NATURE

SATURDAY, OCTOBER 20, 1923.

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Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters should be addressed to the Publishers.
Editorial communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

Scientific Papers and Books.

"Of making many books there is no end; and much study is a weariness of the flesh."

ONE of the problems which scientific investigators have to face is that of the great mass of literature with which they are supposed to make themselves familiar before they proceed along the road in which their interests lie. It is almost impossible in these days to keep in touch with everything published, even in a single department of science, by all the scientific societies and institutions of the world; and the result is that the announcement of an interesting observation or experiment is frequently followed by a claim for priority from another worker in the same field. Creative work of the first order is of course very rarely anticipated in this way, but determinations of properties, measurements of values, observations of structures, records of particular effects, and so on, are often duplicated and sometimes lead to discussions into which unworthy imputations are introduced.

Such publications as the International Catalogue of Scientific Literature and the Royal Society Catalogue are useful as guidance to what has been published on various subjects or by different workers, and several scientific societies publish collections of abstracts periodically, while the excellent Subject Index to Periodicals issued by the Library Association provides a means of ready reference to the titles of many papers worth attention. These and similar aids cannot be neglected by investigators engaged in original scientific work unless they are indifferent to what has been done, or is being done, by others in the same field. It is said that a government official who had been largely responsible for securing a grant for the International Catalogue of Scientific Literature once asked a distinguished man of science whether the Catalogue was very useful, and was astonished at the reply: "I do not know, because I have never used it." Few people engaged in research are, however, so original that they can afford to take this risk; for, like wise inventors, they realise that unless they know what has already been produced they may waste much valuable time in doing something for which no claim for originality can afterwards be substantiated.

The numerous original papers which reach NATURE office every week in publications of societies and as separate reprints, afford us an idea of the difficulty in which every scientific investigator must find himself. We cannot attempt to do more than mention a few points of prime importance or wide interest selected from these papers; for merely to give the titles of them all would occupy several pages every week. Every paper received is, however, sent to a contributor familiar with the general subject and not likely, therefore, to overlook anything of outstanding importance. Our columns of Research Items, and short articles which follow them, represent the result of such eclectic surveys of a body of literature which increases in volume every week, and from which limitations of space permit only a few specific points to be described. Nothing more can be reasonably expected in a general scientific newspaper such as Nature, the main appeal of which is to the scientific world as a whole and not to a specialised section of it.

It is even more difficult to decide how to deal with the great mass of scientific books now published than it is with papers. Within the past four weeks, for example, we have received no less than 150 volumes, almost all of which have distinct characteristics and many of which merit extended notice, on account either of the positions of the authors or the interest of the subjects. It is obviously impossible, however, for us to review more than a fraction of these volumes without destroying the balance and the character of our columns. Our monthly list of Recent Scientific and Technical Books includes bibliographic details of every book received, as well as of others, and this should serve as general guidance to the various works being issued on scientific subjects. By publishing all these titles we are able to do for books what it is impossible to undertake for single papers or memoirs.

As regards reviews, experience shows that those of the essay type, which deal with the subjects of the books broadly and descriptively, are most widely read, and therefore serve the best purposes of both author and publisher. Summaries of the contents of the various chapters of a book, with comments upon them, are more appropriate in prospectuses and advertisements than in the columns of a journal which aims at interesting its readers in the progress of science generally, and not alone in the special portion of the field in which they are themselves working. A review should, however, be a judgment as well as a description; for readers are guided by it in their decision whether to add the book to their libraries or not. Differences of temperament are sometimes responsible for the same volume being praised by one reviewer and condemned by another of equal authority. Some reviewers are always kind, while others are always critical, looking for faults rather than for points worthy of commendation. To this class belonged the reviewer who concluded his notice with the words "We have not found any mistakes, but no doubt there are some." If a book contains a large number of errors, probably the best plan is to neglect it altogether. We prefer not to print lists of such errors, but to send them to the author or publisher, who is always grateful to know of necessary corrections of this kind.

The authors who are never satisfied with the treatment which their works receive are those who evolve elaborate theories, or assert new principles, without sufficient knowledge to understand how untenable their views are. If their works are not noticed, authors of this type nourish the grievance that there is a conspiracy of the scientific world against them. It is useless to publish a short notice stating that the work has no scientific value or is fundamentally unsound. What such authors expect are discussions in detail of the points they raise, though no one else would be likely to be interested in such discussions.

From our point of view, the size of a book affords no standard of the space which may appropriately be given to it. Interest of the subject and distinction of the author are the chief claims to attention. A slender volume may thus be more worthy of extended notice in the form of an essay review than one of a thousand or more pages. With the best intention in the world, however, space cannot be found for adequate notice of all such works now published. Necessity, and not inclination, determines what can be dealt with in this way, and from the rest it is only possible to select some for notice in our Bookshelf columns. What we particularly desire authors and publishers to understand is that the sending of a book for review creates no obligation to publish a notice of it. All that we can undertake is to examine the book and to send it to a reviewer with an invitation to contribute a review of a prescribed length, or to include it in a parcel of books with a request to select a few of the best for notice. The rest appear only in our monthly lists.

Even with these limitations, the congestion of reviews and minor notices is always severe, and we are never able to outrun the flood of literature which continually threatens to overwhelm us. It would be easy to publish every week an equal number of reviews and other notices to that included in the present issue, and yet not exhaust the pile of books which merit consideration. Critical minds may deplore this abundance of printed pages, but to us it seems that most of the books have some original characteristics of style, substance or treatment, and we must confess to a feeling of sympathetic regret for the authors whose works have often to be dismissed somewhat summarily, purely on account of considerations of space. They should be as grateful as we are that leading workers in all branches of science are willing to examine books carefully, and to make some of the volumes subjects of such interesting and useful notices as those which continually appear in the columns of Nature, and are represented by the reviews included in the present issue.

The Scope of Science.

The Domain of Natural Science: the Gifford Lectures delivered in the University of Aberdeen in 1921 *and* 1922. By Prof. E. W. Hobson. Pp. xvi+510. (Cambridge: At the University Press, 1923.) 21*s*. net.

DR. HOBSON'S important book falls into three main divisions: the first consists of four lectures and describes his general philosophical position, or rather, as he would prefer us to say, his view of the nature of science and its relation to philosophy; the second, being in fact the bulk of the book, comprises fourteen chapters, giving a survey of the development of scientific thought in all its main branches from mathematics to biology; the third, which is a sort of epilogue, brings the book within the terms of the Gifford Trust and deals with the limits of natural science and religion: this is the last two chapters. We will say a few words about each in turn.

Dr. Hobson's general view of the nature of science agrees with that of Mach and Karl Pearson. He explains it carefully and frequently, and arranges the main substance of the lectures so that they depend on this thesis and illustrate it. In this view a scientific theory is "a conceptual scheme, designed by the synthetic activity of the mind, working with the data of perception, for the purpose of representing particular classes of sequences and regularities in our percepts." It has nothing to say as to the reality, or non-reality, of anything behind phenomena, nothing as to efficient or final causes. It is an intellectual shorthand, enabling mankind to deal more and more economically and effectively with the facts of perception which crowd in upon us.

Dr. Hobson is very careful to remind us of the implications of this point of view at every turn in his argument, and it is especially congenial to his own mathematical mind. For this reason he has been able to give us an exposition of the doctrine, quite unexampled in England, if not abroad. Mathematics obviously illustrate the thesis best, and he shows us, *e.g.*, how in dynamics the failure sharply to distinguish the conceptual statement of scientific laws and theories from statements as to percepts has obscured the true nature of science. We can speak and think clearly about a conceptual body moving in conceptual space according to definite numerical specifications, whereas there is no meaning in the assertion that a body moves uniformly in a straight line in physical space. In the same way Dr. Hobson quite rightly treats Einstein's theory of relativity as a conceptual correction of the Newtonian conception: not as a revolution and, above all, not as a new philosophy.

It was certainly a happy thought on the part of the lecturer to turn his general argument into a sort of generalised history of science, and a happy liberality on the part of the Gifford Trustees which enabled them to include it within the corners of their scheme. Histories of science are much in the air just now, and we are constantly seeing small popular books issued on some aspect of the subject, generally biographical. Here we have a survey by a master of the fundamental science of all, who has for years interested himself in general scientific development, and applies an acute, impartial and cautious mind to a statement and an estimate of all the leading theories, especially the more recent, in physics, cosmology and biology. It is a most careful and substantial work which will be of the greatest service to future toilers in the same field. For between the popular histories and the specialist and the philosophical—of which this is an eminent example—there is still a gap waiting to be filled by a concrete, lively, up-to-date survey, such as Mrs. Fisher attempted in the 'seventies and 'eighties.

Dr. Hobson's survey requires careful reading, as it has arisen from careful and thorough thinking and writing. He passes from weighing and delimiting the determinist physical schemes of science to a similar comparison and estimate of dynamical theories. From this to a discussion of the conservation of matter and energy, a sphere which gives him scope for penetrating application of his general theory. What is to be understood by the statement that matter can be neither created nor destroyed? If we mean a substratum, substance itself, not identified with any physical properties, but the bearer of them, we remove our principle from all possibility of verification and make it a bare philosophical assertion with no direct relation to the world of percepts, outside the domain of natural science.

This discussion is followed by a full account of the recent electrical theories of the nature of matter and of the various manifestations of radio-activity. Two chapters discuss cosmical theories and Einstein; four, biology in general, the living organism, heredity, and the evolution of species. In all, the same balanced judgment is maintained, with the same readiness to keep and inculcate an open mind towards the indefinite expansion of scientific truth. Thus, while not accepting the adequacy of any determinist scheme at our present stage of thought, we are not to consider that there are any barriers which will prevent "even larger tracts of phenomena from being correlated with deterministic descriptive schemes." In the realm of life, while allowing full force to the contentions of Driesch and the Neo-vitalists, he tells us that we must be prepared to contemplate as a possibility that the ultimate answer to the question, "What is the distinction between living and non-living matter?" will be that, within the categories of science as here expounded, there is no final distinction.

One is not surprised to find in the application of this theory of the nature of science to the question of religion, or rather of theism, in the two concluding chapters, that Dr. Hobson's attitude is frankly, completely and impartially agnostic. He examines the various forms of theistic belief very briefly and points out their difficulties. He also—and this is perhaps the most valuable part of this section—indicates the change which has taken place in the line of defence in recent times. In pre-Kantian times the defenders of theistic theories based them on evidences of design, on the objective universe. This Dr. Hobson dismisses with the remark that those who argued from the mechanism of the world to a Great Mechanic forgot that the watchmaker has his material supplied ready to hand: his design consists in the adaptation of the given material to his own idea. The Great Mechanic of the universe has to supply his own material, and it is precisely in understanding the origin of the material itself, the life itself, that the supreme difficulty lies. The more recent arguments from design arise from the purposive activities, the entelechy as Driesch names it, of particular organisms, not from a general purpose in the universe as a whole. The arguments which now appeal most to mankind—apart from these purposive activities of individual living beings—are the need of a Universal Rational Mind to justify and act as a basis to the general intelligibility of the universe; and the moral argument, that we need the conception of an Ideal Being to supply the notions of value towards which mankind is always striving, and which he does not find in the humble origins of life towards which scientific research is constantly pressing him. This latter attitude dates in its modern prominence from the work of Kant. On the former our author aptly quotes from Dr. Rashdall: "We cannot understand the world of which we form a part except upon this assumption of a Universal Mind for which, and in which, all that is exists. Such is the line of thought which presents itself to some of us as the one absolutely convincing and logically irrefragable argument for establishing the existence of God."

Here Dr. Hobson leaves it, being content in this part of his argument, as in the rest, to state the rival positions which he considers either that science has not yet conquered, or that do not properly belong to science at all. For his own view of science, as a man-made scheme bringing together, clarifying and co-ordinating our percepts for our own convenience of thinking and applying our thought to action, a purely human synthesis is quite sufficient. The perceptual domain is such that whole tracts of it, and processes in it, are capable of description by rational schemes; and these schemes are so far justified by successes in the past that we can see no limit to their extension in the future on the same lines. These lines are, truthful observation, the simplest hypothesis which co-ordinates the facts and verification by a subsequent return to Nature. The progress which man has made in framing such schemes so far surpasses what he has achieved either in ordering his surroundings or improving his own nature, that we are justified in treating it as the index of his advance. It was the most remarkable and permanent achievement of the Greeks. Its return in the sixteenth century marks the beginning of the modern world. Its dominance in the present age confronts us with our most serious problems and inspires us with the strongest source of hope for their solution.

F. S. MARVIN.

A Reconstruction of Polynesian Culture.

The Belief in Immortality and the Worship of the Dead. By Sir James G. Frazer. Vol. 2: *The Belief among the Polynesians.* Pp. ix+447. (London: Macmillan and Co., Ltd., 1922.) 18s. net.

IN Polynesian mythology the god Maui, fishing in the waste waters of primeval chaos, hauls up the island world at the end of his line. It requires no less skilful a fisherman to bring up again the Polynesian world of savage life and custom from the chaos of insufficient and scattered data embedded in travellers' and missionaries' records. Sir James Frazer, by the present volume, deserves to take his rank beside the primeval fishers—though his work of rescuing a world in dissolution must have been much less joyous and probably more difficult than that of the earlier sportsmen. Those who know the immense difficulty of extracting truth from amateur ethnographic material, and of giving it scientific and literary form, will be able to appreciate the industry and genius contained in this latest contribution of Sir James Frazer.

There is probably no more fascinating chapter of ethnography than the life and customs of the Polynesian islanders, as they were before European contamination. The present volume is the best all-round picture of Polynesian life available, for here, as in his other books, Sir James Frazer gives more than he promises. The title indicates that the research will be concerned with native beliefs in immortality and with the worship of the dead. In order not to tear the subject out of its context, however, Sir James describes the Polynesian ideas of the next world against the background of their religious and magical creeds, and these again he places within the setting of tribal life, not forgetting to give us a picture of the physical environment.

Thus, in one archipelago after the other, we receive a vivid though fleeting vision of the lofty volcanic peaks, the forest-clad slopes, and the shaded coral beaches where clearings, smoke, palm plantations, and gabled roofs indicate the sites of villages. We are then led over the settlements, shown the eager gardeners and the skilled fishermen at work, the talented and industrious artists carving and decorating various objects with their fantastic designs, the indefatigable manufacturers weaving mats, shaping and polishing stone implements, building canoes, and erecting huge houses. They are doing all this, in pre-European times, with the aid of stone implements only, without the help of any metal. We see the adventurous sailors setting out on some distant expedition, whether as a semi-religious, semi-dramatic company of wandering performers in the Society Islands, or as a formidable raiding party in Samoa, or as a trading expedition from Tonga to Fiji. We are shown some of the strange and licentious customs of the South Sea Islanders, where a natural exuberance and a touch of artistry redeem them of their cruder features. The ceremonial and festive life of the islanders, culminating in the Areoi performances of the Otahitians, is recorded here in a very complete manner, and the critical caution and constructive talent of Sir James allow us to learn all that is genuine and true about these institutions of which much must, alas, remain for ever a mystery.

It is impossible to summarise briefly this masterly account of Polynesian civilisation, giving due consideration to the differences as well as to the similarities between its various branches. The great uniformity of this culture is indeed remarkable in a people scattered over a wide area in small and isolated communities. Linguistically they are so alike that one must speak, as Sir James does, of one Polynesian language with dialectic varieties. In social organisation they show a remarkable uniformity in structure, with their permanent village communities, with the simple system of kinship terms and the institution of social rank, hereditary and hedged round with taboos and ceremonial observances. Rank gives also political power in a highly developed chieftainship or kingship carried almost to deification. In economic pursuits they are similar, cultivating the same staple plants (taro, sugar-cane, bread-fruit, kava, and palm), and showing the same gaps and developments in arts and crafts.

But, for the student, the differences between the various Polynesian branches are quite as important as their similarities, and the present volume will be of special value and interest just because it does not lump all Polynesians together, but gives a series of monographs, on the Maoris of New Zealand, on the inhabitants of the Tonga archipelago, on the Samoans, the Hervey Islanders, the Otahitians, the Marquesans, and the Hawaiians.

In each chapter, the local beliefs in immortality occupy a dominant position, though always kept in proper proportion within the general picture. It would be useless to summarise each type of Polynesian afterworld. Like their customs and institutions, like their decorative art and mythology, the paradise of these natives is at the same time fantastic and beautiful, quaint and romantic. Born of hope and fear and human presumption, as all such beliefs are, it is a dream-land built up on the pattern of this life, improved and yet formidable, attractive and yet never really desired.

There is no doubt that the beliefs in human immortality, together with the fear of the dead and the hope of their beneficent intercession in earthly affairs, have been among the most important moulding forces of human religion. The chronicles of these beliefs, ranging over the whole world and over all levels of civilisation, which Sir James Frazer is now giving us in one volume after the other, will rank among the most important documents for the study of comparative religion. For the present, Sir James, engrossed in the quest of the immortality of all the peoples of the world, seems to be oblivious of his own: in this descriptive volume, as in the previous one on Australia and Melanesia, he wisely resists the temptation to put forward brilliant theories and daring hypotheses. But those who know Sir James's method realise that before framing any theory he has to study the facts, to collect world-wide material, and examine it by the comparative method. Collected with the author's width and depth of outlook, with his unrivalled grip of sources, and his genius for an all-round presentation, it is given out to scholars, who will thus have before them all the facts bearing on this problem of highest importance. But all anthropologists hope, of course, that there will come a last and crowning volume in this series, in which, as in the fourth part of his "Totemism and Exogamy," Sir James will develop another of his theories which have so greatly influenced modern humanistic thought.

The Rise of Civilisations.

The Cambridge Ancient History. Edited by J. B. Bury, Dr. S. A. Cook, F. E. Adcock. Vol. 1: Egypt and Babylonia to 1580 B.C. Pp. xxii + 704 + 12 maps. (Cambridge: At the University Press, 1923.) 35*s*. net.

THE most valuable and scientific part of this work is the first sixth of the volume, by Prof. Myres, which is an elaborate correlation of Tertiary geology, climate, conditions of life, and movements of races. Though the detail might be gleaned elsewhere, the realisation of the manner in which each change conditions others, the presentation of the continuity of this pre-history, and the living sense of the realities of existence, put plainly to the reader the complexities of tracing the history of man. Such a mass of detail cannot be at all a final statement; the knowledge that has been gleaned in the last fifty years is much too fragmentary as yet. We can welcome this as a piece of courageous charting, which will show where the blank places lie, and make us realise the value of scattered items which may be fitted into place.

Above all, Prof. Myres has the historical sense which is needed for success in interpreting the facts of anthropology and archæology. His attitude about some essential matters may be noted. He accepts fully the production of skull form and features by conditions of food and life, yet also accepts the racial character of skulls. The waiting problem is that of the time required to alter racial types under different conditions; this is not touched on here, for the good reason that there has been no general study of it as yet, although it is at the basis of anthropology. He accepts the unity of European and Mediterranean changes of level in glacial times; and he takes the longer scale of human relation to glacial epochs, as according better with evidences from the Nile. He regards the Mousterian work, of the third glaciation, as having been annihilated by the Aurignacian people arriving from the S.W. The Solutreans he accepts as coming from the N.E. steppe, perhaps derived directly from Acheulean workers, and flowing across Europe, forming the earliest people of Scandinavia, passing down into Egypt, and also southward to Susa. Thus the unity of culture in these regions is accepted. The Capsian was a ruder style, originating in North Africa and pushing up as far as Belgium, leaving kitchen middens, which point to a communal habit. The Magdalenian people are regarded as only an Atlantic branch of the Solutrean in a harsher climate; but the appearance of that type of work in Egypt seems to show that it was not so local, and would be due to a definite movement of a people.

Coming to later times, the Highland or Alpine people are postulated as extending over all the mountainous region from Armenia to France. When we look at the various races already pushing about in the world, it would be incredible that along two thousand miles of unfavourable country one race should persist without spreading down into better lands on both sides. The type is here derived from the food conditions of a forest people who lived mainly on fruits and roots. The principle of skull type being conditioned by climate and food seems the only explanation of the similarity of Alpine people, and we may talk of an Alpine type, while by descent the people might belong to a dozen different races living in the neighbouring plains. This mountain life appears to confer dominant qualities on the people, when mixed with other races. The so-called Armenoid is supposed to have come from the Asia Minor plateau; but if the type depends on mountain life, why should it not equally have grown in the Lebanon or North Syria?

The supreme value of pottery as archæological evidence is lovingly expounded in two pages, after which there is a careful account of the Lake culture, the Danube peoples, Anau and Susa, the Mediterranean culture, the Beaker folk, the Bronze users, and the Halstatt age, explained by several original maps. This work has laid down the first stage of a science, by forming a continuous and consistent scheme of the whole, by which each fresh detail found will have its value as confirming or correcting this framework of our conceptions.

The other chapters which deal with the age of artistic and written records are sound statements of what is now known, and accessible in other works. The most original parts are on the early Babylonian, by Prof. Langdon, and on the early Aegean, by Mr. Wace. In a volume so crowded with detail there must be many differences of opinion, which it is impossible to note here. The treatment of historical material in general does not freely sacrifice it to the internal consciousness of the German school. We may note in passing that glass was not an Egyptian invention, but was very rarely introduced from some outside source during thousands of years, before it became suddenly very common after the conquest of Syria, 1500 B.C. Glaze was known from the earliest prehistoric age in Egypt, but it is not likely to have been invented by that culture. The long priority of Sumer and Elam before the civilisation of Egypt is well stated by Prof. Langdon.

However much work the writers have put into this book, they have been crippled by the editors not allowing illustrations. The ideal of the publication is far too literary. Even the age of Acts of Parliament needs some material representations to understand it, and to write of times in which the whole evidence is material, without using any illustration, is dancing in fetters. It would be as practicable to write of palæontology without a figure of a fossil, or of geometry without a diagram. The salvation of this work would be to issue an explanatory volume of small figures of everything named here, and in a second edition put in numbered references to the figures.

W. M. F. P.

The Genetics of the Fowl.

Heredity in Poultry. By Reginald Crundall Punnett. Pp. xi + 204 + 12 plates. (London: Macmillan and Co., Ltd., 1923.) 10*s*. net.

MODERN genetics is founded in great measure upon the results of experimental breeding work with material which, in the opinion of the average stock-breeder, cannot be regarded as a "real" animal. To him, *Drosophila melanogaster*, and all that pertains thereto, is far too remote to have any bearing upon the peculiar problems of the man who raises stock for profit. He does not understand why Drosophila is unique as genetic material. The experimental biologist must have an animal with few and heteromorphic chromosomes; it must be easily and cheaply kept under laboratory conditions; it must exhibit a very varied characterisation and it must breed rapidly, producing large numbers of offspring in each generation.

It has to be confessed that to the breeder of pedigreed stock, the geneticist has but little to offer that can be applied with profit to the art of breeding specimens of the established breeds—and this is the occupation of the most successful breeders. The breeder has drawn up his own standards of excellence, usually in absolute ignorance of the scientific principles which undoubtedly underlie his art, often indeed in direct defiance of these principles, and has set himself the task of attaining them. In many cases he has succeeded, and it may be accepted that the success of the makers of the modern breed of domesticated animals must have been achieved by methods which were not violently in discord with the principles of heredity which have been disclosed comparatively recently by the geneticist. But these principles were in operation long before the geneticist discovered them, and it was not to be expected that their discovery would result in any profound modification of the breeder's practice. Certainly, the science of genetics can offer to the breeder of pedigreed stock the means of interpreting his successes and his failures, but it is to the creator of new breeds, to the improver of the old, that it can promise most. It can offer more to the breeder of highly fertile, quickly-reproducing stock than to the breeder of cattle or sheep.

Moreover, since at the present time almost the entire weight of the modern chromosome theory of heredity is carried by the dipteran Drosophila, the British geneticist is seeking other suitable experimental material. The organisation of the National Poultry Institute has provided him with a unique opportunity of employing the fowl: there can be no better material for the geneticist working in a research institution, the function of which is to aid the breeder in the solution of his problems. Research is being more and more concentrated in institutes, and above their doors the slogan "Knowledge for its own sake" is not inscribed. In such institutes it is necessary to use material with which the community at large is acquainted, so that its co-operation may be secured, and after all, the study of the phenomena of inheritance in the fowl is equally as thrilling as that which centres around Drosophila. The geneticist cannot readily aid the fancier who is dealing with characters so fine that from the point of view of genetics they demand an outlay in expenditure and meticulous attention by no means commensurate with the theoretical value of the results likely to be obtained; but his interests coincide with those of the utility poultry man who is eagerly demanding knowledge of the mode of inheritance of such characters as fecundity, broodiness, egg-colour, and fertility. The geneticist can, in using the fowl as his material, add considerably to our knowledge of the principles of heredity, and at the same time can bring much-needed assistance to a most worthy section of the community.

Indeed it was with the fowl that Bateson, more than twenty years ago, first showed that the principles enunciated by Mendel, then newly discovered, applied to animals as well as plants. It is certain that had the work of Bateson and Punnett, which immediately followed this, been properly appreciated and adequately financed, the present position of British genetics and of the science of genetics applied to animal breeding would have been very different to-day. It is true that Prof. Punnett has been carrying out experimental breeding work with poultry for twenty years, and that, as his book indicates, he has made most valuable contributions to our knowledge of the genetics of the fowl; but what he has done is but a fraction of what he could have done, had he not been embarrassed by insufficient material and inadequate accommodation.

It seems that at last Prof. Punnett's difficulties are to be removed, for under the auspices of the National Poultry Institute he is to be given the opportunity of carrying on his work under satisfactory conditions. At one time it seemed as though the scheme would fall through, for the response to the appeal for subscriptions towards the funds of the Institute was somewhat tardy. His book appeared most opportunely and greatly strengthened the appeal of the leaders of the poultry industry in England. It showed clearly what had been done by the geneticist working under difficulties, and provided a vision of what could be done when these difficulties were removed. Its reception by the poultry breeders of the country provided an indication of the eagerness with which the "practical" man is turning to the man of science for information. To the poultry-breeder this book is indispensable, for it gives a concise picture of all that has been done by the geneticist working with poultry up to the end of 1922, and no poultry-breeder can afford to disregard the facts with which the book is crammed. To the biologist the book will have a different interest: it will serve as a landmark in the history of the genetics of the fowl, for in the next decade great advances are due. In America, in Australia, in Russia, and in Britain, much concentrated experimental breeding work is in progress. The phenomena of linkage are now being investigated, but owing to the greater complexity of the chromosome constitution—there are seven large pairs and at least nine small pairs of chromosomes, it appears—it cannot be expected that progress will be as rapid and spectacular in the fowl as it has been in the case of Drosophila. To those of us who are working with the fowl this book is a great stimulus: Prof. Punnett's 1933 edition shall bear witness to what the geneticist can do, given opportunity.

F. A. E. C.

Essence and Existence.

Scepticism and Animal Faith: Introduction to a System of Philosophy. By George Santayana. Pp. xii+314. (London, Bombay and Sydney: Constable and Co., Ltd., 1923.) 12*s.* net.

The Life of Reason: Or the Phases of Human Progress. By George Santayana. Second edition. In 5 vols. Vol. 1: Introduction and Reason in Commonsense. Pp. xix+291. Vol. 2: Reason in Society. Pp. viii+205. Vol. 3: Reason in Religion. Pp. ix+279. Vol. 4: Reason in Art. Pp. ix+230. Vol. 5: Reason in Science. Pp. ix+320. (London, Bombay and Sydney: Constable and Co., Ltd., 1923.) 8*s.* net each vol.

MR. SANTAYANA has a wonderful gift of expression and writes with a distinction and charm which are an unending source of delight. Yet he leaves his readers with a strange unsatisfied feeling not free from a touch of resentment. He is a true poet, who can write prose with all the rhythm of verse. Born in Madrid of Spanish parents, he tells us that he has chosen our language for his literary expression, though it is not his native tongue, because he considers that so far as containing truth is concerned one language is as good as another, and he prefers ours. Also, what is truly admirable in a philosopher, he finds it adequate. When we read, however, his sustained but pleasant and well-balanced soliloquising, we cannot but wonder why he should suppose that we are interested in his want of interest in what interests us. Yet this is the whole burden of his philosophy.

Mr. Santayana told us in a recent book that when the War came it found him at Oxford, and he remained there, apparently because he could look on without taking part, indifferent to the result, and comparatively undisturbed. He was content to leave the issue to the statesmen and soldiers; the folly and the wickedness of it might sadden him, but his care was that it should not attach him or invade his philosophic calm. In the same spirit he now contemplates the scientific revolution in mathematics and physics which has produced in our time an intellectual upheaval. It interests him, of course; he thinks it may mean that he is living to see the emergence of a new concept of nature, a new cosmology, comparable with those of Heracleitus, Pythagoras, or Democritus, but as a philosopher he has no part in the matter, and the issue, whatever it be, will not disturb him. He glories in the fact that he does not understand the new principle and is easily and comfortably warned off the attempt to understand it. He knows he has not the technical equipment of the mathematician, and so he must and will accept the new discovery whenever the mathematicians and physicists tell him they are agreed.

It is possible there are many students of science who will heartily approve this maxim of the aloofness of philosophy from all actual scientific research. It seems to express exactly what the great scientific leaders of the nineteenth century were always insisting on, the positivity of physics, the speculative nullity of metaphysics. Gladly will they respect the moralising, soliloquising, mysticising philosopher, especially if, like the author we are considering, he be endowed with poetic genius, so that he will not interfere with the stern experimental work in which science is engaged. But if that ideal would suffice for the last century it fails utterly to satisfy the present. The coming of the theories of relativity has changed the whole aspect of the scientific world and the whole attitude of men of science to philosophy and of philosophers to men of science. Science and philosophy are now engaged in a conjoint undertaking, the adaptation of the human mind to a new cosmogony forced upon it by the necessity of fitting experimental facts into natural conceptual frames.

What then, in the present state of our science, has Mr. Santayana to tell us which is positive? What is the substantive part of his contribution? He has something very definite to say, and whether he knows it or not, and whether he cares that it should be so or not, it proves to be singularly in accord with the significance and direction of the new scientific theories. He tells us he is a materialist, but adds that it may be he is the only philosopher who is. All that this seems to mean is that, with Spinoza, he seeks the unity of the world in an objective and deterministic principle rather than, with Leibniz, in a subjective and creative principle. He is no more materialist in the ordinary acceptation of the term than Spinoza is atheist. His theory, however, merits the attention of experimentalists.

His theory is that "existence" is not a datum. We can have no image of it and no idea of it. We accept it with "animal faith." What is "given" to the mind in knowledge is not the *existence* of objects but their *essence*. This is true of the mind itself, of the *cogito ergo sum*, equally with the objects of the physical world. Essence is not a subjective eject: it is objective in the fullest meaning of the term. This rejection of existence as a datum is of special significance in philosophy, for it serves to separate Mr. Santayana from the realists with whom his "materialism" would seem naturally to associate him, from those who, like Prof. Alexander and Prof. Lloyd Morgan, insist on the importance of assuming the existence of the non-mental world, even though it may need to be accepted "with natural piety." But it is of peculiar significance in science; for if Einstein and the orthodox relativists are right, science has no longer any use whatever for this relic of an older world-view and its pious preservation is a superstition. Santayana's doctrine therefore, which does not reject existence but denies that it is a datum and excludes it from knowledge, is singularly in accordance with the theory that in physical science we are not contemplating absolute existence but co-ordinating phenomena by means of invariants. The "animal faith" which makes us believe the existence of a datum is not the philosophising will to believe or reason for believing: it is the ordinary man's intuition or instinct.

What then is essence, or rather what are the essences, which Mr. Santayana presents as the objective reality of things known? To the philosopher it is perhaps enough to say that they are the Platonic Ideas interpreted in a modern way, a concept which recalls Croce's æsthetic images, except that essences are not the creations of a *fantasia*, or the expressions of intuitions, but passively discerned objects. We are more interested, however, to know what is their status in science. They are, we are told, the indispensable terms in the perception of matters of fact and they render transitive knowledge possible. They are distinguished therefore from "bits of sentience" or pure sense-data, on one hand, by their external reference and from existents or pure existences, on the other hand, by their relatedness. The value of the doctrine to science is then that it takes us behind all such philosophical distinctions as primary and secondary qualities, universal and particular ideas, abstract and concrete terms, giving us at once what is ultimate in the reference to reality. Mr. Santayana takes as an illustration the colour quality "yellow." I may see a buttercup, the intuition is then a sensation; or I may see it with my eyes shut, it is then an idea or a dream; or I may see it with my eyes open when there is no buttercup there, then it is hallucination. Whatever be the difference in the mode of apprehending or in the object of reference, the essence yellow is one and identical.

To see the relevance of this theory to scientific research we have only to recall the endeavour of Mach to construct science out of the relations of sense-data. Mach found he had to fall back on a quite arbitrary hypothesis of parallelism. How different his task might have appeared had he had this conception of essence. His difficulty was to get to existence, and this demands belief. If, on the contrary, with Mr. Santayana, we start from the realm of essence, which demands no belief, we may at once find conclusive reasons for believing that sundry intuitions of parts of it exist in fact. This discrimination of essence brings too a wonderful clearness to the comprehension of the nature of scientific research. All data and descriptions, all terms of human discourse, are essences, inexistent. Existence is an intuition, inexpressible, not knowledge but ignorance, a purely animal faith. The distinction cuts science free from all the perplexities and antinomies which arise when reality is identified with existence (*e.g.* the non-existence of the past and future, the inextensiveness of the present).

Having expounded this important distinction of essence and existence, Mr. Santayana then proceeds, somewhat to our surprise and with at least the appearance of complete inconsistency, to select from the essences the philosophical concept of substance and the naturalist concept of matter to be the foundations of his new Jerusalem, a system of philosophy which we are led to expect is shortly to appear. We look forward to it with deep interest, for the present introduction shows him inspired with a new vision and emboldened to undertake constructive work. His book closes with a critical epitome of the history of modern philosophy in which, except Spinoza, each leading philosopher is pelted with epigrams, and ironically dismissed.

H. Wildon Carr.

Evolving Biology.

Outlines of Evolutionary Biology. By Prof. Arthur Dendy. With Glossary of Technical Terms. Third edition, revised and enlarged. Pp. xliii+481. (London: Constable and Co., Ltd., 1923.) 16*s.* net.

WE extend a welcome to this revised and enlarged edition of an exceedingly useful book, which has been a favourite since it was first published some ten years ago. It is an introduction to the study of the principles of biology, well thought out by a teacher of experience, who has himself made important contributions to the science. There are five parts, dealing with the following subjects: the structure and functions of organisms and the cell theory; the evolution of sex; variation and heredity; the theory and evidence of organic evolution, with particular insistence on adaptations; and, finally, the factors of organic evolution. What gives the book its particular merit, in addition to the indispensable qualities of lucidity and good judgment, is its concreteness. Prof. Dendy is always bringing the student into touch with concrete examples which illustrate the principles discussed and enable the reader to get a firmer grip.

There is throughout the book a scientific good humour. Thus when the author is discussing such a thorny question as the transmissibility of individually acquired somatic modifications, he is temperate in his language and judicial in his survey. He does not dogmatise and he does not suggest that the only tenable position is Lamarckian; and yet he is not in the least wobbly, as this quotation may show.

"On the whole, then, the available evidence seems to indicate that suddenly and exceptionally acquired characters, such as mutilations, are occasionally but only rarely inherited to such an extent as to be recognisable, while, on the other hand, characters which are due to the continued action of some external stimulus, extending perhaps over many generations, in the long run become so firmly impressed upon the organism that they affect the germ cells as well as the somatic cells and thus become truly blastogenic."

We happen to think that this is a misinterpretation of the evidence, but our point is that Prof. Dendy puts the problem before the student in an eminently fair-minded fashion.

The author wishes good speed to the investigators of the chemical and physical processes that go on in the living body, but he denies that the formulæ of chemistry and physics can be made to cover all the phenomena of life.

"We may, perhaps, believe that, as living matter became more and more complex in its structure, it entered progressively into new energy relations with its environment, which became more and more unlike those exhibited by inanimate matter, until at length they passed in some respects altogether beyond the reach of chemical and physical explanations."

This appears to us to be, on the whole, the scientific position at present, though the wording is a little suggestive of the idea that mind is a resultant of complexifying proteins and energy-relations, which is absurd, as Euclid used to say when he was tired. Moreover, it is open to question whether there is any "inanimate matter" anywhere. But what we wish to say is this, that if we shared Prof. Dendy's non-mechanistic views, as we do but more also, then we should not entitle a chapter "the mechanism of evolution." The point is that evolution transcends mechanism, and, if that is so, it is a pity to say mechanism when you only mean *modus operandi.* For there can be no doubt that if one says "mechanism" often enough in reference to vital processes, people will end in believing us, and we shall believe it ourselves!

We have referred only to a crumpled rose-leaf, for we really think that the book is as good as any book has a right to be. It is singularly attractive in every way—beautifully printed, with many interesting illustrations of great interest; and it is a personal deliverance. Most alteration, naturally, has been made in the part dealing with heredity. There is a valuable glossary, but we think it was a psychological mistake to put it in the forefront of the book. What a thorny hedge to these fair pastures!

Natural History of Pheasants.

A Monograph of the Pheasants. By William Beebe. In 4 volumes. Vol. 4. Pp. xv+242+23 coloured plates+27 photogravure plates+6 maps. (London: H. F. and G. Witherby, 1922.) 12*l.* 10*s.* net.

THE fourth and final volume of this great Monograph[1] treats of the golden pheasants (Chrysolophus), the bronze-tailed peacock pheasants (Chalurus), the peacock pheasants (Polyplectron), the ocellated pheasants (Rheinardius), the Argus pheasants (Argusianus), and the peafowl (Pavo).

These groups comprise forms of surpassing beauty of plumage and remarkable habits. The life-histories of a number of the species treated of were previously unknown, since no ornithologist had ever penetrated the remote fastnesses in which their lives are spent, while in the case of others much remained to be learned. Mr. Beebe's researches have lifted the veil which has hitherto masked the ways of many.

To the illustration of the seventeen species and subspecies here described, twenty-two coloured plates

[1] Previous notices relating to this Monograph appeared in NATURE, vol. 102, p. 302; vol. 107, p. 235; and vol. 110, p. 105.

are devoted; twenty-seven exquisite photogravure plates depict their haunts, nesting sites, courtship and dancing places; while a series of maps illustrate the geographical distribution of all the forms.

Regarding the two species of Thaumalea, the golden and Amhersts' pheasants, though both have long been familiar in captivity or in a semi-domesticated state, yet little or nothing was known of them in their native haunts. This is well illustrated by the case of the former bird. Although this beautiful species has been kept in captivity for centuries (even prior to 1747 in England) yet in a wild state probably no other pheasant was so absolutely unknown to naturalists. Mr. Beebe, however, succeeded in penetrating the bird's exceedingly remote retreats and gives a graphic account of its home-life in the deep rugged mountain forests of Central China. Here he witnessed its wonderful courtship, in which the gorgeous ruff of the male plays an important part, but all his endeavours, however, to find its nest were unavailing, and it still remains to be discovered. The same great difficulties were experienced in the search for the Amhersts' pheasant. For many days the bird remained but a phantom, until at last a glimpse of "its royal self" was presented in its remarkably fine home in the forests on the frontier of Yunnan and Burma, where it haunted the steep sides of lofty valleys traversed by rushing torrents. Here the author saw the cocks in all their glory of ruff and body-plumage, and beautiful beyond description. Apart from the pleasure of recording their actions, Mr. Beebe was not able to add much to the little already known, and failed to find a nest.

From discussing the typical pheasants the author proceeds to treat of those of the Argus group (Argusianinæ), commencing with the bronze-tailed peacock pheasant (Chalurus). This genus includes two species which are confined to the Malay States and Sumatra respectively. Both are rare in their native haunts and in collections, and have never been kept in captivity. Practically nothing was known of their life-histories prior to the author's investigations. The Malayan species (*C. inopinatus*)—"a true bird of the wildness" —inhabits the dense jungles of the central mountains of the Peninsula. Hitherto the knowledge of this species has been derived from skins, and many days passed after Mr. Beebe reached its haunts, which ranged from humid dark ravines to summit ridges where warmth and brilliance prevailed, ere he was able to catch even a glimpse of the bird. Eventually he came across a party from which he secured a specimen, and was shown a nesting site on the side of a rocky defile. The Sumatra species (*C. chalurus*) is an inhabitant of the interior of that great island, where no white man has seen it alive.

The peacock pheasants (Polyplectron) are ornamented with many gorgeous metallic eye-spots, which are most developed in the male and are displayed by him during courtship. Mr. Beebe found the grey-backed species (*P. bicalcaratum bicalcaratum*) occurring singly or in small families among the mountains of Burma and Western China, where they are shielded by terrible growths of thorn cane. They seldom fly, but skulk through the jungle in the day-time and roost on trees at night. Once the haunts were discovered they were found to be not very uncommon, and their courtship, one of the most remarkable among birds, was seen to commence with a lateral display, although the climax was reached in a wonderful frontal performance in which every ornament of the male's plumage was brought to bear to influence the little female. The Malay species (*P. malaccensis*) is a native of lowland jungle where it is well guarded by a myriad tropical terrors which rise at every foot to dispute advance into its domain. It proved to be the most difficult of the Malay pheasants to locate. Day after day the search had to be given up, and it was only when Mr. Beebe resorted to tracking by himself alone that success came, and even then he had to fight his way and suffer much for even a brief peep of these splendid birds. At last, however, in a land of dreadful silence, leeches, sand-flies and mosquitoes, he found the objects of his search in fair numbers. The Bornean species (*P. schleiermacheri*) is a native of the hilly jungle near the centre of the island. Of this species the author was only able to obtain a handful of feathers from a bird trapped by a Dyak, nor could he learn anything trustworthy about this pheasant from the natives, who are well versed in all the other species. Hence he concludes that it must be exclusively uncommon. Of the three other species of this genus, *P. katsumatæ*, *P. napoleonis*, and *P. bicalcaratum germaini*, he was unable to visit the haunts in the Islands of Hainan and Palawan and in Cochin China and Siam, but he gives accounts of their histories so far as they are known.

The ocellated pheasants (Rheinardius) are large birds as strange in appearance as they are rare and mysterious in life. Their general characters unite them closely with the Argus pheasants, but they are much less specialised. Like them they have the remarkable habit of clearing small tracts in forests as arenas for their displays. Two forms are known. The Annam species (*R. ocellatus*), a magnificent bird, has a singular history, for its identity was founded on several feathers, from an unknown source, discovered in the Paris Museum prior to 1856; but it remained undescribed, and it was not until 1882 that a specimen procured by Commander Rheinart set all doubt at rest as to its distinctness. Very few examples have been obtained from its haunts in the dense mountain forests which separate the Laos country from Annam—a region which is inhabited by semi-savage tribes. The Malay species (*R. nigrescens*) is also very rare, and only a few specimens were procured among the central mountains of the Peninsula. Mr. Beebe tells us that it is the most mysterious of all the birds of the Argus group. He lived in their neighbourhood, heard their calls, found a dancing arena of an individual that had met with disaster, and yet, after weeks of search, he never caught a glimpse of the bird itself.

The Argus pheasants (Argusianus), of which three species are known, Mr. Beebe regards as being in many ways the most extremely ornamented and specialised members of the pheasant family. The adult males measure six and a half feet in length; two-thirds of this is taken up by the central tail-feathers, while "the ocelli on the secondaries are marvels of design and shading, resembling marble-like spheres revolving in separate sockets, and all with bright lights as exquisite and effective as if carefully planned for some exact and delicate purpose." The evolution of these "eyes" is illustrated in one of the coloured plates. The males make, and keep clear, large dancing areas in which they call the females and where they show off their marvellous frontal displays. Regarding the Malay species (*A. argus*) and the Bornean bird (*A. gnayi*), the author tells us that few white men have shot or seen them in their wild homes, owing to the fact that "no deliberate attempt has been made to circumvent the birds, or to adapt one's approach to the peculiarities of life habits." Hence he was very anxious to make as thorough a study as possible of these marvellous creatures. At first he was pessimistic, being told that he would not be able to get further than hearing the birds. Many of their habits are affected by their curious practice of creating special places—a cleared arena about three yards in diameter—in the forest jungle, where the male displays before the female. Mr. Beebe found that it was here alone that he could observe the birds, and, having made good use of this discovery, he has been able to give elaborate descriptions of what he observed. The third species, the double-spotted Argus pheasant (*A. bipunctatus*), is only known from a portion of a feather, without a history, found in the British Museum in 1871. This differs so decidedly from any corresponding feather in the known species, that the author has little doubt that it represents a distinct form.

For the two species of peafowl, Mr. Beebe has established a sub-family (Pavoninæ) "on account of the character of the tail moult, which typically is from the central pair outward." They also "form a distinctly isolated group, and we have no idea of their line of ancestry. The femoro-caudal muscle, for example, is absent in Pavo and in Meleagris [the Turkeys] while present in all other gallinaceous birds; the syrinx in Pavo is simpler than in any others of its family." Of the two species, the well-known Indian bird (*Pavo cristatus*), from which the domestic bird is descended, is a native of India, Assam, and Ceylon. Its habits are well described by the author from personal observation. Semi-domesticated peafowl occur in many parts of India and are considered sacred birds; while the black-winged form is a very remarkable sport or mutation occurring sporadically among domestic Indian birds, sometimes one or two appearing in a brood. Albino birds are never found in a wild state. The second species, the green peafowl (*P. muticus*), is a native of Chittagong, Burma, Siam, Cochin China, Malay Peninsula, and Java. The habits of the two species are almost identical, where Indian birds only are considered; but even where the green bird is most abundant, it occurs in small isolated groups, which are extremely sedentary.

Mr. Beebe is to be heartily congratulated on the completion of his great work. Many excellent Monographs devoted to various groups of birds have appeared, including princely volumes on the pheasants, but no treatise on any group has ever been so enriched by the researches of its author as this. Yet, Mr. Beebe, great traveller and naturalist as he is, only achieved success with many species through his unfailing enthusiasm and a remarkable display of indomitable determination. Indeed he failed only where success appears to have been humanly impossible.

W. E. C.

Vitamins.

Vital Factors of Foods: Vitamins and Nutrition. By C. Ellis and Prof. Annie L. Macleod. Pp. xvi+391. (London: Chapman and Hall, Ltd., 1923.) 25*s.* net.

IF there still remain people sceptical of the existence of what have been called "vitamins," this book should go far to convince them that there are certain elusive substances, present in food only in the most minute quantity, but nevertheless necessary to enable growth to take place and to maintain normal health. The reviewer is unaware of the publication of any other work on this subject of so comprehensive and impartial a nature as the present one. In a branch of knowledge on which so much research is still being carried on, it is not to be expected that the very latest discoveries should find their way to a textbook, but that of Ellis and Macleod appears to have omitted little or nothing up to the date of its production. It will be found very useful.

Like most new and far-reaching discoveries, that of vitamins has not escaped the danger of being regarded as displacing or reducing to little importance previous work on such matters as the energy value of food. While it is perfectly true that, in the absence of vitamins, no amount of food, however great, suffices for health, it is nevertheless equally true that no amount of vitamins can compensate for a lack of energy value. In actual practice, however, there is, under certain conditions in which fresh vegetable food is absent from the diet, more risk of damage to health from this factor than from absence of total quantity. Such, for example, is the position of those populations which live mainly on rice, or in circumstances in which preserved or canned food is the chief article consumed.

The reviewer is glad to note that the authors have adopted Drummond's suggestion of dropping the final *e* of the original name "vitamine" and appending a capital letter to express the particular kind of vitamin referred to. This practice is rapidly being generally adopted, since it is, on the whole, more satisfactory than any other that has been advocated. The origin of the name will soon be forgotten and it will become just a name, like "enzyme," which does not suggest yeast whenever it is used. In connexion with the title of the present book, it may be noted that there are other factors of food equally as "vital" as vitamins. The term "accessory factor," sometimes used, is apt to suggest, on the other hand, that these factors are only of subsidiary importance.

A brief account of the elementary principles of nutrition precedes the main subject. This appears to contain all that is needed for the purpose. We may ask, perhaps, if water, salts, and vitamins are to be added to the traditional fats, carbohydrates, and proteins as necessary constituents of a diet, why omit oxygen? The first chapter is devoted to a general account of the nature of vitamins, with a history of their discovery. It is pointed out that we do not know how they act. In many ways they behave like catalysts; in other ways, they seem more related to the chemical messengers or hormones. McCollum directs attention to the fact that they do not behave as hormones in the sense of being produced in one organ for the purpose of bringing about reactions in other places. They are not formed by the animal organism at all, so far as we know.

A useful account of experimental methods is given in the second chapter. It is to be feared that inattention to freedom from traces of vitamins in the control diet has been the source of erroneous statements. As to their chemical nature, we have still practically everything to learn. Like enzymes and hormones, they are so extremely powerful that we can remove more and more unessential impurities from them, without affecting their activity. Thus we finally arrive at a trace of a substance which has very few chemical properties of any kind. Some method by which these substances can be readily separated from large quantities of the materials containing them has yet to be worked out. Possibly it may be found in an application of the adsorption method used with success by Willstätter in the case of enzymes.

The making of concentrated preparations is described, but it is to be regretted that the extravagant cost of commercial products in relation to their actual content in vitamins is not more insisted upon. As Drummond has well pointed out, eggs and oranges are equally useful at less than a fiftieth of the cost. If a reasonably varied diet with fresh fruit and vegetables be taken, there is no need to worry about vitamins. It is curious that so many people fail to realise that vitamins are not drugs, to be taken under medical direction, but natural constituents of food. It does not matter how much of them be taken, provided that it is enough.

Detailed discussion is given of the various disorders associated with deficiency of vitamins. It is here that the question as to whether there are more than the three (A, B, and C) vitamins comes into prominence. Three chapters are devoted to practical problems of appropriate diets for infants and adults, and a final chapter on the interesting question of the vitamin requirements of fungi, moulds, and bacteria is added. An appendix gives tables of the distribution of the vitamins in various articles of diet. It is a remarkable fact that although some animal products are rich in certain vitamins, the ultimate source of these appears to be in all cases the vegetable kingdom.

The book may be highly recommended. The work of so many different investigators is given that the reader is at times rather bewildered, and a summary of the established data, given at the end of each chapter, would be a welcome addition. There is, however, an excellent index. W. M. Bayliss.

The Atom of To-day.

The Structure of the Atom. By Prof. E. N. da C. Andrade. Pp. xv+314. (London: G. Bell and Sons, Ltd., 1923.) 16*s.* net.

To give a comprehensive critical survey of the prevailing theories of atomic structure and to indicate their triumphs and inadequacies in a volume of reasonable size is the professed object of the book under review. This is a bold design. It is all the greater pleasure therefore to record that the book is an almost unqualified success. It is, moreover, heartily welcome, for it provides just that critical introduction to modern atomic speculations which should be in the hands of every student, and can be read with profit by most researchers. Such a book has until now not been available in English, and the want is scarcely filled by the recent translation of Sommerfeld's classic work, which is rather too long and elaborate and somewhat too one-sided (spectroscopic) to be entirely suitable in this connexion.

To come to details. The book is divided into two parts dealing with the existence and properties of the nucleus and with the extra-nuclear structure respectively. In Part I. after a short historical introduction, the first evidence for the exceedingly open structure of the atom is presented in detail, as derived from the passage of swift corpuscles through matter. An important feature is the account of the work of Lenard on the absorption of swift cathode rays, now too often overlooked, which started atomic speculation on its present path. There follows an excellent account of the work of Rutherford in establishing the nuclear structure, with its extensions by his school, and then the radioactive evidence, including the recent work of Ellis on the photoelectric effect and the interesting speculations of Meitner. There is next a discussion of the modern work on very close collisions between α-particles and light nuclei—artificial disintegrations by Rutherford, and the deviations from the law of inverse squares. A chapter on positive rays, with Aston's law of integral atomic masses, concludes the nuclear evidence. In this chapter there is one of the few questionable omissions. In a paragraph on the separation of isotopes, Harkins's work on hydrogen chloride is alluded to, but there is no mention of the very elegant work of Brönstead and Hevesy on mercury.

Part I. then concludes with a critical account of such theory of the nucleus as is yet possible, and two short but necessary digressions, one on X-rays from the classical point of view, and the other on the general empirical laws of optical spectra. Both are good, but exception can be taken to smaller points in the optical chapter. To emphasise the fact that the majority of known atomic spectra have not yet been ordered into series is to overlook the fact that the time is still short during which there has been a real theoretical incentive so to order a difficult spectrum. But the yearly output of such spectra at least partially ordered in series is now considerable. Again, it is unfortunate that it has been stated that atoms in general emit *two* optical spectra, when we now have Al III and Si IV. But this, no doubt, like the statement, already partly untrue, that there is no detailed theoretical foundation for optical terms of the forms of Rydberg and Ritz, is evidence rather of the present rate of progress than of inadequacies in the book. The general theory of these term-forms was announced by Bohr at the recent meeting of the British Association.

Part II., on the extra-nuclear structure, starts with two long chapters on the dynamical model of atoms of one and more than one electron. Clear as they are, these are the least satisfactory chapters in the book; we return to their consideration later on. They are followed by a concise account of Bohr's general theory of atomic structure, which could perhaps be bettered in minor points. The discussion of firmness of binding compared to orbits of the same quantum number in hydrogen could be made clearer by an explicit definition and use of "the effective quantum number" of the external Keplerian loop of the orbit and its relation to the actual total quantum number. Again, no clear distinction is made between the true relativity effect on a Keplerian orbit and the similar effect due to deviations in the law of force from the inverse square, such as occur in practice from the variable screening. Finally it is stated in error that the fifth and sixth electrons are bound in 2_1 and the thirteenth and fourteenth in 3_1 orbits—a statement contradicted by the relevant table on page 224. The error repeats an early statement by Bohr, which he has superseded by this table.

Following this there is an excellent sympathetic account of static models of the atom and their value in organising the facts of chemistry. This chapter makes it clear in an interesting way that though all attempts to make static models with any natural physical reality are a waste of time, such models, like the elastic spheres of the kinetic theory, have a large legitimate "place in the sun." The book concludes with what should prove a very useful survey of the present chaotic state of magnetic theory.

To return to the chapters on the dynamical atom. The reviewer would make the general criticism that they present the subject from a point of view which, without prejudice, may be called too "Sommerfeldian." Without in any way belittling Sommerfeld's classical contributions, it is the correspondence principle and the fundamental frequencies of the atomic system, Bohr's method of attack, and not the Wilson-Sommerfeld quantum conditions, which ought to be made fundamental, above all in a book for physicists. "Ought" is the word, for reasons which the author of this book has himself formulated as clearly as possible, for this is the method which seems to work best, and to be in closest touch with physical reality. His prefatory quotation of Kelvin should be re-quoted—"Nothing can be more fatal to progress than a too confident reliance on mathematical symbols; for the student is only too apt to take the easier course, and consider the formula and not the fact as the physical reality." In effect this makes the section on elliptic orbits sad reading; we are also given Sommerfeld's admittedly unsatisfactory attempt to give a theoretical basis for Ritz's term-form. It is much to be desired that we might have had instead Bohr's elegant proof of the Rydberg form for central orbits (now superseded, as mentioned above), which is both physically and mathematically unexceptionable. It is possible that this was not available to the author, though it has been current for some time.

It is only just and right, however, that this review should close as it began on a note of praise, for the merits of the book are many and its defects few. No one can have anything but praise for the system and selection of references which leave nothing to be desired, and for the exquisite photographs by Blackett, Aston, Paschen, Siegbahn, and de Broglie reproduced in the four plates. The book should go through many editions—the more the better.

R. H. FOWLER.

The Physical Aspect of Physiology.

(1) *Interfacial Forces and Phenomena in Physiology: Being the Herter Lectures in New York in March, 1922.* By Sir William M. Bayliss. Pp. ix+196. (London: Methuen and Co., Ltd., 1923.) 7*s.* 6*d.* net.

(2) *The Vaso-Motor System.* By Sir William M. Bayliss. (Monographs on Physiology.) Pp. v+163. (London: Longmans, Green and Co., 1923.) 7*s.* 6*d.* net.

(3) *The Electrical Action of the Human Heart.* By Dr. Augustus D. Waller. Edited by A. M. Waller. Pp. ix+103. (London: University of London Press, Ltd., 1922.) 7*s.* 6*d.* net.

HOWEVER distinguished a man of science may be, we still expect the books he writes to increase his reputation. These two books by Sir William Bayliss will scarcely do this. It is not that they are bad books, but that they are not good enough for so distinguished an author.

(1) The volume on "Interfacial Forces and Phenomena in Physiology" is lucid and readable, and will certainly stimulate to further thought many who are interested in the problems lying on the borderland between the physical and the biological sciences; but here its virtues end. In the first chapter we are introduced to the electron theory of the atom and the latest work on crystal structure; but the promise of this chapter is not maintained. The treatment of the subject is almost exactly the same as that in the first edition of the author's "Principles of General Physiology." Though the advances of the intervening seven years are mentioned their bearing is not always recognised. For example, Sir William Bayliss persists in calling protein solutions "emulsoid," while confessing that emulsions never behave like protein solutions, and he makes no use of the insight into the constitution of colloidal solutions that the work of McBain gives us. It is probably the hypnotic effect of the word "emulsoid" that makes the author assume that a protein solution must inevitably behave as a heterogeneous system.

The classical theories of surface tension and adsorption are all based on statistical mechanics, and it is just when we come to the mechanism of the living cell that statistical theory fails us. These theories have been available to physiologists for many years and have been of scarcely any use because no precise deductions can be made from them in connexion with physiological problems. The new treatment of surface phenomena that we owe to Langmuir and to Adam holds immense possibilities for the physiologist, yet Sir William Bayliss dismisses Langmuir almost summarily. There are cases where statistical theory is of use to physiologists, notably in the treatment of processes that go on in a relatively simple medium, such as blood. The particular theory that has proved of most use here is the Law of Mass Action, but this law we are told we ought not to use. Sir William Bayliss adopts the attitude of one who reproves a friend for removing a nut with hammer and cold chisel, while he admits that the only spanner available does not fit.

(2) The book on "The Vaso-Motor System" is more purely technical. It contains a useful summary of the work done on the control of the blood flow through arteries and capillaries. Much of the evidence at present available is confused and conflicting. As one of the most successful investigators in this branch of physiology, we might reasonably have expected Sir William Bayliss to sum up the evidence judicially, and to give us the benefit of his conclusions on doubtful points. This he does not do. He merely states all the results obtained by all the workers, and leaves the reader to pick his way among them as best he can.

(3) The late Prof. Waller's book on "The Electrical Action of the Human Heart" consists of a series of four lectures delivered by the author in 1913. The first two lectures contained a résumé of certain facts and theories based on the author's work with the capillary electrometer, and a comparison of these early results with those obtained by means of the string galvanometer of Einthoven. The remaining

two lectures are devoted to a discussion concerning the significance of certain features of the electrocardiogram.

From a historical point of view, this little book is of considerable interest; but, in a subject so young as electrocardiography, a period of ten years is sufficient to bring about considerable modification in views previously current, and the omission of references to the more recent work cannot fail to detract from the value of hypotheses based on the earlier experiments. One cannot help feeling that the views expressed are those of an advocate rather than a judge. In such small and unimportant details as the nomenclature of the different deflexions of the electrocardiogram, it is somewhat surprising that a pioneer worker in this branch of physiology should be so reluctant to adopt a phraseology which is now almost universally employed.

J. C. B.
A. D. R.

Organic Preparations.

(1) *An Advanced Laboratory Manual of Organic Chemistry.* By Dr. M. Heidelberger. Pp. 103. (New York: The Chemical Catalog Co., Inc., 1923.) 2 dollars.

(2) *Organic Syntheses: an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals.* Edited by J. B. Conant, H. T. Clarke, R. Adams, and O. Kamm. Vol. 2. Pp. vii+100. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1922.) 7*s.* 6*d.* net.

(3) *A Method for the Identification of Pure Organic Compounds by a Systematic Analytical Procedure based on Physical Properties and Chemical Reactions.* By Prof. S. P. Mulliken. Vol. 4: Containing classified descriptions of about 3700 of the more important compounds belonging to fourteen of the higher orders. Pp. vii+238. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1922.) 30*s.* net.

(4) *Cours de chimie organique.* Par Prof. F. Swarts. Troisième édition, revue et augmentée. Pp. iii+674. (Bruxelles: M. Lamertin; Paris: J. Hermann, 1921.) 50 francs.

(1) METHODS of preparation in organic chemistry, like all other branches of the science, tend to become out-of-date, and probably every teacher has his own list, culled from recent literature, which he gives to those students who have to bridge a gap between "preparations" and "research." Indeed, if properly chosen, supplementary preparations of the kind mentioned lend themselves admirably for the purposes of initial instruction in the methods of research, when, as sometimes happens, the research on which the advanced student is started does not involve the preparation of large quantities of initial material.

The book under review contains a number of preparations of this kind which the author has collected after many years of experience of teaching and research, and these he now offers to his fellow-teachers with an apology in his prefatory note for the fact that many of the details have been taken from his own work and that of Dr. Walter A. Jacobs, of the Rockefeller Institute. Organic chemists will, however, know that it is the first-hand information that counts, and that the author writes of a subject with which he is fully competent to deal.

The book is well printed and easy to read. The printer has evidently experienced difficulty in setting up some of the more complex formulæ, and the result is, in some cases, apt to make one dizzy, but, even thus, it is better than the easier and cheaper method of attempting to represent such formulæ in a straight line. Dr. Heidelberger has produced a useful little book for those teachers of organic chemistry who may wish to give their advanced students some more difficult preparations than those usually to be found in the ordinary laboratory manuals.

(2) This is the second volume of the series and is well up to the high standard set by the first. Twenty-five preparations are described, and all of them deal with compounds likely to be required in an organic chemical research laboratory. Each substance is treated under three headings, namely, (1) procedure, (2) notes, and (3) other methods of preparation; the method of procedure being given in sufficient detail to enable an ordinary advanced student to follow it with ease. The notes are in every case well written and give valuable and essential advice which will be of the greatest assistance to those who have to carry out the preparations. Brief but cogent criticisms are given of other methods of preparation in the sections devoted to this head, and the reasons why such methods have proved unsatisfactory in practice are clearly stated.

In every case the preparation has been carried out by one of the associated editors and checked by another, and as all four of them are organic chemists of high standing, there is no room for error. If it were possible to make this admirable compilation still more admirable, it might be done by a freer use of graphic formulæ at the heading of the chapters—they take more room, but are well worth it—and by pandering to English laziness by giving where possible the volume of solutions as well as the weight. For example, on p. 75, the expression "400 g. of 28 per cent. ammonium hydroxide" means a calculation and therefore extra work.

(3) Looked at from the point of view of a research chemist of some thirty years' standing, the first feeling produced on reading Prof. Mulliken's volume is one of doubt as to whether the immense labour and skill expended in its compilation were really worth while; the second is a sense of disappointment that, by the exclusion of all references, an opportunity has been lost of making the treatise of real value to research workers; for it can scarcely be doubted that the work is intended for the research chemist, because who else would be interested in the vast number of compounds tabulated?

The author's "method" may, and probably does, do all that he claims, but it is scarcely conceivable that any organic chemist would use it, even if he had sufficient time at his disposal to enable him to do so. The vast majority of organic chemists, when they isolate a new compound, subject it first to an elementary analysis and then determine its empirical formula by the usual methods. They then look up the formula in Richter or in one of the many annual or decennial indexes based on empirical formulæ, as indeed they all are, and then refer to the literature. Even then identification can never be regarded as certain until direct comparison has been made. Physical properties and chemical reactions are interesting, but often misleading, and the lack of any reference to the literature prevents the chemist from doing the one thing he ought to do, that is, to prepare some of the material and compare it with that which he has obtained. In the event of the substance being too difficult or too expensive to prepare, there is another, though less satisfactory, method for establishing identity, and that is by preparing some crystalline derivative and comparing this with the same derivative prepared from the standard. But here again the author does not help, because he mentions no derivatives. If he had given references and had described one or two typical derivatives, the book would doubtless have been larger, but it would have been infinitely more useful.

(4) The book before us is the third edition of a work which evidently finds a considerable sale on the Continent. It is, as the author says, "un cours" and not "un traité," and does not, therefore, pretend to cover the whole field of the special subject with which it deals. Nevertheless the book contains 674 pages, and it should be possible to deal with most of the more important aspects of the science in this space. On the whole, the author has succeeded in compiling a readable book, and one which should be of great use to the student, provided he has facilities for acquiring help in the initial stages to fill the gaps which the author has left. It is, for example, unlikely that the student would obtain a working knowledge of stereoisomerism or of tautomerism from the rather meagre descriptions given in this book. Indeed the basic theoretical parts are too short and too difficult to follow. Otherwise the book is a valuable one and is well printed and set up. J. F. T.

The Composition and Examination of Volatile Oils.

The Volatile Oils. By E. Gildemeister and Fr. Hoffmann. Second edition, by E. Gildemeister. Written under the auspices of the firm of Schimmel and Co., Miltitz, near Leipzig. Authorised translation by Edward Kremers. Third volume. Pp. xx+777. (London: Longmans, Green and Co., 1922.) 32*s*. net.

WITH the volume before us the English translation of the second edition of Gildemeister and Hoffmann's "Volatile Oils" is now completed. The publication of the book has unfortunately been very materially delayed by the War, so that a period of no less than nine years has elapsed since the appearance of the first volume in 1913, and there are but few references to the results of investigations published since 1915. In the second volume the oils derived from plants belonging to a number of families were dealt with in detail; in the present work those obtained from the Rutaceæ (including, therefore, lemon, orange, and other Citrus oils), Burseraceæ (myrrh and elemi), Dipterocarpeæ (Borneo camphor oil), Myrtaceæ (myrtle, pimento, bay, clove, eucalyptus, cajuput), Umbelliferæ (caraway, dill, anise, celery, ajowan, asafetida), Ericaceæ (wintergreen), Labiatæ (lavender, sage, thyme, mint), Compositæ (chamomile, wormwood), and many other families, are considered.

The thoroughness with which the task has been attacked may be well exemplified by the monograph on lemon oil. Tables of statistics are followed by a map showing the districts of production of lemon, orange, and bergamot oils in Sicily and Calabria. The various methods of extracting the oil are then carefully described and the descriptions illustrated by a number of photographic reproductions. The properties and constituents of the oil are next exhaustively dealt with. Details of the chemical examination of the oil occupy 24 pages. No fewer than eleven methods of determining the citral present are described, and, which is most important, the objections to their use, and the results of the methods when tested in Messrs. Schimmel's laboratory, are appended.

Here and there in the work statements may be met with that are now no longer correct; thus on p. 492

carvacrol is said to be the only phenol present in Spanish oil of thyme, whereas Mastbaum has shown that the Spanish oils of *Thymus vulgaris, T. Zygis, T. hiemalis,* and *Corydothymus captatus* all contain notable proportions of thymol; in this case at least the discrepancy may be due to the length of time that has elapsed between the completion of the work and its publication. To clove oils 18 pages are devoted, and here also the description is accompanied by a map of the islands of Pemba and Zanzibar showing the distribution of the clove plantations. For the determination of the percentage of eugenol in the oil a 3 per cent. solution of sodium hydroxide is recommended, whereas in the "British Pharmacopœia" a 5 per cent. solution (of potassium hydroxide) is given.

Eucalyptus oils are very fully represented, no fewer than 141 being mentioned, the great majority of them, however, being of scientific rather than economic value. The commercial oil of *E. amygdalina* is now referred to *E. amygdalina,* Labill., var. *Australiana,* Baker and Smith.

The task of translation, always a rather tedious one, has been admirably accomplished by Dr. E. Kremers, of Madison, Wis. The work is couched in excellent English, reads very easily, and shows only occasionally a somewhat literal rendering of the German original. Both paper and type are good, and clerical errors are seldom to be found.

Viewing the work as a whole, one cannot but be surprised at the mass of information which has been collected by the author, sifted in the laboratories of Messrs. Schimmel, and is now offered to the scientific world. Notwithstanding the disadvantages under which the book has been compiled, translated, and issued, it must be regarded as one of the most complete in existence on the subject. It will doubtless prove a mine of information for all workers on volatile oils, and it is difficult to see how any scientific library can be complete without it.

Low Temperature Carbonisation of Coal.

Low Temperature Carbonisation of Bituminous Coal. By A. McCulloch and N. Simpkin. Pp. xii+248. (London: H. F. and G. Witherby, 1923.) 18*s.* net.

THE low temperature carbonisation of bituminous coal is a process which has received much attention from writers, speakers, and experimenters, and Messrs. McCulloch and Simpkin have made a useful summary of the work that has been carried out. The preface insists quite rightly upon the importance of the subject in connexion with atmospheric pollution by smoke. If commercial success can be attained "Not only will it be possible to ensure a smokeless atmosphere, but, at the same time, a considerable conservation of our coal resources will result, and the country will be provided with a home supply of fuel oil."

The constitution of coal, the history of attempts dating from Parker's "Coalite" process to solve the problems of low temperature carbonisation, the difficulties arising from the expansion of coal on heating and its low thermal conductivity, the processes connected with the names of McLaurin, Del Monte, Fischer and Gluud, Illingworth and others, the nature of coal tar and of low temperature tar in particular, are discussed in turn in the seven chapters of the work. The printing is clear, and forty-three illustrations are given, most of them useful line drawings of plant, but some of Sir George Beilby's microphotographs of coke are included.

It is very difficult to write a book of this kind judicially and critically as regards large-scale operations, unless from a first-hand experience, to which the authors do not seem to make any claim either in the preface or the text. The account of each process in existing circumstances remains to a great extent a repetition of the claims made for it, although an exception must, of course, be made of those experiments which have been made and fully described by the Fuel Research Board.

The more theoretical portions of the book make mention of many researches, apparently more than have been digested. Thus, perhaps, the most striking result obtained by Messrs. Greenwood and Hodsman in their work on "The Factors Influencing the Yield of Ammonia during Carbonisation" was that oxygen did not decompose the ammonia, but was used up in the preferential combustion of other substances. The work is referred to by the authors on p. 33, but on p. 34 they say that "the presence of oxygen is detrimental to the formation of high ammonia yields since it decomposes the ammonia produced."

On the whole, however, the book stands as a good and readable account, brought well up-to-date, of a very important side of modern experimental developments in the utilisation of coal. J. W. C.

Complex Space.

Prolegomena to Analytical Geometry in Anisotropic Euclidean Space of Three Dimensions. By Prof. E. H. Neville. Pp. xxii+368. (Cambridge: At the University Press, 1922.) 30*s.* net.

WERE a Greek from the Academy of Plato to visit England, it would surely please him to find a title he could read without using a dictionary. Should he persist in acquainting himself with the first chapters, he would be delighted with the precision of language and thought and with the homeliness of the contents; indeed, it may be said that the number of readers of this beautifully executed work will be a fair measure of the Greek spirit among our geometers of the present day. To barbarians it will seem to cut right across the course of modern geometry with an independence which shows itself in nomenclature and notation, in absence of references, and most of all in the limitations which the author has placed upon himself in the selection of his material. This is partly accounted for by the fact that Prof. Neville is avowedly a disciple of Mr. Russell, whose well-known aphorisms are scattered over the book, and it is scarcely to be expected that a subject written in the form which modern logic demands should develop itself along lines which appear fundamental in discovery.

The earlier part of the book is an introduction to vector analysis followed by an excellent discussion of Cartesian axes and vector frames. Perhaps it should be mentioned that "anisotropic" space does not imply any "medium" theory—Prof. Neville's words have no implications but are equivalents of the symbols of the Principia. Anisotropic space is flat space of three dimensions which does not touch the absolute in four dimensions. The second half of the book is devoted to the construction of algebraic space out of those properties of vectors and points which were suggested as significant in the earlier chapters. This is a most valuable contribution, and we confine our attention to it.

Geometers say that a circle is cut by a line of its plane at two points, real or imaginary. There are great advantages in doing so, but if asked for reasons they content themselves with explaining that this is a conventional way of talking and that imaginary "points" merely stand for certain pairs of imaginary numbers. How they stand for them is not clear. To find a logical basis one of two methods may be adopted. The first, that of von Staudt, consists of replacing the imaginary points by an equivalent real elliptic involution: any construction which has been algebraically thought out by the use of imaginaries at intermediate steps can be replaced by a more elaborate real construction which can be actually carried out by pencil on paper. This method has the beauty of being geometrically relevant.

The second plan, which is that adopted in this book, has the logical advantage of allowing the real points no special privilege. Algebraic complex space is built up from such fundamental relations as hold between vectors and vectors and between vectors and points in ordinary geometry; in other words, we remove the loose convention or postulate used by the "teacher in a hurry," and carefully devise a unique construct within which all the required operations can be carried out. This however has obvious geometrical disadvantages, as it involves an embarrassing array of relations in which we have no reason to be interested.

It may be doubted if there can be any true interpretation of a space in the modern sense which does not deal with the group of transformations for which it is the accepted field. The ordinary geometry, as introduced by Prof. Neville, involves lines, directions, distances, all accepted from experience; no such geometry can dispense with the idea of motion unless it has first laid down a series of postulates such as he dislikes. This geometry, which he repeatedly refers to as "kinematical," cannot be any more logical, and is far less vivid when all reference to motion is excluded. His original space is the field of such transformations, and as such is really trivial in the complex domain. "To use geometrical language," writes Russell, "... is only a convenient help to the imagination." Prof. Neville's geometry reminds us of the notorious Euclidean point when it has moved, for what help to the imagination can come from a discussion of lines perpendicular to themselves or the bizarre metrical geometry of the isotropic plane? Just as the logician objects to Staudt's method as a search for complex space within real space, we fear most geometers will not pleasantly accept the task of picking out projective properties from the mass of metrical relations which Prof. Neville's method imposes on them.

George Westinghouse.

A Life of George Westinghouse. By Dr. Henry G. Prout. (For a Committee of the American Society of Mechanical Engineers.) Pp. xiii + 375. (London: Benn Bros. Ltd., 1922.) 18*s*. net.

THE American Society of Mechanical Engineers has undertaken to issue volumes devoted to the lives of some of its great men; and the supervision of the work has been entrusted to a committee of the Society. The first book of the series was a special edition of the autobiography of John Fritz, honorary member and past president. The present volume is the second of the series.

In the almost complete absence of personal records, letters, notes, and other material from which a biography could be prepared, the committee has had to draw upon the memories and impressions of those men still living who were nearest to Westinghouse, and the editor's duty has been to co-ordinate their contributions. This method of preparing a biography has both its advantages and disadvantages; for while it helps towards the forming of a reasonable perspective, the result is rarely of any great literary interest. Such an interest, although of secondary significance during the man's generation, is a considerable asset to the perpetuation of his memory.

The genius of George Westinghouse is expressed in patent specifications and in industrial processes and products. On account of the diversity of these activities the editor has considered that a chronological survey would be confusing, and the record of achievements is dealt with under the different subjects to which they apply; in this manner an admirable summary is presented of the work of Westinghouse and its value in the world of industry.

The two major achievements made by Westinghouse were the development of the air-brake, which greatly influenced railway transport, and the application of alternating currents in the production and distribution of power. In the former he acted primarily as an inventor, in the latter as an industrial organiser. Both activities resulted in the evolution of industrial concerns, vast in size and ramifying in many directions. At the present time some seventy of these concerns exist. In other fields, he developed the use of natural gas at Pittsburgh and took out thirty-eight patents in this connexion; he did important work both in steam engineering and railway signalling, and in forty-eight years he took out some four hundred patents.

Whether Westinghouse was greater as an inventor or as a manufacturer is debatable, but both his inventions and his industrial ventures would have suffered much without this unique combination of capacities.

The greater part of the book deals with a survey of technical and manufacturing achievements, but the two concluding chapters give a well-drawn portrait of Westinghouse—the man. The editor shows him to be a man possessing almost superhuman qualities linked with very human weaknesses, a man of impelling personality, an idealist whose feet were firmly planted on the ground, a genius in imagination and vision, with marvellous powers for concentration, persistence, audacity, and fortitude to carry the fruits of his genius to such conclusions that they enormously benefited mankind. Perhaps the greatest weakness that is evident from the editor's presentation is a too great self-reliance and an inflexibility of mind when once a decision had been made. A most outstanding characteristic was his capacity for leadership, and his relations with his men were inspired by a man-to-man comradeship and good feeling, an instinct which has become traditionally known in industry as "the Westinghouse Spirit," which in its essence embodies in the highest degree loyalty and enthusiasm.

Aristotle and Physical Science.

(1) *Aristotle: on Coming-to-Be and Passing-Away.* (De Generatione et Corruptione.) A Revised Text, with Introduction and Commentary by Harold H. Joachim. Pp. xl+303. (Oxford: Clarendon Press; London: Oxford University Press, 1922.) *32s.* net.

(2) *The Works of Aristotle: Translated into English. Meteorologica.* By E. W. Webster. Pp. vi+140. (Oxford: Clarendon Press; London: Oxford University Press, 1923.) *7s. 6d.* net.

(1) THE treatise "On Coming-to-Be and Passing-Away" is one of very great interest to the pure Aristotelian. The question discussed in it is this: the four most elementary substances known to us being earth, air, fire, and water, how do these change into one another and how do they form less simple substances such as flesh and bone? For example, what happens when water is boiled in a kettle? To such questions as this the Atomists had already given an approximately correct answer. The scientific man will naturally ask whether Aristotle made any real advance on his predecessors; if he did not, why should we trouble ourselves about his views on such problems? It must be regretfully admitted that he did not make any such advance.

Aristotle seems to have been a good deal impressed by the atomic solution, but refused to accept it, criticising it with some severity, as indeed he always does criticise with severity all his forerunners. But what better had he to offer? Matter, says he, is one substratum underlying all phenomena: so far perhaps we agree with him, since modern science more and more tends towards belief in one substratum, and the weak point of the old Atomists was that they preferred a multitude of different groups of absolutely primitive matter, as Dalton did. Again, this substratum assumes the forms of the four so-called elements (which are not, strictly speaking, "elements" for Aristotle). Now if this could be interpreted to mean that the substratum appears in the four forms of solid, liquid, gaseous, incandescent, it would be very good sense, but unluckily Aristotle never put it that way. No, they are somehow formed by combinations of the two pairs of contraries, hot and cold, dry and moist: when water is boiled, the cold-moist is transformed into the hot-moist; and the efficient cause of these combinations and transformations is the movement of the heavens, in particular of the sun. Certainly the scientific man will be tempted to wish with Bacon that Democritus had come down to us instead of Aristotle—at least so far as this question is concerned.

But the pure Aristotelian does not fret himself over such considerations. His one aim is to understand the meaning of his master and to delight in the subtleties of that astonishing world of close-packed thought, microscopic and yet universal. He will, like Prof. Joachim, find this treatise "fascinating and masterly," and he will give thanks unstinted to him for his superb exposition of it. Only those who have wrestled with the prodigious difficulties of such a work for themselves can appreciate the learning and mastery shown by him on every page of his commentary. The text also is very greatly improved: it is something of a shock to learn how untrustworthy is that of Bekker which we have been in the habit of accepting without demur.

(2) This miscellaneous work discusses various phenomena of the heavens (such as clouds, comets, the rainbow), the nature of the sea, earthquakes, wind, thunder, many properties of "composite bodies" such as iron, wood, honey, and plenty of other things besides. The admirer of Aristotle's biological works will be sorely disappointed by it; here are none of the flashes of insight and the grand generalisations which astonish us in those works, but here are his vices to be seen in abundance, especially the almost total absence of experiment, and the failure to test his hypotheses, the need for doing which he might have learnt from Socrates. One soon becomes weary of reading one facile explanation after another, almost always on wrong lines: for example, the Milky Way is "a fringe attaching to the greatest circle and due to the matter secreted." At the same time, it is of some interest, as testifying to the universality of its author's outlook on the world; "the number of things that man spied into," said Goethe of Aristotle, "is beyond belief." Perhaps the most interesting observation is that "we have only met with two instances of a moon rainbow in more than fifty years," which shows how Aristotle kept his eyes open; how many of us have seen two of them? But it is not given to any one man to be supreme alike in biology and physics.

The translation is excellently done, and Webster's early death—he was killed in battle in 1917—is a sad loss to scholarship.

A Survey of Scientific Literature.

Statistical Bibliography in Relation to the Growth of Modern Civilization: Two Lectures delivered in the University of Cambridge in May 1922. By E. Wyndham Hulme. Pp. 44 + 5 Tables + 4 charts. (London: Grafton and Co., 1923.) 6*s*. net.

THIS book contains two out of the four lectures delivered by Mr. Wyndham Hulme as Sandars reader in bibliography at the University of Cambridge in May 1922, and forms a notable contribution to the science of bibliography. Mr. Hulme's thesis is the need of co-operative action in bibliography, and in these lectures he urges as an example of this need the importance of bibliographical data as an aid to the illustration and interpretation of changes in the progress of modern civilisation.

The growth of scientific literature as a measure of man's activity has not been generally recognised—though the records previous to the nineteenth century are as a rule much more full and trustworthy than the ordinary data of the statistician—and Mr. Hulme here shows by means of graphs and tables how bibliographical statistics may not only serve to confirm conclusions already reached from other sources, but may also aid us to define and explain more precisely important movements of our social and industrial history. He takes as an example the International Catalogue of Scientific Literature as being fairly representative of the world's scientific literary output, and has compiled statistics for the years 1901 to 1913 for each of the 17 sections into which that work is divided, and correlated these with statistics of patents for invention, trade, population, etc. The figures given from the International Catalogue admittedly cannot be taken as final, for they are not only themselves subject to many adjustments, but they are also confined to the literature of pure science, and any influence that may have been exerted by advances in technology is obscured. Moreover, each branch of science is treated as a whole, and the behaviour of the various subclasses within each branch and their interrelation cannot therefore be studied. Nevertheless, the figures show certain features which would probably not be greatly modified by a more detailed examination. There is, for example, an undoubted indication of the rhythmic progress of a science, which appears to proceed in alternate periods of growth and stagnation and rises to a period of maximum output which in some cases it may be possible to predict. The year 1910 seems to have been a peak year, for there is evidence of a general falling off in all sections of the Catalogue and in patents after that year, but unfortunately the confusion arising from the War has so vitiated all statistics for years later than 1913 that it is impossible to check the extent and the duration of this depression.

Another surprising feature to which Mr. Hulme directs attention is shown in the geographical distribution of the journals indexed in the Catalogue throughout the period 1901–13. The figure for Germany and Austria is only just less than those for France, Russia, the United States, and Great Britain combined, while these four countries follow in the order given, with Russia appreciably higher than the United States or Great Britain.

In connexion with the English patent statistics which

Mr. Hulme gives from 1561 to date, the introduction of the patent specification about 1730 is an important landmark which should not be overlooked. Its need arose out of the increasing specialisation in industry—itself a sure indication of the commencement of industrial growth—and its establishment as a permanent part of patent practice so long after the introduction of the patent system is a parallel to the long time-lag that existed up to the eighteenth century between actual practice and its corresponding literature. This time-lag and the early divorce of industry from literature are well shown by Mr. Hulme in two interesting "tabular surveys" of the literature of architecture and the textile industries which give the earliest printed monograph in the different subdivisions of these two subjects, and in themselves form valuable bibliographical charts.

It is, however, more with the method advocated than with the conclusions drawn by Mr. Hulme—important and interesting as these are—that we are here concerned, and it is to be hoped that both bibliographers and statisticians will realise the utility of this new apparatus which may not unworthily play its part in the elucidation of many problems.

Our Bookshelf.

Catalysis in Organic Chemistry. By Paul Sabatier. Translated by Prof. E. Emmet Reid. Pp. xxiv+406. (London: The Library Press, Ltd., 1923.) 25*s*. net.

PROF. SABATIER's book, of which an American translation is now issued, has been written on a basis which is considerably broader than the brilliant researches with which the name of the author is universally associated, and is very far from being a mere résumé in book-form of those researches, valuable as that would be. It is also more than a mere text-book for the instruction of students, since, instead of giving merely a few illustrative examples of particular types of chemical change, the author has usually enumerated all the most important examples, with references to the original literature in which they are described. The result has been to produce a monograph of remarkable completeness, in which the references alone would cover many pages, since they are several thousands in number.

The translation has been well done, although English readers will be amused to see on p. 25 a sentence which ends in a hyphen as a result of a refusal to repeat the second half of a name, which has already been printed on the preceding line. The pagination of the book is also very confusing, since, in opposition to all English precedents, the outer corners are occupied by paragraph numbers, the page-numbers being relegated to the inner corners, until the index is reached, when they revert to the usual position, thus giving the impression that 969 and 350 are consecutive pages. A very full author-index and subject-index have been added by the translator, in which again a novel system has been adopted, since all the references are to paragraphs and not to pages.

The American translation contains a supplementary section of 12 pages by Prof. Bancroft on "Theories of Contact Catalysis," and a number of signed footnotes by American workers. A biography, covering two pages only, is of very real value in directing attention to the range of Prof. Sabatier's researches, since his earlier work in inorganic chemistry has been largely overshadowed by the brilliancy of his later work in organic chemistry. It is also of interest to read that in 1907 he declined an invitation to follow Moissan at the Sorbonne, preferring to retain the chair of chemistry at Toulouse, which he has now occupied for nearly forty years.

The Wheelwright's Shop. By George Sturt ("George Bourne"). Pp. xii+236+8 plates. (Cambridge: At the University Press, 1923.) 12*s*. 6*d*. net.

THE title of this book gives no indication of the enjoyable nature of its contents. The author transports us into rural England as it was before the hand craftsman had disappeared before the march of machinery, and lets us into the secret of how these men found their working lives to be worth living. The knowledge which comes to the man who has to get out his own timber by the use of hand tools, and the intimate acquaintance with its peculiarities so acquired, are possessed by few workmen to-day. The book is very human, and is diversified throughout by quaint touches which throw a flood of light on the development of village life in England. Such a book could not be written except by one who had lived among the things described, and was intimately acquainted with the people. The wheelwright's shop still exists in Farnham, although it has moved with the times; its first records date back to 1706, and it came into the possession of the author's grandfather in 1810 and remained in the family until 1920.

The reader will learn a great deal more than how waggons and carts used to be built. "In the slow transition from village or provincial industry to city or cosmopolitan industry, one sees a change comparable to the geologic changes that are still altering the face of the earth. Already, during the eighties and nineties of last century, work was growing less interesting to the workman, although far more sure in its results. Whereas heretofore the villager had been grappling adventurously and as a colonist pioneer with the materials of his own neighbourhood, other materials to supersede the old ones were now arriving from multitudinous wage-earners in touch with no neighbourhood at all, but in the pay of capitalists. So the face of the country was being changed bit by bit . . . village life was dying out; intelligent interest in the country-side was being lost. . . . Seen in detail the changes seemed so trumpery and in most cases such real improvements. That they were upsetting old forms of skill—producing a population of wage-slaves in place of a nation of self-supporting workmen—occurred to nobody." The book can be recommended thoroughly to all who wish to extend their knowledge of their fellow men and who are interested in modern welfare problems.

Physics in Industry. Lectures delivered before the Institute of Physics by Prof. A. Barr, Sir James Ewing, and C. C. Paterson. (Oxford Technical Publications.) Vol. 1. Pp. 59. (London: H. Frowde and Hodder and Stoughton, 1923.) 2*s*. 6*d*. net.

THE first of these three lectures directs attention to the great complexity of the problems with which the engineer has to deal; and to the fact that, in many problems of design it is practically impossible to proceed by the method of scientific experiment; "his own experience and his inheritance of the accumulated results of the labours of his predecessors" must largely guide the successful engineer. Sir James Ewing deals with the relation of the physicist to the developmental history of the heat engine, and states that "the impulses towards any new departure are, in general, given by men who are at home in that delightful country which may be described as the borderland of physics and engineering. I have roamed in it for many happy years, and have been privileged to know some of the great men who have dwelt on its hill-tops. I have enjoyed its morning mists and its changing landscapes." The third lecture gives the experiences and views of a research physicist, working with an important electrical company which manufactures most of the machines, apparatus, and accessories made use of in modern electrical practice. His views on the duties and methods of the research organisation of such a company are of the highest importance, and should receive very close consideration by all who are interested in industrial research.

(1) *Essentials of Modern Physics.* By C. E. Dull. Pp. xi+525. (London, Calcutta and Sydney: G. G. Harrap and Co., Ltd., 1923.) 5*s*.
(2) *The Elements of Applied Physics.* By Prof. A. W. Smith. Pp. xiv+483. (London: McGraw-Hill Publishing Co., Ltd., 1923.) 12*s*. 6*d*.
(3) *Practical Heat.* Edited by T. Croft. (Power Plant Series.) Pp. xiii+713. (New York and London: McGraw-Hill Book Co. Inc., 1923.) 25*s*.

IN our issue of December 9, 1922, p. 792, we directed attention to the first of a series of reports on the teaching of physics in the United States by a committee of the American Physical Society formed to investigate the subject and to make recommendations for the future. The three books under notice may be regarded as outcomes of that report, for their aim is to provide a sound knowledge of the fundamental principles of the subject and to show how those principles find their applications in the common experiences of everyday life. The first is for secondary school use and introduces each principle by a familiar fact depending on it, the second supplies the needs of a student in his first year at a University intending to become an engineer, while the third is a more complete exposition of the principles which underlie heat engineering. All are well printed, and the latter is abundantly illustrated. There are a few lapses on fundamental points, but they do not seriously interfere with the usefulness of the books for those who wish to know the "why" of things they see around them.

Plane Geometry: An Account of the More Elementary Properties of the Conic Sections, treated by the Methods of Co-ordinate Geometry, and of Modern Projective Geometry, with Applications to Practical Drawing. By L. B. Benny. Pp. vii+336. (London: Blackie and Son, Ltd., 1922.) 10*s*. 6*d*. net.

ON the whole, Mr. Benny's book is one that we would heartily recommend to the class of students he had in mind while writing it. It is not a book for beginners; it is not a book for mathematical specialists. But for the student who wishes to acquire a fairly competent knowledge of the methods of analytical conics, combined with the modern geometrical point of view, the book should prove very useful. The style is attractive, and the treatment interesting.

Mr. Benny's aim is clearly to combine the geometrical with the analytical treatment of conics. This aim is one that all should approve. The only fault we can find with the author's treatment is one that he himself mentions in the preface, namely, that there is a sort of see-saw between geometry and analysis in alternate chapters. This gives a rather unpleasant impression, and we must confess that when we first took up Mr. Benny's book the impression it made was a bad one. But continued study of the book showed that the fault is more apparent than real. Perhaps in a future edition Mr. Benny could so rearrange the material as to work the geometrical and the analytical into a really organic whole. S. B.

Electrical Engineering Laboratory Experiments. By Prof. C. W. Ricker and C. E. Tucker. Pp. xiv+310. (London: McGraw-Hill Publishing Co., Ltd., 1922.) 11*s*. 3*d*.

A STUDENT in an electrical engineering laboratory should be taught to rely on his own resources and encouraged to exert his own initiative. At the beginning of his course it is advisable that he perform rapidly under careful supervision the fundamental testing experiments. He should then be assigned work which requires a certain amount of originality. If he shows a particular interest in any problem, he should be encouraged to make a research on it. The teacher is occasionally rewarded by finding a keen and accurate observer who has the ability to analyse his experiments and draw useful conclusions from them. In the book under notice fifty-six experiments are given ranging from the wheatstone bridge to the mercury arc rectifier and from the direct-current generator to the load characteristics of a three-phase commutator motor. The theory given of the various tests is not too lengthy and can be easily understood. The book can be commended to teachers and students.

Practical Chemistry. By Dr. L. C. Newell. Pp. viii+543. (London and Sydney: D. C. Heath and Co., n.d.) 6*s*.

DR. NEWELL'S work is not a "practical" text-book in the English sense, but an elementary text-book of chemistry along the lines now followed in America. Industrial applications are kept in the foreground, and illustrations of technical plant are numerous.

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.]*

A Calculation of the Atomic Weights of Isotopes.

SOME months ago, when engaged on a study of radioactive disintegration series, the results of which appeared in the October issue of the *Philosophical Magazine*, I was able to formulate simple rules from radioactive data which enabled me to calculate a list of the atomic weights of the principal isotopes of both common and radioactive elements. This list, which will be published in due course, agreed closely, although not identically, with all the experimental values of the atomic weights of the isotopes of the common elements determined up to that date (June 1923) by Aston and others. Since then, in a recent issue of NATURE (September 22, p. 449), Aston has published some further results with which my predictions agree so exactly that I feel constrained to give here a brief account of how my list was arrived at, and to state some results which have yet to be verified or disproved experimentally.

The main supposition is that there are four separate radioactive series the members of which have atomic weights given respectively by $4n+3$, $4n+2$, $4n+1$, and $4n$, where n is an integer. In the paper mentioned above I give reasons for supposing that the first of these is the actinium series, the second the uranium series, the third a hypothetical series the end-products of which may be bismuth ($a=209$) and thallium ($a=205$), and the fourth the thorium series. It is known that in the uranium and in the thorium series successive changes are principally of two kinds: a succession of α-particles, and the succession α, β, β and α; it is probable, and I assume it to be so, that in the two other series the characteristic successive changes are a succession of α-particles and the succession α, β, α, β. I next imagine that radioactivity continues below the so-called end-products of the series, the uranium and thorium series being continued by the elements of even atomic number and the two other ones by the elements of odd atomic number. There is no experimental evidence for this, nor does it matter. The point is merely that isotopes, which on radioactive evidence would be presumed stable, would be found experimentally to be the isotopes of common elements, and those presumed instable (bodies which supposedly expel β-particles, for example) would not be found. This is reasonable.

An arrangement of this kind yields a surprising amount of information, and it may be claimed that solely from radioactive evidence the following points may be deduced: (1) It is probable, but not impossible, that isotopes do not differ by more than 8 units of atomic weight; (2) only end-products of radioactive series or radio-elements emitting α-particles should be considered when a comparison is made between common and radioactive isotopes; (3) all elements are limited to two isotopes of odd atomic weight (odd isotopes), and these differ by 2 units of atomic weight only; (4) odd elements (*i.e.* elements of odd atomic number) have odd isotopes only, and, if there be two, the lighter one is likelier to be the more stable and consequently the more abundant in Nature; (5) even elements may have both even and odd isotopes, but the former should be as a rule at least twice as numerous as the latter, and an odd isotope should not be either the lightest or the heaviest of all; (6) isobares of common elements may be of even atomic weight only; (7) an element the atomic number of which is given by $4n+3$ has an isotope of atomic weight $4n+1$, and *vice versa*; and (8) an even element has always one isotope a unit of atomic weight higher than one of the isotopes of the element next below it.

Several of the above rules have already been pointed out by Aston from his results on common isotopes. They are indeed the common ground of both ordinary and radioactive isotopes. They do not apply in their entirety to the elements below nickel and cobalt. It is not to be expected that the lightest elements with their simple structure would behave exactly like the heavier ones. In addition, it is probable from atomic weight evidence and certain evidence from Aston's results that the series $4n+2$ and $4n+1$ do not run continuously below the limit of cobalt and nickel.

If the radioactive evidence were decisive in regard to which mass-numbers are unstable, and which are possible isobares, the determination by calculation of all the isotopes of all the elements would not be difficult, but this does not appear to be so. The evidence does not give a complete solution because, among other things, I have not considered possible branching in any of the series. Branching no doubt occurs according to some plan, but up to date I have not discovered what that plan is. Consequently on one or two occasions I have failed to agree entirely with Aston's experimental results. For example, my calculations give two isotopes to calcium, 44 and 40, and two to argon, 40 and 36, but they indicate that 36 is the more abundant, whereas Aston's results (and the atomic weight) contradict this.

For the elements from hydrogen to yttrium my list is identical with Aston's list, which covers this range completely, except that I say that scandium has a second isotope at 47. Zirconium has an isotope at 92 and possibly a third at 94, but no others in addition to its principal one at 90 already established by Aston. Niobium has 93 and 95, molybdenum is simple and 96. Element 43 would have 97 or 99 if either existed, but they do not. (Presumably a missing odd element is one which occurs at a place where two successive odd mass-numbers happen to be unstable.) Ruthenium has 100, 101, 102, and 104, possibly 98, but not 106. Rhodium is principally, and probably only, 103. Palladium is certainly 104, 106, and 108, not 105 but possibly 102 and 110. Silver is as given by Aston. Cadmium is 110, 111, 112, 114, with perhaps 108 and 116, but not 106. Indium is 115 only. Tin and antimony are as given by Aston. Tellurium is mainly 128 and 126, with possibly 130 and 124 but not 122. (Were it not that 128 is greater than the atomic weight of iodine I should be inclined to say that, notwithstanding its atomic weight, tellurium was mainly 128.) Iodine and cæsium are simple as given by Aston. Xenon is as given by Aston, except that I drop 126 or 124. Lanthanum and præsodymium are simple, 139 and 141 respectively. It is more probable that cerium is simple and 140 than complex and 140, 142, and 144. Barium is complex, having 134, 136, and 138 but not, if cerium be simple, 140, and it has no odd isotopes.

The rare earths are not difficult to do in spite of the uncertainty of their atomic weights. Each of the even rare earths is complex. Element 61 would have 147 and 149 if either existed; europium is 151 and 153, holmium 163 and 165, and thulium 169 and 171. In spite of their atomic weights, terbium is 159 only and lutecium only 177. Hafnium is mainly

178 and 180 with some 182, and has no odd isotopes. Tantalum is 181 and 183, tungsten 184 only, and element 75 would have 185 or 187 if they existed. Iridium appears to have 191 as well as 193; platinum has 194 and 196, possibly 192, but 198 is unlikely. Mercury is 198, 199, 200, 202, and 204 and not 201 as Aston finds, but I cannot add 197 as he thinks possible.

Gold is 197 and simple if Aston is right about mercury; otherwise it should have 199 also. Thallium is 203 and 205, lead principally 208 and 206, the former in excess. Bismuth is simple and 209. Polonium is of course 210, and the only member of element 84 with a chance (and that a very remote one) of being isolated. Thorium is simple and 232. One isotope of element 89 is too unstable ever to be isolated. Element 91 has 231 and 233, the former being probably protoactinium. Uranium, which is complex, has been discussed in my paper in the *Philosophical Magazine*.

The order of intensity of the isotopes cannot be given accurately from these considerations, but a rough sorting into major and minor isotopes is not difficult to make. Mass-numbers which belong to no atomic number are difficult to estimate. At present I feel sure of ten even ones and thirty-one odd below polonium, most of which Aston has found. All but one of the former are of the form $4n+2$, and more than three-fifths of the latter of the form $4n+1$. There appear to be at least thirty simple elements if my predictions be added to Aston's certainties. Fourteen of these have accepted atomic weights within 0·05 of a unit, and as many fall short of a unit by this amount as exceed it. I have assumed Aston's whole-number rule in all the numbers given in this letter.

After these mass-numbers had been deduced I found that the complexity of an element was apparently a simple function of the atomic number $16n$. Thus there is a *probability* that elements of atomic numbers $16n+7$, $16n+10$, and $16n+11$ are simple; that $16n+3$, $16n+5$, $16n+13$, and $16n+15$ have two isotopes; that $16n+8$ and $16n+14$ have no odd isotopes; and that $16n$, $16n+2$, and $16n+12$ have odd isotopes. If this deduction be substantiated by experimental work it should throw light on the constitution and stability of the nucleus.

A. S. Russell.
Dr. Lee's Laboratory, Christ Church,
Oxford, October 3, 1923.

The Measurement of Very High Temperature.

In 1914 Lummer[1] described some experiments on an arc burning in a gas at high pressure. His method of determining the temperature based on the increase of surface brightness of the positive crater is extremely unsatisfactory, and his figures, using his own values of surface brightness, appear to be nearly three thousand degrees too low. It seemed desirable, therefore, to repeat and extend the experiments and determine the temperature more precisely. A very accurate way of doing this would be to determine the ratio of the intensity of the light at two wave-lengths as far as possible apart, which would define the temperature if the positive crater were a complete radiator. This assumption need not be made if ratios of the intensities are determined at two different temperatures, one of which is known. Thus, for example, in the region in which Wien's law holds, if a_λ is a constant proportional to the emissivity, the intensity is given by

$$E_{\lambda T} = \frac{a_\lambda \, . \, e^{-c/\lambda T}}{\lambda^5},$$

and

$$\log \frac{E_{\lambda_1 T_1} \, . \, E_{\lambda_2 T_2}}{E_{\lambda_1 T_2} \, . \, E_{\lambda_2 T_1}} = c\left(\frac{1}{\lambda_1} - \frac{1}{\lambda_2}\right)\left(\frac{1}{T_1} - \frac{1}{T_2}\right),$$

which determines T_2 in terms of T_1. Since a_λ, which may also contain the sensitivity of the measuring instrument, disappears from the final equation, this method is very convenient and may be made very accurate.

Two methods were used for determining the intensity, one by the use of a wedge as suggested by Prof. Merton,[2] the other making use of the photo-electric effect. The first method is more convenient in many cases; the second is probably more accurate.

The main difficulty is to make sure that one is really observing the hottest part of the crater. It is very difficult to keep the arc constant at high pressures, and obviously too low a temperature will be found if the arc shifts during the exposure so that part of the measurement is carried out on the colder parts surrounding the crater. If this has been avoided, comparison of the intensity at any two wave-lengths at atmospheric pressure and at high pressure enables the temperature at the high pressure to be calculated in terms of the known temperature of the normal arc. A check in the method is given by the constancy of the temperature found using various wave-lengths. The divergence from the mean is within the limits of experimental error.

Owing to the difficulty outlined above, observations at the same pressure do not repeat very accurately, though the highest values are fairly consistent. The following table summarises the provisional results for an arc in nitrogen:

Pressure in Atmospheres.	Temperature.
1	(4190)A
6	4680
18	6180
33	6520
80	8620

As already stated, these are minimum temperatures; and indications on one plate (10,000° at 50 atmospheres) seem to justify the suspicion that they may be considerably underestimated.

Further experiments making use of a number of improved methods are now in progress, and it is hoped shortly in a fuller publication to give more accurate values for the temperature of the crater as a function of the pressure and nature of the gas. The fact seems certain, however, that one can by this means reach temperatures in the laboratory considerably higher than the temperature at the surface of the sun.

It may be interesting to note here the strong reversal of some of the cyanogen bands shown on the plates within certain limits of pressure and temperature. The phenomenon is most noticeable between 30 and 40 atmospheres, and it should be possible to locate these limits more definitely in the course of the experiments.

I have in conclusion to acknowledge a deep debt of gratitude to Prof. Lindemann for much helpful criticism and encouragement.

I. O. Griffith.
Clarendon Laboratory, Oxford,
September 22.

[1] Lummer, "Verflüssigung der Kohle und Herstellung der Sonnentemperatur." (Sammlung Vieweg.)

[2] Merton and Nicholson (Phil. Trans. Roy. Soc. A. 217). Prof. Merton kindly lent me the spectrometer and wedge which he used in his own investigations, and I take this opportunity of thanking him for the loan of the apparatus and for his assistance in initiatin me into the details of his method.

Early Greek Chemistry.

IT is generally recognised that chemistry began, as the "divine [or, perhaps, "sulphurous"] art" (θεῖα τέχνη) in Hellenistic Egypt, in Alexandria, during the first centuries of our era. The books of its practitioners have existed as copies in most European libraries for many centuries. Those in the King's Library at Paris were mentioned by Olaus Borrichius in the seventeenth century; parts of the most important were published and translated by Hoefer early in the nineteenth century, and the whole *corpus* was published, with a translation, by Berthelot and Ruelle as the "Collection des anciens alchimistes grecs," under the auspices of the French Minister of Public Instruction, in 1887–88, in four volumes. It is not a little surprising to find such an eminent writer on cognate subjects as Reitzenstein, as a result of admittedly hasty examination of the Paris MSS., offering rather severe criticism of the work of Berthelot and Ruelle, since the text of the latter is based on the collation of existing MSS., and not merely on those of Paris. The production of it and of the translation was a work of no small difficulty, as might have been anticipated from the place of origin and date of the original. A very large number of words have no place even in such exhaustive works as Du Cange's "Lexicon."

It is, therefore, particularly gratifying to find Prof. Stéphanidès, of the University of Athens, now undertaking a revision of the text and translation of the "Collection" in many places where they are obscure. His knowledge of chemistry, the literature of alchemy, and—particularly—of modern Greek, are brought into use. Mme. Hammer-Jensen, it is true, has recently attempted in her essay, "Die älteste Alchymie," Copenhagen, 1921, to reconstruct the theories underlying the Greek alchemical MSS., and to rearrange them in order of date. But her evident lack of broad chemical knowledge, and her approach from the way of the so-called "classical" philology, have noticeably hampered her contribution.

Prof. Stéphanidès' article, published in the *Revue des études grecques*, tome 35, No. 162, Paris, 1922, a copy of which he has just sent me, is one of great interest and value. The following may be mentioned as an indication of the type of emendation which he has been able to suggest—throughout with a full appreciation of Berthelot. Many words left untranslated are now given meanings, *e.g.* χάνδρα = "false pearl" in modern Greek. The explanation of the obscure passage given on p. 6 (206, 8) of Stéphanidès' paper is very ingenious. Some of Berthelot and Ruelle's translations read as nonsense, but in the hands of Prof. Stéphanidès the text reveals its meaning: "de la largeur d'un petit miroir très mince' becomes "en forme très mince de *pierre specularis* [mica]." The passage given by Berthelot and Ruelle as, "Quelques-uns après cela font boir un oiseau depuis le soir jusqu'à une heure, puis ils laissent mourir de soif le petit oiseau, en le privant de boisson," etc., is completely incorrect, and should read: "Quelques-uns donnent <les perles> à avaler à une poule <afin qu'elle les garde dans le gézier> depuis le soir jusqu'à une heure, en privant l'oiseau de boisson, et puis, en le sacrifiant, on trouve les espèces <les perles> brillantes." (Improvement of pearls by the action of the gastric juice: a well-known operation in ancient technology.)

There will be some criticism of such renderings as "νιτρέλαιον = acide azotique," and Σαλόνιτρον ἤγουν σκευοβότανον as "βότανον pour la σκευή," because "les Byzantins appelaient βοτάνη la poudre à canon et σκευή le canon." βοτάριον puzzled Hoefer; it has become fashionable to render it "magic plant." Some obscurities are put down to assonance, and belief in "sympathy" (cf. the κρόνος and χρόνος of the Stoics).

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The Musk Ox in Arctic Islands.

DURING my various arctic expeditions I have learnt a good deal about the ovibos (musk ox) from conversation with the Eskimos, and perhaps more from actual observation. Especially when we were in Melville Island (1916–17) we were in almost continuous association with the animal. It has occurred to me that what we know of the present habits and distribution of ovibos throws a light on one of the geological problems of the American arctic.

All my inquiries from the Eskimos and all the observations of our own party indicate that both herds and single animals move slowly—no faster ordinarily than strictly required by the feed. This means that in fertile arctic grass lands, herds move less than five miles a month. But—more important—we have neither observed nor heard about their crossing sea ice. We have never seen ovibos tracks more than one or two hundred yards from shore. It seems that, if they "thoughtlessly" start out upon the ice, they pause within 200 yards, look around for land, and turn in a direction where land is visible.

This means that, through observation and hearsay, I have concluded that the ovibos never cross from one island to another, either by swimming the water or by walking across ice. If this has always been their nature, we can explain their presence on several of the arctic islands only by assuming that once upon a time these islands were connected land.

Some of the arctic islands have numerous raised beaches and other indications that they have been rising rapidly in recent times—the Ringnes Islands, Borden Island, King Christian Island, and Lougheed Island. In none of these have we found any evidence that ovibos were ever present.

Since the living ovibos or remains of the dead are found, so far as I know, in all the other arctic islands, we must conclude that these islands were once upon a time connected with each other, either directly or by way of the mainland of either North America or Asia. It seems clear that the islands where ovibos have never been were at that time either separated by water channels from the land mass which later became the main part of the Canadian Archipelago, or else, and more probably, that they were then beneath the sea.

VILHJALMUR STEFANSSON.

New Court, Middle Temple,
London, E.C.4, September 24.

Scientific Names of Greek Derivation.

ON looking through some arrears of NATURE after the vacation I see, on August 18, p. 241, Dr. W. D. Matthew, in discussing the spelling of names derived from the Greek, asks if we should write "Deinosaur" or "Dinosaur"?

For the spelling it is no great matter, but it does matter for the pronunciation. For example, at one time it was customary, perhaps more or less may still be, to spell Pheidias "Phidias"; consequently, the unlovely pronunciation "Phiddias" was prevalent. So had we not better keep to Deinosaur?

CLIFFORD ALLBUTT.

St. Radegund's, Cambridge,
October 10.

The Problem of Leprosy.

RECENT progress, especially as regards treatment, has paved the way for practical advances in the control of the world-old problem of leprosy, so a brief survey of the position appears to be timely. Ancient records show it has been present in Africa and India, and probably also in China, from the dawn of civilisation. It spread over Europe during the first centuries of the present era, was carried to the New World soon after its discovery, and new epidemics originated in some Oceanic islands as late as the middle of the last century. There is evidence to show that leprosy is now spreading among the Mohammedan races of tropical Central Africa.

Nearly all the countries with the highest incidence of leprosy are situated in humid hot tropical areas of Africa, Asia, and America. Heiser not long ago estimated the lepers of the world at about two millions, which recent figures indicate not to be an over-estimate, as some authorities place the number in China at one million; the 1921 census figure for India is 102,513, with at least an equal number of earlier unrecorded cases, while the rates in very extensive areas of Central Africa have recently been shown to vary between 5 and 60 per mille, and in small areas have run up even to 200 per mille. These are terrible figures when we remember that the present official Indian rate is but 0·32 per mille, in spite of lepers being seen daily in the streets of most large towns of that densely populated country; South Africa has 2248 and the West Indies 1433 known lepers, so the total number in British countries cannot well be less than 300,000. The eradication of the disease is thus a formidable task.

During the latter half of the nineteenth century a remarkable controversy raged between the supporters of the hereditary and contagious theories of origin of the disease. The hereditary view had for a time supplanted the ancient belief in its contagiousness, although the classical figures in support of the hereditary transmission of leprosy in Danielssen and Boeck's book of 1848 have long been shown by advancing knowledge to lend no valid support to that theory. The theory rapidly lost ground after the discovery of the lepra bacillus by Hansen in 1874, and is now finally discredited in favour of the age-long theory of the communicability of the disease. Jonathan Hutchinson's fish theory, also of prebacteriological origin, has had no supporters since his decease.

The precise manner in which the causative bacillus of leprosy passes from the diseased to infect the healthy is still, however, not finally proved, although there is a very general consensus of opinion that it enters through minute lesions of the skin or superficial mucous membranes, especially the nasal, and that prolonged exposure to close contact with a leper is usually necessary before infection takes place. In a series of 700 cases in which the probable source of infection was traced, house infection was shown in about 80 per cent., while in at least 30 per cent. the unfortunate victim had slept in the same bed as a leper before contracting the disease. It is also known that the nodular form is far more infective than the nerve type, owing to the extensive discharge of the lepra bacilli from the ulcerated skin and nasal lesions of the former. Children and persons not over twenty years of age are far more susceptible than those of thirty years and upwards. All these are very important points from the prophylactic side.

The three international leprosy conferences of 1897, 1909, and 1923 have all endorsed the contagiousness of the disease and the necessity of segregation in stamping out or greatly reducing it, as has been so successfully carried out in Norway, where 2833 cases in 1856 have been reduced to 140 at the present time, while during the last two decades the rate per mille has been reduced to less than one-half the former rate in Cyprus and Jamaica through similar measures, the value of which when practicable is undoubted. Unfortunately the expense of compulsory segregation is entirely prohibitive when such large numbers as those of India, China, and Central Africa have to be dealt with, while, even under the favourable conditions of Norway, as compared with backward and poor tropical countries, the time required to eradicate the disease is much prolonged by the impossibility of discovering and isolating the cases in an early stage, as long as this involved life-long separation from relatives and friends with no appreciable hope of recovery and restoration to their homes. The inevitable result is that by the time many of the patients were detected and isolated, other members of their households were already infected, though they develop the disease only after several years, on account of its prolonged incubation period.

Advances in the Treatment of Leprosy.

It is a remarkable fact that, just as the great specific remedies for malaria and amœbic dysentery, cinchona bark and ipecacuanha root respectively, were discovered centuries ago by the aboriginal South American Indians, so the one remedy of value in leprosy, chaulmoogra oil, is an old Hindoostan medicine. It was brought to the notice of European practitioners in 1853, and was shown by Ralph Hopkins of Louisiana to be able to clear up a certain proportion of incipient cases, although it only retarded the advance of typical ones, being too nauseating to allow of more effective use by the oral route.

Intramuscular injections of the oil proved to be more efficient, and in 1913 Victor G. Heiser reported 11 per cent. of apparent cures after some eighteen months of painful injections, which only a certain number of lepers will submit to. These observations led Rogers to search for a soluble preparation of the active portion of the oil more suitable for injection purposes, which he found in 1916 in the sodium salts of the different fractions of the unsaturated fatty acids of chaulmoogra and hydnocarpus oils derived from *Taraktogenos kurzii* and *Hydnocarpus wightiana*. First the lower melting-point fractions were used under the name of sodium gynocardate, while afterwards he concluded that sodium hydnocarpate was more active than either the former or than sodium chaulmoograte. E. L. Walker and Marion Sweeney confirmed these observations and showed that these fractions had a direct lethal action on acid-fast bacilli as a class when added to cultures. This led them to suggest a direct action of the drug on the lepra bacillus *in vivo*.

As these soluble preparations were still painful and slow in their action, Rogers commenced to use them intravenously, when he observed occasional severe febrile reactions with inflammation of leprous nodules accompanied by extensive breaking up of the lepra bacilli in them, followed by gradual absorption and eventual disappearance of both the bacilli and all signs of the disease. The same worker next showed that a soluble sodium salt of the fatty acids of codliver oil, sodium morrhuate, and of soya-bean oil (sodium soyate) were also effective in leprosy, although they had no direct action on acid-fast bacilli *in vitro*. More recently, he has found an increase in the amount of lipase in the blood of treated cases, and Muir in Calcutta has shown that this ferment decreases after a severe general reaction, indicating that it has been used up during the destruction of the bacilli in the body.

Shaw-Mackenzie showed these soaps to stimulate the action of pancreatic ferment *in vitro* on fats; so Rogers has suggested that they may act through the lipase, dissolving the fatty coating of the lepra bacilli *in vivo*, much as Dryer has succeeded in doing *in vitro* in the case of the tubercle bacillus, a point of practical interest also in connexion with the use of sodium morrhuate in tuberculosis, which is still under trial. In the case of leprosy large numbers of the bacilli may be safely disintegrated by the treatment with apparent enhancement of the resisting powers of the patient's system, complete disappearance of extensive nodular leprosy having occasionally followed a very severe febrile reaction of a month or more in duration, followed by gradual clearing up of the disease during the following year without any further treatment. Moreover, K. K. Chatterji has obtained an active preparation against leprosy from mim oil, and Muir others from linseed and even from olive oil, so an immense field has been opened up for further search for possible curative products against both leprosy and tuberculosis.

In 1920 Prof. Dean and Dr. Hollmann in Honolulu made a further practical advance when they showed that ethyl ester chaulmoogrates and hydnocarpates can be successfully used by the intramuscular method in place of the more troublesome intravenous injections of the sodium salts. Similar preparations to theirs were the basis of "leprolin" issued by a German firm several years earlier and used with some success in leprosy by Engel and others.

Reports from all parts of the world now suffice to prove that an important advance has been made in the treatment of leprosy by these various researches, the less advanced cases being naturally more amenable to the treatment, and although in such a chronic disease as leprosy, with a very long incubation period, it is difficult to decide if actual cure can be brought about any more than in tuberculosis, yet a few of the earlier Calcutta cases have now remained free from active signs of the disease for from five to eight years. There is good reason, therefore, to hope some are actually cured, while there is no doubt the infectivity of the disease is removed in many of the earlier cases, with consequent decrease of possible contagions from them.

PROVISION FOR TREATMENT.

The practical question now arises as to how far the improved treatment can be utilised in the struggle against leprosy. The third International Leprosy Conference at Strasbourg in July last endorsed its value, and laid it down that segregated lepers should be provided with the best treatment. Only a very small percentage of the total lepers segregated in India and other British-governed countries are receiving its benefits, however, much less the vastly greater numbers of free lepers, including most of the earlier amenable cases, the infective powers of which might be largely abolished by six months' to a year's treatment. The treatment would cut short the new infections arising from them among their relatives and others living in their houses, and solve the hitherto unsurmountable problem of dealing effectively with the early cases of the disease, which it is often impracticable to segregate. It affords the only hope of a rapid diminution of leprosy in India, Central Africa, and other countries with very numerous lepers.

For this purpose, in addition to agricultural colonies for indigent and especially dangerous lepers, it will be necessary to organise out-patient leprosy clinics in connexion with as many hospitals as possible, where the weekly injections can be given, on the plan developed by E. Muir at the Tropical Disease Hospital. Here about 100 cases are under regular treatment, and much research work is being done with the view of improving further the treatment in the leprosy laboratory of the Calcutta School of Tropical Medicine. By this means it should be possible to render a large number of the earlier cases non-infective at a far lower cost than in settlements, and to produce a decline of new infections, and ultimately in the incidence of leprosy, hitherto impossible to obtain.

Unfortunately, it must in truth be admitted that the United States is doing far more for its lepers in the Philippines and Hawaii, both as regards segregation and in applying the newer treatment, than Great Britain is for her much greater number of lepers, mainly due to lack of funds, especially in India and Central Africa. During the last few months, however, a British Empire Leprosy Relief Association has been founded under the chairmanship of Lord Chelmsford, with the support of a number of leading British physicians and men of science, which will shortly attempt to raise the large sums necessary to remove this reproach from the British nation. This has become all the more imperative now that the Strasbourg Leprosy Conference has pointed out the obligation we are under to provide the best treatment for our segregated lepers. It applies equally forcibly to the free, earlier, and more curable cases, and it is to be hoped that no further time will be lost in bringing the knowledge that science has now furnished to the relief of those who are perhaps the most cruelly afflicted of the human race. L. R.

The Geographical Position of the British Empire.[1]

By Vaughan Cornish, D.Sc.

The Position which has been occupied.

The British Empire, although situated in every continent, with shores on all the oceans, is seen to have a definite geographical position when we consider the ports of call which unite its lands and the naval stations which guard the communications. During the growth of the Empire eastward and westward from Great Britain, numerous harbours were held at different times, those retained being a selection unrivalled by the ports of any other State in commercial and strategic position.

The naval station of Bermuda, well withdrawn from aerial attack, has a central position in the great western embayment of North America intermediate between the ocean routes which connect Great Britain with Canada and the West Indies. No foreign ports flank the route between Canada and the west coast of Great Britain. At the western gateway of the South Atlantic we have excellent harbourage in the Falkland Isles. Malta, the capital of our fleet in the Mediterranean, has a commanding position at the straits which connect the eastern and western basins, and the naval station at Gibraltar helps to ensure the junction of the Home and Mediterranean Fleet and to protect the Cape route. The British army which is kept in Egypt as garrison of the Suez Canal ensures our use of this gateway so long as we can navigate the Mediterranean. If that navigation be interrupted we can still oppose the seizure of the Isthmus, for we are able to send reinforcements by way of the Red Sea. East of Egypt the British island of Perim stands in the Straits of Bab-el-Mandeb, and the garrisoned fuelling station of Aden provides the necessary port of call on the routes to Bombay and Colombo. Colombo, in the Crown Colony of Ceylon, is at the parting of the ways for Australia and the farthest parts of our Asiatic possessions, and Singapore stands at the narrow gateway of the shortest route between India and the Far East.

The Cape route to India and Australasia is improved by British ports of call in Sierra Leone, St. Helena, and Mauritius, and is more effectively dominated from British South Africa than at first appears, for although there is open sea to the south there are no useful harbours in the Antarctic continent, and on the African coasts the harbours are under British control for a thousand miles from Cape Town.

Of the six great foreign Powers, the French alone are posted on the flank of both routes between Great Britain and the Indian Ocean, and no Great Power has its home territory on that ocean. Thus the principal lands of the British Empire—Canada, the British Isles, South Africa, India, and Australasia—have good communications with one another across the Atlantic and Indian Oceans both in peace and war.

The conditions of strategic communication across the North Pacific, on the contrary, are adverse to us, owing mainly to the circumstance that we opened up British Columbia across the prairies and by the coasting voyage. Had our colonising route been across the Pacific, the Hawaiian Islands, which were first brought into touch with the Western world by the ships of the Royal Navy, would have been a British settlement and one of our first-class naval stations. As things happened, however, these islands were first needed by the Americans, and now form the essential western outpost of the United States navy. Between them and British Columbia the ocean is empty of islands, and Fanning Island, south by west of Hawaii, with the adjacent small coral islands in our possession, are no adequate substitute, even apart from overshadowing by a first-class naval station in the neighbourhood. Thus there is no good strategic communication between Australasia and Canada across the North Pacific. In this connexion it must be remembered that cousinship does not relieve the American Government from the obligations which international law imposes upon neutrals. It was not until three years after the outbreak of the War that America could offer us any facilities in the harbour of Honolulu which were not equally open to Germans. It must also be noticed that we have no control of the Panama route between New Zealand and Great Britain.

Turning to the question of communication between British Columbia and India, it is important to realise that the Pacific coasts of North America and Asia are in a direct line with one another, forming part of a Great Circle, so that there is no short cut across the ocean, as the map misleadingly suggests. Thus the course between Vancouver and Hong Kong is not only very long, but also closely flanked by the home ports of Japan, so that its security in time of war depends upon the attitude of the Japanese.

When, therefore, we differentiate the routes on which we have well-placed naval stations and recruiting bases from those dominated by the ports of some other Great Power, we see that the lands of the Empire are united by the Atlantic and Indian Oceans and strategically separated by the North Pacific. Thus the form in which the Mercator map is usually drawn by British cartographers with Canada in the upper left and Australasia in the lower right corner is a good representation of our maritime Empire, for it shows the countries as connected across the Atlantic and the Indian but not across the Pacific Ocean.

Upon this map a symmetrical distribution of our lands is revealed when a Great Circle is drawn connecting Halifax in Nova Scotia, the eastern terminal port of the Canadian Pacific Railway, with Fremantle, the western terminal port of the Australian railway system. This truly direct line is twisted on Mercator's map into the form of the letter S. The line passes through Lower Egypt close to the Suez Canal following the general direction of the Main Track of the Empire, which is the steaming route from Canada to Great Britain, and thence by the Suez Canal to India and Australia. At one end of the line lies the Canadian Dominion, and at the other Australasia, to the north the British Isles, and to the south the Union of South Africa, the chief homes of the British nation. Our

[1] From the presidential address delivered to Section E (Geography) of the British Association at Liverpool on September 13.

coloured peoples are also distributed symmetrically about the line, India being on the east, the Crown Colonies and the Protectorates of Africa on the west, so that it is the axis of symmetry of the Empire. Not far from its middle point is the Isthmus of Suez, where our direct line of sea communication is crossed by the only continuous route for the international railways which will connect our Indian and African possessions, and adjacent to the Isthmus is the central station of our airways.

Such is the form and position of the British Empire, regarded as a maritime organisation, which in fact it is.

The Empire thus mapped has an intermediate position among the commercial, national, religious, and racial communities of the world such as is occupied by no other State. The ocean routes must always be the link between the two great land areas of the world, and in the present state of land communication provide the connexion between the numerous independent systems of continental railways. The chief of these systems is based on the ports of continental Europe, of which the greatest communicate with the ocean, and therefore with other railway systems, by way of the English Channel. Thus the island of Great Britain is intermediate between the principal termini of the European railways and the other railway systems. Its harbourage is unequalled by that of any country of continental Europe, and its supply of shipbuilding material and coal exceptionally good. Thus the physical characters of the island accord with its position on the commercial map, and the metropolitan British in their intermediate position have become the chief common carriers of international commerce.

The Suez Canal, where we have the principal control, is the gateway between the railway termini of Europe, the greatest manufacturing centre of the world, and those of the monsoon region of Asia, the greatest centre of population. It is also on the shortest route between the railways of North America and India.

How far-reaching is the effect of our intermediate position is strikingly suggested by the fact that it is the British naval stations which would, if available, provide America with the best line for reinforcement of the Philippines, the Achilles heel of the Republic. The distance of Manila from the naval shipbuilding yards of the United States is almost exactly the same by Panama and Suez, but the Pacific connexion is bad, owing to the great distance between the stations of the American Navy. The relation of Port Said and Singapore to America and the Philippines is only one of many cases in which our position is intermediate between the home and colonial possessions of a white nation. Thus the important French possession of Indo-China has to be reached from France either by way of the Suez Canal where we maintain a garrison, or by rounding the Cape where we have a national recruiting base, as well as a station of the Royal Navy. The true significance of our intermediate position has, however, been generally missed owing to a one-sided interpretation of strategical geography. An intermediate station, particularly a naval station, has commonly been regarded as a blocking position, a barrier where freedom of movement can be interfered with. The historical fact is, however, that the harbours of the British Empire have also been a link between nations. In the War the British Empire was the link of the allied and associated powers, and its geographical position is unequalled for making a benevolent alliance effective or for checkmating the action of an alliance formed with a sinister purpose.

The British Empire provides in Canada the one link on the political map between the European and American divisions of the white race. Of the 1650 million people in the world, the whites number about 500 and the coloured 1150. The former are mainly grouped on the two sides of the North Atlantic Ocean; of the latter, the greater part, about 800 million, are in the monsoon region of Asia, which includes India, Indo-China, China proper, and Japan.

In tropical Australia the British, in the exercise of their discretion, have set up a barrier between the white and coloured races. The problem of Australian settlement is complicated by the circumstance that the northern coast-lands lie in the Tropics, and have a climate which makes field work very arduous to white men. It is, moreover, uncertain if British families would continue true to ancestral type in this climate. If, however, settlers from the neighbouring monsoon lands of Asia be admitted, it would be impossible to maintain a colour line between tropical and temperate Australia, and the labour of the Commonwealth would in time be done by coloured people. The Australian British are far from the main body of the white race and from Great Britain, the chief recruiting base of their own nation. On the other hand, the distance by sea between Townsville, Queensland, and the Japanese coast is no longer than the course of the coasting steamers from Fremantle to Townsville; and the other lands of monsoon Asia are even nearer than Japan.

The relations between geographical environment and national welfare indicate that the decision to erect a barrier against coloured labour in tropical Australia is best both for the white race in Australia and for the coloured people of the monsoon region of Asia. The admission of coolie labour would deteriorate the national character of the Australians, for the greatest nations are those which provide their own working class. The descendants of the Asiatic coolies would on their part have a stunted existence as a community unable to share fully in the national life of their new land, yet cut off from the main body of their own people. Far better, then, that the Asiatic coolie should remain where the family life of his descendants will be part and parcel of national life.

Neither should it be assumed that there is not room in Asia for a large addition to the population. The pressure of population in China is largely due to the undeveloped condition of mining, factories, and communications. The coal-fields are unsurpassed in the world, and iron ore is abundant; if they were worked, and factories were based upon them, the new occupations and improved market for agricultural produce would provide at home for many of those who now migrate overseas. The further development of manufacture in India would operate in the same direction. The growth of a manufacturing population in China and India would stimulate cultivation and stock-rearing in the sparsely inhabited region under Asiatic rule which runs diagonally across the meridians from the Persian Gulf to the Amur, and includes the eastern provinces of Persia at one end and Mongolia and Manchuria at the other. This has for the most part a light rainfall, but comprises much fine prairie country and some good agricultural land, while in the more arid tracts there are many great rivers fed from snowfields and glaciers which could be made to irrigate large areas.

Adjacent to the Indo-Chinese peninsula are the East Indies, the climate of which is suited both to Indians and Chinese, with great tracts of undeveloped land the productivity of which is attested by luxuriant forest. The sparsely peopled regions of Asia near to India, China, and Japan by land and sea, and for the most part connected with them by ties of civilisation, provide an area for the overflow from these countries which is more than twice as large as tropical Australia and British Columbia, together with California, Washington, and Oregon, the American frontier provinces of English-speaking labour.

India includes one of the most important borderlands within the Orient, that of the Mohammedan and Hindu worlds. The Punjab, with its great rivers and plain, is in such striking contrast to the mountains and plateau of Iran that we are apt to lose sight of the fact that, climatically, it more resembles the highland on the west than the rainy valley of the Ganges on the east. It is an eastern borderland of Islam, a religious world which is mainly comprised in the belt of dry country which stretches diagonally from the Atlantic shore of Morocco to the Altai Mountains. Delhi, under the Great Moghul, was an advanced capital of the Mohammedan world just within the Ganges valley, which is the headquarters of Hinduism. In this sub-imperial capital the two antagonistic civilisations are now linked to the government of Great Britain, and the age-long wars between them have ceased.

Up to the time of British predominance, India was the terminal position of continental conquerors unused to the sea, who did not develop the advantages of a salient maritime position. The ports of India lie conveniently for a long stretch of coast-land on the great gulf which forms the Indian Ocean, and now, owing to the facilities provided by British shipping, much of this coast-land has easier communication with India than with its own continental interior. Several British possessions in the parts of Africa adjacent to the Indian Ocean are in the intermediate position between the principal homelands of the black peoples and the overflowing population of India, and nowhere has the responsibility of our intermediate position called for more careful examination of the rights and interests of competing coloured races. The decision with reference to Kenya which has just been given by the Home Government recognises the main physical regions in the coloured world as political divisions of the Empire within which the established races have special rights, which it is our duty to safeguard.

From the foregoing facts it is clear that the British people, metropolitan and colonial, are in a greater degree than any other nation the doorkeepers of the world in respect of economic, strategic, and racial communications.

THE CONSOLIDATION OF THE POSITION.

The consolidation of the geographical position which the British nation has won turns upon the future of colonisation within the Empire. The ratio of white to coloured people in the Empire is only about one to six. The former are mostly of British stock. The latter are of many stocks, differing physically from each other as much as from the white people, and belonging to diverse religions. Their numbers are steadily increasing under British rule. Consequently, if the Empire is to be guided by the British, the numbers of our race must also increase. There is, however, a school which considers that if our ideals of ethics and efficiency are once accepted by the coloured peoples, the racial complexion of the Empire will be unimportant, as public affairs will be regulated by our principles. This proselytising point of view does not take account of the contingency that British ideals implanted in coloured stock may receive alien development in future generations owing to biological causes. Our confidence in Western culture in general, and the British version of that culture in particular, is based more upon the power of adaptation which it has shown in our hands since the Renaissance and the era of oceanic discovery than upon any system of which we can hand over a written prescription. It is only in our own national communities, mainly composed of British stock, with minorities nearly akin, that we can be confident that British ideals will develop typically in the way of natural evolution. Therefore in our own interests and in that of the coloured races (who conflict among themselves) it is desirable to maintain the present proportion of the British stock, to whom the Empire owes the just administration of law and a progressive physical science.

We have to note that the population of Great Britain, which is now forty-three million, outnumbers the combined population of Canada, Newfoundland, South Africa, Australia, and New Zealand in the proportion of two and a half to one, and increases more rapidly than that of all these Dominions. Thus the chief source available for the British peopling of the Dominions is the metropolitan, not the colonial, population.

The number and density of the population of Canada is exceeded in the proportion of about ten to one by the white population of the United States, hence it is inevitable that there should be a large flow of people from the latter country to the Dominion. As it is essential to unanimity in the Empire that the Canadians should continue to be British in sentiment and not become pan-American, a large immigration from Great Britain is required in Canada. Moreover, the population of continental Europe outnumbers that of Great Britain in the proportion of something like ten to one, and as emigrants go to Canada from many European countries there is a further call for British immigrants to maintain the British character of the Dominion.

The co-operation of the Union of South Africa in the War only became possible after the failure of an insurrection by part of the Boers. Since the number of persons of Dutch and British stock is about equal, an influx of British colonists is required in order to ensure unanimity between South Africa and the rest of the Empire.

The population of Australia stands to that of Japan as about one to ten. The Japanese are a patriotic as well as an advanced nation, and claim equality with the white nations from patriotic motives. It is evident, therefore, that a strong reinforcement of British population is needed to maintain the doctrine of a white Australia. For the same reason New Zealand also needs emigrants, since Australasia is strategically one.

But what are the needs of Great Britain? There is a school which teaches that we should be strategically safer if we had no more people than our farms can feed, which would be about one-half of our present population; that we have passed the number which can ever be supported here in comfort; and that additions to the population would deteriorate its quality by packing the slums. The same school contends that emigration, by taking the best and leaving the worst, will produce a disgenic effect in the home country. The conclusion is that the salvation of Great Britain can only be ensured by a drastic reduction in the size of the working-class family. The strategic argument used by this school is out-of-date, as the proper plan of campaign for a combination of Powers bent on breaking up the citadel of the Empire is not naval blockade but aerial bombardment, and what the country now needs for its defence is a great development of technical industries and therefore a large population. A rural Britain would be quite unable to defend itself.

The economic argument shows too little appreciation of the permanent commercial advantage of our geographical position. As soon as the world gets again into its stride, conditions in Great Britain will improve, and thereafter each increase in the population of the world outside will provide more work in this country since our geographical position is unsurpassed for rendering economic service to other nations.

The common notion that we are packing the slums is contradicted by the census. Taking the case of the Metropolis, not only is central London less closely peopled than formerly but the five rural counties round London contain a million residents who were born in London and have spread out into the countryfied surroundings.

Neither does the census support the loose assertion that the towns are unable to replenish their population without fresh blood from the rural districts. The proportion of London residents who are London-born has steadily increased throughout the last forty years, and the birth-rate in towns is as high as in rural districts even when corrected for the effect of migration between them. Happily, also, the opinion formerly current that the townsman was deficient in morale was refuted by the War, in which our urban regiments showed a sustained valour which has seldom been surpassed in the long annals of military history.

The contention that selection for emigration will leave us only the worst, ignores the essential consideration that the best youngster for the Dominions is not necessarily the best for the Home Country. Here we need lads with sufficient business tenacity to resist the restlessness of youth quite as much as the Dominions need those who have a taste for frontier life.

The unequal distribution of men and women as between Great Britain and the Dominions limits the marriage-rate and consequently the total birth-rate of the British throughout the Empire in a way to which no other nation is equally subject. The excess of women in Great Britain cannot, however, be wholly paired in the Dominions unless the exodus of men to the United States be largely re-directed to our own lands.

Now that the limitation of the family is year by year determined more by choice and less by chance, it is important that all should know the size of family which is necessary for increase of the race. Taking account of the present age of marriage and the number of deaths before that age, I find that a general preference for the family of three would not quite maintain our numbers in Great Britain even if all migration ceased. If, therefore, the size of family be universally decided by choice the number of the race cannot be maintained, far less increased, under present conditions unless those who enter into matrimony cherish the ideal of a family of four children. Upon this, more perhaps than upon any other factor, depends the continued efficacy of the British Empire for guiding backward races, enlarging international commerce, and restricting the range of war.

The Sun and the Weather.

A RECENT article by C. G. Abbot and his colleagues of the Smithsonian Astrophysical Observatory (Washington: Proc. Nat. Acad. Sci., vol. 9, 1923, No. 6, p. 194) directs attention to a remarkable decrease in the amount of heat radiated by the sun during 1922 and the early months of 1923. This amount, the so-called "solar constant," has been well below its average value since the beginning of April 1922. No such outstanding sequence of low values has been found since the beginning of observations in 1905, and if the sun's variation influences terrestrial weather, 1922 and the early months of 1923 ought to show this influence. If the temperature of the earth's surface were determined directly by the amount of solar radiation, this long-continued deficiency would give rise to a general fall of temperature by 2° or 3° F. Owing to the complexity of the atmospheric circulation, no such simple direct response is to be expected, but we may reasonably look for anomalous weather, and in fact the winter of 1922–23 appears to have been unusually disturbed in North America. In different districts there were extremes of both heat and cold, drought and rainfall, and the authors remark that "while it is far too early in the study of the relations of solar radiation and weather to state that the extraordinary solar change caused the unusual winter weather, it does no harm to draw attention to both."

If we turn to Western Europe, we find similar disturbed conditions, especially in the north, while the Arctic Ocean has been characterised by low pressure and abnormally high temperature. The coincidence with low solar radiation may be remarked, but it is difficult to trace any actual connexion between the two. The most that can be said at present is that both in North America and Europe the storm tracks lay for the most part rather far north. During sunspot minima, which are usually associated with low values of solar radiation (as in the present instance), a similar northward displacement of the storm tracks has been remarked, and in fact has been made use of by Huntington and Visshe in their theory of climatic changes (NATURE, vol. 111, 1923, p. 561). The solar effect, however, is difficult to trace because of the great complexities introduced by terrestrial conditions, and particularly by the movements of Arctic ice. For example, the anomalous weather of May last in the British Isles has been traced back to ice movements and variations of North Atlantic currents set on foot in 1921 and the early months of 1922 (*Meteorological Magazine*, June 1923, p. 100), that is, before the decrease of solar radiation had set in, though of course the latter may have played some part in it. It will be possible to analyse the effects of the decrease in greater detail when the volumes of the "Réseau Mondial" for 1922 and 1923 are completed, since this publication gives the deviations of temperature from normal at a large number of stations distributed over the globe.

Current Topics and Events.

THE resignation of Prof. A. G. Green from the post of chief research chemist to the British Dyestuffs Corporation is followed by the announcement that Prof. W. H. Perkin has been appointed advisor to the headquarters research staff of the Corporation. This notice is reminiscent of a statement published in the *Times* of February 11, 1916, to the effect that "Prof. W. H. Perkin, F.R.S., of Oxford has been appointed to conduct the Research Department of British Dyes (Limited) and he has also accepted the Chairmanship of the advisory council of the company." Taking these two notices in conjunction, it does not appear that the recent one entails any material change in the relationship between the Waynflete professor of chemistry in the University of Oxford and the British Dyestuffs Corporation. Meanwhile the Corporation has in quick succession lost the whole-time services of Prof. Robinson, Dr. Herbert Levinstein, and Prof. Green. Moreover, in his last report to the Corporation, the chairman of the merger company intimated the directors' belief that "further economies can be effected in our research department." It will be of interest to note the attitude of the reappointed advisor towards the impending diminution in the research staff. Although the 400,000*l.* spent in research during four years is a considerable sum, yet it is probably less than the expenditure on trained chemists incurred by the pre-War forerunners of the Corporation, taking into account the much smaller capital sum at the disposal of these firms. The chemical staff of the Corporation is smaller considerably than that of any of the larger units of the Interessen Gemeinschaft. If, therefore, the Corporation is to compete successfully against its foreign rivals, further economies as regards chemists are very undesirable; for without ample technical assistance, the Corporation cannot fulfil the purpose for which it was founded with very substantial financial assistance from the Government, namely, with "the primary objects of supplying dyes and colours to those British trades which depend for their continuance on their ability to obtain them."

THE "light plane" trials at Lympne have demonstrated the possibility of man-flight with 3 horsepower engine. Two aeroplanes tied in the principal test for fuel economy, with 87·5 miles to the gallon. The former had a 3½-6 h.p. engine, a speed of 55 m.p.h., and a mileage for the week of 362; the latter 5½-10 h.p., 74 m.p.h., and 775 miles, to which must be added a winning climb to 14,400 ft. The decisive value of excess power is thus shown. The cost of light planes built singly is about 500*l.*, and the competing machines were handled by the most experienced pilots in the country, while Maneyrol, perhaps the most brilliant pilot present, met with fatal accident, thus reminding us that flying still has its special risks. It would, therefore, be rash to conclude that flying is now cheap, easy, and entirely safe, but in spite of these cautions the results achieved will stimulate flying in many directions. The Director of Research indicated one of the most interesting of these in remarking that trials on light planes could be applied to geometrically similar aeroplanes of the largest size. There is a fairly satisfactory theory of similar aeroplanes, but the best type is being slowly evolved by the efforts of designers and the criticisms of pilots. What is suggested is that it is possible to investigate the relative merits of different types on the scale of the light plane at comparatively small expense, and then to apply the results to the largest aeroplanes, which have proved enormously expensive in development by direct methods.

AN account of the investigation of a prehistoric flint mine at South Down, about three miles north of Chichester, was given by Major A. G. Wade at a meeting of the Prehistoric Society of East Anglia held at Burlington House on October 10. Major Wade has identified twenty-one circular depressions, averaging about 12 ft. in diameter, running along the summit of the Down in a straight line from east to west. Three of these, on excavation, proved to be mine-shafts sunk in the chalk for the purpose of extracting flint-nodules. The first shaft measured 12 ft. in diameter and 15 ft. in depth, and the second 9 ft. in diameter and 9 ft. in depth. Although no galleries were found, the first shaft was deeply undercut on one side where the miners had followed a vein of flint. In this shaft a pick made from an antler of red-deer, similar to those found at Grimes' Graves and Cissbury, indicated the method employed in mining. A large number of implements of Aurignacian type was found in the infilling of the shafts, and in the second the top-stone of a saddle quern of green sandstone. A large elongated axe is regarded by Mr. Reginald Smith as identical with a late Acheulean form. The discovery is one of considerable interest, as the pits are in all respects comparable with those at Cissbury, while if the type of the implements is accepted as evidence of date, they support the view that both mines are of palæolithic age. The quern stone, unless it can be shown to be later than the implements, would then suggest a much earlier date for corn growing than is usually accepted. The excavations were carried out with the permission of the Duke of Richmond, by whom the implements, mollusca, and animal remains have been presented to the Brighton Museum.

THE *Publishers' Circular* for September 1 contains some suggestive remarks by Mr. T. W. MacAlpine on "Scientific Literature: the Need for Co-ordination." Their gist is that publishers, who cannot be expected to know the requirements of every branch of science, might welcome advice from a committee or committees of scientific workers such as might be appointed by the British Association. Among the points to be specially considered are form and style of treatment, degree and nature of illustrations, uniformity of nomenclature and symbols, size of page and of printed area, selection of type, division into chapters, paragraphs, etc., and the numbering of them, list of contents, and index. Though we hold the view that too much standardisation often checks improvement by hindering natural selection, still we think some steps could well be taken along the path sketched by Mr. MacAlpine. He is perhaps not aware that there already exists a committee of the British Association appointed to advise on similar matters in special reference to zoology and the allied sciences. The last report of this committee, presented at the Liverpool meeting, deals with some questions that directly concern publishers. One of these is the precise and correct dating of volumes and parts. The other, discussed at length, is "What constitutes Publication?" The answer is summarised thus: "Publication of a new systematic name is effective only when the volume, paper, or leaflet in which it appears is obtainable at a price in the way of trade by any applicant, or is distributed widely and freely to circles interested, it being always of a character suitable to the publication of such matter."

AT last Lyme Regis has a museum and the beginnings of a type collection of the fossils for which it is famed. The desirability of such a collection has been felt by some of the residents for many years, but the question of cost has blocked the way. In 1901 the late Mr. T. E. D. Philpot, a landowner at Lyme, erected a suitable building, but the Town Council did not see its way to find the necessary funds to maintain it, and the fabric stood empty and forlorn. Attempts to revise the situation were made early in 1914 and Mr. Philpot was approached in the matter, but the movement was abruptly ended by the outbreak of War. On Mr. Philpot's decease, two years ago, his representatives renewed his offer to the Town, and this time the Council was persuaded to accept the handsome gift. Fortunately, an enthusiastic palæontologist, Dr. Wyatt Wingrave, was ready to act as honorary curator and to lend his own private collection of local fossils. These, with a few from other sources, form quite a respectable nucleus around which all geologists will be glad to see the growth in Lyme itself of a collection worthy of the world-wide reputation of the place. The annual report shows what a good beginning has been made and includes the usual appeal for funds, for cases, and for gifts of specimens, all of which should be forthcoming now there is a place to put them and a curator to watch over them.

IN the September issue of *State Technology*—the journal of the Institution of Professional Civil Servants—the Act of the United States Congress of March last classifying civil servants is published in full. Its principal interest for us is the prominent position it gives to the professional and scientific civil servant. In Great Britain, the administrative heads of government departments, even when their concern is mainly with scientific or technical matters, are men with a classical or literary education and no scientific or technical knowledge, and the Institution of Professional Civil Servants has been urging for some time that members of the scientific staff of a department are as likely to make as good administrators as the men with no knowledge of the affairs of the department at present chosen. From the above Act, it appears that this is recognised in the United States, and in their civil service, professional and scientific work is administered by men with professional and scientific experience. The salary attached to the highest posts, whether professional or administrative, is 7500 dollars per annum.

A SMALL but instructive pamphlet on the co-operative development of Australia's natural resources has been published by the Commonwealth Institute of Science and Industry. The whole field of Australia's resources is briefly surveyed and attention is directed to certain urgent problems that await solution. Particularly important is the section dealing with agricultural and pastoral problems. The ravages of vegetable and animal pests are shown to be enormous. In New South Wales and Queensland alone, the total area covered by the prickly pear is not far from double the entire cultivated area of the Commonwealth. From plant diseases alone the annual loss to Australia is estimated at more than 5,000,000*l.*; animal pests are even more costly. In a bad year the sheep-fly may cause a loss of 4,000,000*l.* A long list is given of investigations needed in the interests of agricultural, pastoral, and forest industries. The pamphlet makes a strong plea for the application of scientific method and research in the development of Australia's resources. Copies may be had free of charge on application to the Director of the Institute at Melbourne.

AMONG the many new periodicals of varying aims and quality relating to wireless telegraphy and telephony, we are glad to welcome a new-comer in *Experimental Wireless*, of which the first monthly issue is before us. This in its own words is a " Journal of Radio Research and Progress," and wisely leaving to the more popular type of paper, elementary matter, broadcasting news, and doings of societies, concentrates upon articles on recent developments and experimental research. For example, a new connexion for valve generators, in which the oscillating circuit is connected between the grid and the filament, is described in an article by E. W. Gill, and the possibilities of the neon tube both as an oscillator and a receiver are discussed by E. H. Robinson. Another suggestive article deals with the correction of distortion produced by amplification, especially in the case of loud speakers. Notable among several other important contributions is an account of investigations of the Radio Research Board on the fading of signals. Another way in which the proprietors of the journal are encouraging research work is in the maintenance of a laboratory and testing service whereby readers' apparatus can be calibrated and other electrical measurements made entirely free of charge. The journal should be an important help to workers in wireless and is entirely independent of trade interests or other wireless organisations.

DR. A. KOSSEL, the well-known physiological chemist of the University of Heidelberg, celebrated his seventieth birthday on September 16 last.

THE Fothergillian gold medal and prize of the Medical Society of London have been presented to Sir Arthur Keith, Conservator of the Museum of the Royal College of Surgeons.

THE Thomas Hawksley lecture of the Institution of Mechanical Engineers will be delivered at the institution on Friday, November 2, at 6 o'clock, by Sir Westcott S. Abell. The subject will be " The Mechanical Problems of the Safety of Life at Sea."

WE much regret to announce the death on October 10 of Dr. J. A. Harker, F.R.S., at the age of fifty-three; of Dr. A. A. Rambaut, F.R.S., Radcliffe Observer, Oxford, and late Royal Astronomer of Ireland, on October 14, at the age of sixty-four; and of the Hon. Nathaniel Charles Rothschild, on October 12, aged forty-six.

THE Council of the National Institute of Agricultural Botany has appointed Mr. A. Eastham to be Chief Officer of the Official Seed Testing Station for England and Wales. Mr. Eastham, who studied agriculture and botany at the Lancashire Agricultural School, Cheshire Agricultural College, and the University of Edinburgh, completed his training in Canada, where he specialised in agricultural botany. Previous to his return to England, Mr. Eastham held botanical and seed-testing appointments in Canada.

PROF. W. D. TREADWELL, of the Technical High School, Zürich, will lecture on " Electrometric Methods in Analytical Chemistry " on November 2, under the auspices of the Manchester sections of the Society of Chemical Industry, the Institute of Chemistry, the Society of Dyers and Colourists, and the Manchester Literary and Philosophical Society.

THE fifth of the series of public lectures on " Physics in Industry," being given under the auspices of the Institute of Physics, will deal with the subject of " Physics in the Textile Industries." It will be delivered by Dr. A. E. Oxley, physicist to the British Cotton Industries Research Association, at the Institution of Electrical Engineers, Victoria Embankment, London, on Monday, October 22, at 5.30 P.M.

THE sixth annual general meeting of the British Association of Chemists will be held at the Chemical Department, University of Birmingham, Bournbrook, on Saturday, October 27. A chemical exhibit has been arranged by Prof. G. T. Morgan, to precede the meeting. The Society's annual dinner will be held at the Queen's Hotel, Birmingham, during the evening. The president, Dr. H. Levinstein, will take the chair at both the general meeting and the dinner.

ACCORDING to a Press announcement, a " Mammoth's Shoulder Blade " has recently been landed at Douglas, Isle of Man, having been brought up in a trawl off Ramsey. The bone is supposed to be the shoulder blade of a mammoth. From the back to the end of the blade is 6 ft.; the bone is 2 ft. thick and more than 3 ft. wide. Lengthy accounts were given of the mammoth, the period in which it lived, etc. Photographs have been submitted to Mr. T. Sheppard, of the Municipal Museum, Hull, from which it is clear, as might have been expected, that the " bone " was the skull of a whale.

RECENT issues of the *Times* (September 29 and October 10) reproduce many interesting photographs of the effects of the great earthquake in Japan. They show how well some of the great public buildings in Tokyo (such as the Metropolitan Police Station and the Imperial Theatre) withstood the shock of the earthquake, though they were afterwards destroyed by fire. The magnitude of the sea-waves is represented by a photograph of a scow, or flat-bottomed ferry-boat, thrown bodily on to the quay at Yokohama. A third picture illustrates a not uncommon effect of great earthquakes, that of railway-lines left suspended in air while the bridge below has collapsed.

A GRANT of 25,000*l*. has been made by the Development Commission to the new Research Institute for the investigation of animal diseases to be erected in connexion with the Royal Veterinary College, Camden Town, London. Sir John McFadyean, principal of the College, will be the first director of the Institute.

THE report of the field work of the Smithsonian Institution for the past year describes the manifold activities of this important body. Accounts are given of no less than twenty-two expeditions organised by it and its branches; they include geological explorations in the Canadian Rockies: the use of the great 100-inch telescope at Mount Wilson Observatory in connexion with a special vacuum bolometer and galvanometer to measure the heat in the spectrum of the brighter stars: an expedition to the North Pacific Fur Seal Islands: the collection of Australian fauna for the Museum, and a similar enterprise in little-known parts of China: botanical investigation in the

Republic of Salvador and Guatemala: archæological studies at the Mesa Verde National Park, Colorado, and of totem poles in Alaska. Less generously endowed scientific institutions in Great Britain will look with envy on such enterprises, but will recognise them with full appreciation as important additions to the general stock of human knowledge.

THE Rede lecture for 1923, by Prof. H. A. Lorentz, on "Clerk Maxwell's Electromagnetic Theory" is to be issued in pamphlet form in November by the Cambridge University Press.

MESSRS. DULAU AND CO., LTD., 34 Margaret Street, W.1, have just circulated a useful catalogue (No. 105) of second-hand books on entomology, general zoology, geology, and mining. Nearly 2000 works are listed, and the prices asked appear very reasonable.

MESSRS. ERNEST BENN have in their autumn list several books of scientific interest, among which we notice "The Principles and Practice of Wireless Transmission," by Parr, in which the theory of the production and control of wireless waves is set forth in non-technical language; "Across the Great Craterland to the Congo," by A. Barns; "The Diseases of Glasshouse Plants," by Dr. W. F. Bewley, of the Cheshunt Experimental Station, giving the practical results of the experimental work of the station in recent years; "Successful Spraying," by P. J. Fryer, which is primarily intended as a handbook for the practical grower wishing to know the results of recent researches upon the subject; "An Introduction to the Study of Chinese Sculpture," by L. Ashton, which professes to be the first European book dealing with this branch of Chinese art; and "Plastic Art in China," by O. Siren, with an introduction and epigraphic notes by P. Pelliot.

PROF. W. E. DALBY is bringing out, through Messrs. Edward Arnold and Co., "Strength and Structure of Steel and other Metals," the main purpose of which is to correlate strength of metals with their structure. In this volume the subject has been considered from the point of view of the engineer, and, so far as possible, in terms readily understood by the engineer. Other books in the same publishers' announcement list are: "A Handbook of the Coniferæ and Ginkgoaceæ," by W. Dallimore and A. B. Jackson, containing descriptions in easily understood terms of all the cone-bearing trees, with information upon their economic uses and cultivation. Although the book is primarily a general work upon conifers, special attention has been given to those that are hardy in the British Isles or are of outstanding economic importance. A feature of the work is the series of keys to genera and species which are designed to assist beginners in the work of identification. "British Hymenoptera," by A. S. Buckhurst, L. N. Staniland, and G. B. Watson, with an introduction by Prof. H. Maxwell Lefroy, being an introduction to the study of the habits and life-histories of British saw-flies, wood-wasps, gall-flies, ichneumon-flies, ruby-wasps, digger-wasps, mud-wasps, wasps, bees, and ants. Information is given as to their identification, and technical terms are carefully explained.

Our Astronomical Column.

THE WANT OF SYMMETRY IN STELLAR VELOCITIES.—Proc. Nat. Acad. of Sciences, U.S.A., for September contains an article by Dr. G. Strömberg, of Mt. Wilson, on this subject. This unsymmetrical distribution was first found by B. Boss from a study of measures of parallax and radial velocities; later Adams and Joy found it independently. Stars of high speed appear to move towards the hemisphere between galactic longitudes 160° and 340° (through 250°).

Dr. Strömberg extends the research to the globular clusters and spiral nebulæ, finding that all known objects appear to show the same asymmetry; he conjectures that it may arise from the existence of a fundamental system of reference, with regard to which excessive velocities are very infrequent. The stars of moderate velocity were found to be divisible into two groups, one with a slightly eccentric velocity-ellipse in the galactic plane, the other with a more eccentric ellipse.

The stars of high velocity give an ellipse with axes parallel to the last ellipse, while the globular clusters and spiral nebulæ give circular distribution: in each case the group-motion increases *pari passu* with the internal motions. On the assumption that the spiral nebulæ have acquired the maximum attainable velocity, he calculates the position of the fundamental frame, and shows that referred to it the sun is moving with velocity 651 km./sec. towards R.A. 305°, N. Decl. 75°.

NEW TRANSIT INSTRUMENT AT PARIS.—M. B. Baillaud, director of the Paris Observatory, describes in the *Comptes rendus* of the Paris Academy of Sciences for August 7, a new transit instrument which has been erected at the Observatory for the determination of the time that is distributed by wireless signals from the Eiffel Tower. These signals are now used so widely that the question of their degree of accuracy is important to many astronomers; hence an instrument was designed of such a size that it could be reversed on every star. The object glass is by M. Viennet, and is of excellent quality; its aperture is 4 in. and focal length 48 in. The magnifying power is 60; the self-registering micrometer has two threads that travel in opposite directions at the same rate, crossing each other at the centre of the field. The threads are driven by electric motor and the rate of driving is regulated by a rheostat. The object of the two threads is to save the time required to get the star on the thread again after reversal; having been observed on one thread up to reversal, it is automatically found very close to the other after reversal. The order of positions is reversed for alternate stars.

The level error is found both by spirit levels and by nadir observations. The collimation error is at present determined on the nadir, but collimators are in course of erection.

The results of time determination are satisfactory. The figures that are printed never show a greater range for separate stars on the same night than a tenth of a second; it seldom exceeds half of this amount.

Research Items.

The Sheel-na-gig at Oaksey.—The Sheel-na-gig or phallic figure, usually found in churches, is probably the survival of a fertility cult. That at Oaksey, in North Wiltshire, is described in the September issue of *Man* by Miss M. A. Murray and Mr. A. D. Passmore. It is carved out of the same stone as that of the church, a thirteenth-century edifice, but there is nothing to show whether it is in its original position, or whether it is contemporary with, or earlier than, the church. But the size and importance of the left hand in the sculpture are noteworthy and suggest a pre-Christian origin for the figure. The flat surface of the stone has been slightly hollowed so as to make the figure stand out in relief. The weathering of the stone has practically destroyed the features, which appear to have been rudely indicated.

The Island Culture Area in America.—In the thirty-fourth annual report of the Bureau of American Ethnology, 1912–13, recently issued, Mr. J. Walter Fewkes discusses the prehistoric island culture area of America. He concludes that, from the data now in hand, it is possible to distinguish three cultural epochs in the West Indies. The earliest people were cave-dwellers, a mode of life that had not totally disappeared at the arrival of Columbus, a culture extending through both the Greater and Lesser Antilles, though, owing to the absence of caves, it naturally did not exist in the Bahamas. The absence of fine stone objects separates the West Indian cave-man from that of the following epoch, the agricultural West Indian, when stonework reached a perfection not excelled elsewhere in the two Americas. The archæological evidence of the third epoch, or that of the mixed race formed by an amalgamation of agricultural and Carib elements, appears to indicate a decline in the arts, as would naturally be expected from the nature of the life of the inhabitants. All three stages of culture—cave-man, Tainan, and Carib—coexisted when the West Indies were discovered. The first mentioned had been driven to isolated, undesirable localities; the Tainan held the Greater Antilles, but had been submerged in the Lesser except in Trinidad; the Carib occupied the islands between Trinidad and Porto Rico, and was slowly encroaching on the Greater Antilles at the coming of Columbus.

Early Arithmetical Processes.—At the recent meeting of the British Association, the Rev. C. A. Brodie-Brockwell, professor of Hebrew and Semitic languages, law, and history in McGill University, Montreal, presented to the Anthropological Section a paper dealing with the evolution of arithmetic with special reference to the principles of compound-time or reckoning. He maintained that modern scholars, through neglecting to take into account the fact that pre-Christian Mediterraneans used arithmetical processes without analogy in modern arithmetic, had obscured the meaning of ancient time determinations. He proceeded to show wherein the ancient processes differed from the modern, and suggested that owing to the fact that the ancients worked in units larger than those we employ, it was necessary to divide or subdivide according to the method of computation before the figures were comparable with modern calculations. Thus, according to the method of computation, any given figure may be divisible by two, three, or four to arrive at its modern equivalent. Prof. Brockwell concluded by demonstrating the application of his theory of compound-time to a Babylonian tablet, previously undeciphered, which was discovered by Prof. Hilprecht, to Plato's Millennium Cycle, and to Proclus' Pythmenic Indices.

Imagery in Thinking.—In *Discovery* for August, Prof. T. H. Pear gives a very lucid account of the vehicles and routes of thought. He thinks that the recent mobilisation of psychologists for practical work has led to the neglect of a problem which at first sight appears rather theoretical, but may actually have far-reaching practical results. It is well known that people vary in the way in which they think, but having classified people as visuals or audiles, there is a tendency to neglect the consequences. The writer thinks that for practical purposes people can be described as visualisers or verbalisers according as they tend to think in pictures or words. Each type of thinking has its own advantages and also its own drawbacks, and extremes of either type often fail to understand the other, not infrequently with serious consequences. Should a teacher or a doctor be too exclusively one type it might account for some failures in dealing with particular pupils or patients. The visualiser he holds is less likely to be impressed by an orator's rumbling stream of words or less easily hypnotised by a sonorous phrase or platitude, but, as against this, he may be paralysed by impressive tailoring or a pretty smile. The article is an excellent example of sound scientific thought expressed in non-technical language.

Sex Reversal in the Common Fowl.—At the recent meeting of the British Association in Liverpool, no little interest was excited by Dr. F. A. E. Crew's account of a case of complete sex-reversal in the common fowl. A hen, after laying a number of fertile eggs in a perfectly normal manner, was converted into a cock which became the father of chicks. This remarkable reversal of sex seems to have resulted from the destruction of the ovary by tubercular disease and its replacement by testes. Dr. Crew has published his observations on this and similar cases in a recent number of the Proceedings of the Royal Society (Series B, Vol. 95, No. 667) and Miss Honor B. Fell gives a more detailed account of their histological features in the first number of the *British Journal of Experimental Biology* (October).

Reproduction in *Paludestrina jenkinsi*.—It has long been suspected that the Gasteropod mollusc, *Paludestrina jenkinsi*, reproduces itself by means of parthenogenetic ova. If so, it is the only mollusc in which this phenomenon is known to occur. The probability is converted into a practical certainty by the careful breeding experiments of Mr. Guy C. Robson, described in the first number of the *British Journal of Experimental Biology* (October). No male has ever been observed and there is no evidence of hermaphroditism. This little snail is also remarkable for the curious manner in which, in the British Isles at any rate, it has extended its range in recent years from brackish estuaries to inland fresh waters, which, as Mr. Robson suggests, may have something to do with its parthenogenetic habits.

The Shape of Plant Cells.—The botanist who is under the impression that the typical shape and mode of division of a normal parenchymatous cell is fully represented by the usual text-book diagram, where such cells are always in transverse or longitudinal section, is recommended to study the paper by Mr. Frederic T. Lewis in the Proceedings of the American Academy of Arts and Sciences, Vol. 58, No. 15. The author has prepared serial microtome sections of the pith of the elder, from which outline drawings and then wax models of the cells have been prepared by standard methods. The result is to show that the cells are essentially tetrakaidecahedra, as the mathematicians and physicists had anticipated; from the models it is possible to reconstruct the method by which this form is restored after cell division.

"RED PLANT" IN STRAWBERRIES.—During recent years the spread of a mysterious disease among strawberries has been reported under this name from one centre of strawberry growing after another, in some districts the strawberry growing industry being seriously threatened by its depredations. Typically diseased plants have been under observation at the Research Station, Long Ashton, Bristol, and now Messrs. E. Ballard and G. S. Peren report that the disease is only a special form of the well-known "cauliflower" disease of strawberries which has been known for some thirty years and was first discovered by Mrs. Ormerod. As in the case of the "cauliflower" disease, the causal organism in "red plant" is found to be the eelworm *Aphelenchus fragariæ* Ritz. Bos, a conclusion which, as recent correspondence in the *Gardeners' Chronicle* witnesses, is in agreement with that of other practical observers familiar with the disease. "Red plant" appears to be an unfortunate name for the disease, as it is only when the eelworm attack synchronises with a certain stage of development in some varieties of strawberry that the striking red colour develops in the petiole and lamina of the ill-developed leaves.

CONTROL OF FINGER-AND-TOE BY LIMING.—In Bull. No. 29 of the North of Scotland College of Agriculture, Prof. Hendrick describes an experiment carried on for several years at Craibstone under conditions particularly conducive to the spread of finger-and-toe disease. The soil is sour and very poor in quality, and turnips have been grown on the same land since 1915; mass infection has been induced by leaving plenty of diseased material upon the plots, and manures favourable to the increase of the disease have been systematically applied. Although disease occurs yearly on the limed plots as well as on the unlimed, in the former case a large proportion of the roots are fit for use, even though touched by disease, whereas in the latter case most of the roots are rotten and unusable. It would seem that though a cure is not effected, some measure of control can be exercised by adequate applications of lime, in moderate excess, but in each individual case it will be necessary to balance the cost of the liming against the improved value of the crop, in order to determine whether the procedure is economic and advisable.

INAUDIBLE AIR-WAVES.—The current number of *Science Progress* (pp. 294-297) contains an article by Dr. C. Davison on inaudible air-waves resulting from explosions. These waves are manifested chiefly by the rattling of windows, the disturbance of pheasants, and the traces of barographs. Such effects are noticed far beyond the area within which the sound of the explosion is audible. For example, the firing during the Dogger Bank action of January 24, 1915, was heard in England to a distance of 208 miles, while pheasants were disturbed near Workington (320 miles). The velocity of the inaudible air-waves is slightly less than that of sound, but, when a silent zone is developed, the sound-waves, which at first outrun the inaudible waves, in the outer sound-area follow them after a brief interval. As windows are shaken and pheasants are disturbed in the silent zone, it is suggested that the inaudible air-waves cross the silent zone close to the ground while the sound-waves travel at a somewhat greater elevation.

INDUSTRIAL WATER SUPPLY IN THE UNITED STATES.—An inquiry into the nature and source of the water used in industrial establishments in the United States has led to some interesting results. These are published in Water Supply Paper No. 496 of the United States Geological Survey. The census of 1920 showed that 35·7 per cent. of the total population lived in 287 places each of more than 25,000 inhabitants. Analyses of the water supply of these 287 places and, in addition, of many smaller places, are given so that each state is represented by at least two cities. These details deal with the bulk of the water used for industrial purposes even if they show the character of the water used by less than half the total population. Many of the analyses are the work of the Geological Survey; others have been obtained from municipal, state, waterworks, and commercial laboratories. Of the 307 cities quoted in the report the great majority has surface water but a few have ground water. A sketch map shows the average distribution of hardness. This quality, due to calcium and magnesium salts, is practically the only one of much industrial importance. The figures show that of the 39,000,000 persons served with the waters analysed, about 17,000,000 use water with less than 55 parts per million of hardness, 6,000,000 use water with 55 to 100 parts per million, and most of the remainder use water with 100 to 200 parts of hardness per million. The pamphlet contains also a discussion of the treatment of water for public supplies.

THE DETERMINATION OF SEA-LEVEL.—In an article in *Science Progress* for October on the levels of land and sea, Sir Charles Close discusses the problem of arriving at the mean level of the sea as the datum to which height on the Ordnance Survey maps of Great Britain are referred. What is required is the mean position of the sea surface as determined over a considerable period of time, at all states of the tide, and not merely at high and low water. The most satisfactory way of arriving at this mean is by the use of self-recording tide-gauges. In practice the mean of the hourly tides measured over a long period will give the result desired. For this purpose tidal stations were set up at Dunbar in 1913, Newlyn in 1915, and Felixstowe in 1917, and are still at work. Each of the two stations of longest duration show a range in height of the annual mean sea-level of 2·3 inches. Hence it is obvious that the value of mean sea-level cannot be obtained during the period of a year. At other stations in the British Isles and elsewhere, annual fluctuations have been noted. In fact the probable variation of height of any one year from the mean of a large number of years is about half an inch. The most important variations are meteorological and are in part local, in part worldwide. Of smaller significance are the latitude variation tide with a period of 431 days and the lunar tides of 18·6 years.

SUNSPOTS AND AIR TEMPERATURE IN AMERICA.—The *Monthly Weather Review* for May contains an article on sunspots and terrestrial temperature in the United States based upon a communication to the American Meteorological Society by Mr. A. J. Henry of the U.S. Weather Bureau. It is pointed out that annual deviations of temperature give evidence of short period variations within the 11-year sunspot cycle. Sometimes warm and cold years alternate; in other cases the cycle, cold to warm, would be completed in three, four, or five years. During the period 1870–1921, a heat maximum corresponds fairly well with a maximum of sunspots and *vice versa*. Prior to that period the agreement is not so good. The author mentions that until some allowance can be satisfactorily made for the movement of cyclones and anticyclones, it is hopeless to seek for effects of changes in the intensity of solar radiation in the temperate zone. Observations are used for as many stations as practicable in the United States, and in using the published means of temperature derived from the daily extremes, appropriate corrections have been applied to reduce to true means. Temperatures dealt with range between the years 1750 and 1921, but the number of stations are very few prior to 1825. Summarising the conclusions and results of various authorities on the subject, the author states that it appears that the weight of evidence is in favour of the existence of a variation in the air temperature of the globe corresponding roughly with that of the spottedness of the sun, an increase in spots corresponding with diminished terrestrial temperature and *vice versa*. The effect is best shown in the tropics and is difficult to trace in temperate latitudes. There were three pronounced maxima and minima of temperature between 1873 and 1921, the maxima occurring in 1878, 1900, and 1921, and minima in 1875, 1893, and 1917.

BOMBAY MAGNETIC CURVES.—We have received from the Director of the Government Observatory, Bombay, a collection of photographic copies of Bombay magnetic curves for selected disturbed days during the years 1906 to 1915. Records are included from several hundred days, covering about 150 large sheets. Magnetic disturbance at Bombay is seldom large except in H, the intensity of the horizontal component. The curves reproduced are mostly for this element, but the declination and vertical force curves are also reproduced for some of the storms. The times, and the base line and scale values, are clearly shown in every case, and the reproductions are excellent; thus much valuable information is deducible as to the character of magnetic disturbance in Bombay. As compared with curves from European or North American stations, the Bombay curves are comparatively free from rapid oscillations. Some of the curves, however, are decidedly lively, including those for February 9-10, 1907, September 12-13, 1908, May 14-15, 1909, September 25, 1909 (when there was considerable loss of trace), and June 17, 1915. There are many examples of "sudden commencements" of magnetic storms, all or nearly all exhibiting the characteristic rapid rise of horizontal force. In some cases this increase of force persists for a number of hours, the curve having a crested appearance; in other cases a fall to less than the normal value follows hard on the initial rise. The weight of the volumes of collected curves is considerable, and the Director of Bombay Observatory expresses his regret that owing to the heavy postage, and the necessity for economy, he has been obliged to restrict the issue. He would be glad, however, on receipt of the postage, to send a copy to any magnetician who would like to have one.

COCONUT OIL.—The coconut oil industry is surveyed in the *Chemical Trade Journal* for September 7. This substance is known to us as a fat; only in warmer climates is it an oil. It is obtained from the kernels of the fruit of the coconut palm, which flourishes in India, Ceylon, and other tropical countries. The first importations into Europe occurred in 1815; they have since steadily increased. The article contains brief accounts of the properties (physical constants, etc.), composition, and manufacture of the oil. The bulk of the oil is used in the soap and candle industry. Future prospects are discussed.

A DIRECT READING X-RAY SPECTROMETER.—In 1915 Duane and Hunt found that a spectrum of general X-rays is terminated sharply at the short wave end, the boundary wave-length being precisely connected by Planck's quantum relation with the maximum voltage applied to the X-ray bulb. The output of general X-rays is roughly proportional to the square of the voltage, and provided the peak-voltage is the same, the energy-distribution curve of the X-ray spectrum is found not to vary markedly with the shape of the wave-form of the exciting potentials which obtain in practice, whether from coil or transformer. For medical purposes, at any rate, it is sufficient to assume that in the absence of a filter the general quality of the rays is independent of the means by which the X-rays are generated but is determined only by the position of the quantum limit. Drs. Staunig, March, and Fritz, of Innsbruck, have designed a convenient type of X-ray spectrometer for measuring this boundary wave-length. In this instrument (the English agents for which are Messrs. Schall and Son, 71 New Cavendish Street, W.1) a narrow slit of X-rays passes through a thin plate of rock salt crystal and the deviated beam is observed visually as a narrow band on a fluorescent screen provided with a scale of wave-lengths. The crystal is capable of rotation, and the observations consist essentially in measuring the minimum deviation between the reflected beam and the undeflected beam. In practice it is convenient to ascertain both the right-hand and left-hand positions of the deflected beam and halve their angular separation, thus avoiding a determination of the zero position. It is important that the observations should be made in a darkened room by an eye thoroughly adapted to darkness. The spectrometer, which should be earthed, is brought as near the X-ray tube as possible, the protection for the operator being afforded by sheet lead. As will be gathered, the instrument is also capable of being used as a means of measuring peak-voltage.

TEMPERATURE OF THE CROOKES DARK SPACE IN GLOW DISCHARGE.—Herr R. Seeliger, in the issue of the *Zeitschrift für Physik* of June 29, contests the opinion recently expressed by Günther-Schulze that the temperature in the dark space of the glow discharge is high (NATURE, October 13, p. 557). The canal ray particles are in part neutral, and do not behave like elastic spheres to which the geometrical laws of mechanical collision can be applied. When collisions take place in which the charge is altered, the changes of velocity and of direction are small; when the colliding particles are absorbed, this takes place without previous appreciable loss of velocity. It is only for the first type of collision that the free path is of the same order as the molecular free path; for the second it is very much greater. For ionic velocities, with high or "anomalous" cathode drop, these properties of the canal rays can probably be directly applied to the glow discharge; for smaller values, corresponding to normal cathode drop, similar complete observational results are not available. Certain qualitative observations (*e.g.* those of Dempster) point to the fact that things are essentially the same in both cases; and observations made so far on canal rays (+ions) do not suggest the existence of the difficulties raised by Günther-Schulze; but seem rather to be in agreement with the results obtained by him as to energy relations and distribution of velocity, without assuming a high temperature in the dark space. All direct measurements of the temperatures of the cathode, and of the dark space, have shown that these are only a little higher than that of the surroundings, not much more than 100° C., although in special cases the temperature of the cathode can be raised to the melting, or even the vaporisation, point.

A Library List of Scientific Books.

ABOUT two years ago the Washington Academy of Sciences published a list of one hundred popular books in science suitable for inclusion in public libraries. The list has since been revised, and is reprinted below. The original list included the titles of forty-three books by British authors, but many of these have now been omitted as the volumes are out of print. All the works in the present list are obtainable through booksellers in the usual way. As the list was compiled for American libraries, the majority of the books mentioned in it are by American authors. We know of no similar list for British libraries, but one would no doubt be welcomed by librarians and others. Though librarians may be able to discover which books are interesting, they have no easy way of finding out which of such books are trustworthy and which are not merely unorthodox but misleading or misinforming.

In inviting correspondents to assist in preparing the list subjoined, the Committee of the Washington Academy of Sciences asked that the tests to be applied in selection of books should be as follows: "(1) The book must be *readable*; if the average visitor to the library takes the book home, it will interest him so much that he will read it through, and will come back to ask the librarian for another on the same subject. (2) It must be *accurate*; preferably written by one who knows his subject at first hand. Minor points are: (3) up-to-dateness; (4) small bulk; (5) attractive binding, type, and illustrations.

"The relative number of books in different branches of science is not fixed. For example, a good book in mathematics may be substituted for a poor book in anthropology, provided anthropology is not thereby left wholly unrepresented."

The Committee has performed a useful service in selecting one hundred books which it feels fairly sure are scientifically trustworthy, and believes to be readable. It is obvious that a list of this kind must be subject to revision, and indeed should be revised frequently to keep up with the progress of science and the publication of books better adapted to the purpose. The Committee adds: "In general, it need hardly be said that even a tried and tested list can never be completely satisfactory, for the simple reason that there is no such person as the 'average reader.' Every individual has his own foundation of natural capacity and education, and his own background of experience and interests. We therefore need one series of lists covering all types of capacity, another series differentiated according to kind and duration of education, another series distributed according to age and to variety of experience, and still another adapted to the varied types of man's interests. Provided with such a set of lists we could name twenty-five scientific books which would be almost certain to interest keenly any given individual. Lacking such provision, we can only hope, on behalf of the very general list herewith submitted, that every reader who can be induced to read anything at all serious will find on the list a few books which appeal to him strongly, and that none of the other books will give him the impression that science makes reading-matter which is difficult or forbidding."

GENERAL SCIENCE.

1. J. ARTHUR THOMSON, Editor. The Outline of Science.
2. THOMAS HENRY HUXLEY. Selections from Huxley.

MAN.

3. EDWARD L. THORNDIKE. The Human Nature Club.
4. WILLIAM JAMES. Psychology.
5. ROBERT S. WOODWORTH. Psychology; a Study of Mental Life.
6. HENRY FAIRFIELD OSBORN. Men of the Old Stone Age; their Environment, Life, and Art.
7. O. T. MASON. The Origins of Invention.
8. O. T. MASON. Woman's Share in Primitive Culture.
9. WALTER HOUGH. The Hopi Indians.
10. E. V. MCCOLLUM. The Newer Knowledge of Nutrition.
11. H. C. SHERMAN. Food Products.
12. WALTER H. EDDY. The Vitamine Manual; a Presentation of Essential Data about the New Food Factors.
13. E. O. JORDAN. Food Poisoning.
14. WILLIAM WILLIAMS KEEN. Medical Research and Human Welfare.
15. ELLSWORTH HUNTINGTON. Civilization and Climate.

HEREDITY.

16. CHARLES DARWIN. The Origin of Species.
17. E. M. EAST and D. F. JONES. Inbreeding and Outbreeding.
18. W. D. CASTLE, J. M. COULTER, C. B. DAVENPORT, E. M. EAST, and W. L. TOWER. Heredity and Eugenics.
19. T. H. MORGAN. A Critique of the Theory of Evolution.
20. E. G. CONKLIN. Heredity and Environment.
21. FRANCIS GALTON. Hereditary Genius.
22. PAUL POPENOE and R. H. JOHNSON. Applied Eugenics.

BIOLOGY.

23. J. ARTHUR THOMSON. The Wonder of Life.
24. J. ARTHUR THOMSON. The Haunts of Life.
25. E. L. BOUVIER. The Psychic Life of Insects.
26. WINTERTON C. CURTIS. Science and Human Affairs.
27. WILLIAM A. LOCY. Biology and its Makers.

ZOOLOGY.

28. A. B. BUCKLEY. The Winners in Life's Race.
29. E. W. NELSON. Wild Animals of North America.
30. THEODORE ROOSEVELT. African Game Trails.
31. C. W. BEEBE. Jungle Peace.
32. WITMER STONE and W. E. CRAM. American Animals; a Popular Guide to the Mammals of North America north of Mexico.
33. FRANK M. CHAPMAN. Camps and Cruises of an Ornithologist.
34. J. H. FABRE. Social Life in the Insect World.
35. MAURICE MAETERLINCK. The Life of the Bee.
36. OLIVER P. JENKINS. Interesting Neighbors.
37. W. S. BLATCHLEY. Gleanings from Nature.
38. ALFRED G. MAYER. Sea-shore Life.

BOTANY.

39. W. F. GANONG. The Living Plant; a Description and Interpretation of its Functions and Structure.
40. W. J. V. OSTERHOUT. Experiments with Plants.
41. PAUL SORAUER. A Popular Treatise on the Physiology of Plants for the use of Gardeners or for Students of Horticulture and Agriculture.

42. MARCEL E. HARDY. The Geography of Plants.
43. CHARLES DARWIN. Insectivorous Plants.
44. C. W. TOWNSEND. Sand Dunes and Salt Marshes.

MICROSCOPIC LIFE.

45. RENÉ VALERY-RADOT. Louis Pasteur, his Life and Labours.

PALEONTOLOGY.

46. F. A. LUCAS. Animals of the Past.
47. H. N. HUTCHINSON. Extinct Monsters and Creatures of Other Days; a Popular Account of some of the Larger Forms of Ancient Animal Life.

GEOLOGY AND GEOGRAPHY.

48. J. W. GREGORY. Geology of To-day.
49. HALLAM HAWKESWORTH. The Strange Adventures of a Pebble.
50. R. S. LULL and others. The Evolution of the Earth and its Inhabitants.
51. T. C. CHAMBERLIN. Origin of the Earth.
52. GEORGE P. MERRILL. The First One Hundred Years of American Geology.
53. ELLEN CHURCHILL SEMPLE. Influences of Geographic Environment.
54. J. E. SPURR, Editor. Political and Commercial Geology and the World's Mineral Resources.
55. ALBERT P. BRIGHAM. Geographic Influences in American History.

GEOLOGIC AGENTS.

56. JOHN TYNDALL. The Forms of Water in Clouds and Rivers, Ice and Glaciers.
57. T. G. BONNEY. The Work of Rains and Rivers.
58. T. G. BONNEY. Volcanoes, their Structure and Significance.
59. ISRAEL C. RUSSELL. Volcanoes of North America.
60. CHARLES DAVISON. The Origin of Earthquakes.

METEOROLOGY.

61. R. G. K. LEMPFERT. Weather Science.
62. R. DE C. WARD. Climate, considered especially in Relation to Man.

THE OCEAN.

63. JOHN MURRAY. The Ocean.

ROCKS AND MINERALS.

64. GRENVILLE A. J. COLE. Rocks and their Origins.

ASTRONOMY.

65. ROBERT S. BALL. The Story of the Heavens.
66. F. W. DYSON. Astronomy.
67. GEORGE E. HALE. The New Heavens.
68. CHARLES G. ABBOT. The Sun.
69. ISABEL M. LEWIS. Splendors of the Sky.
70. KELVIN MCKREADY. A Beginner's Star Book.
71. H. H. TURNER. A Voyage through Space.
72. ARTHUR BERRY. A Short History of Astronomy.

CHEMISTRY.

73. E. E. SLOSSON. Creative Chemistry.
74. ELLWOOD HENDRICK. Everyman's Chemistry.
75. HENRY C. FULLER. The Story of Drugs.
76. JEAN HENRI FABRE. The Wonder Book of Chemistry.
77. ROBERT KENNEDY DUNCAN. The Chemistry of Commerce.
78. GEOFFREY MARTIN. Modern Chemistry and its Wonders.
79. FREDERICK SODDY. The Interpretation of Radium.
80. F. P. VENABLE. A Short History of Chemistry.
81. EDGAR FAHS SMITH. Chemistry in America.

PHYSICS.

82. FREDERICK SODDY. Matter and Energy.
83. JOHN MILLS. Within the Atom.
84. ALBERT EINSTEIN. Relativity.
85. J. A. FLEMING. Waves and Ripples in Water, Air, and Aether.
86. DAYTON C. MILLER. The Science of Musical Sounds.
87. WILLIAM BRAGG. The World of Sound.
88. MARION LUCKIESH. Color and its Applications.
89. C. V. BOYS. Soap Bubbles: their Colours and the Forces which Mould them.
90. ERNST MACH. Popular Scientific Lectures.
91. FREDERICK SODDY. Science and Life.

MATHEMATICS.

92. A. N. WHITEHEAD. Introduction to Mathematics.
93. LEVI LEONARD CONANT. The Number Concept, its Origin and Development.
94. JOHN WESLEY YOUNG. Lectures on the Fundamental Concepts of Algebra and Geometry.
95. JAMES BYRNIE SHAW. Lectures on the Philosophy of Mathematics.
96. AUGUSTUS DE MORGAN. On the Study and Difficulties of Mathematics.
97. DAVID EUGENE SMITH. Number Stories of Long Ago.

HISTORY OF SCIENCE.

98. WALTER LIBBY. An Introduction to the History of Science.
99. W. T. SEDGWICK and H. W. TYLER. A Short History of Science.
100. ANDREW D. WHITE. A History of the Warfare of Science with Theology in Christendom.

The Zermatt Meeting of the Swiss Society of Natural Science.

THE 104th meeting of the Helvetic Society of Natural Science was held at Zermatt on August 30–September 2. On the evening of the first day, after a business meeting in which Lucerne was chosen as the meeting-place for next year, the Society was welcomed by the local and cantonal authorities at a soirée given by the Science Society of the Rhone Valley, called the Murithienne. The next day, which was very wet, was devoted appropriately to business: general meeting with speeches in the morning; sectional meetings in the afternoon.

M. le Chanoine Besse, curé of Riddes, who had been chosen as annual president, took the opportunity of his opening address piously to recall the names and the lifework of some of the most prominent *savants* of the valley. A member himself of the Congregation of St. Bernard, he was able to point to the long tale of patient study pursued by successive members of the same body; in particular he sketched the life of Laurent-Joseph Murith, 1742–1816, geologist, conchologist, ornithologist, entomologist, as well as archæologist, who lived just long enough to be one of the first members of the infant Helvetic Society. Among the other men whose lives he told in impressively simple language I would only mention that of Walther Ritz, 1878–1909, the brilliant young physicist, born at Sion, whose ideas not only made a great stir at the time, but have also proved a source of inspiration since.

In the various Sections a number of interesting communications were made. The Mathematical Section opened with a causerie of my own on the nuptial number of Plato. Prof. Speiser then explained a very pretty geometrical figure of rational points on the straight line and circles touching the latter in those points and touching one another, and Prof. Wavre, of Geneva, gave a short account of some work on a substitution in the realm of several complex variables. After the meeting I communicated by desire a new theorem of Prof. W. H. Young's in the theory of trigonometric series; he had promised to speak on this subject, but was prevented from attending the meeting. I pointed out how the theorem itself as well as the proof again illustrate the efficacy of the method of integration with respect to a function of bounded variation.

In the Physical Section the communications fell distinctly into two classes, pure and applied, the latter being in the majority. The former included an account of the separation of neighbouring radioactive substances as carried out in the Brussels laboratory of August Piccard, and another of experiments made in Prof. Perrier's laboratory at Lausanne by S. Gagnebin, on the thermic variation of the dielectric constants of quartz. These latter form part of a general scheme of research undertaken in the Lausanne laboratory on the dissymmetries of solid matter; they constitute, moreover, a fine example of the use of the triode lamp in the problem of measuring exceedingly feeble capacities with imperfect isolation. In applied physics we may in particular mention an account of the determinations of the variation of the first modulus of the elasticity of steel under changes of temperature, made in Prof. Jaquerod's new horological laboratory at Neuchâtel; it is expected that the result of the creation of this department will have a beneficial effect on the Swiss watchmaking industry. Almost all the remaining contributions consisted of technical improvements in telegraphy and wireless telephony, among which we note the realisation of very simple and strong, but small, apparatus, of national importance to Switzerland in so far as they are to be set up in the huts of the Alpine Club.

The Botanical Section was strongly represented. P. Konrad gave an account of his researches on certain fungi in the Jura; in particular he has found a new type of Hymenomycetes which enables him to settle certain systematic questions hitherto unsolved. Prof. Schinz, of Zürich, showed a collection made by one of his staff, Prof. A. Thelling, unfortunately himself absent, of the flowers of Zermatt, corroborating, among other things, the known fact that, in this region, plants are able to exist at a greater height than in other parts of Switzerland.

Dr. W. Vischer, of Bâle, spoke upon heredity in relation to the physiological properties of *Hevea Brasiliensis*, the chief rubber producing plant at the present time. Prof. E. Fischer, of Berne, gave two communications; the first on the work carried out under his direction by Dr. Baumgartner, who has been able to show that an interesting family of fungi, the Laboulbeniaces, hitherto supposed to be confined almost exclusively to North America, contains numerous representatives in Switzerland. The excessive minuteness of these organisms renders their recognition extraordinarily difficult. The second of Prof. Fischer's communications related to the infection of certain plants by rust-fungi (Uredineæ), which he had collected in the Rhone valley, and by means of which new light is thrown on the susceptibility of determinate races or groups of plants to infection by definite fungi. Prof. Jäggli gave great pleasure to his audience by his account in Italian of the mosses he has studied in the pass of Sasso Corbaro, near Bellinzona; he has found several hitherto unknown in the Tessin. The remarkable variety found in such a small area is doubtless due to the lie of the region in relation both to the Alps and the Mediterranean. Fernand Chodat, the son of Prof. Chodat, of Geneva, spoke upon the determination of the concentration of hydrogen ions in the soil and its influence on the vegetation. In places where the same group of plants occurs, the concentration is found to be remarkably constant in spite of external differences of the surroundings; hence it may be expected that this factor plays an important part in the distribution of plants. Prof. Schellenberg, of Zürich, spoke upon a subject closely connected with that of Prof. Fischer's second communication. The parasitic fungus which formed the subject of his investigations, Sclerotinia, attacks especially the quince tree, and others of the same family.

In the Section of Geophysics, Meteorology, and Astronomy, we may refer to an interesting communication by O. Lütschg, of Bern, giving exact details with respect to the advance of a certain glacier founded on archives of the year 1300; and in the Section of Anthropology and Ethnology, in addition to the account given by Prof. Pittard, of Geneva, on Palæolithic traces in Northern Africa, we must notice H. Junod's communication on totemism among the Tongas, Pédis, and Vendas. The curious customs which he had chronicled during his long residence in South Africa among these peoples seem to indicate that the totemism which exists, more particularly among the Pédis, may be a relic of the past, the real meaning of which has been lost and the practice become degenerate.

Among other communications of interest we note, in the Section of the History of Medicine and of Science, Dr. Morgenthaler's account of a hysterical case at the beginning of the sixteenth century. The account as written down by the doctors at the time is so exact that it is possible in the present day to diagnose the case precisely. In those days the patient was fortunate to escape being tried and burned for witchcraft. In the same Section, Prof. G. Senn examined carefully the pharmaceutical-botanical handbook of Theophrastus (chapters 8-20 of his "Historia plantarum"), and came to the conclusion that we have here a conglomerate of results from various sources, which were edited rather inefficiently at a later date by an unknown person. Nevertheless, the book has scientific value, and certainly contains parts due to Theophrastus.

In each of the Sections there was, besides the scientific communications read and discussed, a business meeting which, for the most part, presents no interest to a British public; we notice, however, with pleasure that Sir Clifford Allbutt was elected an honorary member of the Society, in recognition of his important contributions to the history of medicine. In the Physical Section, moreover, two matters of general interest came up: first, the question of the federation of the Swiss Physical Society with the International Union of Pure and Applied Physics, and secondly, the creation of a Swiss periodical for physicists. The Helvetic Society as a whole had already given in its adhesion to the International Research Council, and the question was put by the central president to the Physical Society, as a branch of the larger body. It was decided to answer in the affirmative. A Swiss Committee of Physics was there and then constituted, comprising provisionally five Swiss members. This committee is to be considered as distinct from the committee of the Swiss Physical Society, which may contain non-Swiss members, and the possibility was left open of its being enlarged at a later date by the addition of electrical engineers, or representatives of other branches of applied physics. The committee will examine shortly the question of sending a delegation to the meeting which it is proposed to hold in December at Paris.

In discussing the second matter, it was pointed out that there does not exist at the moment any Swiss periodical devoted exclusively to physics, and in which memoirs in any one of the three national languages equally are accepted. The consequence is that much of the good work done in Swiss institutions is regarded outside Switzerland as belonging to the countries where the results are published. On the initiative of some of its members, the Society decided to consider at an early date the creation of a trilingual review, of the type of the *Helvetica Chimica Acta*, recently created for the purpose of publishing the work of Swiss chemists in Switzerland itself. The question is more difficult in the case of physics, since, unlike chemistry, it cannot count on the regular support of the industrial people. A committee *ad hoc* is to examine whether it will prove possible to transform and extend the *Archives des Sciences Physiques et Naturelles*, hitherto published at Geneva. This was the wish of Philippe Guye, and he had for years been working with this aim in view, when his untimely death deprived the world of science of one of its most valued leaders. It is to be hoped that the preparations which he had made will be found to render this transformation possible. The alternative would be to create a totally new review, the *Helvetica Physica Acta*.

GRACE CHISHOLM YOUNG.

University and Educational Intelligence.

BRISTOL.—Prof. J. W. McBain has received the degree of doctor of science from Brown University, Rhode Island, United States, where he is delivering a dedicatory address at the opening of the new chemical laboratories.

CAMBRIDGE.—Mr. H. Godwin, Clare College, has been appointed junior demonstrator in botany, and Mr. H. E. Green, Fitzwilliam Hall, re-appointed second assistant at the Observatory.

Dr. Mollison, Master of Clare College, has offered a gift of 500*l.* to found a prize to be called the "Mayhew Prize," to be awarded by the examiners in Part II. of the Mathematical Tripos to the candidate of the greatest merit, preferably in the subjects of applied mathematics.

LONDON.—Dr. A. Logan Turner will deliver the Semon lecture in the lecture hall of the Royal Society of Medicine, 1 Wimpole Street, W.1, on Thursday, November 1, at 5 o'clock, taking as his subject "The Advancement of Laryngology: a plea for adequate training and closer co-operative action." Admission will be free, without tickets.

A course of eight lectures on "Some Biochemical Aspects of Animal Development" is being delivered by Mr. H. G. Cannon in the Zoological Department of the Imperial College of Science and Technology on Mondays at 5.30, terminating on December 3.

SHEFFIELD.—The University Council has made the following appointments: Prof. F. C. Lea, to the chair of mechanical engineering, in succession to emeritus Prof. Ripper; Mr. R. R. S. Cox, to be assistant lecturer and tutor in mathematics; and Mr. M. H. Evans, to be an assistant lecturer in physics.

ACCORDING to the *Chemiker Zeitung*, Dr. James Franck has been appointed to the chair of physics in the University of Berlin, vacant by the death of Dr. Heinrich Rubens.

THREE residential scholarships for British women graduates, tenable at the American University Women's Club in Paris, have been awarded by the British Federation of University Women to the following candidates: Miss Olive Farmer (London and Cambridge)—Mary Ewart Travelling Scholar, 1923–24; Miss Benedicta J. H. Rowe (Oxford); and Miss Helen Waddell (Belfast)—Susette Taylor Fellow, 1923–24.

THE Department of Leather Industries of the University of Leeds has issued a report on the sessions 1921–23, in which it is noted that the Ph.D. degree of the university was conferred on completion of two years' research work in the department on Mr. E. C. Porter for a thesis on "The Alkaline Swelling of Hide Powder," while another former student of the department, Mr. F. L. Seymour-Jones, has been awarded a Ph.D. degree by Columbia University for a thesis on "The Hydrolysis of Collagen by Trypsin."

THE University of Leeds entertained on September 13 a party of members of the Institute of Journalists. In connexion with this visit a convenient summary of the history and activities of the University was printed, special prominence being given to the departments of Leather Industries, Colour Chemistry, and Textile Industries, all of which were inspected by the visitors. It is noted that to provide university instruction costs on an average 83*l.* a year for each full-time student, while the average fee paid by such students is 40*l.*

AN article on "The Civic University and the State" in the *Fortnightly Review* for October contains a timely plea for the recognition of the importance from an Imperial point of view of adequate provision in the English provincial universities for economic and industrial research and advanced studies in civics. Mr. MacInnes, the writer of the article, points out that were full advantage taken of the unique opportunities in the universities of Birmingham, Bristol, Leeds, Liverpool, Manchester, and Sheffield, for work in these fields they would attract from the Dominions many research students who would otherwise drift to foreign countries. Hitherto these universities have attracted very few of such students, owing partly to failure to make their resources sufficiently well known and to devise convenient procedures for students from abroad. Nor is this surprising. The university staffs are hard put to it to meet the requirements of English students, and in the absence of any special inducement to cater for the needs of students from abroad, it is not to be expected that they should go out of their way to do so. Something has been done by the Universities Bureau to disseminate in every part of the Empire a knowledge of the resources of the universities in other parts, but that is not enough by itself to stimulate intra-Imperial migration of students. Discussing the perils to which universities are exposed by reason of dependence on State subsidies, the article points out that a democratic community naturally inclines to the view that, since the people pay for their maintenance, as many persons as possible should enjoy their benefits, and as a large majority fail to appreciate the benefit of having in their midst a university pursuing, however efficiently, its traditional aims, they are inclined to look for benefits more direct and easily recognisable.

Societies and Academies.

MANCHESTER.

Literary and Philosophical Society, October 9.—H. B. **Dixon**: On coal-dust explosions at the Mines Department Experimental Station at Eskmeals. The coal-dust theory of explosions in mines, started fifty years ago, led to many small-scale experiments, both in England and abroad, which did not definitely solve the problem. The large-scale experiments instituted by the Mining Association in 1908 first showed the violence of pure coal-dust explosions and indicated methods to study and counteract them. In the model mine at Eskmeals, Cumberland, it has been possible to give complete demonstrations of the violent character of pure coal-dust explosions, and to obtain records of the speed and pressure of the flame. It has also made possible many experiments on the effect of damping the dust and of diluting it with inert shale or other incombustible powders. The Eskmeals Committee in 1914 advised a 1 : 1 mixture of coal and inert dust throughout the roadways of "dry and dusty" mines—as a minimum amount of inert dust. The experiments made this year with the finely ground dust from various coal seams in England and Scotland—especially that with the Arley Main dust—have shown that it is possible to explode a 1 : 1 mixture. But the precautions taken to meet the coal-dust danger have resulted in a great saving of human life. The yearly fatal accidents from explosions in mines during the decade 1873–1882 reached 661 per million workers, in the decade 1911–1920 the yearly average fell to 111; for the last three years the average has been still lower.

MELBOURNE.

Royal Society of Victoria, August 2.—Mr. Wisewould, president, in the chair.—C. **MacKenzie** and W. J. **Owen**: Studies on the comparative anatomy of the alimentary canal of Australian reptiles. The alimentary canals of lizards, skinks, monitors, and of poisonous and non-poisonous snakes, were described. Without a knowledge of the reptilian gastro-intestine there could not be a correct understanding of the apparent complex human intestinal arrangement and its method of fixation adapted to the erect posture. In the bearded and the frilled lizards, a well-defined cæcum appears together with development of mesenteric colon (human ascending colon). Associated with this is the presence of the mesial fold approximating the colon to the pyloric region, which is best demonstrated in Koala. Thus in these lizards is found early evidences of the method of accommodation of the large intestine to the erect posture.—G. G. **Heslop**: Further studies in contagious bovine pleuropneumonia.—E. W. **Skeats**: The evidence of Post-Lower Carboniferous plutonic and hypabyssal intrusions into the Grampian Sandstones of Western Victoria.—A. Jefferis **Turner**: New Australian Micro-Lepidoptera.—F. **Chapman** and C. J. **Gabriel**: A revision of the Australian Tertiary Patellidæ, Patelloidiidæ, Cocuclinidæ, and Fissurellidæ. The fissure, keyhole, and common limpets are discussed. Of the 23 species described, 14 are new. Three of the fossil species are still found living, and have an ancestry dating back three million years, the fossils being indistinguishable from those dredged up in Western Port Bay. The persistence of these species supports the idea of the general stability of the Australian continent since ancient geological time, so far as the absence of sudden changes of coast-line is concerned.

Diary of Societies.

MONDAY, OCTOBER 22.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. Shattock: Arteries.

INSTITUTE OF PHYSICS (at Institution of Electrical Engineers), at 5.30.—Dr. A. E. Oxley: The Physicist in the Textile Industries.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section), at 7.—J. Harrison: Four-wheeled Brakes for British Light Cars.

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—D. Gabell: Presidential Address.

TUESDAY, OCTOBER 23.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—The Secretary: Report on the Additions made to the Society's Menagerie during the months of June, July, August, and September 1923.—E. A. Spaul: Acceleration of Metamorphoses of Frog-Tadpoles by Injection of Anterior-lobe Pituitary-gland Extract and Iodine.—H. C. Abraham: A New Spider of the Genus Liphistius from the Malay Peninsula, and some Observations on its Habits.—A. Subba Rau and P. H. Johnson: Observations on the Development of the Sympathetic Nervous System and Suprarenal Bodies in the Sparrow.—M. A. Smith: A Review of the Lizards of the Genus Tropidophorus on the Asiatic Mainland.—J. G. H. Frew: The Larval Anatomy of the Gout-fly (*Chlorops tæniopus* Meig) and two Related Acalyptrate Muscids with Notes on their Winter Host-plants.—A. Loveridge: (1) Notes on Mammals collected in Tanganyika Territory, 1920–1923. (2) A List of the Lizards of British East Africa (Uganda, Kenya Colony, Tanganyika Territory, and Zanzibar), with Keys for the Diagnosis of the Species.

INSTITUTE OF MARINE ENGINEERS, INC., at 6.30.—W. S. Patterson: Boiler Corrosion.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Dr. G. H. Rodman: A Talk about the Housefly and how it endangers the Health of Man.

ROYAL ANTHROPOLOGICAL INSTITUTE (at Royal Society), at 8.15.—F. A. Mitchell-Hedges: The Discovery of an Unknown Race: The Culture of the Calchaqui of Central America.

WEDNESDAY, OCTOBER 24.

FEDERATION OF MEDICAL AND ALLIED SERVICES (at 12 Stratford Place), at 4.—Conference to consider what practical means, if any, are possible to extend the system of providing for the periodical medical examination of the Larger Assurance Policy Holders.

ROYAL MICROSCOPICAL SOCIETY (Industrial Applications Section), at 7.—J. E. Barnard: Lecture Demonstration dealing with the Efficient Use and Manipulation of the Microscope.—Dr. Marie C. Stopes: The Microscopy of Recent Coal Research.

THURSDAY, OCTOBER 25.

ROYAL SOCIETY OF MEDICINE, at 5.—Sir E. Sharpey Schafer: The Relations between Surgery and Physiology (Victor Horsley Memorial Lecture).

SOCIETY OF DYERS AND COLOURISTS (London Section) (at Dyers' Hall, Dowgate Hill), at 7.—I. E. Weber: Hydrogen Peroxide Bleaching.

FRIDAY, OCTOBER 26.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5.—S. H. Piper and E. N. Grindley: The Fine Structure of some Sodium Salts of the Fatty Acids in Soap Curds.—Dr. E. A. Owen and G. D. Preston: X-ray Analysis of Solid Solutions.—Dr. H. Chatley: Cohesion.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: The Distinction between Congenital and Acquired Forms of True Hernia.

NEWCOMEN SOCIETY (in Prince Henry's Room, 17 Fleet Street), at 5.30.—L. St. L. Pendred: The Value of the History of Technology (Presidential Address).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. E. Saunders: Adventures with a Camera at the Zoo.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—A. V. Ballhatchet: Crystals for Wireless Reception.

PUBLIC LECTURES.

SATURDAY, OCTOBER 20.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Tutankhamen and his Times.

MONDAY, OCTOBER 22.

UNIVERSITY COLLEGE, at 5.—Miss H. M. Holdsworth: The Problem of teaching Spoken English to Foreigners.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—H. G. Cannon: Some Biochemical Aspects of Animal Development. (Succeeding Lectures on October 29, November 5, 12, 19, 26, and December 3.)

TUESDAY, OCTOBER 23.

UNIVERSITY COLLEGE, at 5.30.—P. Fleming: The Care of School Children's Eyesight.

GRESHAM COLLEGE, BASINGHALL STREET, at 6.—W. H. Wagstaff: Geometry. (Succeeding Lectures on October 24, 25, and 26.)

WEDNESDAY, OCTOBER 24.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. J. C. Drummond: Vitamins in relation to Public Health.

UNIVERSITY COLLEGE, at 5.30.—T. G. Hill: Illustration of Books.

THURSDAY, OCTOBER 25.

FINSBURY TECHNICAL COLLEGE (Leonard Street), at 4.—E. M. Hawkins: Analytical Chemistry (Streatfeild Memorial Lecture).

FRIDAY, OCTOBER 26.

UNIVERSITY COLLEGE, at 5.15.—B. Seebohm Rowntree: Factory Life as it is and as it might be.

SATURDAY, OCTOBER 27.

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