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Science and the State.

AT the session of the Imperial Economic Conference on October 16, Lord Salisbury, Lord President of the Council, made a statement with regard to the Department of Scientific and Industrial Research. In the course of his remarks he said that it has become more and more accepted that the business of research is really an essential element in the industrial progress of the country. Notwithstanding that we all believe in private enterprise, a measure of Government intervention and research is requisite in this, as in many other things.

There are several phases of research which the Research Department has under its purview; for example, maintenance of industrial and commercial standards, work for Government services, and research for industrial purposes. As regards industrial research, while it is likely that the work of private enterprise will be more efficient than that of a Government department, on the other hand the Government possesses certain advantages. For example, the State can afford to finance researches which may prove to be so protracted as to be beyond the scope of private enterprise. Again, the Government has at its command an immense mass of accumulated knowledge. Thirdly, and this point of Lord Salisbury's is one which calls for comment, there is a large number of scientific men who are willing to work for the Government at far less than would be the remuneration of their great talents, and are willing through the Government to place their knowledge at the service of the community. If Lord Salisbury implies by this that the Government is willing and ready to trade upon the patriotism of a research worker, or upon his desire for the security of tenure which is so vital if he is to do good work, then it is truly a deplorable statement. Too often is it assumed that scientific men should be expected to work for the Government at less than would be the just remuneration of their services, though rarely are the mercenary advantages of the one-sided arrangement so baldly claimed by a responsible Minister.

Lord Salisbury went on to refer to the National Physical Laboratory as the outstanding illustration of the success of what in the long run is probably the biggest element of progress in industry, and that is research by the Government itself for industrial purposes. He stressed also as of Imperial importance the work of the Forest Products Board in connexion with timber, and of the Food Investigation Board on the transport of fruit overseas. Lord Salisbury concluded by paying a tribute to the business-like and economical administration of the Research Department.

Officialism in Education.[1]

THE British Science Guild has issued a Memorandum on the subject of bureaucratic intervention in education, which, it states, has reached an acute stage and "has become detrimental to educational development and efficiency." The main charge made by the Guild is that official intervention in educational administration, as distinguished from efficient educational control, is now so excessive—both on the part of the Board of Education and Local Education Authorities—that governing bodies of Technical Institutions and Secondary Schools are becoming mere advisory bodies, without any freedom of action which would allow them to develop the individuality of their institution and take a lively and responsible interest in their progress. It is also pointed out that heads, appointed for their educational powers, are crippled by officialism, both as regards initiative and freedom to experiment on one hand, and on the other by the large demands for clerical work in the nature of "returns," which unduly curtails the time which they can devote to their proper work as educationists.

There have been similar protests from other sources. Local Education Authorities have themselves protested against the apparent endeavours of the Board of Education to assume greater control of matters which should be left to local discretion and to local knowledge. Here we find the British Science Guild accusing Local Education Authorities of acting similarly towards governing bodies of educational institutions. We have also heard of heads who have made similar protests against their governing bodies. We do not suggest that the protests are unwarranted. On the contrary, we think that there is much official intervention that is not only unnecessary and expensive, but is also detrimental to educational development.

We have an example in the working of the new scheme of national certificates in chemistry and in mechanical and electrical engineering, referred to in an article in NATURE of July 14, p. 45. Apparently the scheme is designed to secure all the advantages of internal examinations and of reasonable freedom in the arrangement of the courses of work to meet local conditions and needs, coupled with just enough central control and assessment to secure the attainment of some uniform *standard* of work on which a national certificate can be issued, bearing the endorsement of the Board of Education and of the appropriate institution of chemists or engineers. The scheme is excellent, but we have reason to fear that before courses of study are recognised they are so modified—"mutilated" was one word which we heard—by the Board that they all bear a close resemblance to one another. If such be the fact, it is certainly an example of hampering local discretion and tending too much towards that machine-like uniformity beloved by bureaucrats, whose tendency is to worship at the shrine of organisation and to ignore the essential needs of educational progress.

We are not blind to the need of some measure of central control and to some sound and efficient organisation, but any attempt to standardise education, whether in school, technical institution, or university, is just as certain to put an end to progress as is the standardisation of any machine—like a motor-car, for example—bound to prevent any development or improvement in that particular machine. If the increased bureaucratic intervention which is complained of is tending to do this thing, then it must be resisted strenuously.

[1] Memorandum on the Increase of Bureaucratic Intervention in Education. (British Science Guild.)

The Lister Ward of Glasgow Royal Infirmary.

THE managers of the Royal Infirmary, Glasgow, recently decided that, for various reasons, the celebrated Lister Ward of the Infirmary should be destroyed. It is not surprising to know that this decision has elicited many strong protests, and that an appeal has been made for the preservation of what is a unique relic in the history of medical science.

The ward in question was Ward 24 of the "New Surgical House," and was Lister's male ward from 1861 to 1869. It was the scene of his first attempts to apply the results of his studies on the healing of wounds to combating the septic disease which was rampant. By their success it became the birthplace of modern surgery. In 1912, when the reconstruction of the Royal Infirmary had advanced so far that the ward was no longer used, it was decided to pull down the block in which it is situated. Then a movement arose for its preservation as a memorial of Lister, and the managers of the Infirmary decided to keep it.

This decision the managers later rescinded, and the ward has really escaped destruction through force of circumstances. It was arranged as a museum, with relics and portraits of Lister and hospital furniture of the period, for the occasion of the visit of H.M. King George on July 7, 1914, and a few weeks later it was occupied by wounded soldiers from France. Now it is in use as cloak-room and reading-room for the women medical students. The relics, etc., are stored in the Pathological Institute, and it is hoped to use them in furnishing the ward, so as to illustrate some of the conditions under which Lister worked in it—a task of no great difficulty.

The sentimental value of the place is felt by those who teach in the Royal Infirmary and by their students and by visitors from abroad. No one questions the value of Burns's cottage at Ayr; yet apparently the

majority of the managers of the Royal Infirmary regard Lister's ward only as an obstruction.

Recently a pamphlet has been published by Mr. James A. Morris (Glasgow: MacLehose, Jackson and Co.), who, besides telling the story of the ward, shows that if the proposals of the Lister Memorial Committee were carried out, there would be practically no obstruction left. Actually, it is not the whole block which it is desired to preserve, but only the one ward itself, with three little rooms, which are an integral part of it and the basement below. Providentially, it would seem, this one of Lister's wards was on the ground floor. An appeal is being made to the managers of the Infirmary in the hope that a definite and strong expression, not only by members of the medical profession, but also by all those who cultivate science, as to the "historical and spiritual values of this famous landmark in the history of surgery," will convince them that the destruction of the ward would be regarded as a breach of trust, and its preservation as a simple act of respect for a memorial of achievements by which all civilised peoples have benefited.

The New Anthropology.

Tutankhamen and the Discovery of his Tomb by the late Earl of Carnarvon and Mr. Howard Carter. By Prof. G. Elliot Smith. Pp. 133. (London: G. Routledge and Sons, Ltd.; New York: E. P. Dutton and Co., 1923.) 4*s.* 6*d.* net.

LAST year's discovery of a rich and varied collection of funerary equipment and other objects of Egyptian art of the time of Tutankhamen must inevitably reanimate the already vigorous discussion of cultural origins and the meaning of cultural symbols and uses. The prediction of the late Dr. W. H. R. Rivers in 1911 that the theories then advanced by Prof. Elliot Smith would be bitterly opposed by ethnologists of the older school has been abundantly fulfilled. Those theories attributed the creation of civilisation as we know it the world over to Egyptian initiative, and since their author has now himself entered upon the discussion of the recent discoveries in Egypt, the occasion is afforded for presenting a review of at least the chief lines of the argument developed with ever-increasing weight of detail during the past decade. For most of them reference need be made only to this admirable little volume written particularly to interpret the essential features in Egyptian custom and belief which found expression in Tutankhamen's time.

First, then, concerning Egyptian funerary ritual and its origins in the life of the early Egyptian community, the achievement of the new anthropology is twofold: with true imaginative power it has penetrated the veil of mystery and unintelligibility, which is the obscuring work of later ages, to the naïve realism of the early Egyptian mind, and, allowing the proved facts of early life in the Nile basin then to speak for themselves, it has provided us with a complete and consistent account of the rise and spread of our culture. Civilisation, for the new school, began when the early Egyptians invented the art of irrigation to extend artificially the area of cultivation of barley. The irrigation-engineer of early Egypt was the first man to organise the labour of his fellows. He conferred the benefits of security and prosperity upon the community and upon every individual member of it. He personified every subsequent idea of kingship. The life of the community flowed from him in a sense as real and actual as that in which the Nile was subject to his control. To identify him with these subtle forces was less an act of metaphysical ingenuity than one of unsophisticated realism. He became the incarnation of the life-giving powers which he bestowed upon his people. He became a god, assimilating to himself attributes of the shadowy Great Mother, and was apotheosised after death as Osiris. Eventually his powers were extended and transferred to his successor, Horus, himself credited with the immortalisation of the dead king. The whole of the elaborate equipment of Tutankhamen's tomb is inspired by this same motive: identification with Osiris and participation in his immortality and deification.

Funerary couches such as the three discovered last year, one representing a cow, the second a lion, and the third a hippopotamus, have been known previously from fragments and are among the most familiar objects represented in wall-paintings and upon papyri. In themselves they shed a flood of light upon the essential *naïveté* of the Egyptian mind at work upon the elaboration of our human beliefs; but also they focus attention upon an important chain of evidences concerning the migration of culture. The cow in Egyptian belief was not only the giver of milk, maintaining life in childhood and adult age, a foster-mother; she was also, even sixty centuries ago, the Divine Cow, identified with the actual mother of mankind, the Great Mother, Hathor, who was at one and the same time a cowrie, a grain of barley (both symbols of life-giving), a cow, and the moon. If the great giver of life and immortality were both a cow and the moon, she was then the appropriate vehicle to transport the earthly king heavenwards. The representation of this occurrence is a commonplace of Egyptian painting, and realism could scarcely be carried further than rhe representation in some cases of the very stars upon the belly of the animal. The lion-headed couch of the tomb is inspired by a like motive. The lion was Horus, the

son of Osiris, as well as the Divine Cow the function of which was to perform those ceremonies which would ensure the continued existence of the father. The hippopotamus, a symbol of the divine midwife, brought about the rebirth of the king whereby he became a god. Immortality was the sole distinctive possession of a god in early times.

The use of such vehicles for human transportation to the celestial regions is widespread and is everywhere determinative of deity. The whole conception is so peculiar and so much a part of a particular community experience that it is incredible that two peoples independently should have adopted its remarkable symbolism. Yet it is found to have spread throughout western Asia and the parts of Europe that came under the influence of Greek civilisation; India and eastern Asia; Indonesia and Central America. The general adoption of such a convention affords a striking illustration of the diffusion of culture, and since its origin in Egyptian beliefs is demonstrated, its presence in Syria and Mesopotamia, in Asia Minor and Syria and Greece, in India and eastern Asia, in Central America and Peru, is but a measure of the world's cultural debt to Egypt herself. In India the convention exercised an exceptional fascination over the minds of its ancient inhabitants, who, from about three or four centuries B.C. onwards, were accustomed to represent the vehicles of the gods in many different guises. Of these, one of the most interesting was the *makara*, the composite monster regarded as a crocodile but originally nothing more than the capricorn of the zodiac—the Babylonian combination of antelope and fish. In India, too, a great variety of the heads of other animals were substituted from time to time for the antelope's, notably the elephant's.[1] These evidences are but amplifications, on the cultural side, of the formidable array of facts, somatological and cultural, elicited earlier. Craniological evidence from Polynesia, the Malay Archipelago, the Asiatic littoral, and the Pacific coast of Central and South America accords perfectly with the facts concerning the geographical distribution of the practice and technique of mummification, of megalithic monuments, and of ancient mines. Mr. W. J. Perry [2] has not only related these two last-mentioned cultural records, but has also explained the motives which impelled small bands of civilised people to wander and to settle.

The statement has been made, and repeated as recently as the present year by prominent archæologists well acquainted with the facts, that the Egyptians were not a sea-going people; whereas we know from their literature that they did engage in maritime enterprise, and it is perfectly well established that they invented shipbuilding and were the builders of the first sea-going ships. It is equally definitely established that every other people in the history of the world who engaged in maritime traffic adopted the Egyptian conventions of both shipbuilding and seamanship. It is unreasonable to pretend that the transportation of the elements of early civilisation from Egypt to Syria and Crete and East Africa and Babylonia was not effected by the Egyptians themselves. In each of those places Egyptian colonists exploited natural products and planted the germs of Egyptian civilisation, which in the course of its development acquired certain local peculiarities. But from Crete and Syria and Babylonia secondary diffusions took place in most cases, no doubt without direct Egyptian participation. The recognition of cultural elements of Egyptian inspiration in India by no means involves the claim that either a single Egyptian or a single Egyptian word ever reached that country. The first is necessitated by the facts: the second is an unessential possibility. A Babylonian *element* colours the southern Indian culture; an Indian *element* that of Burma, Siam, and Cambodia. Behind all is the Egyptian origin and inspiration.

Most of the misunderstanding concerning the new theories has been due to a failure to understand the nature of such secondary diffusion. It cannot be made too clear that no claim has been advanced on behalf of direct transmission across great distances. The journeys may have been small, and few individuals may have achieved them, but the culture they bore with them was virile, and if degraded by change of hands, by time, and by racial and environmental as well as by merely geographical remoteness, it has not been degraded beyond recognition.

[1] Important evidence provided by the elephant-head in demonstrating the reality of the diffusion of culture so far as Scotland in the west and America in the east is set forth in correspondence in NATURE of Nov. 25, 1915, p. 340; Dec. 16, p. 425; Jan. 27, 1916, p. 592; Feb. 24, p. 703.
[2] "The Children of the Sun," 1923, etc.

Glass-making in England.

Glass-making in England. By Harry J. Powell. Pp. x+183. (Cambridge: At the University Press, 1923.) 25*s.* net.

ANY one who takes the trouble to look through a catalogue of works in English dealing with the subject of glass will be struck with its poverty. For the most part, books on glass have been written by collectors and admirers of glass for other collectors and admirers, or by antiquarians and artists interested in stained glass. The number of books written by those intimately connected with the manufacture of glass, however, has been remarkably few. Since 1849, when Apsley Pellatt wrote his "Curiosities of Glass Making," giving an account of the processes of making all kinds

of glassware, the number of books of any note, written by persons having intimate acquaintance with the industry, can be counted on the fingers of one hand. Thus, W. Gillinder's unpretentious but, in its day, useful little book appeared in 1854; in 1883, H. J. Powell, to whom we owe the volume under review, was the chief author of a book on the "Principles of Glass-making"; while, since 1900, two other books have appeared giving some account of the manufacture of glass. It is doubtful if any other important industry has so poor a technical literature.

Now, for the first time, if we except A. Hartshorne's work on "Old English Glasses," published in 1897, we have a general history of glass-making in England, one, indeed, written by a manufacturer of specially rich experience and knowledge of the handicraft. It is a matter of great regret that he did not live to see the actual publication of the book.

The book gives, in the space of fifteen chapters, a general survey of glass-making in England. It carries us back to the Roman occupation, discusses such remains of this period as have been discovered, as also of the glasses of Anglo-Saxon date, but without arriving at any definite conclusion on the existence of a native industry before the thirteenth century.

It was in 1226 that we first meet with the definite and undeniable existence of the industry in Great Britain, at Chiddingfold in Surrey. The south-eastern counties of England, Surrey and Sussex in particular, appear to have been favourite spots for the native glass-makers during the thirteenth, fourteenth, fifteenth, and sixteenth centuries, largely on account of the presence of much beechwood, which was the favourite fuel of the glass-maker. The native productions during these centuries do not appear to have reached a very high level, and it needed the impetus of foreign workmen from the middle of the sixteenth century onwards to raise the art of glass-making in Great Britain, some of these workmen coming from Venice and others from Lorraine by way of the Low Countries. The moving spirits, however, who assisted most effectively in the English developments were most of them Englishmen, of whom Sir Robert Mansell in the first half of the seventeenth century was the most persistent of the pioneers in the industry, being responsible for the development of glass-making at Newcastle and mainly instrumental in introducing coal instead of wood as the fuel in glass furnaces.

One of the achievements of this period, namely, the first part of the seventeenth century, was the production of lead crystal glass, which constituted a contribution of fundamental importance to the industry and was destined, in virtue of its capacity to bear cutting and decorating, to supplant the famous Bohemian glass for ornamental purposes. By the middle of the eighteenth century the English crystal glass was already beating the Bohemian glass as that previously had beaten the Venetian.

Of considerable interest is chap. iv., on English drinking glasses, since it presents the view of a glass manufacturer and opposes various theories of glass collectors. Mr. Powell held the view, with which the reviewer heartily concurs, that connoisseurs have often attempted too much in endeavouring to assign dates and periods to articles of glassware on the basis of variety of form, of decoration, and of tint. Artistic development and skill varied so considerably from factory to factory that it was quite possible for different forms, both simple and highly developed, to be produced at contemporary factories; whilst it is a comparatively simple matter to reproduce tints in glass. Some factories, indeed, have made a study of the reproduction of antique glasses, and the author himself was responsible for some fine reproductions of Venetian glass.

Chap. xiv. is of special interest from the point of view of the scientific development of glass. It contains notes of the author's own experience as a glass manufacturer between the years 1875 and 1915, and the experiments recorded prove that there was at least one works in Great Britain which did not depend on rule-of-thumb methods. A study of the records of the provincial glass-houses (chap. vii.) shows that enterprise was by no means lacking, even during Government control (see chap. xii., the Excise Period), when it was a matter of surprise that men could still be found to carry on glass manufacture under the conditions prescribed by law, which insisted that notice in writing must be sent to the Excise Officer before any of the important operations of glass-making could be carried out.

Not unnaturally, the main portion of the book is concerned with glass-making as an art. As a handicraft the author's view was that glass-making was doomed. He states so quite definitely in the preface; and, whether his view be correct or not, it was the chief factor at any rate which induced him to write this account. The disappearance of glass-making as a handicraft and the introduction of the machine, however, did not necessarily mean to him the final loss of the artistic in glass. He says: "If mechanically produced tableware is inartistic and ugly the fault lies with the designer. . . . Designs, whether for hand-made or mechanically produced tableware must be evolved from an intimate acquaintance with the nature of molten glass and the technique of manufacture rather than from the superior inner consciousness of the art school."

Several of the chapters of the book were written as lectures or as journal articles, and in some ways the book is therefore disjointed, whilst some of the chapter

headings do not convey the correct idea of the contents. Thus, one chapter (chap. x.) is devoted to the records of the famous Whitefriars factory, but its chief title is "Flint Glass." The chapter on "Old London Glass-houses" (chap. vi.) and that on "Provincial Glass-houses" (chap. vii.) both contain much detailed information, including such references as occur to the investigations of Faraday, Harcourt, and of Stokes on optical glass, and, indeed, to the whole subject of optical glass—except the brief reference later on to War developments.

One would like to have seen included some account of trade union influence in the nineteenth century, and something more about the condition of the industry in the last fifty years than the statement that it was in "a parlous state," while the concluding chapter (chap. xv.) on "Glass-making during the War" is somewhat sketchy. It may be admitted that the War developments gave a suggestion of what the future might be, and perhaps it was best that the detail should be left for the younger generation of men to fill in.

There is no existing book to which the one under review can be rightly compared. It stands as a definite and valuable contribution to our knowledge of the history of glass-making in Great Britain. The book is well got up and illustrated, containing one hundred and six illustrations, mostly photographic reproductions. W. E. S. TURNER.

Fungi and their Spores.

Researches on Fungi. By Prof. A. H. Reginald Buller. Vol. 2: Further Investigations upon the Production and Liberation of Spores in Hymenomycetes. Pp. xii+492. (London: Longmans, Green and Co., 1922.) 25*s.* net.

PROF. BULLER'S original volume, entitled "Researches on Fungi," was published in 1909, and with its distinctive point of view and original observations attracted considerable attention among botanists. The author, in the preface to the present volume, states that it is to be considered as volume 2 of the original work, and that volumes 3 and 4 are in an active state of preparation. Such industry is itself remarkable, but such productivity in book publication is even more so at the present time, and is explained by the generous help towards publication provided by the Canadian National Council for Scientific and Industrial Research. The Birmingham Natural History and Philosophical Society has made a grant towards the cost of reproduction of the illustrations in the present volume, which include many beautiful photographs as well as a number of the author's original and extremely helpful diagrams.

The volume divides sharply into two sections. The first eight chapters are very diverse in character. They exhibit the author again as a born naturalist, making full use of the resources of a modern laboratory to extend the range of his interesting field observations. But it must be confessed that a certain diffuseness and prolixity make these early chapters difficult reading. Some of the material has been published before in the Transactions of the British Mycological Society, notably the chapters on slugs and squirrels as mycophagists, and all this early section might gain by condensation.

Chapters ix-xiii are very different in character. They include a most interesting attempt to interpret the organisation and development of the hymenium of the Agaricineae. In 1911 the author commenced this investigation upon the common mushroom, *Psalliota campestris*. Experience proved this plant an unsuitable starting-point, but realising the significance of the mottled appearance of the gills of Panaeolus, Prof. Buller worked out the progressive development of successive series of basidia and spores, in different phases in contiguous irregular areas on the mottled gill, and thus was successful in presenting a most complete analysis of the hymenial organisation. *Stropharia semi-globata* was similarly and most completely worked out, and incidentally might prove a better class object for the elementary student than the common mushroom, which only yielded up the secrets of its organisation when Prof. Buller returned to the attack armed with experience gained upon these other types. In this and the succeeding volumes the author promises an analysis of the two main types of hymenial organisation, that of Panaeolus and of Coprinus, and of the various sub-types he has distinguished.

This work must form the basis of laboratory study and teaching on the Agaric hymenium for many years to come. Interpretation throughout the work is entirely teleological, and while this permits a biological significance to be attached to many of the facts presented in so interesting a fashion with almost suspicious facility, it leaves the way open for a later reinterpretation of fungus organisation based upon a fuller knowledge of the complex machinery of heredity and growth and its relation to environment.

Geodesy and Geodynamics.

Naturwissenschaftliche Monographien und Lehrbücher. Vierter Band: *Einführung in die Geophysik.* Von Prof. Dr. A. Prey, Prof. Dr. C. Mainka, und Prof. Dr. E. Tams. Pp. viii+340. (Berlin: Julius Springer, 1922.) 12*s.* 6*d.*

THE title of the work under notice is a little misleading, and might better have been "An Introduction to Geodesy and Geodynamics," considering

that it contains no reference to such important branches of geophysics as terrestrial magnetism, earth currents, auroræ, and atmospheric electricity, not to say meteorology. Within its chosen limits, however, it affords a welcome summary of a considerable body of knowledge concerning the earth, which has not hitherto been accessible in anything like so concise and handy a form.

The work is divided into three parts, by different authors, but is as unitary a treatise as can be expected in the case of a wide field of rather loosely-connected studies such as geophysics. The first part occupies more than half the volume, and is distinguished from the two later parts by its largely mathematical character; it deals with the figure of the earth, the theory of tides and seiches, and the density and rigidity of the earth. The determination of the geoid by triangulation is first briefly explained, including an account of the essential features of the instruments used and the methods of reduction. The application of gravity measurements to the same problem is then dealt with; a short summary of potential-theory is followed by a description of the instruments and methods used in gravity-determinations, both absolute and relative; Clairaut's theorem connecting the ellipticity of the earth with the ratio of gravity at pole and equator and of gravity with centrifugal force at the equator is proved and discussed in connexion with observations for the north and south hemispheres separately. There is a brief chapter on measurement of heights above sea-level, by levelling, trigonometrical surveying, and barometric observations, followed by a longer but condensed summary of the changes of level of the sea itself; the tide-producing potential of the moon is developed, following Darwin in the main (not even a bare reference is made to the important work by Proudman and Doodson in this field), and the equilibrium theory, Laplace's dynamical theory, and Airy's canal theory of tides are summarised. Tidal currents and seiches are also touched on: the important influence of barometric pressure scarcely receives sufficient mention. The first part of the book ends with a long and interesting section on the constitution, mean density, and internal pressure of the earth; the basis and conclusions of the theory of isostasy are explained, and the various lines of evidence bearing on the rigidity of the earth are well summarised.

The second part of the book relates to seismology, and rapidly reviews the instruments used, the records obtained, and the conclusions thence derived as to the path and speed of the longitudinal and transverse waves, and the bearing of this evidence on the theory of the constitution of the earth.

The third section will probably be the most interesting to the majority of readers of the book, because it deals in a non-mathematical, discursive way with the borderland region between geodesy and geophysics. There the causes which have led to the present surface features of the earth are discussed. Without accepting Wegener's theory of continental displacements, the author adopts the broad principle that large lateral displacements of continental blocks must be taken into account in geology, though discounting the very uncertain astronomical evidence thus far adduced in favour of measurable rates of variation of relative longitude. Considerable space is also devoted to the causes of vulcanism and of earthquakes.

Our Bookshelf.

Civil Engineering Geology. By Cyril S. Fox. Pp. xvi+144. (London: Crosby Lockwood and Son, 1923.) 18*s*. net.

A CIVIL engineer laid the foundations of modern geology; it is therefore singularly inappropriate that civil engineers should be somewhat dependent upon the geologist for decisive opinions on the geological aspects of engineering schemes. The author would attribute the engineer's diffidence in the matter of geology to the air of specialisation with which an awesome nomenclature has invested the subject. Engineers are themselves rather at fault in having allowed the cloak of William Smith to descend on others' shoulders. The geology of field operations involves little more than a common-sense application of first principles to special types of observations made on the engineer's own ground.

Geology is now, however, a subject studied by most engineering students, who are well equipped for the study. The author's purpose is to induct civil engineers to a territory which they might have shared equally with geologists from the first, and this purpose is achieved in an inspiring book; it deals in a thoroughly practical way with geology from the engineer's point of view, and is in no sense a slender original design erected on a trimmed mass of material quarried from other works—the author's published work excepted. A brief introduction leads directly to the problems of water supply (Pt. I.); Pt. II. deals with field operations, Pt. III. with building materials. From first page to last the book bears the stamp of experience and practical acquaintance with engineers' problems. Illustrations include sketches taken from the author's field notebook; that a few of these are truly "sketchy" is less a defect than a positive merit, which the engineer will promptly recognise. Criticism can be directed only against their scale. These sketches are supplemented by numerous structural sections and photographs.

Assuming the reader is not familiar with geology, the conventional methods of representing the commoner rock types should receive early mention; the need for the "key" is urgent in Figs. 13-18; it is first given in Fig. 24. Similarly the terms strike, anticline, etc. which are freely used in Pts. I. and II. are defined in Pt. III., and rock classification is attacked before rock-forming minerals have been described. The author outlines a new scheme of rock classification which will

appeal to petrologists no less than to engineers. The inclusion of nephelinite under syenites is a slip which, with a few others, will doubtless be corrected later.

A. B.

An Advanced Course of Instruction in Chemical Principles. By Arthur A. Noyes and Prof. Miles S. Sherrill. Pp. xviii+310. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1922.) 18*s.* net.

PROFS. NOYES and SHERRILL have produced a work which might be mistaken at first sight for yet another text-book of physical chemistry, since it deals with such subjects as vapour-pressures, osmotic pressures, electrolysis, chemical equilibrium, chemical change, and the phase rule. A closer study of the book reveals the fact that it is quite distinct, both in its purpose and in its method, from the ordinary text-books of descriptive physical chemistry. This contrast is shown not only by what the book contains but also by what it omits. Thus, the newer theories of the structure of atoms, molecules, and crystals have been reluctantly omitted, in spite of their interest and importance, since on the chemical side they are mainly empirical, the general principles (if any) on which they are based being mathematical and physical rather than chemical.

A clear view of the purpose of the book is obtained by studying the series of problems which it contains. These are not merely supplementary to the course of instruction but are its most important feature. The total number of these problems is nearly 500; but suggestions are given for a shorter course when the time available is too short to cover the whole of the syllabus. In some respects the book recalls Nernst's "Theoretical Chemistry," although it is in some ways a more attractive book for the student. Thus the whole of the text is contained in less than 300 pages; and the English student has the advantage of reading it in the original language instead of in a translation. From the point of view of the teacher of chemistry, the problems on which the book is based are of importance as ensuring that the student really understands what he is being taught, and is able to apply it in a direct way to chemical problems. It is indeed difficult to imagine any course that would be of more value to the student of physical chemistry in enabling him to secure a real mastery of his subject; and this fact more than compensates for the absence of the more popular features which can be used to add to the attractiveness of a descriptive text-book.

Studies in Religion, Folk-lore, and Custom in British North Borneo and the Malay Peninsula. By I. H. N. Evans. Pp. viii+299. (Cambridge: At the University Press, 1923.) 20*s.* net.

MR. EVANS, now curator of the Taiping Museum, includes in this book notes collected during two series of explorations. The first part describes his investigations in the Tuaran and Tempassuk districts of North Borneo; the second deals with the customs and beliefs of the woolly-haired Negritos, the wavy-haired Sakai, and the Jakun pagans of the Malay Peninsula. This latter may be regarded as a supplement to Messrs. Skeat and Blagden's "Pagan Races," and Mr. Skeat's "Malay Magic." In North Borneo the coast districts are occupied by the Bajaus and Illanuns, proto-Malayans, but the Dusan pagans of the interior naturally attracted Mr. Evans's special attention. He gives an excellent description of the beliefs and customs of this interesting race. Much of his account of their religion, folklore and customs, and of head-hunting, now happily obsolete, may be compared with the records of other explorers in these regions.

The method of Mr. Evans wins our confidence. He gives the actual notes of his work and the sources of his information, without any attempt at generalisation, which is particularly dangerous when dealing with isolated communities where the culture varies from one valley or jungle to another. Even in the Malay Peninsula he has been able to add something to the harvest already garnered by Messrs. Skeat and Blagden. The folk-tales are mostly concerned with animals and their ways, and supply interesting parallels to those current in adjoining regions.

The Elasmobranch Fishes. By Prof. J. F. Daniel. Pp. xi+334. (Berkeley: University of California Press, 1922.) 4.50 dollars.

As the author reminds us in his preface, of all living fishes the Elasmobranchs are by far the most interesting and important for the understanding of the Vertebrata. In this handsome and beautifully illustrated volume Prof. Daniel gives a general account of the sharks and rays chiefly from a morphological point of view, though not neglecting the relation of structure to habits and food. Each of the eleven chapters dealing with the external form and the anatomy of the various systems of organs begins with a very clear description of *Heptanchus maculatus*, followed by a comparison with other more specialised forms, and concludes with an adequate bibliography. Thus the reader is presented with an excellent survey of the range of structure presented by the whole group. Matters of fact are very accurately stated, but in dealing with theoretical deductions of a more general nature, the author seems to be on less certain ground. One serious blunder only have we met, on p. 309, where the kidney tubules are called "nephridia." Surely it is now recognised that these tubules, derived from the cœlomic wall, have nothing to do with the true nephridia of Amphioxus and the cœlomate Invertebrates, but are rather to be compared to the cœlomoducts so constantly found in the latter? Prof. Daniel is to be congratulated on having produced a most instructive and attractive book which should prove useful both to students and to teachers of zoology.

The Story of the Maize Plant. By Prof. P. Weatherwax. (University of Chicago Science Series.) Pp. xv+247. (Chicago: University of Chicago Press; London: Cambridge University Press, 1923.) 1.75 dollars.

THIS volume serves to gather together in a convenient form much of our scattered knowledge of the maize plant, and provides a concise summary of the general history of this important food and forage crop. The accounts of the morphology, anatomy, and ecological relations of maize lead up to an exposition of methods of cultivation and harvesting, followed by a detailed description of the flowering organs and the development of the grain or seed. The author indicates the

great possibilities of improvement in quality of seed that might be brought about by a judicious application of the principles of plant breeding.

Maize would appear to have been much valued in aboriginal America, but with the great increase in colonisation which followed the voyage of the *Mayflower* it has steadily increased in importance until now the United States produce three-quarters of the total world-crop.

A special feature of the book is the excellence of some of the original text figures, which are both clearly drawn and well reproduced, being among the best hitherto published for this plant. The aim of the book, with others in the same series, is to reach the educated layman as well as the specialist, and the volume offers a useful and interesting résumé of the subject dealt with.

Supplying Britain's Meat. By G. E. Putnam. Pp. 169+16 plates. (London, Calcutta and Sydney: G. G. Harrap and Co., Ltd., 1923.) 5*s.* net.

MR. G. E. PUTNAM is the consulting economist to Swift and Company, Chicago. Of the seven chapters of his book, the first three, and possibly the sixth, deal with the subject selected for the title of the book. The remainder are devoted to an economic justification of the big-scale United States businesses dealing with the distribution of meat and meat products, and to a defence of their conduct as stated in the official reports of American commissions, and the large volume of unofficial criticism from the American public.

From the British point of view, the most significant fact is that only 60 per cent. of the beef, and 50 per cent. of the mutton consumed in Great Britain is home-grown, and there seems little possibility of the home supplies even maintaining this proportion in the future. The manner in which this deficiency in home supply has been met by Imperial and foreign shipments is very well traced out. The sections dealing with the distribution of imported meat contain a detailed defence of the middlemen. The author believes that they perform indispensable economic functions, and further, their work cannot be done efficiently unless they are units in an organisation in the closest touch with the firms of meat exporters.

Letters of a Radio-Engineer to his Son. By John Mills. Pp. vi+265+12 plates. (London: G. Routledge and Sons, Ltd., 1922.) 10*s.* 6*d.* net.

AT the present time practically every student at a technical college, and most school-boys, are intensely interested in radio communication. The author takes advantage of this and writes a book in familiar language as an introduction to understanding the latest developments of the art. He expends no time in describing fluid theories or pith balls. He plunges at once into describing protons and electrons and, provided his reader consents to follow him, shows what an essential part they play in radio apparatus. How to measure an "electron-stream" and "electron-moving-forces" are simply described. Inductance and capacity, tuning and resonance and the harmonics in the human voice are explained. Broadcasting stations, trans-Atlantic telephony and the telephone circuit with its amplifying stations connecting New York and San Francisco are also described. The author, who is a well-known expert of the Western Electric Co., concludes by pointing out how excellently ordinary telephony and radio telephony can be united so that the voice vibrations can be carried over wires and across wide spaces before they come to the receiver. The two methods use the same general principles and much of the apparatus used is common to both.

Epping Forest. By E. N. Buxton. Ninth edition revised. Pp. xiv+182+6 maps. (London: Edward Stanford, 1923.) 2*s.* 6*d.*

THE ninth edition of this little book, which has been out of print since 1915, is very welcome. It contains a history of Epping Forest, with an account of the topography, accompanied by several coloured maps. Other chapters follow on the animals, birds, insects and pond life of the forest area, as well as the trees, flowering plants, mosses and fungi. A short chapter gives an account of prehistoric man and the animals he hunted. Another is devoted to the geology of the district. A final chapter has been added on the management of such a forest. It will no doubt be found useful by students, naturalists and others who visit Epping Forest and wish to know more of its natural history.

The Chemistry of the Inorganic Complex Compounds: an Introduction to Werner's Co-ordination Theory. By Prof. R. Schwarz. Authorised translation by Dr. L. W. Bass. Pp. x+82. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1923.) 8*s.* 6*d.* net.

THIS book is a translation from the German of an introduction to the study of co-ordination compounds. It is an excellent little book for the purpose, and even advanced workers in this branch of chemistry will find it of value on account of the fact that a reference to the original literature is given in the case of all the compounds that are referred to throughout the book. The form in which the book is issued is very attractive, and it should have a large circulation among English readers.

Handbook of Steel Erection. By M. C. Bland. Pp. ix+241. (London: McGraw-Hill Publishing Co., Ltd., 1923.) 12*s.* 6*d.*

THERE are but few books dealing with this subject, and for the most part treatises on structures do not give adequate treatment to the methods of erection. The volume before us gives both descriptions of these methods and also the calculations involved in determining the strengths of the appliances used. Civil engineering students will find the book a useful supplement to their text-books on structures.

The Unconscious: an Introduction to Freudian Psychology. By Israel Levine. Pp. 215. (London: Leonard Parsons, Ltd., 1923.) 7*s.* 6*d.* net.

AN excellent short account of the Freudian theory in its general philosophical aspect. The author finds no need to force on the reader unpleasant descriptions of particular neuroses, and he treats the whole concept of the unconscious as a metapsychology. Its relation to older classical conceptions and to modern rival theories is briefly but quite clearly indicated.

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.*]

X-rays and Crystal Symmetry.

MR. T. V. BARKER directs attention (NATURE, October 6, p. 502) to the difficulties that may arise in the classification of crystals in consequence of the use of the X-ray methods of analysis, since the latter take note of features in crystal structure which are not always the same as those from which the older methods draw their deductions. From the same point of view he discusses also the existence of the molecule in the crystal.

It is to be remembered that all inquiry must be directed to the determination of the relative positions of the atoms and the molecules within the unit of pattern, and of the forces which they exert on one another. The nature of the symmetry of the crystal and the possible existence of the molecule are questions of academic interest only, except in so far as they contribute to this end. From this point of view the difficulties described by Mr. Barker seem to lose much of their importance.

The symmetry determinations of the older and well-known methods are complete when the crystal has been assigned to one or other of the thirty-two classes: and this can generally be done, though there often remains some uncertainty. On the other hand, the X-ray methods determine the form and size of the unit of pattern and the number of molecules which go to the making of it. It is an open question which only experience can answer, whether the X-rays give absolutely correct evidence on this point: whether, for example, they might overlook some difference which, repeated at some multiple of the spacing determined by the rays, implied a larger unit of pattern. The difference might be of such a kind as to be incapable of detection however great it might be, or it might be missed merely on account of insufficient magnitude. So far, the evidence points to the possession by the X-rays of the power to detect any material difference: they can, for example, make apparent the difference between two neighbouring atoms of carbon in the diamond which are due only to differences in the orientation of their attachments to their neighbours. Moreover, the X-rays give such information as to the relative positions of the atom-groups into which the crystal unit may be divided that the crystal can not only be assigned to its proper class, but also to its proper type among the two hundred and thirty possible types of structure, as defined either by the space group of symmetry movements which the crystal possesses or by the arrangement which the X-rays have found. There is only one exception of importance. The X-rays cannot in general determine whether a crystal has or has not a centre of symmetry: and this sometimes leaves the alternative as to whether a crystal belongs to a certain type of symmetry in a lower class or to another type in a higher class obtained from the lower by adding the centre of symmetry. If it is known from observation of form or otherwise whether there is or is not a centre of symmetry the ambiguity disappears.

The general arrangement of the molecules having been found, any further observations of the form or other physical properties of the crystal have a value not because they may put the crystal up or down by a whole class, but because they help in the interpretation of the structure as it has so far been discovered.

So far as present experience shows, the atom group referred to above has the same composition as the chemical molecule: though it is not to be expected that it should have exactly the same form. In rock salt it is possible to associate with the sodium atom any one of the six chlorine atoms that surround it, and to say that here is the molecule: or it may be said, if preferred, that the molecule has disappeared. In an organic crystal, naphthalene for example, there is one atom group which may with some justice be described as the molecule. Even here, however, many of the carbon atoms have two hydrogen neighbours, one of them belonging to the molecule to which the carbon atom belongs, and one to a neighbouring molecule. Is there any difference in the nature of the attachment of the carbon to the two hydrogens? If there is, then there is definitely something which may be looked on as the molecule since there is a group which has the same composition as the free naphthalene molecule and would actually form such a molecule on the dissolution of the crystal, though the shape might be slightly changed. If not, then it might be said, as of the diamond, though to a lesser degree in this case, that the whole crystal was one molecule. The position of the hydrogen would be an example of "co-ordination." The nature of the hydrogen attachments is obviously of the highest importance; and we may hope to learn more about it by further experiment. Only in that light, however, is there any interest in discussing the question of the existence of the molecule in the naphthalene crystal. W. H. BRAGG.

The Optical Spectrum of Hafnium.

IN our letter to NATURE of March 10, 1923, we gave a preliminary list of the most prominent lines between 2500 and 3500 Å. U. in the arc spectrum of the new element hafnium, discovered by Coster and Hevesy (see NATURE, January 20, February 24, April 7, 1923). In this list we included only lines of intensity of $2\frac{1}{2}$ and more, using a scale of intensity from $\frac{1}{2}$ to 6. Prof. Hevesy has now been able to supply us with a pure hafnium preparation containing according to X-ray analysis not more than about 1 per cent. zirconium, and in addition small traces of titanium, manganese, and niobium. With this preparation we have photographed both the arc and the spark spectrum of hafnium. As to the arc spectrum, we have controlled all our older measurements of the published lines, and also of the weaker unpublished lines, and have added to these a considerable number of still weaker lines.

The spark spectrum does not seem hitherto to have been examined. On the other hand, Bardet (*Comptes rendus*, t. 176, p. 1711, 1923) a short time ago published a list of lines belonging to the arc spectrum of hafnium in the region between 2300 and 3500 Å. U. As it is not stated and cannot be inferred whether his lines are given in the international or in the Rowland scale, it is sometimes difficult to decide whether a line in his table coincides with one of our lines or not. As all his lines with the exception of 6 are stated as "moyenne," "faible," "extrêmement faible," "à peine visible," we think that his preparation was not very concentrated. As a whole, the two spectra are not very different; yet Bardet does not find all the stronger lines given in our first table, which (with one exception) are now all confirmed, and the relative intensity of his lines are rather different from ours. This seems to indicate that the hafnium spectrum can

differ much according to the conditions of excitation. This also, as is well known, is the case with the zirconium spectrum.

The spectra were photographed with the same instrument as before, and the arc spectra were produced in the way previously described; the spark spectra were obtained with a large induction coil between carbon electrodes saturated with the hafnium salt solution. In the table above we give the hafnium lines in international Å. U. in air measured against iron normals, and an estimation of their relative intensity I, both in the arc and in the spark spectrum (scale ½ to 6, lines weaker than 1 omitted; 6 denotes very strong, 5 strong, 4 rather strong, 3 not strong, 2 faint, 1 weak, ½ extremely weak, *d* diffuse). The wave-lengths are given to 0·05 Å. U., the accuracy which is generally reached; at the longer wave-lengths an error of about 0·1 Å. U. may be possible. Where (Ti), (Mn), (Nb), or (Zr) is added it means that the line in question is nearly coincident with a line belonging to the spectrum of one of these elements, traces of which we have mentioned were present, but that the line is so much stronger relative to the other lines of that element present in the spectrum that it is almost certain that the line really belongs to the hafnium spectrum.

λ.	I. Arc.	I. Spark.	λ.	I. Arc.	I. Spark.	λ.	I. Arc.	I. Spark.	λ.	I. Arc.	I. Spark.
2497·00	5	5	2713·45	½	1	2918·60	5	4	3156·65	5	5
2500·75	3	4	2713·85	4	3	2919·55	6	6	3159·80	5	5
2502·65	4	3	2718·55	5	5	2924·60 (Zr)	3	3	3162·60 (Ti)	5	6
2510·40	–	2	2727·40	3	2	2926·40	1	3	3172·95	5	6
2512·70	6	5	2729·10	4	3	2929·60	6	5	3174·90	1	1
2513·00	6	5	2731·10	1*d*	2	2929·90	4	4	3176·85	6	6
2515·50	4	4	2735·05	–	1	2940·25	1	2	3179·50	1	2*d*
2516·85	6	6	2737·80	3	2	2940·80	5	5	3181·00	4	4
2517·85	1	2	2738·75	5	6	2944·70	4	4	3189·70	4	4
2521·45 (Nb)	3	4	2743·60	4	3	2947·15	3	4	3193·50	5	5
2531·15	5	5	2751·85	5	5	2950·70	5	5	3194·20	6	6
2532·10	–	1	2756·90	3	4	2954·20	5	5	3195·60	2	2
2532·95	4	4	2761·65	5	4	2958·00	4	4	3200·00 (Ti)	4	5
2537·30	5	5	2762·70	4	3	2961·80	4	4	3202·15	1	2
2548·15	4	4	2764·55	½	1	2964·85	5	5	3203·70	3	4
2548·50	1	2	2766·95	4	3	2967·25 (Ti)	3*d*	4	3206·15	4	5
2548·95	–	1	2770·45	4	4	2968·85	6	5	3206·70	–	2
2549·10	–	2	2772·35	3	4	2973·40	–	3*d*	3217·15	5	5
2551·35	5	6	2773·00	3	3	2974·10 (Nb)	2	3	3220·60	4	5
2559·25	4	5	2773·40	6	6	2975·35	1	1	3226·95	2	3
2563·60 (Mn)	4	5	2774·05	5	4	2975·90	5	6	3230·10	3	2
2570·70	2	3	2775·25	4	3	2977·60	4	4	3243·40	4	2
2571·70	5	6	2779·35	5	5	2979·25	5	4	3249·50	4	3
2572·95	1	2	2784·50	½	1	2980·80	5	5	3253·70	6	6
2573·90	5	5	2786·30	3	4	2982·70	5	4	3255·30	5	6
2574·90	1	2	2808·00	5	5	2984·05	–	3	3262·55	3	3
2576·80	5	5	2809·60	1	1	2990·80	–	3	3267·10	5	3
2578·15	5	5	2812·30	2	2	2992·00	–	1	3280·00	5	5
2582·50	5	5	2813·85	4	4	3000·10	5	5	3283·40	5	3
2591·30	5	5	2814·45	4	4	3001·85	1	2	3289·70	1	1
2595·55	1*d*	2	2814·80	3	3	3011·20	2	3	3291·05	4	3
2599·15	1	2	2816·10	1	2	3012·85	6	6	3294·55	–	1
2602·65	3	3	2817·70	5	3	3016·75	6	5	3298·95	3	2
2602·85	3	3	2818·95	4*d*	3*d*	3018·30	5	5	3309·25	4	3*d*
2606·40	5	5	2819·75	4	3	3022·05	–	2	3310·25	5	4
2607·00	5	5	2820·20 (Ti)	6	6	3024·70	–	4	3310·90	1	3*d*
2607·25	2*d*	2	2822·70	6	6	3025·30	–	4	3312·85	6	6
2608·40	3	3	2829·30	3	4	3031·15	5	6	3317·20	½	1
2609·95	3	2	2833·30?	5	4	3034·55	2	1	3317·95 (Ti)	5	6
2612·55	3	2	2834·15	4	3	3046·05	4	4	3324·15	½	2
2613·60	4	5	2845·80	5	5	3050·75	5	4	3328·15	5*d*	5
2614·25	1*d*	2	2849·20	5	5	3054·50	4	3	3332·70	6	6
2616·60	4	3	2850·10	3	3	3055·45	4	3	3352·00 (Ti)	6	6
2620·90	1	2	2850·90	4	3	3057·00	5	5	3358·90	5	3
2622·70	6	6	2851·20 (Ti)	5	4	3067·35	6	5	3360·05	4	3
2626·90	3	4	2857·65	4	4	3069·15	3	3	3366·70	4	2
2635·75	3	4	2858·70	1	2	3072·90 (Ti)	6	5	3378·90	4	3
2636·95	4	3	2860·30	1*d*	3	3074·10	3	3	3384·15	1*d*	3*d*
2638·70	6	6	2860·55	3	3	3074·80	4	4	3384·65	5	4
2641·40	6	6	2861·05 (Nb)	5	6	3076·85	2	3*d*	3386·10	4	4
2642·70	5	3	2861·70	6	6	3080·75	6	6	3389·80	5	5
2647·25	6	6	2863·35	3	2	3091·75	1	2	3395·00	3	4
2649·10	3	4	2866·35	6	6	3092·25	4	4	3397·50	4*d*	3*d*
2652·30	1	2	2867·75	1	2	3096·75 *	5	4	3399·80	6	6
2652·75	3	2	2873·65	3	2	3100·75	–	1	3402·45 (Ti)	4	3
2657·45	4	4	2876·35	5	5	3101·40	6	6	3407·75	4	4
2657·80	5	5	2879·10	4	4	3102·45	–	1	3410·15	5	6
2661·85	5	5	2885·50	3	4	3109·10	6	6	3412·35	3	1
2665·95	5	5	2887·15	4	4	3114·85	–	1	3413·75	5	3
2668·25	4	3	2887·55 (Ti)	4	3	3116·95	3	4	3417·35	5	3
2669·00	5	4	2889·60 (Mn)	5	5	3119·95	4	4	3419·20	5	4
2671·20	3	4	2892·55	4	3	3123·90	1	1	3428·40	5	5
2676·55	2	3	2894·00	–	1	3126·30	2*d*	3	3438·25	6	6
2677·55	2	3	2894·85	1	1	3128·75	3	3	3441·85	3	2
2678·35	1	2	2898·25	6	5	3131·80	–	5	3462·65	4	4
2683·35	5	6	2898·75	5	4	3134·75	6	6	3467·60	3	2
2685·15	3	4	2904·40	5	5	3137·55	3	3	3472·40	5	5
2688·35	2	1	2904·80	5	5	3139·70	3	4	3479·20	6	6
2697·05 (Nb)	2	2	2909·85 (Ti)	5	5	3140·75	3	4	3487·55	½*d*	3
2703·15	1	2	2912·75	1	1	3145·30	5	6	3495·75 (Ti)	5	5
2705·60	6	5	2913·15	½	1	3148·45	4	4	3497·40	5	5
2706·70	6	5	2916·50	6	5	3151·65	4	3	3505·20	6	6

* In our former letter erroneously given as 3097·75.

A similar examination of the hafnium lines in the remaining part of the spectrum which is obtainable photographically, will appear shortly. We publish this table first, because it comprises the region in which high accuracy is easily reached by smaller spectrographs, and will therefore mainly be used for identification, as the hafnium spectrum shows few characteristic lines in the visible part of the spectrum.

H. M. HANSEN.
S. WERNER.
Universitetets Institut for teoretisk Fysik,
Copenhagen, September 20.

The Isotopes of Lead.

IT was suggested by the writer in 1912 that the end-products of the uranium and thorium disintegration series should differ in atomic weight from that of common lead, which chemically they closely resemble. As the atomic weights of these products, determined experimentally later by Richards and others as approximately 206 and 208 respectively, "bracketed" the atomic weight of common lead, it was not unreasonable to suppose that common lead is a mixture of isotopes of which the mass-numbers 206 and 208 are chief. This, although probable, is still unproved. The further deduction that conceivably lead in Nature has been mainly produced by the disintegration of uranium and thorium has received some, but not a great measure of support. If it could be shown experimentally that common lead has some isotopes which are not likely to be produced by disintegration, this hypothesis would be more difficult to maintain; if the difference were complete the hypothesis would be disproved.

My analysis of the complexity of elements, of which some account was given in NATURE of October 20, leads logically to the conclusion that common lead consists principally of mass-numbers 204, 205, 206, 207, 208, and 210, of which probably 206 and 208 are chief. This is surprising since the mass-numbers of isotopes do not differ generally by more than 8 units, and radium B weighs 214. Most of these numbers may also be derived from Aston's published results for the isotopes of elements 18, 34 and 50, the atomic numbers of which, like lead, are of the form $16n+2$. In addition, the mass-numbers 205 and 207 are deducible from this consideration: an element of even atomic number z may have an isotope of odd mass-number a apparently only when the difference $a-2z$ is unique. The differences 3, 5, and 7 do not appear to belong to any element,

but 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, and 39 may be most probably assigned to elements 34, 36, 44, 48, 50, 50, 54, 54, 60, 64, 66, 66, 70, 70, 76, and 80 respectively. (The results for elements 34, 36, 50, 54, and 80 are Aston's.) If this be accepted, it follows that the differences 41 and 43 belong to element 82, because (*a*) the mass-number 201 appears to be unstable (being the head of a series of unstable mass-numbers 201, 157, 113, 73, and 33), and therefore 41 cannot be assigned to element 80; and (*b*) because it is to be expected that element 82, like 66 and 50, has two odd isotopes. These are in consequence 205 and 207.

Of the six isotopes mentioned above, 206, 208, and 210 are end-products of radioactive series; possibly 207 is also; so that this analysis, if confirmed experimentally, cannot by itself claim to dispose of the view that common lead may be of radioactive origin. But neither does it necessarily support it; the matter is still left open.

It is not unlikely that the odd mass-number 205 is an isobare, because thallium ($z = 81$) is likely to consist of mass-numbers 203 and 205, not only because its atomic weight lies between these numbers but also from the analysis in my last letter. Aston, by showing that mercury has probably an isotope of 197, first established the possibility of the existence of odd isobares in the inactive elements, since it is very probable that gold's principal isotope is 197 also. But, in general, odd isobares are likely to be rare among inactive elements, but not impossible, as I said.

Neodymium, dysprosium, and ytterbium were not mentioned in my last letter. The chief isotopes of the first of these appear to be 142, 144, 145, and 146, possibly 148 and 150 also; of the second, 160, 161, 162, 163, 164, and possibly 166; and of the third 172, 173, 174, 175, 176, and possibly 178. I should like also to make a few minor alterations to previous statements. Lanthanum is apparently not simple but includes (possibly very little of) 137; gold is not likely to have 199; holmium is mainly 165. Tellurium should contain 122. But as I have now been able to calculate simply both unstable mass-numbers and even isobares, details are not of first importance.

It is not asked that any of the mass-numbers of this or of the previous letter should be accepted before being disproved or confirmed by experiment. But they are of interest as being the most probable numbers obtained by a simple and straightforward consideration of the facts of radioactivity on the reasonable assumptions stated.

A. S. RUSSELL.

Dr. Lee's Laboratory, Christ Church,
Oxford, October 13.

Problems of Hydrone and Water: the Origin of Electricity in Thunderstorms.

PROF. ARMSTRONG'S friendly criticism (NATURE, October 13, p. 537) of my theory of the origin of electricity in thunderstorms seems to neglect the fact that my explanation of thunderstorms is based entirely upon experimental and observational evidence. If experiments can be said to prove anything, then my work and the work of others has shown conclusively that: (*a*) if there are ascending currents exceeding 8 metres per second in the atmosphere, there must be a great deal of breaking of rain drops; (*b*) every time a water drop breaks there is a separation of electricity; (*c*) the broken water drops retain a positive charge; (*d*) the air attains a negative charge. On the other hand, observations have shown that there is a considerable excess of positive electricity brought down by rain. These are all tangible facts which any one can test by making the suitable experiments, and I have done nothing more than arrange them into such a form that a reasonable account of the phenomena of thunderstorms results.

Surely Prof. Armstrong does not wish to suggest that all this work is wrong because it does not fit in with his theory of hydrones. He cannot expect us to neglect the evidence that electricity is produced when drops break, because, according to his theory, it appears more likely that electricity would be produced when drops combine.

What alternative has he to offer to a theory which has met with very wide acceptance? He says: "Assuming that my interpretation be correct, may not the great rise in potential required to produce lightning have its origin in the coalescence or co-operation of minute drops charged by an external source?" This is very depressing, for it throws us back to where we were twenty years ago, with an unknown "external source" of electricity and erroneous ideas of the increase in the potential of a cloud due to the coalescence of the drops.

G. C. SIMPSON.

Meteorological Office, London.

The Occurrence of Urease.

LETTERS on the occurrence of urease are printed in NATURE of August 11 and September 22. In the former, Prof. Werner reports that he has found urease in all the leguminous nodular growths he has tested; in the latter, Prof. Beijerinck describes how he has detected the enzyme in *B. radicicola*. Prof. Werner writes: "So far as we have been able to ascertain, the peculiar root nodules of leguminous plants have not hitherto been tested for urease." I reproduce, therefore, the following passage from an article on "The Function of Hormones in regulating Metabolism," by my son and myself, published in the *Annals of Botany*, vol. xxv., No. xcviii., April 1911.

"Lastly, we may refer to the nodular growths on the roots of leguminous plants; these are known to be most essential to the proper growth of the plant but their function is by no means clear; it is well known that they are the seat of bacteroids and it may be that these function as assimilators of atmospheric nitrogen gas and convert it into ammonia; or it may be that they exercise digestive functions and serve to 'deamidate' amino-compounds. At all events, they are distinctly alkaline, whereas the root sap is acid. Moreover, it has been shown by Hutchinson and Miller, that, when distilled with magnesia under reduced pressure, the nodules furnish more ammonia than do the roots (0·043 per cent. against 0·016 per cent.). We suggest that some part at least of the influence exercised by the nodules may be due to their aminogenetic power. We propose to make this assumption the basis of experimental inquiry."

Then, I would direct attention to the British Association Report, Australia, 1914, where, at p. 109, the following passages are to be found, at the end of the Report of the Committee for the Study of Plant Enzymes.

"In view of the presence of ammonia in the nodular growths appearing on the roots of Leguminosæ, it appeared probable that the enzyme Urease would be found in these. It has been detected in the nodules from Lupins and a number of other Leguminosæ. Attempts to detect the enzyme in organisms cultivated from the nodules have thus far been attended with negative results.

"Mr. Benjamin, working at Hawkesbury Agricultural College, near Sydney, Australia, has detected urease in nodules from several Australian plants, including wattles; also on tubercles derived from the

Cycad, *Macrozamia spiralis*. He has found urease also in the seeds of *Abrus precatorius*."

The earlier experiments referred to were my own. Mr. Benjamin had assisted Mr. Horton and me in our work on urease, published early in 1913. He was a young Australian and he undertook the observations, on his return, at my request. When in Java, in September 1914, I had the opportunity, at the Buitenzorg gardens, of testing fresh Abrus seeds and of confirming Benjamin's result. I may say, the amount present is small, in no way comparable with that in Soja beans.

To me the presence of urease in the nodules is little short of a matter of course—in view of their "ammonicity." The interest of the observation lies in the possible application thereof.

Urea is foreshadowed as the nitrogenous fertiliser of the future but apparently it has its limitations. All soils, all plants, do not respond to it equally. I was told years ago, that it is particularly good for Pease. Why, Mr. Peasecod? Probably it is not operative as such but merely as a source of ammonia and must be hydrolysed to make it available. Only soils which contain urease would respond. A clover-sick soil may well be wanting in the organisms which give rise to the nodular growths.

To be practical—it would seem to be desirable to test the comparative effect of urea on the growth of non-leguminous plants when grown with and without a leguminous plant, such as clover.

HENRY E. ARMSTRONG.

Colour Vision and Colour Vision Theories.

IN the first of my two recent letters on this subject I selected five of the cases in which Dr. Edridge-Green asserts that the trichromatic theory cannot explain certain phenomena of colour vision; and I indicated, in each case, the source of his error. In more than one case I gave the full proof. In his reply he took no notice of these proofs except in so far as he seemed to admit their accuracy. But he brought forward three other cases, asserting incompetence of the trichromatic theory in connexion with them. In my second letter (NATURE, September 8) I similarly indicated the oversight involved in each of these three additional assertions.

I must confess, therefore, to some degree of surprise that Dr. Edridge-Green, in his letter appearing in NATURE of September 29, should say that he will deal with my explanations regarding the competence of the trichromatic theory when I give them. They are already given, and I shall be glad if he will discuss them. To make the matter definite, I invite him to discuss the trichromatic explanation which I have given, in my first letter, of the case of so-called red-blindness with shortening of the spectrum at the red end. The proof is fully given. Another proof, fully given in geometrical terms, is that dealing with the possible diminution of colour sensitiveness by the annulment of one component sensation.

Instead of discussing any of the eight explanations which I have already given either in full or in outline, Dr. Edridge-Green now points out that he is not alone in regarding the trichromatic theory as inadequate. Unfortunately, misunderstanding of the theory is too regrettably widespread for the reason which I expressed in my first letter. If any reader who is interested in the matter will refer to the discussion which I have given in my book he may recognise that the statement referred to in Dr. Edridge-Green's last letter, concerning contrast and colour blindness, is not correct. It cannot be discussed in the scope of a short letter.

I appreciate Prof. Frank Allen's work greatly. The difficulty to which he refers vanishes, as I am sure he will readily recognise, when the three variables (threshold values) descriptive of non-external action are considered. In fact, in the whole field of contrast, after-images, recurrent images, and inhibition, the trichromatic theory has at its disposal a *double* set, not a single set, of three variables. Such work as that of Prof. Frank Allen is of great importance in view of the need of a formulation of the threshold values as functions of precedent illumination, time, secondary stimuli, etc. His early work, long ago, led me, in attempting something different, to full recognition of the sufficiency of the trichromatic theory.

What blindness must have oppressed the mental vision of Helmholtz, "that investigator, worthy of wonder, leaping before his time," if it were true, as Dr. Edridge-Green asserts, that "There is no fact that directly supports the trichromatic theory." Which Helmholtz elaborated so as to fit facts, and used victoriously to predict others! I know of none that fails to support it. I have studied Dr. Edridge-Green's book very carefully, and I have not found one of his strictures upon the theory with which it was possible to agree. Even Sir William Abney, one of the supporters of the theory, whose experimental work was so admirable, was led to some wrong conclusions through non-perception of some of its possibilities.

W. PEDDIE.

Dundee, September 29.

Sexual Physiology.

IN NATURE of September 1, p. 317, under the heading "Sexual Physiology," a review appeared of the second edition of Dr. Marshall's book "The Physiology of Reproduction." In the course of this notice certain misleading statements are made regarding myself. The reviewer, in referring to the chapter of the work dealing with the subject of the fertilisation of the ovum, states, "The least satisfactory part of the book, both as regards arrangement and subject-matter, is, we think, that contributed by Dr. Cresswell Shearer on fertilisation."

May I point out that I am not the author of this chapter; while I have revised Dr. Marshall's manuscript, and added a number of notes here and there of minor importance, the two sections of which I am the author are clearly indicated in the footnotes, and I think are sufficiently obvious. In regard to that part of the chapter which has called forth the special criticism of the reviewer, "The hereditary effects of fertilisation," I am altogether unresponsible, although I completely agree with many of the opinions expressed by Dr. Marshall in this section. As the whole of this paragraph appears almost unaltered in the old edition, it would seem that your reviewer is by no means as familiar with the original work as he would have us believe.

C. SHEARER.

A FOOTNOTE to Chapter vi., "Fertilisation," states that this has been "Revised, with numerous additions, by Cresswell Shearer." It was assumed, from this, that Dr. Shearer had taken the chapter as it stood in the first edition and had made himself responsible not only for the numerous additions but also for the whole of the subject-matter of this chapter in the present edition, and for its presentation. That we are not alone in reading this meaning into the footnote is shown by the fact that another reviewer, writing elsewhere, states that "Dr. Cresswell Shearer has written in this edition a most excellent chapter on fertilisation." If Dr. Shearer did revise the chapter, then his objections are but

formal; but it would appear that he did not revise, as we understand the term, but merely read the manuscript, placing also at the service of the author certain discrete sections for possible inclusion. The footnote is misleading. THE REVIEWER.

Numerical Relations between Fundamental Constants.

IN connexion with the letter from Dr. Ernest Dorsey in NATURE of October 6, p. 505, it may be pointed out that most of the numerical relations which he describes are implied in the statement given in a paper in the Proceedings of the Physical Society of London (vol. 27, p. 425, 1915), that all units derived from e, m, and c can be expressed (with considerable accuracy) in the C.G.S. system in terms of simple integers (2, 3, or 4), powers of 10, q and π. Here q is a pure number, which represents the value of $2\pi e^2/hc$. This constant is the same as that employed in Sommerfeld's papers on the fine structure of spectrum lines, where it is denoted by α. If the relation of Lewis and Adams (*Phys. Rev.* vol. 3, p. 92, 1914) be accepted, the numerical value of q or α is $(15/\pi^2)^{\frac{1}{4}}/(4\pi)^2 = 7{\cdot}28077 \times 10^{-3}$.

Whether this be the correct value or not, the number represents one of the most important physical constants, and corresponds to a deep-seated relation between the ultimate nature of electric force and that of magnetic force. The quantum theory indicates the existence of discrete magnetic tubes of induction determined by the fundamental unit (h/e), and it has been suggested to me by Mr. W. H. Watson, of the University of Edinburgh, that the constant may be interpreted as giving the relation between a quantum magnetic tube and a unit electrostatic tube of force.

As regards the occurrence of integral powers of 10 in the expressions for physical constants, it must be remembered that the units of length, mass, and time in the C.G.S. system are not entirely arbitrary. The assumption is made that the gram is the mass of 1 c.c. of water at the temperature at which its density is a maximum, and the fact that the "molecular number" (Trans. Chem. Soc. vol. 113, p. 389, 1918) of water is 10 possibly accounts for the relations concerned. Dr. Dorsey includes the gas constant in his list, and here again the physical properties of water are involved through the definition of the Centigrade scale of temperature.

H. S. ALLEN.

The University, St. Andrews.

Insects in Korean Amber.

ON the morning of September 1 I saw a piece of carved amber, containing Diptera of several species, in the shop of G. M. T. De Silva in Yokohama. I was informed that it came from Korea (Chosen), but as the exact locality and geological horizon were unknown, and the price was rather high, I did not purchase it. At noon of the same day the earthquake occurred, resulting in the destruction of the whole of Yokohama, including De Silva's shop. I should be greatly interested to learn anything more about this Korean amber, the insects in which should be described. Some days earlier I saw in Mr. Y. Nawa's museum at Gifu a very fine lot of fossil insects, apparently of late Tertiary age. These have never been critically studied or described, but it is to be hoped that they will eventually be properly recorded. I could not discuss them with Mr. Nawa, as he knows no English, and no interpreter could be found at the time of my visit.

T. D. A. COCKERELL.

University of Colorado, Boulder, Colorado.

Tidal Dissipation of Energy.

IF g denote the intensity of surface gravity, ρ the density of water, and h the elevation of the water surface above its mean position, the potential energy of the oceanic tide is $\frac{1}{2}g\rho h^2$ per unit area. The kinetic energy must be comparable. If h has the equilibrium amplitude of 35 cm., the total energy of the ocean, the area of which is $3{\cdot}7 \times 10^{18}$ cm.^{2}, must be about $2{\cdot}2 \times 10^{24}$ ergs.

Now the mean rate of dissipation of energy by tidal friction is about $1{\cdot}4 \times 10^{19}$ ergs/sec. Thus the whole energy of the tides would be dissipated in about $1{\cdot}6 \times 10^5$ sec., or two days, if dissipation continued at its average rate and no new energy was supplied.

It follows that tidal friction in shallow seas must absorb so much of the energy in the tidal waves that reach these seas, that the lags of the tides in the open ocean may differ by some hours from those calculated on the usual assumption that the coasts may be treated as simple reflecting boundaries.

HAROLD JEFFREYS.

St. John's College, Cambridge.

Repellents of Clothes Moths.

IN NATURE of September 8, p. 376, appears a report of a lecture on "Plants in Relation to the Health of Man," in which Dr. A. W. Hill refers to the supposed property of camphor as a preservative of clothing against moth. Henri Fabre found camphor and naphthalene to have no effect upon moths, and I have found these insects utterly indifferent to such odoriferous substances. In fact, I doubt if they can smell at all. It would be interesting to hear of some definite experimental result bearing upon this point.

REGINALD G. JOHNSTON.

51 Belmont Hill, London, S.E.13.

SOMEWHAT surprisingly, no precise experiments with the object of discovering effective repellents of clothes moths, of which at least three distinct species occur in this country, appear to have been carried out by any one. Mr. R. G. Johnston is perfectly correct in regarding as devoid of any real foundation the popular belief in the efficacy of camphor as a preservative of clothing against moth, although there is no reason for supposing the insects in question to be deficient in olfactory sense. Naphthalene again, if merely scattered loosely in a drawer or wardrobe containing clothes, will certainly afford no protection whatever. On the other hand, naphthalene is quite satisfactory as a repellent if placed inside clothing which is afforded the additional protection of a wrapping of stout paper, the edges of which freely overlap, and are tightly secured by means of pins. E. E. A.

Amanita muscaria on Hampstead Heath.

THE difficulty of obtaining a supply of this mushroom for scientific investigation is well known to physiologists and chemists. Its disappearance, except in unfrequented woods, is probably accounted for by its attractive colouring and its subsequent destruction as one of the most poisonous representatives of its family. Therefore its occurrence near London deserves to be put on record. A fine specimen, weighing 140 gm. and measuring 12 cm. in diameter, was brought to me for identification by Mr. H. C. Simmons, who found it, after the heavy rains of last week, on the West Heath in the low-lying ground between the North End and Spaniard's Roads.

O. ROSENHEIM.

75 Hampstead Way, London, N.W.11,
October 17.

Boskop Remains from the South-east African Coast.

By Prof. RAYMOND A. DART, University of the Witwatersrand, Johannesburg, South Africa.

THE controversy raging over the Piltdown remains, and the coming of the War shortly afterwards, were the two events which conspired to distract the attention of the scientific world from the significant discovery which was made in South Africa in 1913,

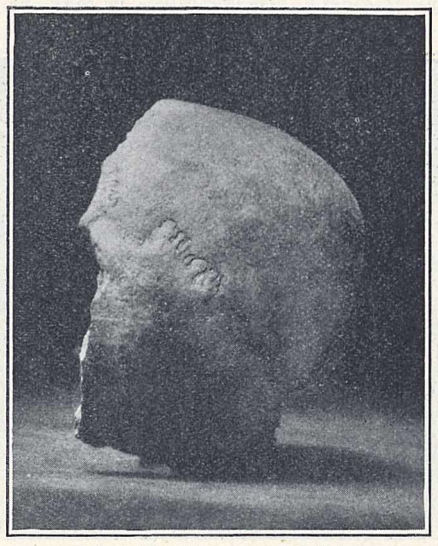

FIG. 1.—External view of the right parieto-occipital fragment of *Homo capensis*, showing the lambdoidal and sagittal sutures.

when a farmer unearthed some fragments of a human skull at Boskop near Potchefstroom in the Transvaal. Last year, the discovery of a more primitive human race in *Homo rhodesiensis* has served to redirect attention to the part which Africa still has to play in elucidating the wider questions of human origins and human migrations.

Since the time the bet between the two farmers as to the "humanity" of the Boskop remains was settled, Mr. FitzSimons, Director of the Port Elizabeth Museum, has been assiduously excavating the rock shelters in that neighbourhood. In June last he forwarded to the Department of Anatomy in the University of the Witwatersrand a consignment of skeletal material which contained the remains of several members of the ichthyophagous Strandlooper race which preceded the Hottentots along the coastal areas.

The Strandloopers, now extinct as a race, were the builders of gigantic kitchen-middens in South Africa. In the particular rock-shelter at Tzitzikama explored by Mr. FitzSimons, this material, in which the Strandloopers had been interred, was removed layer by layer to a depth of fifteen feet. At this level he came upon bones of an entirely different calibre and appearance. Recognising this fact and appreciating the possibilities of the discovery, he forwarded these specimens separately. Altogether, I have received remains of some five individuals from this site, and though mixed together and fragmentary they afford definite evidence that they belong to the same race as was found in the Transvaal in 1913.

Figs. 1 and 2, which illustrate the outside and inside views of part of the right parietal and occipital bones, demonstrate the thickness and texture of the cranial bones in this race. Fortunately, the fragment crosses the line of the sagittal suture (Fig. 1), hence the cranial form is accurately known. It reveals the same type of breadth, flattening, and central depression in *norma occipitalis* that was pointed out for Boskop man by S. H. Haughton.[1]

Fig. 3 shows the inner aspect of three other pieces which were found to articulate exactly along the line of fracture. The state of preservation and general appearance of the bones justifies the assumption that they form part of the left half of the cranium represented by our right parieto-occipital fragment. Fig. 4 is an external view of the same three bony pieces on a rough reconstruction of the endocranial cavity which errs, as I have since determined, on the side of generosity in volume.

So far as the evidence goes, the skull appears to be that of a woman; for other specimens (which I believe to be male) show a more marked glabella, more robust eyebrow ridges, and a greater development of the frontal lobes of the brain. The smallness of the mastoid process, the thickened and tuberculated inferior margin of the tympanic plate, and the very vertical forehead also corroborate its feminine character.

When the fragments have been oriented, the following provisional measurements are obtained: maximal length 210 mm., and maximal breadth 150 mm., as

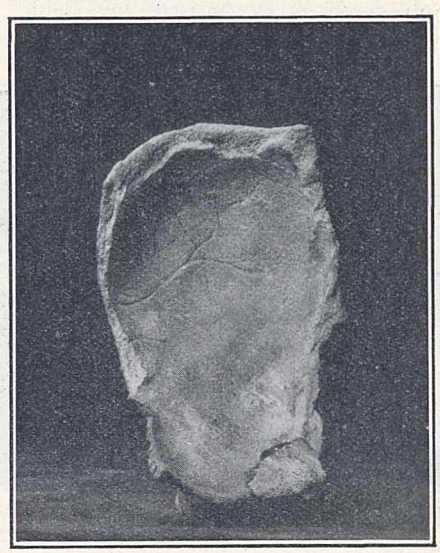

FIG. 2.—Internal view of the right parieto-occipital fragment of *Homo capensis*, showing the thickness and texture of the cranial bones.

compared with the length of 205 mm. and breadth of 154 mm. secured for the Boskop calvaria. If this length be correctly determined, we are in the presence of the longest-headed human skull yet discovered. It was undoubtedly dolichocephalic.

The first estimations of its endocranial content seemed to show, on account of the extraordinary length, a figure even higher than that secured by

[1] "Preliminary note on the ancient human skull remains from the Transvaal." Trans. of the Roy. Soc. of S.A. Vol. vi. Pt. I. 1917.

Haughton (1832 cubic centimetres), and by Broom [2] (1960 cubic centimetres) for the Transvaal specimen; but after taking casts from the fragments and reconstructing the endocranial cavity, my endocranial cast gives a far smaller capacity—in the vicinity of 1750 cubic centimetres. This figure still reveals a capacity far in advance of the average for modern European brains (Meckel's brain capacity was only 1320 cubic centimetres and Raphael's 1420 cubic centimetres), and is the more striking when it is remembered that the skull is female. The other male crania indicate a greater capacity.

Concerning the Boskop endocranial cast Elliot Smith said, "Its features present a curious blend of those characters which are regarded as distinctive of Mousterian and Aurignacian types of men respectively; but whereas the general form presents certain resemblances to the former, in all essential respects the cast conforms to the type represented by the Cro-magnon man of Western Europe." Broom (*loc. cit.*) goes further and believes it not unlikely that the Boskop type was ancestral to both Neanderthal and Cro-magnon man.

Unfortunately, insufficient jaw remains exist to prove or disprove Broom's contention concerning the supposed massive mandible and large canines. On the whole, the delicacy of the facial skeleton of this specimen is in strong contrast with the massive build and thickness of the calvaria, and scarcely favours the expectation of massive jaws. On the other hand, the nasal process of the maxilla is relatively enlarged and plays an enhanced rôle in bounding the nasal aperture and wall—features emphasised by Boule ("Les Hommes fossiles") as indicating the *ultra-human*

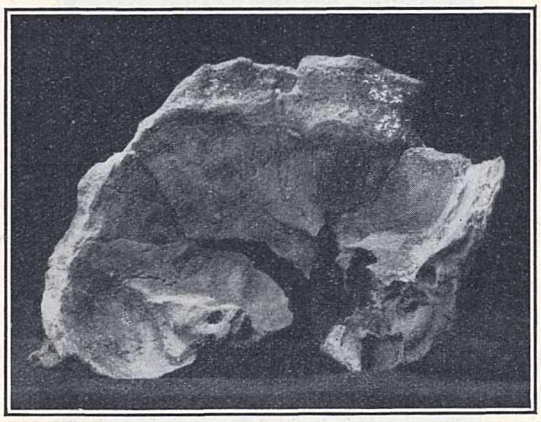

FIG. 3.—Internal view of the three fragments of the left side of the skull of *Homo capensis*. The vascular arrangements are particularly well-marked.

character of Neanderthal man. The pithecoid nature of the small mastoid process, supra-mastoid ridge, mandibular fossa, and superciliary ridges in this type, features which once more link it to primitive Neanderthaloid forms, were emphasised by Haughton (*loc. cit.*). The same point of view is favoured by the relatively low development of the frontal lobes of the brain.

The endocranial cast of this specimen reveals further an extremely broad and depressed Sylvian fossa. The cast is sufficiently complete in this region to show that here the Sylvian depression was even wider and more patent than in the endocranial cast of the Mousterian man of La Chapelle, concerning whom Boule does not hesitate to say that the island of Reil was partially exposed. It seems that, in this respect, our Boskop woman was even more pithecoid. The sulcus lunatus also is prominently indicated in the right parieto-occipital fragment. Incidentally, it may be stated

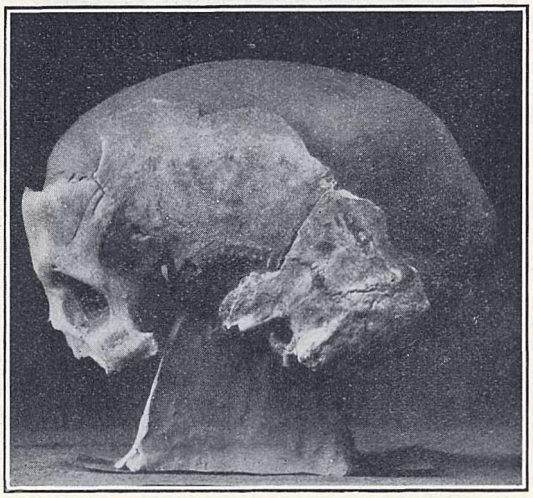

FIG. 4.—External view of the three fragments of the left side of the skull of *Homo capensis* on a rough preliminary reconstruction of the endocranial cavity. Features to be noted are referred to in the text.

that the endocranial cast indicates a marked asymmetry of brain and skull, the right frontal pole and left occipital pole respectively being more expanded than their fellows of the opposite side.

While certain of the foregoing data betray primitive, if not even Neanderthaloid, features, the study of other skeletal remains favours the Cro-magnon affiliation. A complete femur (also apparently female) indicates by its length (461 mm.) a stature in the vicinity of 5 feet 6 inches, which is considerably above that of Neanderthal man; and the male stature was presumably more considerable. Its straightness and slender build (despite a tendency to the exhibition of a third trochanter, a fossa hypotrochanterica, and a high pilastric index) are also in strong contrast with that of Neanderthal man. The vertebral column in a male specimen in the lumbar region (3rd, 4th, and 5th vertebræ) gives a general lumbar index of 97·4, which indicates a marked lumbar curve (kyrtorhachism) such as is found in modern Europeans.

The more detailed study of the remains may throw clearer light upon a bizarre mingling of characteristics which, at the present time, is highly confusing. It may prove justifiable, as Broom is already convinced, to separate this human group from both Neanderthal and Cro-magnon man as a separate species (*Homo capensis*). There is no doubt, meantime, that these new human documents, which have been brought to light through the energy and enthusiasm of Mr. FitzSimons, have further emphasised the anthropological wealth of Africa, and the need for more cautious investigation of the deeper strata of our coastal rock shelters, with

[2] "The evidence afforded by the Boskop skull of a new species of primitive man (*Homo capensis*)." Anthrop. papers of the Amer. Mus. of Nat. Hist. Vol. xxiii., Pt. II. 1918.

the strictest observance of the methods of modern archæology.

Through this discovery we now know definitely that the Boskop race preceded the Strandlooper race historically. They perhaps owed their extinction to the latter, the Solutrian culture of which (so ably examined by Dr. L. Peringuey,[3] the Director of the South African Museum) indicates familiarity with the uses of the bow. We know further that the Boskop specimen was no human freak, but a type representative of a race once widely distributed in South Africa from the Transvaal to the remotest south-eastern corner of the continent.

The implements, culture, and æsthetic achievements of these big-brained men of pre-history still remain to be discovered. Their employment of ochre in their burial rites indicates their familiarity with pigments and the artistic and symbolical uses to which they might be put. The remarkable parallelisms between the so-called " Bushman " art and that of Cro-magnon man in Europe was insisted upon by Sollas many years ago, and the evidence may yet be forthcoming which will conclusively solve the fascinating yet elusive problem of their correlation.

[3] " The Stone Ages of South Africa," etc. Annals of the South African Museum. Vol. viii. July 5, 1911.

Insulin and its Value in Medicine.[1]

By Prof. J. J. R. MACLEOD, F.R.S.

CARBOHYDRATES are essential in the chemical processes upon which life depends. Not only is the glucose, the form in which they are mainly absorbed into the blood, the source of muscular energy, but it is also in some way necessary in the oxidation of fats. Preceding its oxidation, glucose undergoes a series of preliminary changes which proceed step by step in such a manner that a long series of intermediary substances is formed; and when anything interferes with the process at any stage, as in diabetes, glucose accumulates in the blood and tissue fluids, causing the main early symptoms of the disease, hyperglycæmia and glycosuria. Later involvement of the oxidation of fats results in the accumulation of the ketone bodies in the organism, and these, by their toxic action, cause the often fatal condition of coma.

The control of this process of carbohydrate metabolism has for years been assumed to be the function of a hormone derived from the Isles of Langerhans of the pancreas. Although the existence of this hormone was fairly certain, little success resulted from attempts to extract it in potent form from the pancreas, probably because it was destroyed by the powerful digestive enzymes also present in such extracts. Banting and Best circumvented these by making extracts of the degenerated residue of pancreas following ligation of the ducts, it having previously been shown that in this residue the islet cells are more or less intact but the external secretory cells are largely degenerated. The extracts were found to remove the two chief symptoms of diabetes in depancreatised dogs. Alcoholic extracts of adult beef pancreas were also found to contain the hormone, and by their continued use it was possible considerably to prolong the life of the diabetic animals. J. B. Collip then succeeded by fractional precipitation with alcohol in ridding these alcoholic extracts of irritating substances, so that they could be repeatedly injected into diabetic patients.

With larger supplies of insulin available, it was now possible to show that it removes all of the observable symptoms of diabetes in depancreatised dogs. Thus, not only did it cause glycogen to become deposited in large quantities in the liver when sugar was fed to the animals, the first analysis giving more than 20 per cent. of this substance (J.B.C.), whereas without insulin traces only are found, but it also caused the respiratory quotient (ratio between CO_2 and O_2 in respired air) to become raised. These results were soon confirmed on diabetic patients. In more recent work, in which depancreatised dogs were given insulin daily along with considerable quantities of carbohydrate, life has been prolonged for over four months, and by careful comparison of the sugar balance of the animals it has been found, by F. N. Allen, that a small amount of insulin is capable of causing relatively much more glucose to be metabolised than when a large amount is given. Or, in other words, the glucose equivalent per unit of insulin is much higher with small than with large doses.

Although there can be no doubt of the high therapeutic value of insulin in the treatment of many cases of diabetes, its value as a new instrument for the investigation of problems of metabolism other than those relating to this disease is also high. Evidence for this belief is founded, among other things, on the striking effects of insulin on normal animals. When it is administered to rabbits, for example, the first effect is a very rapid lowering in the percentage of sugar of the blood—first observed by J. B. Collip—and when this reaches a certain level symptoms of a peculiar nature supervene. These consist usually of violent convulsive seizures each lasting for a minute or so, and of a gradually increasing state of coma, with fall in body temperature, ending often in death from respiratory failure. Symptoms of a similar character occur also in other animals, including man, after large doses of insulin.

The symptoms were found to be dependent on the lowering of blood sugar; thus, they usually supervene in normally fed animals when the blood sugar has fallen to about 0·045 per cent., and they are removed immediately by the addition of glucose to the blood either by administering this sugar subcutaneously or by causing it to be liberated in the body from glycogen, as by the injection of adrenalin (epinephrin). It was found, moreover, that, of all the sugars, glucose alone has an immediate and lasting effect, even leavulose and galactose, which are its nearest neighbours, having only a slight and transitory action.

Although the symptoms commonly occur in well-fed

[1] A lecture delivered in the Section of Physiology of the British Association at Liverpool on September 17.

animals when the blood sugar is about 0·045 per cent., they may fail to be observed until a much lower level has been reached. This is particularly the case when a large dose of insulin is given some time after food. The liability of symptoms to occur at the above percentage of blood sugar has served as a useful basis for measurement of the dosage of insulin, one unit being defined as the amount which can lower the blood sugar to the convulsive level of 0·045 per cent. within four hours in rabbits weighing about 2 kilogrammes. Since this "physiological" unit, as it is called, is said to be stronger than is necessary for certain clinical purposes, it has been decided for the present to use, as the "clinical" unit, one that is one-third the above strength. This question of the physiological assay of insulin is receiving much attention at present.

These observations clearly pointed the way to the next problem, namely, the cause for the lowering of blood sugar. At first it seemed as if this should soon be solved, for, as already mentioned, it has been found that insulin not only causes glycogen to be deposited in the liver of diabetic animals, when sugar is given, but also causes the respiratory quotient to become raised in a manner to indicate that there is increased combustion of carbohydrate. It seemed likely that stimulation of the same processes in the normal animal under insulin must be responsible for the disappearance of glucose from the blood. But the experimental evidence goes to show that the mechanism of action is much more complex. It has recently been found that glycogen is not formed when insulin is given along with sugar to normal animals (McCormick, O'Brien, and E. C. Noble); indeed, when given to those that are well fed it is decreased in amount (Dudley and Marriam), and no certain evidence can be obtained from respiratory experiments that more active combustion of glucose is a necessary accompaniment of the lowering of blood sugar. The consumption of oxygen greatly increases in dogs preceding the onset of symptoms, and the respiratory quotient usually becomes somewhat raised (Dixon, Eadie, and Pember), but in mice changes of an opposite character occur (Dudley, Laidlaw, Trevan, and Boock); in rabbits the symptoms are at first like those in dogs, though less marked, and subsequently like those in mice.

The glucose which disappears is apparently neither oxidised to carbon dioxide and water nor polymerised into glycogen. For the present the problem is unsolved, but we must not lose sight of the possibility that insulin changes both glucose and glycogen into some intermediary product which we fail to identify with our present methods of analysis, either because it does not give the reducing reactions upon which the detection and estimation of sugars depend, or because it is not precipitated by alcohol after treatment with strong alkali, which is the characteristic property of glycogen. That such substances may exist in the tissues is indicated by the fact that it is impossible after injecting large amounts of sugar into animals to recover much more than one-half by chemical analysis of the entire body.

Whatever may be the nature of the mechanism by which the blood sugar becomes lowered, there is no doubt that it acts in the tissues and not in the blood itself (Eadie). Thus, the addition of insulin to blood incubated outside the body does not alter the rate at which the sugar disappears from it, and when the isolated heart is perfused with a suitable saline solution containing sugar the addition of insulin to the solution causes this to lose its sugar more rapidly (Hepburn and Latchford). The hypoglycæmic effect of insulin lasts for a period which varies in different animals. In rabbits the blood sugar often begins to rise again in about an hour after the injection, but this depends very largely on the amount of glycogen which is stored in the liver. This becomes converted into glucose to replace that lost from the blood, so that well-fed animals show much quicker recovery and can withstand much larger doses of insulin, without the development of symptoms, than those previously starved. This mobilisation of the carbohydrate reserves would appear to depend on the transmission to the liver through its nerve supply of messages set up by the hypoglycæmic condition, for Burn has shown that if the nerve pathway (splanchnic) be locked by the drug ergotonine, insulin causes, in well-fed animals, a more profound degree of hypoglycæmia than otherwise.

Another important effect of insulin is on the hyperglycæmia due to other causes than removal of the pancreas. So far as it has been investigated, insulin is capable of preventing the development of hyperglycæmia in all these conditions. Most attention has been paid to its effect on the hyperglycæmia due to epinephrin, partly because of the possibility that insulin may be assayed by determining the amount necessary to antidote a known amount of epinephrin, which itself can be accurately assayed, and partly because an investigation of the physiological antagonism between these two hormones may throw some light on the mechanism of the action of insulin. One example may be given to illustrate this. We have seen that insulin causes the glycogen stored in the liver to become less in amount, acting in this regard like epinephrin, although probably much less quickly. When insulin is given along with epinephrin, however, glycogen disappears from the liver much more slowly than with epinephrin alone, indicating that under certain conditions the pancreatic hormone arrests rather than stimulates the breakdown of glycogen. When these two hormones are in excess in the body, one prevents the other from causing glycogen to disappear. Another curious result of a somewhat similar nature has been obtained by Burn with pituitrin, a hormone derived from the pituitary gland. When it is given along with epinephrin it also prevents hyperglycæmia, and when it is given with insulin it prevents hypoglycæmia. These results indicate the very puzzling nature of the problem of the action of insulin, and they show that this action may possibly be linked with that of other hormones in the animal.

Chemically, insulin usually gives the biuret test, and it behaves in its general properties not unlike a proteose. It may, however, be a much simpler substance, since active preparations have been obtained from the pancreas of the skate, in which no biuret test could be obtained. Its chemical identity being unknown, it is of course out of the question that it could at present be prepared synthetically.

The Origin of Petroleum.

UNLIKE most problems concerning origins, which have but a philosophic or academic interest, that of the genesis of petroleum has a distinctly practical significance, for if solved, prospectors for mineral oil would be provided with important data and chemists might learn how to produce artificially valuable substances similar to, if not identical with, natural petroleum. Man's fertile imagination has spun not only an embarrassing number of speculations and hypotheses concerning the nature of the raw material or materials from which petroleum has been derived, but also innumerable explanations of the *modus operandi* of its formation. Of these, only a tithe remains. Explanations that affirm a cosmic origin or postulate volcanic activity as the effective cause, have long been abandoned, and to-day there are only three which find scientific support. The least popular of these, the inorganic theory, affirms that petroleum originates from the interaction of metallic carbides, presumed to exist immediately below the earth's outer crust, and steam, whereby various hydrocarbons are formed, and these undergo further changes, including polymerisation, to produce the compounds that are found in petroleum. It has recently been suggested that the methane synthesis from carbon monoxide or dioxide and hydrogen, in the presence of a catalyst, such as vanadium or nickel, of which traces are found in petroleum, might also explain the initial formation of hydrocarbons in Nature, and the presence of methane in natural gas; but these suggestions fail to interpret the occurrence of optically-active substances in petroleum, and the presence of nitrogen in some oils, while geologists have met them with uncompromising hostility.

The views that are uppermost to-day are that petroleum is derived from either animal or vegetable substances, or from both of these sources, and the chief direct evidence supporting this organic theory is the occurrence in petroliferous strata of vegetable and animal remains, including, in a few cases, remains of bacteria. Important, if less direct, testimony is the presence in petroleum of the optically-active substances cholesterol and phytosterol, which are characteristic constituents of animals and plants, respectively. The various elaborations of this view are mainly concerned with the nature of the chemical reactions involved, and how they are influenced by the three determining factors of pressure, temperature, and time; it is, however, not easy to formulate any one hypothesis to explain the formation of such complex mixtures as mineral oils, and still more difficult to account for the great diversity in chemical composition exhibited by mineral oils from different localities.

The evidence admitted by those who believe in a purely animal origin includes the statements: that petroleum found in primary rocks is much more often accompanied by animal than by vegetable remains; that formations containing only plants are not bituminous; that mixtures of hydrocarbons similar to those found in petroleums can be made artificially from animal fats, and that such production can be observed in Nature to-day, notably in the coral reefs and lagoons of Djebel Zeit in Egypt. The scarcity of animal fossils in petroliferous strata is explained by assuming that the fauna were either skeletonless, or, if not, their calcareous coatings were dissolved by the carbon dioxide liberated during their decomposition. Advocates of the vegetable origin doubt if the supply of animal matter has been sufficient for the purpose, plants being much more plentiful than animals; they comment on the absence of phosphatic deposits from the vicinity of oilfields; and many trace relationships between coals and petroleum.

Mr. E. H. Cunningham-Craig is one of the foremost supporters of the purely vegetable theory, and in opening the discussion on the origin of petroleum, held by the Institution of Petroleum Technologists in London on October 9, he brought forward evidence in its favour derived from recent researches. Geological evidence is accumulating in support of the view that coals and lignites are related to petroleum. Thus, in Trinidad, the three main oil-bearing horizons have each a carbonaceous phase in some other district, and the petroliferous and carbonaceous phases approach each other very closely in some localities. Similar evidence is found in Venezuela, Burma, Assam, Hungary, and Rumania. The D'Arcy well, near Dalkeith, was drilled on the assumption that oil-shale deposits represent petroleum that is "dead and buried," and therefore that free petroleum might be found beneath the oil-shale series; actually it was discovered below the oil-shale at each of two predicted depths. Dr. F. Bergius, of Heidelberg, has hydrogenised coal by heating it in free hydrogen in an autoclave at very high pressures and at temperatures up to 455° C. As the result of an exothermic reaction, a liquid was obtained that was "almost identical with crude petroleum." The determining factors of the formation were the proportion of volatile matter in the coal and the pressure. Nature, it is thought, may act in a similar way, but more slowly and at lower temperatures, on vegetable matter before it has reached the coal stage, *i.e.* while it still contains much hydrogen in proportion to carbon.

Supporters of the animal theory, said Mr. Cunningham-Craig, should endeavour to repeat Dr. Bergius's experiments with animal matter in place of vegetable. Cannel coals yield most oil on distillation; they contain much inorganic matter and are not highly carbonised. Torbanites also give high yields of oil and are to be regarded as cannels containing colloidal inorganic matter which has been heated in a natural autoclave. In this process it is assumed that the oil liberated from the torbanite combines with the colloidal inorganic matter to form the gels that can be seen in the microscope; but the conversion into petroleum has not been complete owing to partial carbonisation. Prof. A. E. Flynn has separated and investigated the gels occurring in torbanite from Nova Scotia, and has proved conclusively that they are not vegetable fossils; so that if oil-shale is petroleum "dead or buried," torbanite is petroleum "still-born."

Mr. Cunningham-Craig's paper met with many criticisms, both from the chemists, led by Dr. A. E. Dunstan, and from the geologists, led by Mr. Dewhurst. Dr. Dunstan raised obstacles to more than one theory; for example, he cannot admit that the laboratory methods of producing hydrocarbons from fatty acids

are applicable in Nature, and it is difficult to see why the molecules of such acids occurring in natural fats and containing even numbers of carbon atoms should give rise to molecules present in petroleum which contain both odd and even numbers of carbon atoms. He has analysed many times the liquids obtained from coal by the Bergius method, and has found that their similarity to petroleum is very remote. How can the presence of benzene, toluene, and xylene in certain petroleums be explained? Is it not probable that there are several modes of origin? Light is required on the origin of the vast amounts of methane present in natural gas. What happens to the nitrogen and phosphorus contained in animal organisms? Why is iodine so scarce in petroleum? Mr. Dewhurst said that petroleum found in the Upper Silurian was much earlier than the earliest vegetation, and earlier than the coal found in the Late Devonian. Palæozoic oil was probably formed from any organic matter available, and there were two distinct types of oilfield: the lignitic, of vegetable origin, which was deposited in areas where the climate was moist, and oilfields of marine animal origin, which are found associated with deposits of salt, gypsum, etc., and were formed in deltas that were cut off later from the mainland.

The discussion generally was suggestive and served its purpose in crystallising thought around important nuclei. If it did not bring nearer a definitive solution of the problem, it at least showed how far we have progressed since the time when a Polish cleric, named Kluk, traced the origin of petroleum to the Garden of Eden, which was so fertile that it must have contained fats; at the Fall this fat partly volatilised and partly sank into the earth, where it was finally transformed into mineral oil by the changes induced by the Flood. Truly, a science progresses by changing its points of view.

Obituary.

Dr. Herbert McLeod, F.R.S.

DR. HERBERT McLEOD, who died on October 3, was born at Stoke Newington on February 9, 1841, and was the son of Mr. Bentley McLeod. He was educated at Stockwell Grammar School. In 1860 he became lecture assistant to Prof. A. W. Hofmann at the Royal College of Chemistry. Former students of this College never forget the brilliant way in which McLeod carried out the experiments shown at the lectures. Hofmann was so impressed by his ability that he arranged that, in addition to acting as his assistant, McLeod should take the entire College curriculum. He worked with Hofmann on aniline dyes and had a part in the discovery of magenta. McLeod accompanied Hofmann to Berlin. A little later he returned to the Royal College of Chemistry as assistant to Prof. Frankland. At this period he published papers on acetylene, on a new form of aspirator, and, in conjunction with Frankland, a Report to the British Association on the determination of the gases in well-waters.

In 1871 McLeod was appointed professor of experimental science (afterwards chemistry) at the Royal Indian Engineering College, Cooper's Hill. He held this post till 1901. In 1876 he published a description of "An Apparatus for Measurement of Low Pressures of Gases." The McLeod gauge described in this paper is now commonly used. A little later, in 1878, McLeod published, in conjunction with G. S. Clarke (now Lord Sydenham), a paper on "Some Figures exhibiting the Motion of Vibrating Bodies and on a new Method for Determining the Speed of Machines." The method, developed in this and in later papers on the subject, has since led to most important applications. He devised a sunshine recorder and took a keen interest in meteorology, making daily observations at 9 A.M. and 3 P.M. over a period of twenty years.

A visit paid by the late Lord Salisbury to the Royal College of Science led him to invite McLeod to co-operate with him in scientific experiments. Week-end visits to Hatfield House were frequent until Lord Salisbury became Prime Minister. Some account of these experiments was given in the obituary notice of Lord Salisbury which McLeod wrote for the Royal Society.

From 1888 onwards McLeod had been reading proofs of the Royal Society's Catalogue of Scientific Papers. After the death of Mr. George Griffith in May 1902, McLeod undertook the direction of this Catalogue. His chief work upon the Catalogue was the preparation of a subject-index to all scientific papers published between 1800 and 1900. All the index slips necessary for this work were prepared under his direction, and the volumes for mathematics, mechanics, and physics were published. The author Catalogue for 1883–1900 was also under his charge, and he had seen half of this through the press when, in 1915, he was obliged, through ill-health, to give up active work.

McLeod was honorary LL.D. of St. Andrews, was elected a fellow of the Royal Society in 1881, and was president of the Chemical Section of the British Association at Edinburgh in 1892. He became a fellow of the Chemical Society in 1868 and served on its council in 1871–74, and again 1880–84. He was vice-president of the Chemical Society in 1887–90, and again 1901–4. He served on the Council of the Royal Society in 1887–89.

Dr. Arthur A. Rambaut, F.R.S.

Arthur Alcock Rambaut, Radcliffe Observer at Oxford, who died at a nursing home on October 14, after a prolonged illness, was born at Waterford on September 21, 1859, and was a son of the Rev. E. F. Rambaut. At Trinity College, Dublin, he won a first science scholarship in 1880 and took his degree the following year as senior moderator and gold medallist in mathematics and mathematical physics. Having spent some time as senior science master at the Royal School, Armagh (where he had been educated himself), he was in 1882 appointed assistant at the Dublin University Observatory at Dunsink under Sir Robert Ball. He had charge of the transit circle and observed regularly with it for about eight years, the results being published in Parts VI. and VII. of the "Astronomical Observations and Researches made at Dunsink." This work was laid aside when Mr. Isaac Roberts presented the observatory with a 15-inch reflector, with which some of his earliest work in astronomical photography had been made. Rambaut

commenced work with this instrument as soon as the clockwork had been somewhat improved, and a photographic survey was made of the great star cluster in Perseus and published in a paper by Ball and Rambaut in the Trans. R. Irish Academy. Soon after, in the autumn of 1892, Ball left for Cambridge and Rambaut was appointed to succeed him as Andrews professor of astronomy and Royal Astronomer of Ireland. During the next five years he continued his photographic work, but under great difficulties and with long interruptions, as the mounting, clockwork, and the dome under which the instrument was housed were all found to be useless and had to be replaced by others.

In 1897 Rambaut left Dunsink to take up the post of Radcliffe Observer at Oxford. Up to that time the Radcliffe Observatory had been devoted almost altogether to meridian work, and the observations made since 1839 had been regularly published. But a vast number of observations made in the years 1774 to 1838 had never been prepared for publication, and Rambaut spent a good deal of time examining them. He showed that they had been carefully made and would be worth printing, but he did not succeed in obtaining the necessary means for reducing and printing these old observations. In the meantime the Radcliffe Trustees decided to procure a first-class instrument for astronomical photography, and a tower was built in the grounds of the observatory, surmounted by a dome 32 feet in diameter. In this was, in 1902, erected a photographic instrument by Sir Howard Grubb, consisting of a photographic refractor of 24 inches aperture and an 18-inch refractor for visual work. In 1904 stellar parallax work was commenced, arranged according to the programme proposed by Kapteyn and in consultation with him, and this work has been continued ever since. A volume of the Radcliffe Observations published about a month ago contains the resulting parallaxes of 2400 stars in addition to full descriptions of the instrument and measuring apparatus.

More than a year ago Rambaut was attacked by illness, from which he never recovered. It was therefore very fortunate that the chief work of his life had been completed. He will be much missed by the many friends his cheerful and kindly disposition had won for him at Oxford. He leaves a widow and three sons to mourn his loss. J. L. E. D.

DR. J. A. HARKER, O.B.E., F.R.S.

JOHN ALLEN HARKER was born at Alston, Cumberland, on January 23, 1870, and died at Highgate on October 10. He was thus only in his fifty-fourth year at the time of his death. The son of the Rev. John Harker, Congregational minister, he was educated at Stockport Grammar School, thence proceeding to the University of Manchester (Owens College), where he was elected Dalton scholar in chemistry in 1891 and a year later Berkeley fellow in physics, taking his M.Sc. A research course at Tübingen followed, where he took the Ph.D.

Harker spent some little time in France, working with Moissan on electric furnaces, and in collaboration with Chappuis carried out in 1900 a classic comparison of the gas and platinum thermometer scales. About this time the National Physical Laboratory was being brought into being at its first home at Kew Observatory, and Dr. Harker was one of the little band of devoted workers whom Sir Richard Glazebrook gathered round him at the beginning of the great endeavour which resulted in the present institution at Teddington. Harker became chief of the thermometry branch of the Physics Department. His work over a period of the next ten years is largely reflected in a series of valuable papers, mostly on high temperature measurement, for which he received the F.R.S. in 1910. At the International Petroleum Congress at Vienna in 1912 he was the delegate of the British Government. His researches with W. F. Higgins on flash-points of oils enabled him to make valuable contributions to the discussions. In association with the present writer, Dr. Harker subsequently worked on the thermionics of high-temperature furnaces—a subject on which he gave a Friday evening discourse at the Royal Institution. In 1913 he went for several months to Eskdalemuir Observatory as temporary superintendent.

When the War broke out Harker was lent by the National Physical Laboratory to the Inventions Department of the Ministry of Munitions, and became director of the research laboratory and was responsible for the organisation of the work of the Nitrogen Products Committee. In this capacity he visited Canada and the United States in 1918, and was on board the Cunard liner *Andania* when she was torpedoed off northern Ireland. On that occasion a generous act of self-sacrifice undoubtedly aggravated the ill effects of the exposure on his constitution. Harker also went on similar missions to Norway, Sweden, and France. He received the O.B.E. in recognition of his valuable War services.

After the War, Harker returned to Teddington for a brief period before setting up as a consulting engineer with Dr. J. F. Crowley in Westminster. He was a vice-president of the Faraday Society, and had served on the Council of the Physical Society. He was a prominent member of, among others, the Oxygen Committee and the Gas Cylinders Committee of the Research Department.

Harker was a man of great scientific keenness and a highly strung and very likeable personality, who will be greatly missed by his friends. He possessed a great fund of scientific reminiscences. Though never of robust physique, he did not hesitate to make frequent inroads on his reserve of nervous energy. His devotion to his War duties doubtless served to undermine his constitution, and at the end his illness was only short in duration. He married Ada, the daughter of the late Thomas Richardson, of Alston, and had two sons and three daughters. The cremation took place at Golders Green on Saturday, October 13. Among those present were Sir Richard Glazebrook and Sir Robert Robertson. Dr. T. E. Stanton represented the Royal Society and Dr. E. Griffiths and Mr. F. H. Schofield the Director and staff of the National Physical Laboratory. G. W. C. KAYE.

WE regret to announce the following deaths :

Rev. H. J. Bidder, a curator of the Botanic Garden, Oxford, on October 19, aged seventy-six.

Mr. R. A. P. Rogers, Donegal lecturer in Trinity College, Dublin, on October 17.

Current Topics and Events.

SPAHLINGER'S consumption cure is once more brought to public notice, and, at the invitation of Baron Henri de Rothschild, Mr. Spahlinger met a number of medical men at the Ritz Hotel in London last week. In an article in NATURE, April 7, p. 453, we published the main facts, so far as they were known, of Spahlinger's consumption cure. His claims were shown to rest on a series of categoric statements of which we still await scientific proof. In some mysterious way, however, the subject recurs like the seasons, and yet we get no further. We are now informed that he cannot produce the "goods" because the Spahlinger family fortune to the extent of 80,000*l.* has been spent in the experiments, and therefore more will be required before the public can taste the benefit. When it is remembered that such a sum would nearly maintain the Rockefeller Institute in New York for a year, it is difficult to understand why the result is so meagre. The object of the meeting in London was to produce a pamphlet which would give the history of Spahlinger's work, particulars of papers which have been read, and clinical histories of the cases hitherto treated. When these works have been in the hands of doctors for a month or six weeks, we are going to hear about the Spahlinger treatment again, we are told, for an appeal will be made to a generous public for money to carry on the work. In these days of scarcity, it would seem advisable to know something about the remedy apart from the claims made on its behalf.

THE statement made by Sir L. Worthington-Evans to the Imperial Economic Conference, on cable communication throughout the Empire, is quite satisfactory. Before the War none of the Atlantic Cables was owned by a British company. Now there are two. The German cable from Emden to New York *via* the Azores has been acquired and diverted, and the cable of the Direct United States Co. has been purchased. The average transmission time for full-rate telegrams between London and Montreal is now about 45 minutes. The other link in the State-owned route to Australia and New Zealand is the Pacific Cable laid in 1902. It is now loaded to its full capacity, and the question of duplicating it is under consideration. In other parts of the world the cables provided by the Eastern Telegraph Co. and its associated companies have proved capable of meeting the demand. These companies and the Pacific Cable Board did invaluable work during the War. Britain, however, has fallen behind other nations in radio communication. America, France, Germany, Japan, and the Argentine have outstripped us. This is due to the apparently interminable negotiations between the Marconi Company and the Government. We have good hopes that with the able help of the Dominion Premiers an agreement will soon be arranged. Lord Burnham suggests that permission be given to private enterprise to operate the stations, the Government reserving the right of purchase after a term of years. Judging, however, from the analogous experiment that was tried when electricity supply companies were first established in Great Britain, we think it very doubtful whether a scheme of this nature would succeed. Several other suggestions have been made, and we sincerely hope in the national interests that this little-creditable dispute will soon be settled.

SINCE Summer Time was first introduced in 1916, many different views have been expressed as to when it should begin and end. Expediency rather than principle seems to have determined these dates, which, in Great Britain, have varied from March 24 to April 8 at the beginning and September 17 to October 25 at the end. There has also been no general agreement between Great Britain and other European countries as to the period during which Summer Time should be in force. Mr. Bridgeman, Home Secretary, told a deputation from the Newcastle Chamber of Commerce on October 19 that he was consulting authorities in France in the hope of arriving at such an agreement. The dates in Great Britain, namely, the day following the third Saturday in April and the day following the third Saturday in September, are laid down by the Summer Time Act, and it will be necessary to repeal or amend this Act in order to extend the period, as urged by the Newcastle deputation. Duration of daylight is, of course, a function of latitude, so that whatever dates are decided upon for the change of time-reckoning must be a compromise as to their effects, even in different parts of Great Britain. During the summer months Newcastle and places north of it do not need Summer Time legislation to give them daylight during all their working hours. On this account, it has been suggested that Greenwich Time should be used near the summer solstice—say in June and July—so that clocks would have to be altered four times a year instead of two. This would, however, increase the confusion already caused by the introduction of Summer Time, and we trust that the change will be limited to two dates a year, whatever they are.

IT is rather interesting to note that among the representatives of the Dominion of Canada at the Imperial Conference now sitting in London, five of them are fellows of the Royal Society of Canada. The Rt. Honourable William Lyon Mackenzie King, Prime Minister, author of several works on political economy; Dr. O. D. Skelton, professor of political economy at Queen's University; Dr. R. H. Coats, Dominion Statistician; Col. A. G. Doughty, Dominion Archivist, are all members of Section II. (History and Literature) of the Royal Society of Canada; whilst Dr. Charles Camsell, who is honorary secretary of the Society, Deputy Minister of Mines, and has under his direction the Geological Survey, the National Museum, and the Mines Branch of the department, is a member of Section IV. (Geological and kindred Sciences). There is also associated with these representatives Dr. J. H. Grisdale, Deputy Minister of Agriculture, also the head of the Experimental Farms of the Dominion, the post formerly

held by a past president of the Royal Society of Canada in the person of the late Dr. W. E. Saunders. It is thus evident that in the fields of literary, historical and scientific research in Canada, the right men were found to represent that portion of the British Empire at the Imperial Conference.

ON Tuesday next, October 30, occurs the centenary of the death of Dr. Edmund Cartwright, the inventor of the power loom and other textile machinery. Born in 1743, a few years after Arkwright, his life coincided with the great Industrial Revolution, to which he made notable contributions. Of a good Nottinghamshire family, he was educated at Wakefield Grammar School and at University College, Oxford, and took holy orders. He was given the perpetual curacy of Brampton, near Wakefield, and in 1779 he was appointed to the living of Goadby Marwood, in Leicestershire; it was there he made his first loom. It was during a holiday visit to Derbyshire in 1784 that his attention was directed to the need of a mechanically worked loom, and though he had had no previous experience of mechanics or weaving, with the aid of the village carpenter and smith, he made a rude form of loom which could be worked by other agency than the hands and feet of the weaver. He took out patents, at Doncaster set up a factory, and there produced the earliest samples of power woven goods. At the same time, he turned his mind to the difficult problem of wool-combing by machinery, and here again made a certain amount of advance. His projects, however, proved financial failures, and in 1793 he sold his factory and removed to London. Among his other inventions was an engine to be driven by steam or spirit vapour, in which he applied the practice of surface condensation. He was also known for his experiments in agriculture and for several years worked for the Dukes of Bedford at Woburn. Though the power loom came into use somewhat slowly, by the beginning of the nineteenth century it was becoming common, and in 1809 Cartwright's services to the cotton industry were acknowledged by the grant to him by the Government of a sum of 10,000*l*. A part of this Cartwright spent on the purchase of a farm in Kent, and there he spent the evening of his days, experimenting to the last.

"THE Martyr Roll of Science" is the title of a sympathetic article by Mr. Harry Cooper in the *Sunday at Home* for October, in which details are given of the life and work of many of those who have given their lives in the pursuit of knowledge and the service of mankind. No mention is made of the victims of engineering and chemical and physical research, and only a passing reference to those of geographical exploration—Franklin, Scott, and Shackleton—the bulk of the article dealing with the tragic happenings of medical research. Arthur Bacot and H. T. Ricketts were stricken down by typhus fever, and the interesting information is given that a hundred years ago Sir Humphry Davy likewise contracted typhus fever, then so familiar in prisons as to be known as "gaol fever," having visited Newgate in order to devise a disinfectant against the disease, but happily recovered. Yellow fever claimed Jesse Lazear, who allowed himself to be bitten by mosquitoes that had fed on the blood of yellow fever patients. The list of X-ray martyrs is unhappily a long one—Hall-Edwards, Lyster, Clarence Dally, Ironside Bruce, Radiguet, Kassabian, Vaillant, Bergonié, and others. Kala-azar attacked Pirrie, and other names might have been added to Mr. Cooper's roll of honour. Thus trypanosomiasis claimed Tulloch; African tick fever, Dutton; yellow fever, Walter Myers; and typhoid fever, Louis Jenner and Allan Macfadyen. "Such heroisms give the answer to those who imagine Science to be a rigid, emotionless thing, and its devotees to be hard men, forgetful of humanity in their intellectual absorption."

THE inaugural lecture of Prof. A. V. Hill in the Anatomy Theatre of the Institute of Medical Sciences at University College on October 16 was a brilliant and inspiring account of the present tendencies of physiological science. Prof. Hill came to physiology from physical science and is thus more favourably situated in regard to his freedom of suggestion and criticism than many biologists of a more restricted training. As present tendencies, he instanced the unparalleled advance in biochemistry during the past few years. It is now difficult to define precisely where physiology ends and biochemistry begins. Day by day the analysis of the whole mechanism of the living organism becomes more refined and elaborate. Prof. Hill cited the brilliant work of Hartridge and Roughton, which has recently brought the study of the time-course of the reactions of hæmoglobin with gases, occupying only a few hundredths of a second, under direct experimental observation. The development of further and finer physical methods of analysis is another tendency, while the old main road of the experimental method remains an essential means to progress in physiology. Direct physiological research on man is developing to the great advantage of medicine and sociology. It is essentially the study of the normal. A fifth tendency is less obvious: the amplification of the field of zoology through the adoption of experimental methods. That may help to correct the analytical tendency. Re-synthesis is necessary and zoology will not forget the animal as a whole. Anatomy, too, will gain as increasingly greater emphasis is placed upon the living structure, and the elucidation of the working of the central nervous system will link up structure with function. Not the least interesting remarks of Prof. Hill were those concerning the spirit of adventure—even a reckless spirit of adventure—in science, without which the most highly organised team work must be sterile and bureaucratic. The adventurer may be wrong, but he "catalyses" his more reasonable brothers.

THE Salters' Institute of Industrial Chemistry has awarded sixty-four grants in aid to chemical assistants, occupied in factory or other laboratories in or near London, to facilitate their further studies.

THROUGH the generosity of the late Mrs. E. O. Durham, wife of Lieut.-Col. F. R. Durham, chairman of the Junior Institution of Engineers, 1907–1909, that Institution has offered annually a bursary of 25*l.* for competition among its members between the ages of 20 and 23 years. By her will, the Institution is to receive a sum to endow the bursary in perpetuity.

WE learn from *Science* that at the annual meeting of the American Chemical Society at Milwaukee on September 12, the Priestley medal, awarded triennially by the society for distinguished services to chemistry, was bestowed on Dr. Ira Remsen, president and emeritus professor of Johns Hopkins University, Baltimore.

THE Council of the Institution of Civil Engineers has made the following awards in respect of selected engineering papers published without discussion during the session 1922–1923: A Watt medal to Mr. T. E. Houghton (Liverpool); and Telford premiums to Mr. J. W. Meares (Guildford), Mr. J. W. Spiller (Maidenhead), and Dr. G. S. Coleman (Manchester) and Mr. Dempster Smith (Manchester); and in respect of papers read before meetings of students of the Institution in London and the provinces during the same period,—Miller prizes to Mr. E. L. Everatt (Newcastle), Mr. J. G. Kimber (London), Mr. A. H. Naylor (London), Mr. E. Sykes (Birmingham), and Mr. F. J. Symonds (London).

APPLICATIONS are invited for the post of an assistant government analyst in Ceylon. Candidates must have had experience in general analytical and bacteriological work and in toxicological analysis, be associates or fellows of the Institute of Chemistry by examination in branch E (chemistry—including microscopy—of food, drugs, and water), and preferably possess an honours degree of a British University. Application forms and further particulars are obtainable from the Assistant Private Secretary (Appointments), Colonial Office, S.W.1.

A MOVEMENT is on foot to commemorate the late Sir Isaac Bayley Balfour. An area of 50 acres in Glenbranter Forest, Argyllshire, where the plants raised at the Botanic Garden, Edinburgh, can be cultivated under suitable conditions and where trials may be made in the rearing of newly imported conifers and other trees, has been secured for the purpose. It is proposed that the area shall be called the Bayley Balfour Arboretum or Garden, and that the memorial shall take the form of a rest-house for the use of visitors. Subscriptions towards the memorial are solicited. They should be sent to the honorary secretary and treasurer, Mr. J. Sutherland, 25 Drumsheugh Gardens, Edinburgh.

MESSRS. LONGMANS AND CO. are publishing shortly vol. 1. of a work on "Cosmology," by Prof. J. O'Neill, of Maynooth, which, it is said, is the first attempt at an English treatise on scholastic cosmology. The study of the text of Aristotle and of St. Thomas has led the author to ascribe to these thinkers views different from those attributed to them in most contemporary manuals. The second volume on "Modern Cosmology" will be published next year; its purpose is to show that scholastic cosmology contains a sounder philosophy of matter than any of its present-day rivals.

Our Astronomical Column.

COMETS.—Very careful search for D'Arrest's Comet has been made by photography by Dr. Innes at Johannesburg and Dr. Baade at Bergedorf, Hamburg; several other astronomers have spent much time in visual searching but without success. The comet has not been seen for two revolutions; the perturbations up to 1917 were computed by Mr. Braae, and those for the present revolution by Mr. Cripps, starting with Braae's elements for 1917. As there was a fairly close approach to Jupiter at the last aphelion passage, it is possible that the second-order perturbations, which were not computed, were sufficient to have a considerable effect on the comet's position. If this is not the case, we must conclude that the comet has suffered disintegration, like those of Biela and Brorsen.

Baade's Comet of October 1922 was still under observation in August by Dr. van Biesbroeck at Yerkes Observatory, its magnitude being about 14.

Dr. Strömgren welcomes the observation of comets over long arcs, since it enables the eccentricity of their orbits to be determined. This is of importance in discussing theories of their origin.

THE EINSTEIN SHIFT IN THE SOLAR SPECTRUM.—Two articles on this subject have lately appeared, which both reach an affirmative conclusion on the presence of the shift in the solar spectral lines that Einstein predicted. *Science* for September 28 contains a summary of a paper read by Prof. C. E. St. John to the American Association for the Advancement of Science. It will be remembered that his earlier conclusions tended to the negative side, but this summary makes it clear that he has now reached an opposite conclusion. Details are not given, but the following quotations clearly express his main result. "The lines of the solar spectrum are not identical in position with those due to incandescent samples of the same elements when observed on the earth, and the displacement is toward the red end of the spectrum." "The displacements of the lines . . . predicted by Einstein amount to 86 per cent. of the total observed effect, the remainder being due to other well-known effects."

The other paper is by Dr. J. Evershed in the October issue of the *Observatory*, and gives details of the confirmatory verdict which was announced to the R.A.S. last June. The lines of iron, titanium, calcium, nickel, sodium, cyanogen, were studied in the sun and in the arc; the study covered all parts of the solar disc, the back of the sun being accessible by means of the light reflected by Venus near superior conjunction. The pressure effect is concluded to be negative, the photosphere having a much lower pressure than our atmosphere. He states that "there seems to be very little doubt that the Einstein effect is present in the solar spectrum; the observed shifts . . . seem impossible to explain by motion, pressure, or anomalous dispersion." It remains to find an explanation of the excess of shift shown by the high level lines in the ultra-violet, and the differences given by separate lines.

Research Items.

DISEASE GODLINGS IN EASTERN BENGAL.—*Man in India*, a periodical edited by that active anthropologist, Rai Bahadur Sarat Chandra Roy, has steadily improved in value as it has now reached its third volume. Perhaps the most interesting article in an excellent number is that on "The Cult of the Godlings of Disease in Eastern Bengal," by Mr. Sarat Chandra Mitra. He gives further evidence to show that the cults of the higher gods—Brahma, Vishnu, and Siva—retain little influence on the rural populations, which is devoted to the propitiation and control of a mob of malignant demons, who cause disease among men and animals, failure of crops, and other evils which menace the villages.

TATTOOING AND LIP DISTORTION.—Two valuable ethnographical articles, both illustrated by drawings and photographs, appear in *L'Anthropologie* (vol. xxxii. Nos. 1-3, August 1923). The first, by Dr. J. Herber, entitled "Les Tatouages du pied au Maroc," describes a remarkable series of foot tattooing in Morocco, the markings taking in some instances an imitation of jewellery, such as anklets, and other decorations of the calf. The second paper, by M. Gaston Muraz and Maddh, Sophie Getsowa, entitled, "Les Lèures des Femmes Djingés, dites Femmes-a-Plateaux," describes the extraordinary types of the labrets used by the Saras-Djingé, improperly called the Saras-Kabas, a tribe of fetish-worshippers in the neighbourhood of Lake Tchad, between the right bank of the Chari and the Arab district of Salamat. The French officers now in charge of this region have taken active measures to prevent this barbaric form of decoration of the female face.

FATIGUE RESEARCH IN FACTORIES.—The Journal of the Royal Statistical Society (July, 1923) contains a paper by Dr. D. R. Wilson on "Some Recent Contributions to the Study of Fatigue." The writer, after giving a short historical outline of the activities of the Industrial Fatigue Research Board, gathers together the conclusions, usually expressed in a tentative way, furnished by several different investigations in different industries. He points out that conclusions, even though they are perforce based on a study of a few individual cases, when confirmed in several widely differing industries, are probably sound. Industrial research as yet is in its infancy, and conditions for carrying it on in a factory bear no resemblance to those of a laboratory. A particular factory may employ only a few individuals on a given process, but, owing to the constitution of the factory, these individuals are typical of any likely to be employed for that process. It therefore seems a likely hypothesis that what is true of these particular individuals with regard to such general problems as the length of the working day, rest pauses, ventilation, etc., will be true of others. It is pointed out that factory research is of the nature of applied science and that the conclusions and methods of several sciences not only have to be utilised, but also adapted, for the particular conditions of factory life.

MENDELIAN INHERITANCE IN A FERN.—The variations of the hart's-tongue fern, *Scolopendrium vulgare*, are well known and have often been illustrated by Druery and others. Prof. W. H. Lang (*Journ. Genetics*, vol. 13, No. 2) has studied the offspring produced by sowing the spores of a plant which was apparently normal except that one leaf was incised on one side though normal on the other. The prothalli so produced gave rise to young plants 75 per cent. of which were normal (entire leaved) and 25 per cent. incised. The latter, when reproduced by spores, bred true like extracted recessives, while the two entire-leaved offspring both proved to be again heterozygous. The original plant was evidently heterozygous, the normal condition being completely dominant to incised leaf. When spores were sown singly, thus producing isolated prothalli, such prothalli gave rise either to all entire-leaved or to all incised-leaved plants, showing that, in accordance with theory, the segregation of factors had taken place in the spore formation.

REVISION OF THE CATILLOCRINIDÆ.—The family of Devonian and Carboniferous crinoids known as Catillocrinidæ is peculiar in combining marked asymmetry in the composition of the cup with but slight asymmetry in its shape; while a large anal tube does not prevent a tendency to symmetry in the fringe of unbranched arms, 11 to 58 in number, which spring directly from the edge of the cup. Mr. Frank Springer's study of this assemblage (Smithson. Misc. Coll., lxxvi. No. 3, Aug. 1923) not only adds new facts to our knowledge of it as well as of the Symbathocrinidæ, but also raises questions of far-reaching importance. These families as well as their allies and admitted ancestors have always been credited with a monocyclic base; in other words no infrabasals have been detected or even supposed to exist in the cup. Mr. Springer now describes and illustrates by photography three small plates hidden within the basals of *Catillocrinus tennesseeae*, the oldest species of the genus. He does not consider that such plates occur in any later members of the family, a fact which may be explained as due to atrophy; but neither does he claim that they may have existed in the predecessors of Catillocrinus. He does, none the less, conclude that these plates are true infrabasals and that "in this species there is a dicyclic base." We hesitate to accept so revolutionary a decision on the evidence of three specimens of one highly modified species. On the other hand, we welcome the support of this distinguished worker for the suggestion that the faunas from Timor which Wanner refers to the Permian are in part of Lower Carboniferous age.

CONTROL OF BUNT AND SMUT.—In Bull. C. No. 3 of the Welsh Plant Breeding Station, K. Sampson describes how satisfactory control of bunt of wheat and covered smut of barley can be obtained by the use of dry copper carbonate, as well as by solutions of copper sulphate and formalin. The dry treatment proved to be good from all points of view save that of cost, but an equally efficacious and less expensive dressing is found in anhydrous copper sulphate and calcium carbonate.

THE GORGE OF THE ARUN.—Capt. C. J. Morris on his way back from the last Mount Everest expedition visited the little-known gorge of the Arun in Nepal. He contributes a paper on the subject to the *Geographical Journal* for September. It was known that below the village of Teng the river falls some 4000 feet in 20 miles, and the object of the expedition was to examine this stretch of the river. This drop was found to be due to a steady fall in the bed of the river, which passes through narrow defiles in which the cliffs rise in places to 10,000 feet above the water level. Capt. Morris's paper contains a sketch map of the gorge of the Arun.

SCALE FOR SEA DISTURBANCE AND SWELL.—On the North Atlantic meteorological chart for October a new scale for sea and swell disturbance is tentatively

suggested. Criticisms or alternative suggestions are invited. The scale, which is proposed by Capt. H. P. Douglas, late Assistant Hydrographer, uses the old notation of 0 to 8 for the sea, and adds 9 for a confused sea caused by currents, tide, a sudden swift of wind, but not necessarily by strong wind. Swell is also shown on a scale of 0 to 9, the main types of swell being designated short, long, low, and high. By a combination of the sea and swell scales, the state of disturbance of the surface waters is expressed by two figures. Thus 43 means a rough sea with a high swell: 37 means a moderate sea with a long heavy swell. The adoption of this or some comparable code and scale would result in greater precision in records than is now possible.

RAINFALL IN AUSTRALIA.—Rainfall charts of Australia prepared by the Commonwealth Meteorologist from the records of 1280 well-distributed stations show that in the year 1922 there was an excess above the average rainfall in 21 per cent. of the total area of the continent. In 1923 this figure was 63. During 1922 the totals were the lowest on record in several places between the south-west corner of Queensland and the plains of New South Wales. Throughout the interior from the Lake Eyre basin to the inland parts of Queensland, New South Wales, and Victoria, and also in the north-west of Western Australia, the shortage was considerable, and would have been more pronounced were it not for the heavy falls in December. The areas with rainfall above the average were chiefly in the tropical north, and in the centre and south-east of South Australia. The wheat areas in New South Wales and Victoria experienced a marked shortage, but the falls were so opportune that in most parts a good harvest was secured. It was the pastoral areas of Australia which suffered most severely. The chart gives annual and monthly rainfall maps and a series of insets showing distribution of rainfall above the average in every year since 1908.

COLD AIR-WAVES IN THE UNITED STATES.—Prof. R. de C. Ward of Harvard University deals with this subject in the *Scientific Monthly* for May. The author makes reference to cold waves alluded to by past pioneers of weather changes, such as Redfield and Prof. Joseph Henry, who realised the progress of cold periods across the continent, from the Rocky Mountains to Bermuda, prior to the publication of weather maps for the United States. The cold waves were then recognised as associated with the rear segments of cyclonic circulations moving to the eastward. The official definition of a cold wave is a fall of temperature amounting to a certain number of degrees in 24 hours, with a minimum below a fixed standard. Minimum temperatures are not so far below the normal in the north as in the south, and where crops are growing all the year round, frosts are dangerous at any time. For intensity cold waves are practically unique in America, and following as they do warm winds associated with the advance segment of a storm, the sudden drop of temperature is very great, amounting to between 20° F. and 40° F. in the 24 hours. The rapidity of advance is determined by the travelling speed of the cyclonic and anticyclonic areas with which the wave is associated. Three or four severe cold waves are generally experienced each winter in the United States, and they commonly last for two or three days. Various activities and interests are seriously affected during the spell of cold. On the Pacific coast cold waves are few and not severe, and in California the occasional frosts are the product of radiation on clear anticyclonic nights. Northers and blizzards are well described.

ATOMIC DISINTEGRATION.—A paper on the photography of atomic disintegration, by Harkins and Ryan, appears in the Journal of the American Chemical Society for September. Photographs of the disintegration of the atom are given, the retrograde motion of the colliding α-particles being plainly visible. A new type of rays is described, called by the authors ζ-rays; they give very faint but definite tracks. Their range is very many times greater than that of δ-rays, and they are probably due to electrons torn out of the atom, possibly from the K level. In the course of the experiments described, it is remarked that oblique impacts never effect nuclear disintegration.

SULPHUR AS A FUNGICIDE.—Mr. Harry Curtis Young has recently published (Annals of Missouri Botanical Garden, 9, pp. 403-435, 1922) a valuable contribution to the much-investigated problem as to the reason for the toxicity of sulphur when used as a fungicide for the control of disease upon plants. He finds that sulphur owes its toxic properties to pentathionic acid, an oxidation compound formed from sulphur and water. On this account the sulphur needs to be applied in a very finely divided and therefore easily oxidised form, and he recommends colloidal sulphur liberated in a medium containing buffers so that it is easily maintained at a reaction between PH 4·0-5·5; above or below this hydrion concentration pentathionic acid is not stable. In the light of this general conclusion there is a brief discussion of the practical problem of producing a suitable sulphur spray or vapour, but the author's investigations on this side of the problem are still in progress.

PETROLEUM AND NATURAL GAS IN AMERICA.—The advance chapters on Petroleum (ii. 31) and Natural Gas (ii. 32) of the Mineral Resources of the United States for 1921 appeared recently, and they furnish some interesting data concerning the post-War phase of the oil-industry in that country. Following unsettled conditions for some six months after the armistice, a gradual revival took place culminating in the oil-boom of 1920, but giving place later to a period of intense depression characterised by a serious drop in the price of oil and its various products, the chief economic feature of 1921. In the spring of 1922 a definite improvement was manifest, which has progressed steadily until the present time, when, in fact, the industry is suffering from a vastly different but equally serious malady from that of 1921—overproduction—and for this California is largely to blame. In 1921 there were produced in the United States 472,183,000 barrels of oil and 724,052,000 M cubic feet of natural gas; while the former figure represents a 33 per cent. increase since the end of the War, the latter shows a significant decrease compared with the two previous years, and it is generally conceded that the natural gas industry in America has reached and is gradually passing its peak of production, so that a steady decline may be anticipated for the future. With petroleum the situation is different, and it is difficult to foresee the trend of events, though once California ceases to produce in the present amazing fashion, the decline-curve for the whole country will undoubtedly be apparent. It is interesting to note that the average daily production of oil in the United States at the moment is about 2,400,000 barrels, to which California contributes practically one-third; in 1921, the year under review, the average daily production for the country was approximately 1,300,000 barrels, to which California contributed less than 25 per cent.

Second Triennial Pan-Pacific Science Congress.

MELBOURNE AND SYDNEY, 1923.

THE Science Congress in Australia in August has been, on the whole, highly successful. Between eighty and ninety visitors from overseas joined with a large number of local members in carrying through a fairly extensive programme of work. It is scarcely to be expected that congresses of the kind will receive many, or any, highly important original contributions to science; their value and their opportunity lie rather in bringing together the workers in widely separated countries, enabling them freely to discuss common problems and ideas, but above all to plan broad systematic investigations on the most efficient co-operative bases possible. The principal achievements of this Congress have certainly been in the last-mentioned direction. In nearly every one of the sciences with which it dealt (including agriculture, anthropology, botany, entomology, forestry, geodesy and geophysics, geography and oceanography, geology, hygiene, veterinary science and zoology), there is abundant room for international effort and team work in so vast an area as that within and bordering upon the Pacific Ocean. The recognition of this has been the driving force behind the whole Congress. Many practical proposals have been brought forward, the carrying out of which will do much for the progress of scientific inquiry in this region.

The general organisation, in the hands of the Australian National Research Council, has been much on the lines of a British Association meeting. The scope and value of the whole movement will no doubt rapidly increase. It is already understood that the 1926 gathering will be in Japan (Tokyo and Kyoto), and that the Japanese Government most generously proposes to make available a sum equivalent to 23,000*l.* to cover expenses.

The Sydney session is not yet concluded at the time of writing, but it is possible to give some indication of the main work of the first session, held in Melbourne on August 13-22.

To many, the most important business of the Congress was that faced by the Anthropology and Ethnology Section, which set itself the task of devising a practical scheme for the immediate intensive study of the native races in the Pacific. So far at least as British possessions are concerned, some very definite proposals have been drawn up, in the consideration of which Dr. Haddon, Sir Baldwin Spencer, Mr. W. J. Perry, and, by letter, Sir James Frazer, Prof. G. Elliot Smith, Prof. C. G. Seligman, and Dr. B. Malinowski, have taken part. These have already been received favourably by the Commonwealth Minister for Home and Territories. They provide not only for field workers but also for the establishment of a school in one of the Australian universities for training both scientific workers and Government administrative officers. There is reason to hope for most valuable results in the few years that yet remain before the rapidly disappearing native cultures pass beyond recall. On Sir Baldwin Spencer's initiative, definite schemes for work on the mainland among the remaining wild tribes have also received the support of the whole Congress.

In the Section devoted to Agriculture, it was to be expected that irrigation and land settlement, especially from the economic point of view, would occupy chief attention. Californian and Australian workers, especially, exchanged striking accounts of development work. That the latter could point to an increase in agricultural and pastoral revenue in the Commonwealth from 80,000,000*l.* in 1906 to 260,000,000*l.* in 1921 showed, even after allowing for higher prices and a slightly increased population, how much was being done by agricultural research and education. The chief decision of the section was an insistence upon the paramount importance of soil surveys, showing characters of both soil and subsoil, and, when practicable, the native flora growing on each type of soil. A resolution to this effect will be presented to the Government of every country in the Pacific region.

Botany, Forestry, Entomology, and Zoology Sections conducted many of their meetings in common. Dr. van Leeuwin (Dutch East Indies) gave an account of the progressive changes which have taken place in the vegetation of Krakatoa since the devastation of 1883. The first (wind-borne) arrivals were spore-producing plants. With time the number of new cryptogams decreased. Seeds of flowering plants came, carried either by wind or birds. Casuarinas arrived early and formed forests. These are now being suppressed by later arrivals, which are tropical rain forest plants; the vegetation being at the present time somewhat similar to that existing prior to the volcanic outbreak and exceedingly dense. The study of this vegetation has been a remarkable example of international co-operation, Dutch, British, French, American, Swiss, and German scientific workers all sharing in it.

The much closer connexion in flora between Australia and the Philippines than between the former and the nearer islands to the north-west was due, according to Dr. E. D. Merrill (Manila), to a former land connexion through New Guinea. This land connexion he termed Eastern Malaysia, maintaining that it was separated from Western Malaysia by an area in "unstable equilibrium," bounded on the east by Weber's line and on the west by a modified Wallace's line. This unstable area had to a large extent prevented movements of plants east and west.

The forestry work was chiefly of local interest. Every scientific gathering in Australia points out the supreme folly of the vast destruction of forests which has taken and is still taking place as settlement advances; and this Congress was no exception to the rule.

The entomologists dealt chiefly with problems presented by indigenous and imported insect pests, particularly the various species of termites in Australia and the timber-boring insects of the islands to the north. The dangers threatening Australia were very fully emphasised and will be the subject of communications to Governments.

A discussion on the genetics of domesticated animals initiated by Profs. E. B. Babcock (California), Cossar Ewart (Edinburgh), and W. E. Agar (Melbourne), resulted in a decision by the Zoology Section to form a special committee of five geneticists to collect information on all genetic research now in progress in Pacific countries and to report to the next Congress. The protection of native fauna was strongly emphasised here, too, every country insisting on the international importance of preserving from destruction much of the unique fauna of Australia. A public meeting was held during the Congress to give support to local authorities in contemplated action towards this end.

With Sir Gerald Lenox-Conyngham and Dr. E. F. J. Love in charge of the Section of Physics, it was natural that geodesy should be very much to the fore. The slight contributions made so far by Australia to this science were contrasted with the

great significance of the study from economic and national defence points of view, and with the chance which Australia has, from its geographic position, form, and dimensions, of making a highly important contribution to knowledge of the figure of the earth and of the form of the lithosphere.

The wide work on terrestrial magnetism being carried out chiefly by the United States was discussed at some length, and again Australia was urged to take up her fair share of it. The desirability of continuing and extending the work of the non-magnetic ship *Carnegie* was affirmed. Other highly interesting subjects cannot be more than mentioned by name, such as gravity work in Japan and the Philippines; earth tides and their employment for determining earth rigidity; pulsatory vibrations and the causes of destruction by earthquakes, with an account of safeguards to property adopted in Japan; international solar physics research; determination of gravity at sea; comparison of accuracy of wired and wireless longitude determinations.

Three matters stand out in the work of the Geography and Oceanography Section. The first is the presence in Sydney Harbour of the new U.S.A. scout cruiser *Milwaukee* (10,000 tons; 35 knots), specially sent out by the American Government to demonstrate to the Congress the Sonic Depth Finder. The vessel has journeyed some ten thousand miles and has obtained a chart of the Pacific bed over which it passed. While the instrument is not yet fully perfected, its value not merely for rapidly obtaining accurate knowledge of the sea bottom, but also in increasing the safety of vessels in many of the intricate channels among the Pacific islands, very greatly impressed the Congress, while the object-lesson of a fighting vessel devoted to scientific work was a valuable one. The second was a full exchange between the countries represented of information as to what they are doing (or, in the case of Australia, merely beginning to do) in the matter of hydrographical surveys. A very fine exhibition of maps was made, principally from the Royal Topographical Service of the Dutch East Indies. Prominence was given to the need for work in the neighbourhood of the Great Barrier Reef and elsewhere. In some regions, charts drawn by Matthew Flinders are still perforce being used. The third subject of importance was the pressing need for co-ordination of meteorological work in the Pacific. There are now numerous stations, working independently, overlapping, and apparently incapable of co-ordination among themselves. The solution urged was the appointment of a British officer at Samoa, it being believed that in no other way could the difficulties in the way of the needed association of activities be established.

Geology possessed numerically the largest Section of all, and a huge amount of matter, nearly all descriptive, was put before it. Indeed, a "pool" of geological information was created, every country contributing as much to it as time, very strictly allotted, would permit. It is impossible to set out briefly the nature of the work discussed; the main subjects have already been indicated in a former article. Between section meetings the geologists distributed themselves over the countryside.

The Hygiene Section went fully into problems connected with mining industries, under the leadership of Drs. R. R. Sayers (U.S.A.), Watkins Pitchford (South Africa), and J. H. L. Cumpston (Australia). Methods of ventilation, sanitation, and medical examination were discussed from different points of view. The progress of the hookworm campaign was followed. In Queensland, where 12 per cent. of the miners are affected, the value of this work is being fully demonstrated.

The establishment of an international organisation, with a number of mobile units moving from island to island introducing methods of modern preventive medical science, is deemed essential if the present dwindling of population of native races in many island groups is to be arrested. New Caledonia in 1853 had 70,000 natives; in 1900 the number was 19,000. Measles from Sydney killed 26 per cent. of Fiji's population in 1875, while influenza in 1918 took off 20 per cent. of the natives of Samoa. There is also continuous heavy toll taken by tuberculosis and venereal disease. A basis for part of the discussion was provided by results, obtained from a widely circulated *questionnaire*, showing the distribution of such diseases as plague, smallpox, leprosy, malaria, beri-beri, and others.

In view of the importance of animal life in the economic positions of most of the Pacific countries, a joint discussion between the Hygiene and Veterinary Science Sections on the difficult subject of international animal quarantine regulation had more than passing interest. The fact that "surra" in the Philippines makes it impossible for horses to be kept shows the significance of the whole matter to Australia. Definite proposals have not yet been submitted to the full Congress.

It will be seen that throughout, the main functions assumed by the Congress have been to examine carefully existing lines of work, and then to point to outstanding needs for individual and combined effort in tackling the innumerable scientific problems of the Pacific region. The extent to which such stimulus will lead to action during the next three years will be the test of the value of a meeting of the kind.

A. C. D. R.

Diseases of Fruit in Storage.

ATTENTION was recently directed in NATURE (vol. 111, April 14, p. 516) to the direct efforts now being made in the United States to open up a new field of service for plant pathology, through the study of the best conditions for preserving fruit and vegetable produce in the market and in transit.

It would seem that in Great Britain, in a less direct manner, through the activities of the Food Investigation Board, working under the auspices of the Department of Scientific and Industrial Research, the same field of service is gradually opening to the scientific investigator. Thus the work of Mr. F. T. Brooks and his collaborators upon the fungus organisms contaminating chilled meat, recently noticed in NATURE (vol. 111, April 28, p. 582), was carried out for this Board, which has now issued, as Special Report No. 12, a report upon "brown heart"—a functional disease of apples and pears, by Dr. Franklin Kidd and Dr. Cyril West.

Occasionally when apples and pears are in storage, or when in transit by ship to Great Britain, although entirely healthy to outward appearance, the inner portion of the fruit decays and turns brown; no organism is found to be present as the cause of this diseased condition, which may be widespread.

The authors report that, in 1922, this internal decay, which they have described as "brown heart," was so prevalent among apples imported from Australasia as to arouse anxiety among those connected with the fruit trade. In a report which is singularly direct in

its analysis of the cause of the practical problem and in indicating the direction in which prevention of the disease may be looked for, the authors show clearly how laboratory investigations, at first sight remote from the practical problem, contribute to its solution.

Laboratory experiments have shown that an exactly similar "brown heart" condition may be produced in home-grown apples, under carefully controlled conditions which leave no doubt that the internal decay takes place when the concentration of carbon dioxide in the internal atmosphere, in the air spaces ventilating the tissues of the apples, exceeds a certain toxic limit. The ventilating system and its communication with the external atmosphere, varies with the variety of apple; naturally, therefore, the toxic limit is reached with different rapidity in different varieties, and thus a reasonable explanation is found of the different varietal susceptibility to "brown heart."

The authors establish experimentally that within wide limits the oxygen concentration is not responsible for "brown heart," and their examination of the ships' holds where "brown heart" has appeared during the voyage confirms the view that it is to be associated with a high percentage of carbon dioxide in the hold where the apples were stored. Thus the importer, the grower, or salesman concerned with the storage of apples and pears has his attention directed to one clearly defined pathological condition to which the fruit is subject, and at the same time a clear suggestion as to the direction in which a remedy may be found.

Incidentally the authors think that their work also elucidates an old-standing problem of the grower, whose apples frequently suffer from a functional disorder known as "bitter-pit." Brown discoloured patches appear just under the skin of the apple and dry up leaving the pits. The original browning and decay seems to be exactly similar to the internal decayed tissue in "brown heart," and is probably traceable to the same cause, a local excess of carbon dioxide in the tissue just below the skin which then turns brown. This suggestion will greatly interest apple growers. "Bitter pit" much depreciates the value of a good apple, and attention will certainly be turned to the possible causes of such local excessive accumulations of carbon dioxide in the ventilating system of the apple tissue.

The New Mechanics.[1]

IT is interesting to speculate on the forecasts which would have been made at the beginning of the century as to the condition of physical theory now. The state of knowledge at that time would have suggested that the atomic theory would proceed to develop along the lines of the older mechanics. One or two phenomena already known did not seem to fit in very well, but it was not very unreasonable to suppose that the increase of knowledge would remove these difficulties. The physicist of that time would not have conjectured what has actually come to pass. There are at present two great bodies of doctrine, either of which seems to hold over a wide field, but neither of which can be at all reconciled with the other. Nature is more like both than like any compromise between them. Of these two doctrines, one is the old-fashioned mechanics, which works for many atomic phenomena; the other—the new mechanics—is known as the *quantum theory*. The underlying true mechanics are really quite unknown, but we have a curious set of rules which have an extraordinary knack of giving the right answer; the branch of mathematics with which these rules are most closely connected is, rather unexpectedly (and with a good deal of qualification), elementary arithmetic. It is the purpose of the lecture to illustrate this.

The first illustration is "atomic number." It has been found possible to number off all the elements known to chemistry, starting from hydrogen 1, helium 2, and so on up to uranium 92, and these numbers have a simple physical meaning which is the most important thing that can be said about the elements. The atomic number is simply the total number of *electrons* which revolve round the *nucleus* of the atom. It can be studied in a variety of ways, of which the most striking is the α-ray photographs of C. T. R. Wilson.

More complicated illustrations are given by the Bohr theory of spectra. The best approach to the subject is through the phenomenon of resonance potentials. If an electron strikes an atom with more than a certain amount of energy, the collision is inelastic and the energy is radiated away all in one wave-length. The collision has raised the atom from one definite condition to another, and the return causes the emission. A complete theory of the hydrogen spectrum has been founded on this idea, and as a result of this theory the various conditions of the atom can be described by labelling the electron (there is only one in hydrogen) with two numbers—thus 4_2 or 6_1. In the higher elements the same idea works and each electron has certain numbers associated with it; here, however, the number pairs have not quite the precisely defined dynamical meanings that can be given them in hydrogen. The spectral lines can also be described in terms of numbers. These numbers have not yet been made to yield the absolute values of the wave-lengths, but it is possible by their means to unravel the general characters of what are often highly complicated systems of lines. For a line, two groups of numbers are required, such as $5(3,2)\rightarrow 2(2,2)$, and there are rules as to what pairs of numbers may go together—for example, the second members of the two groups can differ only by 1, the third by either 1 or 0, whereas the first may differ by any amount. There is still a great deal of work to be done on the subject, but it seems probable that all spectra will at no very distant date be brought under rules of this kind.

This is a very incomplete sketch of the successes of the quantum theory, but that theory is only a partial view of the whole of Nature, because it leaves out of account certain indirect ways in which spectral lines exhibit themselves. The chief of these are the ordinary processes of reflection and refraction of light, which are very well explained on the older theory. A reconciliation of the two views seems at present quite impossible, and this can only mean that there are fallacies in some of the fundamental assumptions that we make unconsciously. Of these almost the only ones, that it would do any good to abandon, are the belief in the continuous nature of time and space, beliefs which have been disturbed by the Relativity Theory of Einstein, which will probably have to be once again revolutionised to reconcile atomic theories. To any one who finds difficulty in Einstein's theory, and that is to every one, this is a rather depressing prospect, but it is quite possible that the new revolution, whatever it may be, will tidy up the whole field and make it easier to deal with, even though it will superficially be less like than before to our crude ideas of the nature of the world.

[1] Synopsis of an address delivered on October 16 at the University of Edinburgh by Prof. C. G. Darwin, the first occupant of the Tait chair of natural philosophy in the University.

University and Educational Intelligence.

CAMBRIDGE.—Mr. F. J. W. Roughton and Mr. W. R. Dean have been elected to fellowships at Trinity College.

A letter from the Chairman of the University of Cambridge Commissioners has been received inviting representations from University bodies and from individual members or groups of members of the Senate on matters in which they desire the proposals of the recent Royal Commission to be modified. These should be sent before the end of the year to the Secretary to the Commissioners, Mr. H. A. Hollond, Trinity College.

EDINBURGH.—Prof. J. J. R. MacLeod, professor of physiology in the University of Toronto, who was awarded the Cameron prize for 1923, delivered two lectures in the University on October 16 and 17 respectively, on the nature of control of the metabolism of carbohydrates in the animal body. He dealt with the discovery of insulin and its value in the investigation, not only of diabetes, but also of other problems of metabolism. The Cameron prize was founded in 1878, and is awarded to an investigator who in the course of the five years immediately preceding has made an important addition to practical therapeutics.

Prof. T. J. Mackie, formerly professor of bacteriology in the University of Cape Town, who was recently appointed Robert Irvine professor of bacteriology, devoted his inaugural address to a survey of the present position of medical bacteriology. Prof. Mackie has made arrangements for developing the teaching of bacteriology as a subject for the degree of B.Sc.

Dr. J. E. M'Cartney has resumed duty as lecturer in bacteriology after a year's leave of absence granted to enable him to carry out researches on certain filterable viruses in the Rockefeller Institute.

LEEDS.—The West Riding County Council has decided to devote the proceeds of a penny rate to the assistance of university education, which has already in the past been consistently supported by the Council.

Mr. W. F. Shanks has been appointed professor of physiology. Dr. Shanks graduated B.Sc. at the University of Glasgow in 1913, with special distinction in physiology, and M.B., Ch.B., in 1915 with commendation. In 1920 he was appointed lecturer in physiology at Glasgow and acted as senior assistant to the Regius professor of physiology. For the last three years he has also been in sole charge of a special course in physiology for the new degree of Bachelor of Education (Glasgow), in which the subject is treated from a special point of view with regard to the physiology of the child, psychology, and other cognate aspects.

The following further appointments have been made: Mr. F. J. Brown to be assistant lecturer in zoology; Mr. A. W. Anderson and Mr. J. McGregor, district lecturers in agriculture; Mr. G. Milne, temporary assistant lecturer in agricultural chemistry; Mr. H. Preston, assistant science tutor; Miss M. K. Morgan, assistant lecturer in geography; and Miss E. Newcomb, assistant lecturer in education.

LONDON.—Free public lectures on "The Treatment of Injuries of the Long Bones produced by Accident or Disease" will be delivered by Prof. E. W. Hey Groves at Guy's Hospital Medical School at 5.30 on November 8, 9, 12, and 13.

Societies and Academies.

LONDON.

Optical Society, October 11.—E. T. **Hanson**: Notes on the elementary algebraic theory of a class of photographic objectives. Equations expressing the absence of Seidel's first four aberrations in an objective consisting of two thin systems of lenses, separated by an interval, are formed. When each of the two thin systems consists of only two lenses, the equations can be put in a form which admits of an elegant graphical solution, regard being paid to the necessity of obtaining a solution in which no one of the lens curvatures exceeds a certain limit.—T. **Smith**: A general survey of the thin double lens. The shapes of the lenses and the types of glass suitable for the construction of an objective free from all first-order aberrations in a primary plane for an infinitely distant object are found on the assumption that the system is composed of two separated thin lenses, each of which consists of glasses cemented together. The analysis indicates that "old" achromats should be used for both component lenses, a conclusion not in accordance with modern practice.—T. F. **Connolly**: New types of levelling instruments using reversible bubbles. A true level can be obtained using reversible bubbles, as the mean of two observations from a single station. The theory is then applied to the design of various types of "self-adjusting" levels and to the adjustment of a collimator.

PARIS.

Academy of Sciences, October 1.—M. Albin Haller in the chair.—A. **Lacroix**: The composition of the meteorite which fell at Saint-Sauveur (Haute-Garonne) in 1914. The examination by metallographic methods proved the presence of metal (nickeliferous iron) and enstatite, with smaller proportions of clino-enstatite, oldhamite, maskelynite, apatite, and graphite. A complete chemical analysis is given, the portion removable by acids (mainly metallic) being examined separately.—Emile **Picard**: H. G. Zeuthen.—Vito **Volterra**: The movement of a fluid in contact with another fluid and surfaces of discontinuity.—Maurice **Gevrey**: The formation and use of Green's functions in the integration of linear partial differential equations of any order whatever with imaginary characteristics.—F. H. **van den Dungen**: New technical applications of integral equations.—Antoine **Zygmund**: On trigonometrical series.—R. **Jacques**: Two networks the two tangents of which belong to linear complexes and the transformations of the equations of the surfaces of constant totalcurvature.—Serge **Bernstein**: The principle of stationarity and generalisations of Mendel's law.—P. **Stroobant** and P. **Bourgeois**: Certain stars the movements of which are parallel and equal to that of the sun.—Paul **Pascal**: The slow formation of a definite compound in mixed crystals. Some anomalies in the cooling curves of mixtures of benzylidene-aniline and anisylidene-aniline have been shown to be due to the slow formation of a definite compound of one molecule of the latter compound with two of the former.—René **Dubrisay** and Pierre **Picard**: The capillary phenomena manifested at the surface of separation of water and vaseline oil in the presence of fatty acids and of alkalies. The drop volume method has been applied to the study of the changes in the surface tension at the surface of separation of vaseline oil and aqueous solutions. The latter included solutions of caustic soda and sodium carbonate, of sodium carbonate and sodium bicarbonate, and of caustic soda with common salt.—H. **Gault**: The soluble ester salts of starch and

the higher fatty acids. Ordinary starch, suspended in a mixture of pyridine and toluene, heated with lauryl chloride, gives a dilaurate of starch. Details of its properties and analysis are given.—Adrien **Guébhard**: The Japanese earthquake.—E. **Rothé**: Earthquakes in France in 1920–21. A table giving locality, time, degree, and epicentral region of nine earthquakes in 1920 and six in 1921. The greatest seismic activity was in the region of the Pyrenees.—E. G. **Mariolopoulos**: The formation of local Mediterranean depressions and the Norwegian theory of the "polar front." The local Mediterranean depressions appear to be formed in accordance with the Norwegian theory of the "polar front."—A. **Guilliermond** and G. **Mangenot**: Cytological observations on the mode of formation of essential oils. The method adopted is based on the selective staining power of indophenol blue. The sections are made by hand or in the freezing microtome, stained, and observed in water. The results of the observations do not confirm the view that there is a relation between tannoids and essential oils.—M. **Prianichnikov**: The assimilation of ammonia by the higher plants. The experiments cited lead to the conclusion that the plant, whether green or etiolated, absorbs ammonia energetically from ammonium salts. Nitrates must be reduced to ammonia before absorption by the root. If in agriculture, the development of the plant is roughly proportional to the rate of nitrification, the causes are of a secondary nature; anything which prevents nitrification, such as acid reaction or insufficient aeration, also prevents the development of the higher plants, so that the nitrification is an important criterion of the condition of the soil.—V. **Lubimenko**: The specific action of light rays of various colours in photosynthesis.

WASHINGTON, D.C.

National Academy of Sciences (Proc. Vol. 9, No. 9, September).—J. **Stieglitz**: (1) A theory of colour production. By reduction, every dye becomes colourless, forming the "leuco-dye"; by oxidation of the latter, the colour is restored. Indophenol owes its colour to the combination within the molecule of a strong positive oxidising atom with a strong negative reducing atom. Colour intensity is increased by increasing the reducing side with a base. The reducing electrons are freed sufficiently from *intra*-atomic restraints to permit vibrations which absorb a portion of white light, the complementary colours appearing in the dye. A similar argument is used to explain the colour of basic dyes such as pararosaniline. (2) A theory of colour production: inorganic compounds. Colour may be produced by a loosely held electron in an atom with an odd number of valence electrons (G. N. Lewis), by *intra*-atomic or *inter*-atomic oxidation reduction potentials, or by both the latter, in the manner similar to that described above in (1).—G. **Strömberg**: The asymmetry in the distribution of stellar velocities (see NATURE, October 20, p. 600).—W. J. **Luyten**: On the mean absolute magnitudes of the K and M giants and the systematic errors in trigonometric parallaxes. The mean absolute magnitude of the Ko giants, assumed to be independent of their position in space, is about +0·7 mag.; that of the M giants is about −0·2 mag. No large systematic error is found in the Allegheny trigonometric parallaxes.—C. E. **Seashore**: Measurements on the expression of emotion in music. Musical expression can be conveyed entirely by the sound wave: frequency determines pitch, amplitude intensity, duration of the single wave extensity, and the form of the wave timbre. All these factors can now be recorded and analysed; *e.g.*, the vibrato in singing is a synchronous pitch and intensity pulsation of about 6 oscillations a second.—G. A. **Miller**: Groups of order 2^m in which the number of the sub-group of at least one order is of the form $1+4k$.—L. **Thompson**: The motion of a falling chronograph projectile. With this instrument, neither the projectile being timed nor the projectile of the chronograph which carries the photographic surface for taking the record, strikes a material object during the experiment. Corrections are made for the influence on the early motion of the chronograph projectile of the magnet from which it is released and also for air resistance. The instrument measures with an error not greater than 1/2,000,000th sec.

CAPE TOWN.

Royal Society of South Africa, August 15.—Dr. A. Ogg, president, in the chair.—M. **Rindl**: Preliminary note on the active principles of the yellow tulip (*Homeria pallida*). The alcohol extract, after removal of the solvent, was separated into a water soluble portion and into a resin. The former yielded crude alkaloid equivalent to 0·017 per cent. calculated on the weight of the plant material. Only 23 per cent. of this is water soluble, and the stems and leaves seem to owe their toxic properties mainly, if not entirely, to this water soluble alkaloid. The alkaloid exerts a digitalis-like action on the circulation, and in large doses is a cardiac poison. Its action is not cumulative. The aqueous solution appears to contain two other alkaloids differing in their behaviour towards organic solvents, as well as an organic base. A primary amine and a very small amount of a glucoside were detected. Extracts from the corms and sheaths contain active substances of the nature of a cardiac tonic. They are very poisonous, and administered to animals in successive small doses, they send the heart into fibrillation and cause sudden death.

SYDNEY.

Royal Society of New South Wales, September 5.—Mr. R. H. Cambage, president, in the chair.—E. H. **Booth**: Atmospheric dust and atmospheric ionisation. A persistent nucleus—which is presumed to be the Langevin large "ion"—requires for condensation a supersaturation 1·075, corresponding to a diameter of $1{\cdot}25 \times 10^{-6}$ cm., taking the density as unity. This is not found in filtered air, nor does it grow in filtered air. It may be produced in filtered air if the air is bubbled through water, although the condensation can be in no way dependent on electrification effects. A "foreign" nucleus is essential; electrification merely enables it to be recognised by mobility tests.—A. R. **Penfold** and R. **Grant**: The germicidal values of Australian essential oils (exclusive of Eucalypts) and their pure constituents, together with those for some essential oil isolates and synthetics. Pt. 1. When tested against *B. typhosus*, the pure constituents, as well as a number of isolates and synthetics, were found to possess coefficients varying from 6 to 20, ketones, alcohols, and a number of phenols possessing well-marked germicidal properties; 1 per cent. suspensions of the bodies examined were prepared in 7½ per cent. rosin soap solution for examination. The phenol ethers, safrol, and isosafrol were found to possess coefficients of 11 to 12. Thymol manufactured in Sydney from piperitone gave the same coefficient as the natural isolate, 25.—A. R. **Penfold** and F. R. **Morrison**: Preliminary note on the electrolytic reduction of piperitone. The preparation in quantitative yield of isomenthone from piperitone by electrolytic reduction at 20-30° C., using a nickel cathode. A current density of 3·5 to 4 amp. was employed with an E.M.F. of 6-10 volts,

the reaction being completed in 12-13 hours using 100 c.c. of ketone. Highly lævo-rotatory samples of piperitone yielded menthone of high dextro-rotation, the semicarbazone of which melted at 113° C.

Official Publications Received.

Commercial Intelligence Department, India. Agricultural Statistics of India, 1920-21. Vol. 2: Area, Classification of Area, Area under Irrigation, Area under Crops, Live-Stock, and Land Revenue Assessment in certain Indian States. Pp. v+205. (Calcutta: Government Printing Office.) 1.8 rupees.

Reprint and Circular Series of the National Research Council. No. 46: Problems in the Field of Animal Nutrition. By Sub-Committee on Animal Nutrition. Pp. 9. (Washington: National Academy of Sciences.) 15 cents.

Bergens Museums Aarbok, 1921-1922. 1 Heft. Pp. 28+26+41+23+5+50. (Bergen: A/S John Griegs Boktryckeri og N. Nilssen & Søn.)

Department of Agriculture, Tanganyika Territory. Report for the Year 1922. Pp. 30. (Dar-es-Salaam.)

Arbeten utgifna med Understöd af Vilhelm Ekmans Universitetetsfond, Uppsala. 29: Die Goten und Langobarden in Italien. Von Nils Åberg. Pp. viii+166. (Uppsala: Almquist & Wiksells Boktryckeri A.-B; Haag: M. Nijhoff; Leipzig: O. Harrassowitz; Paris: Honoré Champion.)

U.S. Department of Agriculture. Farmers' Bulletin No. 1321: Fumigation of Citrus Trees for Control of Insect Pests. By R. S. Woglum. Pp. 59. (Washington: Government Printing Office.) 10 cents.

South Australia: Department of Mines. Geological Survey of South Australia, Bulletin No. 10: The Building Stones of South Australia. By R. Lockhart Jack. Pp. 73. (Adelaide: R. E. E. Rogers.)

Straits Settlements. Annual Report on the Raffles Museum and Library for the Year 1922. By Major J. C. Moulton. Pp. 18. (Singapore.)

Department of Agriculture, Trinidad and Tobago. Administration Report of the Director of Agriculture for the Year ended December 31, 1922. Pp. 14. (Trinidad.) 6*d*.

Commonwealth of Australia. Institute of Science and Industry: Professional Papers. Presidential Address to the Australasian Association for the Advancement of Science, at the New Zealand Meeting, January 1923, by Sir George H. Knibbs: Science and its Service to Man. Pp. 46. (Wellington: W. A. G. Skinner.)

Annual Report of the Meteorological Committee to the Air Council, for the Year ended 31st March 1923. (M.O. 258.) Pp. 62. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

The Phylogenetic Method in Taxonomy: the North American Species of Artemisia, Chrysothamnus, and Atriplex. By Harvey M. Hall and Frederic E. Clements. (Publication No. 326.) Pp. vi+355+58 plates. (Washington: Carnegie Institution.) 6.75 dollars.

The Third-Chromosome Group of Mutant Characters of *Drosophila melanogaster*. By C. B. Bridges and T. H. Morgan. (Publication No. 327.) Pp. x+251+3 plates. (Washington: Carnegie Institution.) 3 dollars.

Undernutrition in Steers: its Relation to Metabolism, Digestion and Subsequent Realimentation. By Francis G. Benedict and Ernest G. Ritzman. (Publication No. 324.) Pp. viii+333+2 plates. (Washington: Carnegie Institution.) 3.25 dollars.

Interferometer Experiments in Acoustics and Gravitation. By Prof. Carl Barus. Part 2. (Publication No. 310.) Pp. viii+113. (Washington: Carnegie Institution.) 1.75 dollars.

Genetic Studies on *Drosophila virilis*; with Considerations on the Genetics of other Species of Drosophila. By Charles W. Metz, Mildred S. Moses and Eleanor D. Mason. (Publication No. 328.) Pp. 94+5 plates. (Washington: Carnegie Institution.) 1.75 dollars.

Diabetic Metabolism with High and Low Diets. By Elliott P. Joslin. (Publication No. 323.) Pp. ix+334. (Washington: Carnegie Institution.) 4.50 dollars.

Astronomical and Magnetical and Meteorological Observations made at the Royal Observatory, Greenwich, in the Year 1919; under the Direction of Sir Frank Dyson. Pp. 8+Axx+A52+C3+D123+5+Exx+E82+19. (London: H.M. Stationery Office.) 40*s*. net.

Cape Astrographic Zones. Vol. 6: Catalogue of Rectangular Coordinates and Diameters of Star Images derived from Photographs taken at the Royal Observatory, Cape of Good Hope; commenced under the Direction of Sir David Gill, completed and prepared for Press under the Supervision of S. S. Hough. Zone −46°. Pp. xxxvii+506. (London: H.M. Stationery Office.) 100*s*. net.

Zone Catalogue of 20,843 Stars included between 40° and 52° of South Declination referred to the Equinox 1900, derived from Meridian Observations and Photographs made at the Royal Observatory, Cape of Good Hope; under the Directions of Sir David Gill and S. S. Hough. Pp. lxxi+418. (London: H.M. Stationery Office.) 100*s*. net.

The University of Leeds. Calendar, 1923-24. Pp. 556+xxxvi. (Leeds.)

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1922. Pp. 119. (Bristol.)

Smithsonian Miscellaneous Collections. Vol. 76, No. 5: The Telescoping of the Cetacean Skull. By Gerrit S. Miller, Jr. (Publication 2720.) Pp. 70+8 plates. (Washington: Smithsonian Institution.)

University of London: University College. Calendar, Session 1923-1924. Pp. lxviii+10+423+lxix-clxxviii. (London.)

Agricultural Research Institute, Pusa. Bulletin No. 139: List of Publications on Indian Entomology, 1920-21. Compiled by the Imperial Entomologist. Pp. 67. (Calcutta: Government Printing Office.) 1 rupee.

The Institution of Civil Engineers. Engineering Abstracts prepared from the Current Periodical Literature of Engineering and Applied Science, published outside the United Kingdom. Supplement to the Minutes of Proceedings of the Institution. New Series, No. 17, October. Edited by W. F. Spear. Pp. 152. (London: Great George Street.)

Department of the Interior: Bureau of Education. Bulletin, 1923, No. 36: Rural Education. By Katherine M. Cook. Pp. 35. Rural School Leaflet No. 12: Consolidation of Schools in Randolph County, Indiana. By O. H. Greist. Pp. 12. Rural School Leaflet No. 13: The Consolidated Schools of Weld County, Colorado. By Prof. C. G. Sargent. Pp. 11. Rural School Leaflet No. 17: The Iowa Plan of Training Superintendents and Teachers for Consolidated Schools. By Mary Campbell. Pp. 5. (Washington: Government Printing Office.) 5 cents each.

Memoirs of the Asiatic Society of Bengal. Vol. 7, No. 5: Vocabulary of Peculiar Vernacular Bengali Words. By F. E. Pargiter. Pp. 321-436. (Calcutta: Asiatic Society of Bengal.) 4.8 rupees.

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verhandelingen No. 11: Regenval in het Noordelijk deel van (Rainfall in the Northern part of) Sumatra's Oostkust. Door Dr. J. Boerema. Pp. iv+63+19 plates. (Weltevreden, Java: Albrecht and Co.)

Diary of Societies.

MONDAY, OCTOBER 29.

INSTITUTE OF ACTUARIES, at 5.—W. Palin Elderton and H. J. P. Oakley: Notes on the Interpretation of "Select" Rates of Mortality.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. Shattock: Actinomycosis: Madura Disease.

TUESDAY, OCTOBER 30.

INSTITUTE OF MARINE ENGINEERS, INC., at 6.30.—Viscount Curzon: Presidential Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Dr. C. E. K. Mees: Amateur Kinematography.

ROYAL SOCIETY OF MEDICINE, at 9.—Presentation of Gold Medal to Prof. Gowland Hopkins, who will lecture on Stimulants of Growth.

WEDNESDAY, OCTOBER 31.

SOCIOLOGICAL SOCIETY (at Royal Society), at 8.15.—Sir W. M. Flinders Petrie: The Growth and Decay of Communities (Lecture).

THURSDAY, NOVEMBER 1.

ROYAL SOCIETY, at 4.30.—E. G. T. Liddell and Sir Charles Sherrington: A Comparison between certain Features of the Spinal Flexor Reflex and of the Decerebrate Extensor Reflex respectively.—J. Barcroft and H. Barcroft: The Blood Pigment of Arenicola.—T. Deighton: The Basal Metabolism of a Growing Pig.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Major Wimperis: Some Recent Developments in Aircraft Instruments.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—W. Wilson: Industrial Research, with special reference to Electrical Engineering Development.

CHEMICAL SOCIETY, at 8.

FRIDAY, NOVEMBER 2.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Sir Westcott S. Abell: The Mechanical Problems of the Safety of Life at Sea. (Thomas Hawksley Lecture.)

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—S. J. Tayler: Photographic Perspective.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—D. V. Hotchkiss: Hydraulic Propulsion.

PHILOLOGICAL SOCIETY (at University College), at 8.—Prof. F. Newton Scott: American Idiom.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—Dr. H. Featherstone: A Critical Report on 100 cases of Spinal Analgesia with Tropacocaine.

SATURDAY, NOVEMBER 3.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10 A.M.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—Dame Helen Gwynne-Vaughan: The Mechanism of Inheritance.

PUBLIC LECTURES.

SATURDAY, OCTOBER 27.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—E. Lovett: The Legendary Folklore of the Sea.

MONDAY, OCTOBER 29.

UNIVERSITY COLLEGE, at 5.—Miss Iza Thompson: The Teaching of Speech to Deaf Children.

MEDICAL SOCIETY OF LONDON, at 5.15. Dr. C. K. Millard: The Disposal of the Dead. (Chadwick Lecture.)

WEDNESDAY, OCTOBER 31.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Major H. G. Anderson: Air Accidents and the Hygiene of Aviation.

UNIVERSITY COLLEGE, at 6.15.—H. Higgs: The Part of Statistics in Civic Education (Newmarch Lectures). (Succeeding Lectures on November 7, 14, 21, 28, and December 5.)

THURSDAY, NOVEMBER 1.

ROYAL SOCIETY OF MEDICINE, at 5.—Dr. A. Logan Turner: The Advancement of Laryngology: A Plea for Adequate Training and Closer Co-operative Action. (Semon Lecture.)

KING'S COLLEGE, at 5.30.—R. Aitken: The Geography of Spain and Typical Spanish Institutions. (Succeeding Lectures on November 8, 15, 22, and 29.)

FRIDAY, NOVEMBER 2.

UNIVERSITY COLLEGE, at 8.—Prof. G. Dawes Hicks: The Fundamental Concepts of Natural Science. (Succeeding Lectures on November 9, 16, 23, 30, and December 7.)

SATURDAY, NOVEMBER 3.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. C. A. Raisin: Volcanoes.