 962 (discovered in 1921). This identification affords material for a great improvement in the orbit elements of these planets. The following planets have been recently named : 829 Academia, 830 Petropolitana, 917 Lyka, 962 Aslög, 984 Gretia, 1026 Ingrid.

THE SPECTROHELIOSCOPE.—A description of this instrument by Dr. Hale has already appeared in the *Proceedings of the National Academy of Sciences*, 10, 361, 1924, and in NATURE, 114, 628, 1924. In the April number, 1926, of the *Publications of the Astronomical Society of the Pacific*, Dr. Hale gives other details of his instrument, which is now permanently set up at his new solar laboratory in Pasadena. Recent observations indicate its wide scope as an important instrument of research and not merely as a very useful scouting auxiliary of the spectroheliograph. The observations are made visually with the hydrogen line $H\alpha$. Besides the prominences around the sun's limb, it is usually possible to see prominences projected on the disc as dark areas, and bright or dark flocculi, including hydrogen vortices around sunspots. In addition, by setting the second slit on different parts of the $H\alpha$ line, on occasions when there are great line distortions due to high radial velocities, the instrument admits of observations being made in rapid succession of, for example, a brilliant eruption on the violet side of the line and, on the red side, of a dark absorbing mass descending rapidly into the hydrogen vortex. Dr. Hale suggests the possibility of a photographic attachment for reproduction of these rapid changes in the form of moving pictures. An account is given of phenomena, accompanying the very large sunspot of January 1926, and another spot in February, which could be seen with the spectrohelioscope. The author describes modifications he is introducing into the construction of an improved instrument for precision measures of some of these solar phenomena, which it is now possible to study in great detail. We hope to publish shortly an illustrated account of the instrument and of Dr. Hale's recent work with it.

Research Items.

THE SOCIAL ORGANISATION OF THE POMO INDIAN.—A detailed descriptive study of a concrete example of social organisation in its actual working is given by Mr. Edward Winslow Gifford in his "Clear Lake Pomo Society," which is published by the University of California as vol. 18, No. 2, of the *Publications in American Archæology and Ethnology*. This is not an abstract analysis, but is an account of the households, their members, and their affinities one to another, familial and social, as well as their occupations and their activities, ceremonial and other, in the Eastern Pomo village of Cigom on the eastern shore of Clear Lake, Lake County, California. A census by a former inhabitant made in 1919 totalled 235 individuals, 25 per cent. hailing from neighbouring villages. These 'foreigners' residing in the village invariably do so because of marriage. All but two of the twenty living-houses were occupied by two or more families, the number of entrances and the number of fires in each house corresponding to the number of families. The nucleus of the family was a mar, his one wife (monogyny being the rule), and their offspring. In size the family group varied from one to ten, but the average was four and a half individuals. Of blood relationships noted, 36 were matrilineal, 16 patrilineal, 5 were neutral, and one unknown. In half the cases the newly-married couple lived with the husband's father, in half with the bride's father. The chieftainship was hereditary, each chief heading a group related to him, usually through females, but there was no village or supreme chief. Among the Eastern Pomo, of eight cases of succession to the chieftainship, four were from the mother's brother to sister's son, one doubtfully so, two from brother to brother, and one from father to son. Among the Northern Pomo, of three cases two were from father to son, and one from mother's brother to sister's son. There was an occasional custom of naming a child for a grandparent, more frequently paternal than maternal.

THE TORADJA OF CENTRAL CELEBES.—Dr. Walter Kaudern, in the second part of his "Ethnographical Studies in Celebes" (Göteborg: Elanders Boktryckeri Aktiebolag), deals with the migrations of the Toradja. It is generally agreed that the Toradja are not the aboriginal inhabitants of Central Celebes. Nor are they a uniform race: two distinctly different types are found, the majority of the people being of a rather dark brown type with round broad face and short broad nose; while the less numerous light brown type has a comparatively oval face, the nose being long and narrow, straight or slightly curved. Apparently the two types were already mixed when they reached Central Celebes. Taking the three big Toradja groups, the Paloe, the Koro, and the Poso Toradja, and basing investigation on accounts of migrations in historic times, legends of prehistoric migrations, inferences from the direction of the home of departed spirits, and cultural, linguistic, and other relations, it would appear that the migrations proceeded along two principal routes, both beginning in the south-east in the tract of Malili on the coast of the Bone Gulf. One went to the north-west to the regions west of Lake Poso, the other went first almost due north and then sent out branches to the north-east and north-west. The former route was that of the Koro Toradja, the latter that of the Poso and Paloe Toradja. The latter only formed part of the easterly stream of people, and moving on in front of the Poso Toradja, spread farther to the north and north-west. Present knowledge is not sufficient to justify any statement as to the kinship of Poso and Paloe Toradja, though there appears to be no essential difference. These migrations were still going on in the eighteenth century. Their cause is obscure; it may have been over-population of the cultivated areas; and attempts to fly from epidemics, of which there is legendary record, may have been a contributory cause.

FOOD OF TERNS.—Dr. W. E. Collinge gives an account (Blakeney Point Publication, No. 26) of his investigation of the food of terns, undertaken at the invitation of the National Trust, in consequence of numerous complaints by local fishermen that these birds were destroying the inshore industry in flat fish. The author found that the food of the terns in the vicinity of Blakeney Point consisted of 40·32 per cent. of fish, of which 25·48 per cent. was food fishes and 14·84 per cent. sandeels. The food fishes were entirely whiting, haddock, herring, and whitebait, and in no single instance was there any trace of flat fish in the stomach contents. He concludes, therefore, that any recent scarcity of flat fish in the Blakeney Point area can in no way be attributable to the terns living there. This vindication should go a long way towards reassuring the local fishermen and enlisting their goodwill in the preservation of this nesting site.

A MALELESS RACE OF DAPHNIA WHICH PRODUCES EPHIPPIAL EGGS.—Dr. A. M. Banta (*Zeitschr. f. induktive Abst. und Vererbungslehre*, Bd. 40, 1925) describes a maleless race of *Daphnia pulex* in which nevertheless the characteristic ephippial or 'winter' eggs are produced and developed without fertilisation. The author notes the characters by which this race differs from other types of *D. pulex*. Males have not been found in this race, in spite of long observations on the stock and experimental efforts to cause their production. The usual parthenogenetic ('summer') and ephippial ('winter') eggs are produced, and in every phase of their ovarian and post-ovarian development resemble the corresponding two types of eggs produced by other Daphnidæ, and their homology with these is beyond doubt. These ephippial eggs—which the author suggests should be called pseudo-sexual eggs—readily hatch without fertilisation. This race is possibly identical with the race found in Spitsbergen, in which similar behaviour has been suspected. The author suggests that the race represents a possible step in advance in the evolution of Cladocera in that (1) it has the ephippial egg adapting it to habitats in which periods of drought or low temperature preclude the survival of active Cladocera or of the usual parthenogenetic eggs, and that (2) it possesses the obvious advantage that the non-occurrence of males leaves every individual productive of eggs of the type called forth by the particular temporary conditions of the environment.

CHANGES IN THE BOTTOM FAUNA OF ILLINOIS RIVER AND PEORIA LAKE.—R. E. Richardson (*Bull. Illinois Nat. Hist. Survey*, vol. 15, 1925) records the changes in the bottom fauna of Lake Peoria from 1920 to 1922. In a former paper it was shown that during the six or seven years preceding 1920 there had been an almost complete extermination of the older normal bottom fauna over a stretch of about 90 miles of the Illinois River, including Peoria Lake, and practically complete oxygen exhaustion. This was associated with a large increase (about eight times) in the animals slaughtered in the Chicago stockyards between 1914 and 1918, with a corresponding increase in the waste matter entering the sanitary canal which discharges into the Illinois River. Heavy mortality among the fresh-

water snails occurred; in August 1917 dead snails acres in extent were seen floating down the river past Peoria and Havana. The present paper indicates a slight though measurable improvement in the condition of the bottom fauna in the two years 1920–22, but the increase in kinds was almost wholly confined to the group of tolerant Sphæriid snails which survived the destruction of 1915–18. The extension of the range of these snails was parallel to the tremendous increase in numbers of tubificid worms, which ranged so high as 69,000 per square yard opposite Rome in August 1922 and is taken as an indicator of bad bottom. The material was collected by a Petersen bottom sampler. Species that have disappeared from Peoria Lake since 1914 include all but three or four of a total of more than 40 species of fresh-water mussels, all the snails of the family Amnicolidæ, and all but one species of the formerly important and conspicuous family Viviparidæ. The author gives a list of the missing species in the same Bulletin, Article 6.

THE ABSENCE OF AN INNATE SEXUAL CYCLE IN CLADOCERA.—Weismann's view that in Cladocera there is an innate sexual cycle quite independent of environmental influences is contradicted by observations by Dr. A. M. Banta (*Amer. Natur.*, vol. 59, 1925), which indicate that stock recently derived from fertilised eggs of *Moina macrocopa* is neither less nor more prone to produce males, under appropriate environmental conditions, than stock which has descended 300 generations since last undergoing sexual reproduction.

THE SYMBIOSIS OF A FERN AND AN ALGA.—Alfred Limberger records some observations (*Sitzungsber. Akad. der Wissensch.*, Wien, Abt. I. 143, pp. 1-6) which make very much more precise our knowledge of the relation existing between the little water fern Azolla and the blue-green Alga Anabæna, which is always found in small cavities in the leaves. There are four species of Azolla distributed over different parts of the globe, but in all cases this blue-green alga is associated with the fern; the intimacy of the relation thus established between two plants of very different type has been a matter of speculation. Limberger succeeded, by cultivating Azolla over winter on fairly dry soil in a cold greenhouse, in obtaining a stock of the fern quite free from the blue-green alga. So long as this plant was kept growing under normal conditions next summer, it grew perfectly well and no significant difference could be noted between the alga-infested and the alga-free cultures of the fern. Curiously enough, with two different species of Azolla thus freed from Anabæna, another blue-green alga, Oscillatoria, was found infesting the fern though not entering the leaf cavity, as if the fronds of this little fern had some definite chemotactic attraction for blue-green Algæ or special facilities for their nutrition. With the algæ-free Azolla, Limberger repeated some previous cultures of the plant in food solution with and without nitrogen. It was now found that the fern free from Anabæna died or grew very poorly in nitrogen-free solutions, whilst the fern with Alga in the leaf cavities flourished. Definite evidence seems thus to be provided for the possibility of nitrogen fixation by the alga, which under unfavourable conditions of growth is utilised by the fern. When other sources of nitrogen are present, the alga seems of little use to the fern, in fact may grow so excessively as to become a nuisance.

AN UPPER CRETACEOUS FLORA.—Under the title "The Flora of the Ripley Formation," Edward Wilder Berry describes, in *Professional Paper* 136 of the United States Geological Survey, an Upper Cretaceous flora of some 135 species. The total number of genera represented is 71; of these a supposed Alga Halymenites, and a form referred to Selaginella, are of doubtful botanic affinity; in addition there are six species of ferns, 9 gymnosperms, 9 monocotyledons, and 105 dicotyledons, of which only 10 belong to sympetalous genera. While nearly all the ferns and conifers found appear to have a wide distribution "as befits their ancient lineage," most of the dicotyledons are recorded for this Ripley formation only, and of the 28 per cent. that occur elsewhere, most of them are only recorded from Greenland, which is perhaps the place of origin of the Upper Cretaceous flora of North America. Sixteen of the Angiosperm genera recorded have not been recognised in post-Cretaceous deposits, and the author points out that the contrast between Upper Cretaceous and Eocene floras is usually under-estimated, in part owing to the habit of laying stress upon the coming of the Angiosperms in Upper Cretaceous time, which it is "the fashion to picture—as a sudden and overwhelming event."

THE MICROSCOPIC STRUCTURE OF COAL.—A most interesting lecture on this subject, given before the Royal Society of Arts by Dr. Reinhardt Thiessen of the United States Bureau of Mines, is published in the Society's journal for April 23. After a brief introductory statement of the manner in which various kinds of coals may be pictured as arising progressively from plant remains such as may accumulate under the conditions of the peat bog, where vegetable decay is very slow and in the lower layers of the peat has practically ceased, Dr. Thiessen proceeded to analyse the various types of appearance found in bituminous coals, the clarain, vitrain, fusain, etc., of British writers, into terms of plant remains recognisable by microscopic study. Under the microscope Dr. Thiessen recognises two main classes of constituent: (1) the compressed woody and fibrous fragments of plants, the anthraxylon, and (2) indefinite masses made up of finely macerated plant material, macerated wood, cuticle, spores, etc., grouped under the term 'attritus.' From this lecture it would appear that the methods of study of the coal mining geologist and the palæobotanists are converging at present in their application of new methods of technique with the aid of the microscope to reveal the minute structure of the compressed fragments of plants embedded in the rocks (Harris, NATURE, May 8, 1926, p. 670).

COLORADO RIVER.—The remarkable characteristics of the Colorado River, U.S.A., form the subject of Water Supply Paper No. 556 issued by the U.S. Geological Survey. The river is of exceptional value for irrigation and water power, as it combines in proper sequence for full development and use a large quantity of water, great concentrations of fall, reservoir sites for the control of flow, sites for power plants, and several million acres of irrigable land below the district in which power can be developed. The drainage basin comprises 244,000 square miles and covers parts of seven States. The most urgent need of the basin is flood protection for cities, towns, and large irrigated areas near Yuma and in the Imperial Valley. It is stated in the report that property to the value of one hundred million dollars and the prosperity of many thousands of inhabitants on both sides of the international boundary between the United States and Mexico are seriously menaced by the lack of efficient control works, and this menace is increasing yearly, the maintenance of banks and levees becoming more difficult and costly as time goes on. Mr. La Rue, the writer of the report, has made systematic

inspection of the basin since 1914, and the information collected, including geological diagrams and photographs, is intended as a basis for outlining a comprehensive scheme of development for the river and for selection of a site for earliest development.

AN ANCIENT SPECIMEN OF URANINITE.—Another estimate of the age of the earth's crust has been formed from the examination of a sample of uranium lead found in South Dakota. The results of this investigation, carried out by T. W. Richards and L. P. Hall, are published in the *Journal of the American Chemical Society* for March 1926. The atomic weight, corrected for the influence of a known thorium content, is 206·02. Since the sample is nearly pure uranium lead, its age is about $1{\cdot}5 \times 10^9$ years.

PENETRATING COSMIC RADIATION.—In a recent communication to NATURE, M. L. N. Bogoiavlensky, writing from Leningrad, gives the results of some investigations made by him in the Caucasus, in a region of radium deposits, on "Highly Penetrating Rays of the Earth." A close survey has been made of the penetrating radiation in an area of about 11,000 square yards, traversed by cracks in travertin, containing radio-active material. The results when plotted give equi-radiation lines roughly parallel to the cracks. A measure of the penetrability of the radiation was obtained by the use of lead screens *beneath* the electrometer at the various observing stations, indicating γ-radiation from a radio-active material at 22 stations out of 92. At the other 70 stations a more penetrating radiation only was observed. The minimum screened values varied, showing a variation (even in this small area) of the ionisation due to a more penetrating radiation than that from radium. At these stations the use of side screens was without effect. Experiments in other places over soil of low radium content gave varying values for the ionisation and showed also a very small absorption of the radiation by lead screens. M. Bogoiavlensky's results would appear to supplement those of Hoffmann, who explains the effects by the existence of a more penetrating radiation from radium than the previously known hardest rays from radium C. Against this, Hess has pointed out that the result is explicable on the assumption that the cosmic rays do not appreciably ionise a gas, but only the softer secondary, etc., rays due to these.

SECONDARY RADIATION FROM THE SURFACE OF THE EARTH.—In the *Physikalische Zeitschrift* (March 15, 1926) Hess discusses the very penetrating 'cosmic' radiation and the difference between the absorption co-efficients in water obtained by Kohlhörster and by Millikan. He takes exception to the use of lead as a screen for absorption measurements on account of the appreciable radium content of different lead samples, and for this reason questions Hoffmann's deduction that the penetrating radiation at sea level can be wholly explained as the result of known radio-active elements. Hess points out that this explanation will not fit the fact that the ionisation first decreases and then increases with increasing distance above the earth. He points out further that the key to the results obtained by Hoffmann and by Behounek may lie in the circumstance that the 'cosmic' radiation experiences the Compton effect on scattering, with consequent formation of softer γ-rays, if it is a fact that the ionisation by the softer derived radiation is much greater than that of the primary rays. Already, in 1912, Hess suggested that a part of the differences between measurements of penetrating radiation on land and water might be referred to differences in the secondary radiation from the surfaces.

THE CRYSTAL STRUCTURE OF CATECHOL.—The crystal structure of catechol has been determined by W. A. Caspari, using the rotating crystal method with the three crystallographic axes as rotation axes. Diagrams obtained by projection of the photographs on paper are given in the *Journal of the Chemical Society* for March 1926. From these the number of molecules per unit cell has been deduced as eight, and their manner of disposition is discussed.

NUTRITIVE VALUE OF SYNTHETIC FATS.—From experiments carried out with albino rats and described in the *Proceedings of the Imperial Academy of Japan* for January 1926, the approximate nutritive values of synthetic fats containing fatty acids of an uneven number of carbon atoms have been tabulated. As a check, the food values of fats containing fatty acids of an even carbon atom content were determined under similar conditions. No sharp line of division could be drawn between these two classes of fats as regards their nutritive value.

INTENSITY OF ILLUMINATION AND PHOTOCHEMICAL CHANGE.—Berthoud and Bellenot's experiments on the effect of the intensity of illumination on the velocity of the interaction of iodine and potassium oxalate have been repeated by F. Briers, D. L. Chapman, and E. Walters to test their theory, and their conclusions are presented in the *Journal of the Chemical Society* for March 1926. They found that the rate of reaction is proportional to the intensity of illumination and not to the square root, as found by Berthoud and Bellenot. It was noticed that the reaction continued after shutting off the light, and values for the life of a hypothetical catalyst are given.

ENERGY RELATIONS OF SOUND WAVES.—A very interesting paper giving measurements in connexion with acoustical apparatus was read by B. S. Cohen to the Institution of Electrical Engineers on April 29. The researches were carried out in the laboratories of the General Post Office. A knowledge of the efficiency of telephone lines and apparatus is necessary in telephone engineering, and much of this knowledge is of equal importance to the radio engineer. The frequency of the waves used in speech extends from a frequency of about 100 to a frequency of about 6000, a range of six octaves. By means of a suitable electric filter it has been proved that good quality speech can be transmitted when all waves having frequencies exceeding 2500 are blocked out. Practically perfect speech is obtained when only waves the frequencies of which exceed 5000 are blocked out. To get perfect musical transmission, frequencies up to about 10,000 have to be transmitted. With a normal voice the average speech energy entering a telephone transmitter is about 100 ergs per second. A good violin gave a fairly uniform output of 600 ergs per second at a frequency between 192 and 1300. A male voice intoning twelve vowel sounds at conversational loudness with a fundamental of frequency 129 had an output of 56 ergs per second, and a female voice intoning a vowel with a fundamental of 129 had an output of 40 ergs per second at conversational volume. The characteristics of the ear have been investigated by American engineers. The threshold of audibility for a normal ear varies from an acoustical pressure of 0·15 dyne per square cm. at 60 frequency to 0·001 dyne per sq. cm. at 1000 frequency. Between 1000 and 4000 frequency the sensitivity remains approximately constant at 0·001 dyne per sq. cm. Many methods are suggested for measuring the acoustical efficiency of apparatus, and some useful curves are given.

The Abyssinian Sources of the Nile.[1]

IN pursuance of the policy to carry out a complete investigation of the hydrological conditions existing in the basin of the Upper Nile, the Egyptian Government has recently published the report of an expedition to the Equatorial Lake Plateau, and has followed this up with the present volume which deals with Lake Tana in Abyssinia, whence the Blue Nile flows to the Sudan and Egypt.

The importance of this lake in the schemes for the control of the Nile waters, and protection from very low floods, depends on the practicability of utilising it, and the Albert lake similarly, for storing up the water of an abundant rainy season to supplement the supply of a year of meagre rainfall.

This report describes the work which was carried on from the spring of 1920 to the summer of the following year by Dr. G. W. Grabham, Government Geologist of the Sudan, and Mr. R. P. Black, of the Physical Department of Egypt. This was the third occasion on which the Abyssinian Government had given permission for studies of the lake and the Blue Nile's outlet from it to be carried out; the earlier ones having been made by Mr. C. E. Dupuis in 1903, and by Mr. R. B. Buckley in 1916. On the present occasion, however, the work was much more detailed and complete, since the observations of levels and discharges were carried on until May 1924, thus providing discharge data over a period of 34 months, including three flood periods.

The southern shore of the lake, where the Blue Nile leaves it, was the part which the expedition examined and surveyed in detail, and they arrived at the conclusion that the lake is of recent formation, owing its origin to a lava flow from the west which has dammed back the drainage of the shallow valley in which the lake now lies. This lava lying on the plateau basalts of Abyssinia furnishes a solid foundation for the construction of a regulator to control the discharge from the lake. In order that the lands and buildings which lie near the lake should not be inundated as the result of controlling the outflow, a regulator is proposed which will allow regulation through a range of three metres below the present normal lake level. This would provide a reserve supply of about 3500 million cubic metres of water to supplement the supply of Egypt in years of abnormally low flood.

The meteorology and geology of the plateau in the neighbourhood of the lake were carefully studied, and especial attention was paid to evaporation, which is an important factor on large lakes, and Lake Tana has an area of 3060 square kilometres. Observations carried out both with evaporimeters on land and by means of tanks floating on the lake, resulted in determining the rate of evaporation to range from 1·5 mm. per day in August to 6·0 mm. in April, giving a total loss of 1480 mm. in the year. The volume discharged at the outlet varied from about 10 cubic metres per second at the end of the dry season to about 500 cubic metres per second when the lake was at its highest level in September. This amount represents a very small fraction of the flood of the Nile at Assuan, in fact less than one-fiftieth of the volume entering Egypt at the highest stage of the flood; so from this point of view Lake Tana's contribution is unimportant; but if by means of a regulator the volume corresponding to a three metres change of level, 3500 millions of cubic metres, were available in the case of an exceptionally small low-stage supply, the situation in Egypt would be greatly improved.

The cost of the necessary works is put very approximately at about two and a half million sterling, but this might be materially increased if much road-making up to the lake should be necessary.

A large amount of information is given on the country and the people inhabiting the region near the lake, and also on the various routes which lead up to it. The work was carried out in somewhat difficult circumstances, since the surveying, levelling, and measurement of discharges aroused much suspicion locally, although the party were furnished with letters of authority by the Abyssinian authorities at Addis Abeba; but with tact and patience this difficulty was overcome and the work was successfully brought to a satisfactory conclusion.

The report contains sixteen hydrographical and meteorological diagrams of much interest besides maps of the lake, and the Blue Nile outlet, while thirty-four very fine photographs give an excellent presentation of the country, the lake shore, and the gorge of the Blue Nile near the lake. H. G. L.

[1] Ministry of Public Works, Egypt. Report of the Mission to Lake Tana, 1920–21. By G. W. Grabham and R. P. Black. Pp. xx+208. (Cairo: Government Publications Office, 1925.)

International Biology.

IN an interesting address on "International Biology" delivered at the third Pan-American Scientific Congress held at Lima, Peru, a little over a year ago, and recently published (*Bull. Pan-American Union*, Dec. 1925), Prof. Vernon Kellogg cited a number of cases in which it is, or would be, of obvious advantage to have international action in matters of biological science. The almost complete stamping out of yellow fever in the western hemisphere is one of the most striking results of co-operative work—a conspicuous example of useful international biology, for all the fighting of disease and the developing of public health activities rest ultimately on biological research and on the applications of the results of such research.

The successful control of insect pests of crops affords another example, for Prof. Kellogg points out that of the fifty most serious insect enemies of crops, orchards, and stock in the United States, more than three-fifths are immigrants, *e.g.* the Hessian fly, flour and grain moths, ox warbles, and the horn fly from Europe, the cotton boll weevil from Mexico, the San José scale from Japan. But he also pointed out that the grape phylloxera went from New England to France, where more than 2,000,000 acres of vineyards were destroyed before a remedy was found, and that the Colorado potato beetle has established itself in south-eastern France and is threatening to invade the potato fields of Germany. The exchange of insects is, however, fortunately not limited to injurious ones. In its native country an injurious insect is more or less kept in check by predaceous and parasitic insect enemies, and it is now a well-recognised part of economic entomological practice to send experts to foreign countries to search for and bring back the native enemies of important insect pest immigrants—there is thus an international exchange of 'good bugs.'

Similarly, there is the exchange of good plants, and Prof. Kellogg points out that a number of regions of the United States owe their present prosperity, and in some cases even the very existence of their agriculture, to the intentional importation of some crop

plant from a distant part of the world, *e.g.* the date oases of California and Arizona, the durum wheat areas of the great plains, the rice fields of California and Texas. Prof. Kellogg remarked that the plants which grow in the colder regions of the earth are mostly species which have crept out of the tropics, adapting themselves as they have spread north and south to the conditions of colder climates, and he thinks there are probably ten times as many undiscovered useful plants remaining in the tropics as are to be found in the colder regions. The plant breeders of the United States are striving to select the hardiest of these tropical species and to adapt them for cultivation as far north as they will grow.

The conservation of migrating birds of practical and æsthetic value affords another example of useful international biology, for the extensive migrations of these birds require that conservation shall hold good in the extent of their range. The rational use and protection of the animals of the oceans that wash the coasts of North and South America was also cited, *e.g.* the fur seals of the Pacific were saved from extinction by international agreements made in 1911 between Great Britain, Russia, Japan, and the United States. But the sperm whale is passing, and unless international action is taken it will soon be gone.

Finally, Prof. Kellogg directed attention to the international exchange of human beings—the matter of emigration and immigration with all the perplexing biological problems inherent to it. While many people consider the economic and political significance of the problem, it is incidental to and determined by the biological results. The National Research Council of the United States has a special committee at work on "the scientific problems of human migrations," for it is fully realised that the strength of the nation rests at bottom on the kind of heredity possessed by the people of the nation—it rests at bottom on biological factors.

Petroleum in the Maracaibo Region, Venezuela.

THE Maracaibo Basin, situated in western Venezuela, is an area of some 25,000 square miles, embracing the State of Zulia and parts of the States of Mérida, Táchira, and Trujillo; within this region occur the principal oilfields of Venezuela, while those of the State of Falcon, lying to the east, are geologically connected therewith. Though the presence of oil in this country was known in the early days of the Spanish occupation, commercial exploration did not commence until 1878, when the Government granted a small lease in the State of Táchira; progress was slow, however, and it was not until 1912 that important developments were undertaken, resulting in the discovery of the now famous Mene Grande oilfield. To-day practically the whole of the basin area is held under exploration or prospecting licences, and besides Mene Grande, the oilfields of La Rosa, Ambrosio, El Mene, La Concepcion, La Paz, Rio Palmar, Rio de Oro, and some potential petroliferous territory in the south, have been discovered.

Geologically the Maracaibo Basin corresponds with a vast geosyncline, the centre of which is occupied by Lake Maracaibo; the peripheral mountain ranges to the west, south, and east are composed of igneous and metamorphic rocks flanked by Tertiary and Cretaceous sediments, of which the Miocene formation is conspicuous for its associated gas and oil seepages. West and south of the lake the structures trend N.E.-S.W., thus conforming to the prevalent Andean trend in this part of the country; east of the lake, especially in the Bolivar district, the E.-W. influence of Caribbean tectonics is shown by the major folds. The chief characteristic of all the structures within the basin is their great linear development, usually coupled with gently dipping rocks. The best-known folds are the Mene Grande-Curaçao anticline (with its curious 'spurs' or 'lobes' running at right angles, and on which the Ambrosio and La Rosa fields are located), the Rio de Oro and La Tarra anticlines southwest of the lake, and the Rio Poco fold running parallel to the Mérida Range in the south.

The most important field is that of La Rosa, situated 27 miles S.E. of Maracaibo city, the scene of a famous gusher in 1922, Barroso No. 2, which flowed a million barrels of oil in nine days; since then 125 wells on this field have accounted for 12,000,000 barrels of oil. The Mene Grande field yielded 18,000,000 barrels up to the end of 1925, the oil being of an asphaltic nature with gravity 0·956; it is piped to and refined at San Lorenzo, thence shipped by lake steamer to Curaçao and elsewhere. The El Mene field has produced 4,400,000 barrels from about 50 wells and is noted for its low gravity oil (0·850) and high petrol and kerosene yields (35 and 38 per cent. respectively). The other fields are smaller, though in most cases important extensions are anticipated. Mr. Campbell M. Hunter, from whose paper read before the Institution of Petroleum Technologists on April 13 the foregoing details are taken, is of the opinion that production for this year in the Maracaibo Basin will substantially exceed 30,000,000 barrels, thus placing Venezuela as the fifth, if not the fourth, largest oil-producing country in the world, a remarkable rise in a little more than seven years.

University and Educational Intelligence.

CAMBRIDGE.—The Civil Commissioner for the Eastern Division has written to the Vice-Chancellor tendering to the University the congratulations and thanks of His Majesty's Government for the very notable part it played in assisting towards maintaining essential services during the recent critical period. About 4000 students were enrolled for national service, more than 2000 were actually called up for work, and enthusiastic appreciation has been generally expressed by those who secured from the undergraduates services "willingly given and unselfishly and efficiently performed."

Notice is given that a professor of mineralogy, in succession to the late Prof. Lewis, will be elected on June 26. Candidates are requested to communicate with the Vice-Chancellor on or before June 19.

The Council has proposed graces for the conferring of the following honorary degrees among others: LL.D. on Sir Samuel Hoare, Mr. Ramsay MacDonald, and Sir Frederick Maurice; and Sc.D. on Sir Josiah Stamp.

Sir Arthur Shipley, Master of Christ's College, is being re-appointed as representative of the University on the Council of the Marine Biological Association.

Applications are invited for the John Lucas Walker studentship in pathology, value 300*l.* a year and tenable under certain conditions for three years. Applications must be sent to reach Prof. H. R. Dean, Pathological Laboratory, Medical School, Cambridge, before June 15.

EDINBURGH.—In recognition of the work done by students of the University at Leith Docks during the recent strike, Mr. Thomas Cowan, a retired shipowner, has sent a cheque for 10,000*l.* for the general purposes of the University. In a letter sent with the cheque

Mr. Cowan, who was chairman of the Emergency Committee of the Leith Dock Commissioners, states that he was greatly impressed with the enthusiasm, initiative, and working capacity of the 270 students who undertook service at the docks and helped to relieve the congestion of traffic there.

LIVERPOOL.—The Senate and Council of the University have resolved to confer the degree of Master of Science, *ex officio*, on Mr. Herbert Clifton Chadwick in consideration of meritorious services rendered to the staff and students, and of distinction in Zoological research during the period 1897-1922, when he was curator of the Marine Biological Station at Port Erin, Isle of Man.

Two post-graduate research fellows will shortly be appointed to the Munitions Committee Research Fellowships, and applications are invited from graduates of the University engaged in industry or research. The value of each fellowship is 250*l.* for the first year and 350*l.* for a second if the appointment be renewed. Applications should reach the Dean of the Faculty of Engineering before June 15.

PROF. A. STOCK of Dahlem, Berlin, has been appointed Director of the Chemical Institute at the Technische Hochschule in Carlsruhe.

PROF. BOHUSLAV BRAUNER, director of the Chemical Institut of the Charles University of Prague and an Hon. D.Sc. of the University of Manchester, has been elected an honorary member of the American Chemical Society.

THE degree of Doctor Rerum Naturalium has been conferred in the Charles IV. University of Prague upon Mr. Edward Browning Sanigar, of Sheffield, for his thesis "The Electrolysis of Complex Cyanides with the Dropping Mercury Cathode." This is the fourth doctorate of this University conferred in recent years on an Englishman.

THE Carnegie Endowment for International Peace has three divisions: Intercourse and Education, International Law, and Economics and History. A report on the work of the first division has recently been issued by the Director, Dr. Nicholas Murray Butler, who is also president of the Endowment. It tells first of the progress of the arrangements for the restoration of the library of the University of Louvain. A sum of 200,000*l.*, towards which the Carnegie Endowment has contributed 31,400*l.*, has been collected, and this will suffice not only for restoration but also for a maintenance endowment of 20,000*l.* Chief among the projects to which funds were allotted during the year is a conference of representatives of the Press of the United States which was to be held with the co-operation of the Academy of Political Science in May in the vicinity of New York. The Division has also invited some fifty American college and normal school teachers of international law and international relations in the United States to visit Paris, The Hague and Geneva during August and September next. At Geneva this party will be in charge of the American Committee of the Geneva Institute of International Relations, to which the Endowment gave 800*l.* last year. The Committee maintains an office for the reception of English-speaking visitors who come to Geneva to study international co-operation. The report announces the constitution of a Comité d'Administration to serve as an executive committee of the Division for work in Europe with offices at the Centre Européen, 173 Boulevard Saint-Germain, Paris. It is about to issue a new quarterly international review, *L'Esprit International*.

Contemporary Birthdays.

June 5, 1843.	Dr. Samuel Garman.
June 6, 1842.	Mr. Henry Martyn Taylor, F.R.S.
June 7, 1877.	Prof. Charles G. Barkla, F.R.S.
June 7, 1868.	Prof. John S. Townsend, F.R.S.
June 9, 1875.	Dr. Henry Hallett Dale, F.R.S.
June 10, 1866.	Lord Montagu of Beaulieu, K.C.I.E.
June 11, 1867.	Prof. Charles Fabry.

Dr. SAMUEL GARMAN, the veteran naturalist, foreign member of the Linnean Society, was born at Indiana, U.S.A. Graduating at Illinois State Normal University, he came for a brief period under the guidance of Louis Agassiz. Dr. Garman has been on the herpetological and ichthyological staff of the Museum of Comparative Zoology, Harvard University, since 1871. He accompanied the late Alexander Agassiz on most of his South American expeditions connected with deep-sea survey work. Dr. Garman is the author of "The Reptiles of Easter Island" (1908).

Mr. H. M. TAYLOR was born at Bristol and educated at Wakefield Grammar School and Trinity College, Cambridge, graduating (1865) third wrangler. In this year the late Lord Rayleigh was the senior wrangler, and the late Prof. Alfred Marshall, the economist, second wrangler. Being blind himself, Mr. Taylor has long been personally identified with the production of embossed books on scientific subjects. We believe that he once composed a standard algebraical treatise in Braille type, afterwards read the copy with his fingers, and again, later, read the proof.

Prof. BARKLA, a Lancashire man, born at Widnes, was educated at University College, Liverpool, going from there to Trinity College, Cambridge, where early he came under the inspiring influence of Sir Joseph J. Thomson. He was appointed Wheatstone professor of physics in King's College, London, in 1909, and since 1913 he has occupied the chair of natural philosophy in the University of Edinburgh. Prof. Barkla's particular investigations have dealt mainly with X-rays and their absorption and secondary emission by solid substances. He was Nobel laureate in physics in 1917, whilst also in that year he was allotted the Royal Society's Hughes medal.

Prof. TOWNSEND, born in Galway, was educated at Trinity College, Dublin, and at Cambridge. He is a chevalier of the Legion of Honour. In 1914 he received the Hughes medal of the Royal Society for his researches on electric induction in gases.

Dr. DALE is a Londoner. He was educated at Tollington Park School, London, and the Leys School, Cambridge, graduating afterwards at Trinity College. Last year he was elected one of the secretaries of the Royal Society.

Lord MONTAGU of Beaulieu was educated at Eton and New College, Oxford. Automobilism and aviation are among his interests. He is a verderer of the New Forest.

M. FABRY, professor of physics at the Sorbonne, Paris, was born at Marseilles. In 1918, jointly with Dr. A. Perot, the Royal Society allotted them its Rumford medal in respect of their contributions to optics, particularly for the introduction of a new method of measuring wave-lengths by utilising the luminous rings formed by interference between two reflecting plates. Recently Prof. Fabry lectured before the Physical Society of London on the absorption of radiation by the upper atmosphere.

Societies and Academies.

LONDON.

Royal Society, May 20.—A. V. **Hill**: The laws of muscular motion (Croonian lecture). In all kinds of contractile tissues there are certain similar, or analogous, processes; so that in discussing properties of striated muscle we are really dealing with very general phenomena. Recent work on the chemical reactions of breakdown and recovery, and the rôle of glycogen, lactic acid and phosphate was discussed. If physiological response of muscle undergoing stretch be less than that of muscle allowed to shorten, why is the tension at any given length so much greater during stretch than during shortening? The answer provides an important clue to the nature of the contractile process. Re-development of contraction after quick release was discussed, and also the 'viscous-elastic' model.

Society of Public Analysts, May 18.—A. Chaston **Chapman**: The detection and determination of glycerin in tobacco. The tobacco is mixed with sodium sulphate (to absorb moisture) and extracted with acetone. The residue from the extract is freed from resins, and its glycerol content determined by a modification of Zeisol's silver iodide method. For a qualitative test the glycerin is separated by extraction and distillation.—Harold **Toms**: The crystalline bromides of linseed and some other oils. The most insoluble bromide of linseed oil, as crystallised from ethyl acetate, is not an ethyl ester, but a glyceride. When hydrolysed with hydrobromic acid it yields, as its only recognisable product, hexabromostearic acid, but this does not prove the absence of tetrabromostearic acid, which is converted by hydrobromic acid into a sticky derivative. The insoluble bromides of perilla, candlenut and para rubber seed oils are identical with the linseed oil bromide. Tetralin is a better solvent than ethyl acetate for crystallising oil bromides.—A. **Bakke** and Paula **Henegger**: The polarimetric determination of sucrose in condensed milk. A modification of the method of Revis and Payne is used, employing mercuric nitrate both as precipitant and as inverting agent. Results agreeing with the gravimetric results were obtained in the winter months, but there was a discrepancy in summer due to such causes as altered period of lactation, period of fresh grass feed, etc., on the original milk.—W. R. **Schoeller**: The separation of iridium from iron. The method used is based on the precipitation of ammonium chloroiridate $(NH_4)_2IrCl_6$; allowance is made for the amount of iron adsorbed by the ammonium chloride precipitate.—H. L. **Smith** and J. H. **Cooke**: The determination of very small quantities of iron. A colorimetric method has been devised in which the sensitiveness of the thiocyanate reaction is very greatly increased. Zinc interferes, and for determining iron in zinc compounds the iron thiocyanite is extracted with a suitable solvent, such as a mixture of amyl alcohol and ether, and the colour of the extract matched.—J. N. **Rakshit**: The determination of total alkaloids, sugar, and oily substances in opium. The alkaloids in an aqueous extract of opium and those remaining in admixture with the opium wax are determined. For the determination of sugar, titration with Fehling's solution after removal of alkaloids gives fairly concordant results. Added oil or wax is indicated by a saponification value differing from that of opium wax, and is approximately determined by the appearance of the opium when heated on a plate over steam.

Royal Meteorological Society, May 19.—E. S. **Player**: Meteorological conditions and sound transmission. (i.) Sounds originating on the surface. Observations were made near the North Foreland, Kent, the sources of sound being the sirens of the light-vessels in the locality. Note-frequency of the sirens did not vary, and, the light-vessels being stationary, distances and bearings remained constant. Examples were met of rapid and continual changes over very short periods in sound intensity, and the effects of humidity, temperature, rain, and the general combination of conditions, were examined. (ii.) Sounds arriving from an altitude. The sources used were aeroplane notes which vary in frequency and obviously occupy positions which are continually changing. Observations of upper-air conditions showed a practically constant fall in temperature, but strata of varying relative humidity. Sound was transmitted well when the variations of these strata were small, and the atmosphere, therefore, more nearly approached a homogeneous state; great or abrupt changes had a destructive effect. Acoustical conditions were often good for surface sounds, while bad for sounds transmitted from an altitude, and vice versa.—J. **Glasspoole**: The wet summer of 1924 and other wet seasons in the British Isles. Maps are given of the rainfall (as a percentage of the normal) of this and other wet seasons over the British Isles since 1870, of from three to seven months' duration. Seventeen such periods are recorded. A comparison of the maps with those for dry periods indicates that while large deficiencies are confined mainly to the south and east of the British Isles, large excesses do occur in the north and west.—C. E. P. **Brooks**: Pressure distributions associated with wet seasons in the British Isles. The average pressure distribution over the northern hemisphere during each of the wet periods enumerated above from 1876 to 1924, represented as deviations from normal, fall into two clearly defined types: (*a*) Greatest deficit of pressure over Iceland; (*b*) greatest deficit of pressure over the British Isles. With a pressure distribution of type (*a*) the S.W. winds over the British Isles would be stronger than normal, giving more orographic rain on the western highlands, and in the four periods classed as of this type, the rainfall distribution was found to be mainly orographic. With a pressure distribution of type (*b*) there would be a tendency for depressions to pass directly across the British Islands, giving an excess of rainfall over the whole country (cyclonic type), and with the exception of April-June 1907, all the periods with a pressure distribution of type (*b*) had this type of rainfall distribution. The conditions in the Atlantic Ocean during and preceding these wet periods were then investigated. (1) Favourable to a wet period of the mainly orographic type: N.E. trade wind velocity below normal nine to twelve months before; S.E. trade wind velocity below normal twelve months before; pressure difference, Sydney (Nova Scotia) minus Ivigtut (Greenland) above normal three months before; amount of ice near Iceland below normal during the wet period. (2) Favourable to a wet period of the mainly cyclonic type: Pressure difference, Sydney minus Ivigtut, above normal three months before; amount of ice near Iceland above normal in preceding spring, but below normal during the wet period. The weak N.E. and S.E. trades and the large pressure difference between Sydney and Ivigtut all contribute to a lower temperature in the North Atlantic, which may thus be the chief cause of a wet season in the British Isles. The part played by the Iceland ice is probably to determine the location of the greatest deficit of pressure.

MANCHESTER.

Literary and Philosophical Society, May 11.—John **Walton**: (1) On some Australian fossil plants referrable to the genus Leptophlœum, Dawson. The paper deals with the genus Leptophlœum, Dawson, instituted in 1862 for a fossil stem of Lycopod affinities from the Upper Devonian of Maine, U.S.A. The importance of some of the features exhibited by the type specimen was stressed, particularly in connexion with the relation between this fossil and the Australian fossils which have been referred to *Lepidodendron australe* or *Leptophlœum australe*. Some hitherto undescribed features of the Australian plants were described. (2) A note on the structure of the plant-cuticles in the paper coal from Toula in Central Russia. These cuticles have been referred to Bothrodendron by some authors, and to Lepidodendron by others. In some specimens the presence of the cuticle of the ligular pit can be demonstrated. The evidence for referring these fossils either to one or the other of the two genera is of a conflicting nature, but on the whole it seems in favour of Bothrodendron. There is considerable difficulty in distinguishing between the smaller vegetative branches of Lepidodendron and Bothrodendron.

PARIS.

Academy of Sciences, April 26.—Maurice **Hamy**: A particular case of the diffraction of solar images.—André **Blondel**: The modulation of transmitting stations with valves fed with continuous current.—S. **Winogradsky**: Spontaneous cultures of (nitrogen) fixing micro-organisms. A study of the substances favourable to the growth of Azobacter in earth cultures.—Charles **Nicolle**, E. **Conseil** and P. **Durand**: The agent of scarlet fever. The authors' experiments confirm the views of Dick, that scarlet fever is due to a Streptococcus, and can be prevented by a vaccine.—Axel **Egnell**: Curvature and divergence.—A. **Demoulin**: Conformal geometry of surfaces and of triple orthogonal systems.—F. P. **Bessonoff**: Nearly periodic functions with one complex variable, defined in the whole of a plane.—Paul **Le Rolland**: The measurement of hardness by the pendulum. A claim for priority in the use of the pendulum for measuring hardness of metals.—Eugène **Barré**: The theory of mine craters.—T. V. **Jonescu**: The variations of intensity of the thermionic current when the distance between the filament and the anode is changed.—Léon and Eugène **Bloch**: A second spark spectrum of iron. A comparison of the arc and spark spectra of iron between the wave-lengths 2300 and 1850 Å.U. shows that the arc spectrum and condensed spark spectrum are clearly different, and to such an extent that it is difficult to find in one the lines characteristic of the other.—E. **Dureuil**: The use of magnesium as electrode supports in spectrum analysis. Magnesium as a support in spectrum analysis has certain advantages over the materials commonly used. In the region between 7000 Å.U. and 3500 Å.U. there are only about a dozen strong lines and these do not interfere. Magnesium electrodes can be used for the production of either arc or spark spectra.—René **Lucas**: The rotatory power of camphor. Experiments giving the rotatory power of camphor for different wave-lengths in sulphuric and phosphoric acid solutions, and a discussion of some criticisms of Louis Longchambon.—G. **Bruhat** and M. **Pauthenier**: The rotatory power in the ultra-violet of tartaric acid in dilute solution. Details of experiments are given which show clearly the existence of a dispersion anomaly, with a change of sign in the ultra-violet, even for solutions containing 0·25 per cent. of tartaric acid.—Pierre **Jolibois**, Henri **Lefebvre** and Pierre **Montagne**: The decomposition of carbon dioxide under reduced pressure by the condensed spark. When the circuit is formed with a conductor of negligible self-induction, removed as far as possible from the decomposition tube except in the neighbourhood of the connexions, the dissociation reaches a limiting value of about 90 per cent. and the yield in chemical energy of the first spark is of the order of 20 per cent., the remainder of the energy of the spark being degraded in the form of radiation.—Mlle. Suzanne **Veil**: The decomposition of hydrogen peroxide in the presence of certain hydroxides in suspension. During the decomposition of hydrogen peroxide by the hydroxides of nickel, iron and chromium in suspension, the chemical phenomena correspond with a magnetic variation of the solid phase. The term 'magneto-chemical' is suggested for such reactions.—L. **Abonnenc**: Drops formed in an electric field. Drops forming at the end of a cylindrical tube are generally reduced in weight when placed in an electric field. It is shown that the viscosity of the fluid remains unchanged.—A. **Demay**: The structure of the crystalline massif of Mont Pilat, near Saint-Etienne.—P. **Russo**: The presence of quaternary glacial deposits in the eastern Riff.—P. **Mougin**: The periodicity of glacier increase.—J. **Thoulet**: The region of active submarine volcanoes of the Hawaii Islands in the north Pacific.— —**Theodor**: The formation of the chromoplasts in the Phanerogams.—Mlle. Eudoxie **Bachrach**: The effects of the intoxication of the lactic bacillus by potassium chloride at different temperatures. Under the prolonged influence of a mineral poison it is known that the lactic bacillus undergoes one of two modifications: either it becomes accustomed to the poison or becomes sensitised. It is now shown that according to the temperature at which the strains are cultivated in the toxic medium, either modification can be obtained at will.—A. **Paillot** and R. **Noel**: The origin of the albumenoid inclusions of the adipose body of insects.—**Raymond-Hamet**: A new method of physiological titration of preparations of ergot.—J. **Gautrelet**, R. **Bargy** and Mme. **Vechiu**: The action of chloralose on the nervous system.—Maurice **Piettre**: The acetone method permitting the localisation in the serum albumen of the hæmolysine of a hæmolytic immunoserum.—J. **Sabrazes**: The Spirochætes of typhoid and paratyphoid excreta; their possible agglutinability by the blood of the carrier; their presence in peritonitis by perforation.—Georges **Blanc** and Jean **Caminopetros**: Some experiments on anthrax infection. Experiments are described showing that the skin is not the only part sensible to anthrax infection, the central nervous system being much more receptive.—**Marage**: The influence of the dose of a drug on the defence of the organism.

ROME.

Royal Academy of the Lincei, March 21.—Umberto **Cisotti**: The electrostatic field due to any number of thin electrified conductors of cylindrical form and with parallel axes.—Giovanni **Lampariello**: Continuous surfaces which assume finite area.—Orazio **Lazzarino**: Generalisation of Joukovsky's formula on the motion by inertia of a semi-rigid gyroscope.—Guérard des **Lauriers**: Dini's problem.—A. **Kolmogoroff** and G. **Seliverstoff**: The convergence of Fourier's series.—Bianca **Nannei**: Immediate effects and hereditary effects in the torsion of a bismuth wire.—Paolo **Straneo**: Physical bases for an extension of the theory of hereditary phenomena.—A. **Proviero**: The use of damping in seismographs. The use of

damping in seismographs is unnecessary and, although a damped apparatus gives trustworthy values of the term μ^2, it is almost replaceable by a single non-damped apparatus and is certainly of less advantage than two non-synchronous seismographs.—Adolfo **Ferrari**: The crystalline structure of the fluorides of certain divalent metals. The anhydrous fluorides, FeF_2, CoF_2, NiF_2, and ZnF_2, exhibit the same tetragonal crystalline lattice, which is of the 'rutile' type.—V. **Caglioti**: A new example of anomalous mixed crystals.—P. **Comucci**: Notes on wulfeenit and vanadinite from Oudida (Morocco).—Cramela **Ruiz**: Barytes from the Giona mine (Racalmuto).—Enoch **Peserico**: Variation in the electrical resistance of the submaxillary gland during functional activity.—C. **Iucci**: Capacity for parthogenesis of the egg of the second generation of the bivoltine race of silkworms.

SYDNEY.

Linnean Society of New South Wales, March 31.—H. J. **Carter**: Entomology—past and present (presidential address). The scientific conception of entomology is modern. The seven orders into which Linnæus divided insects are, with one exception, surprisingly near the modern classification. Historical entomological records show the close interweaving of observation with pure fable characteristic of natural history literature, and great dependence on 'authority' and on superficial evidence. The great importance of the study of entomology and its increasing penetration into practical politics is also discussed. The immense number of insects, their complexity of form and development, their close interrelation, and their vast geological age give them a peculiar value to students of evolution and genetics. Australia, in particular, with its huge area of lightly differentiated regions—so far as defined zoogeographic barriers are concerned—affords a good field for the study of variation. The economic aspect of entomology is becoming more important. Reference is made to the attempts to control such pests in North America as the gipsy moth, the European corn borer, and the Japanese beetle, and in Australia the prickly pear, the cattle tick, and the sheep blow-fly. Satisfaction is expressed at the increasing number of Australian entomologists entering various fields. Among the advantages of having the systematic work done by Australians are: (1) The work is done largely by men who combine field observation with literary knowledge of the subject, and (2) the types remain in Australia for reference.—J. R. **Malloch**: Notes on Australian Diptera (No. viii.). Descriptions and notes on further Australian and Tasmanian species of Sapromyzidæ, Clusioididæ and Muscidæ; one genus and twenty-eight species are described as new.—R. J. **Tillyard**: Upper Permian insects of New South Wales. Part I. Introduction and the order Hemiptera. The upper Permian insect fauna found at Belmont, Warner's Bay, Merewether Beach, and Newcastle, N.S.W., is by far the most highly specialised Palæozoic insect fauna known, and consists of only small to medium-sized species belonging to the orders Hemiptera, Coleoptera, Mecoptera and Neuroptera, together with the two extinct orders, Paramecoptera and Protocoleoptera. All these were holometabolous or ancestral to holometabolous forms, except only the Hemiptera, which are only represented by the sub-order Homoptera. In the Homoptera five families (all now extinct) are represented, with fifteen genera and twenty-eight species, twenty-four of which are described as new. The fauna thus ranks next in importance in number of genera and species to that of the Ipswich Upper Triassic in Queensland; as regards the Sternorrhyncha, it is the richest fauna yet discovered.—C. H. **Curran** and E. H. **Bryan, Jr.**: The Australian Syrphidæ in the Bishop Museum (Diptera). The apparent abundance of species of Psilota is noteworthy as this genus is poorly represented in other parts of the world. Five species (two of Psilota, one Chrysogaster, one Microdon, and one Cerioides) are described as new.—G. H. **Cunningham**: Gasteromycetes of Australasia (iv.). Species of the genus Geaster.

WASHINGTON.

National Academy of Sciences (Proc. vol. 12, No. 4, April).—Carl **Barus**: Mutually counteracting pinhole probes.—Frank C. **Hoyt**: Transition probabilities and principal quantum numbers. Using the 'classical' form of the quantum theory, the transition probabilities are calculated from the term values of the stationary states of an atom alone, and the corresponding amplitudes can also be found. No justification is offered for the method of averaging used.—W. H. **McCurdy**: Absorption and resonance radiation in excited helium and the structure of the 3889 line. See NATURE, January 23, p. 122. The line 3889 Å.U. has a weak component 0·044 Å.U. to the short wave-length side of the main component.—B. **Bruzs**: Thermodynamic derivation of a black body radiation isotherm. A number of processes of the form $A \rightarrow B - Q$, where Q is connected with the absorption of heat, are considered. An 'ideal' substance is used and Q is assumed to be independent of temperature.—Enos E. **Witmer**: Critical potentials and the heat of dissociation of hydrogen as determined from its ultra-violet band spectrum. Lyman found that in the presence of a large proportion of argon, helium emits groups of lines between λλ 1063 and 1670. Working on these results, the heat of dissociation of the hydrogen molecule is considered to be equal to the vibrational energy for that value of the vibrational quantum number at which the frequency is zero. The probable value is 4·34 volts or 100,100 calories. The higher resonance potentials and the ionisation potentials of the hydrogen molecule are calculated.—G. Y. **Rainich**: Curved space-time and radiation. The suggestion is put forward that radiation is concentrated in singular lines, when intensity becomes a statistical conception similar to that of modern conceptions of the mass of a body. This points to a reconciliation of the wave theory of light with the emission theory.—Friedrich G. **Brieger** and A. J. **Mangelsdorf**: Linkage between a flower colour factor and self-sterility factors. Three allelomorphic sterility factors are recognised in Nicotiana. The factor for ivory flower colour and the sterility factors segregate independently; white flower colour is linked with them.—Clyde E. **Kerler**: On the occurrence in the house mouse of a Mendelising structural defect of the retina producing blindness. The defect is characterised by complete absence of rods and external molecular layer and reduction of the external nuclear layer, resulting in total blindness. It affects both sexes, behaves as a Mendelian recessive, carries no lethal action, and appears after birth.—Raymond **Pearl**: Vital statistics of the National Academy of Sciences. (5) The growth of the Academy. The numbers of living members on December 31 of each year are used. In the years 1863–76 the Academy doubled its membership; from 1867–90 it maintained a membership of about a hundred, decreasing afterwards until 1898. Since then it has steadily grown, and at the end of 1925 had reached 230.—Einar **Hille**: On Laguerre's series. (1) The formal Laguerre's series of a certain class of functions

can be shown to be summable Abel. Expansions of zero are obtained and a summation theorem for Hermitian series is given. (2) The summation theorem of (1) can be utilised in the convergence theory of Laguerre's series.—G. A. Miller: Groups containing a relatively small number of Sylow subgroups.

Official Publications Received.

Rhodesia Museum, Bulawayo. Twenty-fourth Annual Report, 1925. Pp. 15. (Bulawayo.)

Report of the Canadian Arctic Expedition, 1913-18. Vol. 14: Eskimo Songs. Songs of the Copper Eskimos. By Helen H. Roberts and D. Jenness. Southern Party, 1913–16. Pp. 506. (Ottawa: F. A. Acland.)

New Zealand. Department of Mines: Geological Survey Branch. Bulletin No. 27 (New Series): The Geology of the Whangarei-Bay of Islands Subdivision, Kaipara Division. By H. T. Ferrar and others. Pp. viii+134+6 plates. (Wellington, N.Z.: W. A. G. Skinner.) 15s.

National Research Endowment. A National Fund for the Support of Research in Pure Science. Pp. 23. (Washington, D.C.: National Academy of Sciences.)

Public Library, Museum and Art Gallery of South Australia. Records of the South Australian Museum. Vol. 3, No. 2. Pp. 103-217. (Adelaide.) 10s. 6d.

Department of Public Instruction: Technical Education Branch, New South Wales. Technological Museum: Annual Report for Year ended 31st December 1925. Pp. 4. (Sydney, N.S.W.: Alfred James Kent.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 14: Theory of Airscrews. By Sandi Kawada. Pp. 361-404. (Tôkyô: Maruzen Kabushiki-Kaisha.) 75 sen.

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, Dominica, 1924–25. Pp. iv+34. (Barbados, B.W.I.) 6d.

The Indian Forest Records. (Economy Series), Vol. 12, Part 3: Second Interim Report on the Work under Project No. 1 by the Section of Timber Testing including the Results of the Mechanical and Physical Tests on certain of the commoner Indian Timbers up to end of 1924. By L. N. Seaman, assisted by C. R. Ranganathan. Pp. 22+10 plates. (Calcutta: Government of India Central Publication Branch.) 1.12 rupees; 3s.

State of Illinois Department of Registration and Education: Division of the Natural History Survey. Bulletin, Vol. 15, Article 8: An Entomological Survey of the Salt Fork of the Vermilion River in 1921, with a Bibliography of Aquatic Insects. By Charles P. Alexander. Pp. 439-536. Bulletin, Vol. 15, Article 9: The Lake as a Microcosm. By Stephen A. Forbes. Pp. 537-550. (Urbana, Ill.)

Memoirs of the Queensland Museum. Edited by Heber A. Longman. Vol. 8, Part 3, March 31. Pp. 183-278+plates 29-43. (Brisbane, Qd.)

Department of the Interior: Bureau of Education. Bulletin, 1925, No. 42: Statistics of State School Systems, 1923–1924. Pp. 43. (Washington, D.C.: Government Printing Office.) 10 cents.

Diary of Societies.

SATURDAY, JUNE 5.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—Dr. W. H. Hartridge: The Fundamental Experiments on which the Resonance Theory is based.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates' and Students' Section) (at Newcastle-on-Tyne), at 3.—P. S. Lea: Notes on Safety Lamps abstracted from Recent Reports.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Walford Davies: The Triad and the Perfect Fourth; their Uses from Hucbald to the Present Day. (With Musical Illustrations.)

MONDAY, JUNE 7.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Prof. F. H. Edgeworth: On the Development of the Cranial Muscles in Protopterus and Lepidosiren.—Dr. G. W. Tyrrell and Dr. M. A. Peacock: The Petrology of Iceland. Part 1—The Basic Tuffs.—MM. Prawochenski and Kaczkowski: Observations on the Fragment of a Horse Skull from Interglacial Deposits near Pulawy, Poland.—Y. Tamura and Dr. F. A. E. Crew: On the Effects of Vasectomy and of Epididymo-Deferentectomy in the Mouse.

INSTITUTE OF ACTUARIES, at 5.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Dr. C. Delisle Burns: The Activity of Mind.

ROYAL SOCIETY OF MEDICINE (Social Evening), at 9.30.—F. T. G. Hobday: Our Animal Friends as Patients (Address).

TUESDAY, JUNE 8.

ROYAL ANTHROPOLOGICAL INSTITUTE (Exhibition of Tardenoisian and Pigmy Types of Stone Implements), at 2.30 (continued until June 22).

MANCHESTER GEOLOGICAL AND MINING SOCIETY, at 4.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Brig.-Gen. Sir Percy Sykes: Chinese Turkestan and the Pamirs.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—E. Heron-Allen and A. Earland: Selective Building in the Shells of the Foraminifera.

RÖNTGEN SOCIETY (Annual General Meeting) (at British Institute of Radiology), at 8.15.—A. E. Speight: Abstracts from Apparatus and Technique for Radiography of the Accessory Sinuses.—Dr. L. A. Levy and D. W. West: A New Method of Dosage for Use in Actinotherapy.

ROYAL ANTHROPOLOGICAL INSTITUTE (at London School of Economics), at 8.30.—M. Terry: Some Little Studied Aborigines encountered during Travels in Northern Australia.

WEDNESDAY, JUNE 9.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. Barcroft: Organs of Multiple Function (4): Lungs.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. W. D. Lang: *Naos pagoda* (Salter): the Type of a New Genus of Silurian Corals.—J. F. Jackson: The Junction-Bed of the Middle and Upper Lias on the Dorset Coast.—Prof. P. G. H. Boswell: A Contribution to the Geology of the Eastern Part of the Denbighshire Moors.

RADIO SOCIETY OF GREAT BRITAIN (Informal Meeting) (at Institution of Electrical Engineers), at 6.

INSTITUTE OF WATER ENGINEERS (at Manchester) (continued on June 10, 11, and 12).

THURSDAY, JUNE 10.

ROYAL SOCIETY, at 4.30.—Dr. A. V. Hill: The Viscous-Elastic Properties of Smooth Muscle.—A. S. Parkes: (*a*) Observations on the Œstrous Cycle of the Albino Mouse; (*b*) On the Occurrence of the Œstrous Cycle after X-Ray Sterilisation.—Isabella Gordon: The Development of the Calcareous Test of *Echinocardium cordatum*.—J. Walton: Contributions to the Knowledge of Lower Carboniferous Plants.—Prof. J. H. Priestley and E. Rhodes: On the Macro-Chemistry of the Endodermis.—D. Keilin: A Comparative Study of Turacin and Hæmatin and its Bearing on Cytochrome.—E. Ponder: The Equations applicable to simple Hæmolytic Reactions.—J. P. Hoet and Phyllis Kerridge: Observations on the Muscles of Normal and Moulting Crustacea.—C. H. Best and H. P. Marks: Additional Note on the Effect of Insulin on the Lactacidogen Content of the Skeletal Muscles.

INSTITUTE OF PATHOLOGY AND RESEARCH (ST. MARY'S HOSPITAL, Paddington), at 5.—Dr. J. Freeman: The Pathological Mechanism of the Asthma Syndrome.

LINNEAN SOCIETY OF LONDON, at 5.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. J. Newton Friend: Science in Antiquity (2).

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—Dr. L. C. Martin: The Distribution of Light in Elementary Optical Images.—T. Smith: (*a*) Note on the Criterion for the Best Position of Focus; (*b*) The Stationary Position of Axially Symmetric Functions.

FRIDAY, JUNE 11.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.—Capt. B. K. Featherstone: Exploration in the Korakoram Mountains.

ROYAL ASTRONOMICAL SOCIETY, at 5.—A. N. Brown: Observations of V Cassiopeiæ (Ch. 8324) in 1921–26.—Dr. J. H. Jeans: Stellar Opacity and the Atomic Weight of Stellar Matter.—Dr. W. J. S. Lockyer: The Spectrum of the Bright-Hydrogen-Line Star H.D.C. 20336 in Camelopardalis (Sp. Type B3 pe).—L. J. Comrie: The Standard Equinox of 1950·0.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5.—J. H. Awbery and Dr. Ezer Griffiths: The Latent Heat of Fusion of some Metals.—D. W. Dye: The Piezo-electric Quartz Resonator and its Equivalent Electric Circuit.—E. J. Evans: The Characteristics of Electrostatic Machines on Non-inductive Loads and on the Coolidge Tube.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (Annual General Meeting), at 8.30.—R. Pickard: The Visual Field in Atheroma of the Retinal Vessels.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. J. C. McLennan: The Spectrum of the Aurora.

CONGRESS.

JUNE 9 TO 12.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (at Colchester).

June 9.—R. A. Smith: Essex in Pre-Saxon Times (Presidential Address).

June 10.—R. Paulson: The Beechwood; its Canopy and Carpet; Dr. E. J. Salisbury: The Plant Communities of the Seashore; C. E. Benham: Dr. Wm. Gilberd of Colchester, author of "De Magnete"; Alderman W. G. Benham: The Borough Arms at Colchester.

June 11.—E. C. Stuart Baker: Some Curious Aspects of Evolution; Alderman W. G. Benham: The Colchester Oyster Fishery; S. Hazzledine Warren: The Correlation of the Lower Palæolithic; E. A. Martin: Break-Names in Geological History.

June 12.—A. Farquharson: The Social Constitution of a County; G. E. Hutchings: The Choice of Maps for Regional Surveys; Dr. C. Tierney: Some of Nature's Secrets.

CONVENTION.

JUNE 7 TO 12.

PHOTOGRAPHIC CONVENTION OF THE UNITED KINGDOM (at Edinburgh).

PUBLIC LECTURES.

MONDAY, JUNE 7.

ROYAL COLLEGE OF SCIENCE, at 5.30.—H. E. Wimperis: The Relationship of Physics to Aeronautical Research. (Institute of Physics Lectures on "Physics in Industry.")

WEDNESDAY, JUNE 9.

KING'S COLLEGE, at 5.30.—Prof. S. Radhakrishman: The Philosophic Basis of Hinduism. (Succeeding Lectures, under auspices of British Institute of Philosophical Studies, on June 16 and 23.)