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The Imperial Agricultural Research Conference.

GREAT BRITAIN is an industrial country; but the British Empire, of which it is the head and centre, is an Empire of agriculture, and of extraordinarily various agriculture conducted under extraordinarily various conditions. At first sight there is little in common between the production of wheat, livestock, or fruit in England and the great Dominions, the growing of rubber in Malaya, of the oil-palm or ground-nut in India and West Africa, and of the sugar-cane or banana in the West Indies. But in truth all crop- or fruit-growing and all livestock husbandry rest on the same fundamental principles, though their application may present a very different problem in different countries; and therefore all agriculture has at least one common interest—the elucidation of those principles.

The Imperial Agricultural Research Conference, which is to meet in London at the beginning of October, will be primarily an attempt to survey and organise the scientific resources of the Empire for the increase of agricultural knowledge. Research has two main requirements—first (a long way first), trained men; and second, equipment. In both these requirements the Empire is, broadly speaking, far below the needs of the work to be done and the problems demanding a solution—problems not of purely scientific interest but of immediate importance for the prosperity, and almost for the existence, of large populations. In Great Britain it is true that we possess, thanks mainly to Sir Daniel Hall, a coherent organisation of agricultural research institutes, reasonably staffed and equipped. But outside Great Britain, and with a few exceptions, such as the Animal Diseases Station which Sir A. Theiler has established in South Africa, agricultural research, where it exists at all in any sense worthy of the name, is sporadic, ill-equipped, and un-organised. Yet in the tropical and sub-tropical colonies alone (without including the Dominions and India) there are something more than 2,000,000 square miles, and 50,000,000 people practically all dependent on agriculture of one kind or another.

No conference can provide men or money. Money, however, is now available to some extent from the Empire Marketing Board, which is devoting to the encouragement of agricultural research a not insignificant proportion of its income; the provision of trained men is a matter of time, the offer of a career, and personal inspiration.

But the conference which meets in October can and will attempt to answer the question, "How can the different parts of the Empire best help one another in their common aim, the advancement of agricultural science?"

To those familiar with any kind of research, this general heading will suggest many specific problems. First and most important of all, there is the recruitment and training of research workers. It is well known that while in some branches of science there is a fair supply of young men coming forward to take up research, in others there is a lamentable deficiency; for example, from almost every part of the Empire there is a demand for trained geneticists, which is, and for the moment must remain, unsatisfied. For the solution of this problem we must look mainly to the universities of the Empire, and particularly of Great Britain. Again, what can be done to help the man now engaged in research? Is the time yet ripe for an extension of the principle already embodied in the highly successful Imperial Bureaux of Entomology and Mycology? For the establishment, for example, of Imperial bureaux of soil science, veterinary science, or agricultural economics? If so, on what plan should such new organisations be set up? Then there is the difficult problem of publications, and of the collection and interchange of information, so that a man examining an agricultural question on the Gold Coast, for example, may have at least a reasonable chance of starting with a knowledge of the work already done or being done in other parts of the Empire upon the same or connected problems.

The interchange of research workers is another matter to which a close analysis ought to be applied; if a definite and practicable scheme can be devised, there can be no doubt of its advantages. A man working alone or almost alone in a comparatively small tropical colony, far from the stimulus of companionship with his scientific fellows, must benefit enormously by a period of re-freshment (in the most literal sense of the word) at Cambridge, Rothamsted, or some similar centre; just as those who are fortunate enough normally to work in such centres may well obtain unexpected advantages from a complete if temporary change of surroundings, and the opportunity of applying the test of new conditions to hypotheses and results reached in laboratories and on land thousands of miles away. Another question of magnitude which can only be fully considered at a conference where the whole Empire is represented is the project of an Imperial chain of research stations—how many there ought to be, where situated, and how far each should endeavour to become the recognised authority for the whole Empire in one branch of agricultural science, besides meeting the imperative requirements of its own locality.

The conference must primarily apply itself to such administrative or semi-administrative questions; but naturally the groups of specialists present will discuss among themselves their own technical problems, which are scarcely suitable for the whole conference. Possibly, however, the most valuable part of such a conference is not to be found in the official discussions of questions formally brought before the conference or committees of the conference; it is to be found in those private and unrestrained conversations in which one man of science really speaks to another with freedom about his own difficulties, hopes, methods, and ideas. The first Imperial Agricultural Research Conference is sure to be interesting, and it ought to produce most important results in the improvement of the machinery for the supply, equipment, and co-operation of men engaged in research. But one result should follow, which by itself will fully justify the conference; a mutual knowledge and personal appreciation between men scattered all over the British Empire, which will render their co-operation not only easier and more pleasant, but also more fruitful, than it can be made by any official machinery.

Biometric Studies.

(1) *The Biology of Population Growth.* By Raymond Pearl. Pp. xiv + 260. (London: Williams and Norgate, Ltd., 1926.) 10*s*. 6*d*. net.

(2) *Alcohol and Longevity.* By Raymond Pearl. Pp. xii + 273. (New York and London: Alfred A. Knopf, 1926.) 15*s*. net.

THE present generation regards with relatively small alarm the probings of a paternal government into the life and death of the individual. Yet less than a hundred years ago the principle of *laissez-faire* was still dominant and the jurisdiction of Whitehall was strictly limited. No longer ago than 1753, a Bill introduced into the House of Commons to provide for a census of the people met with vehement opposition. One member "feared lest some public misfortune or an epidemical distemper should follow the numbering," while another was overpowered by the discovery that there could be "any set of men, or indeed any individual of the human species, so presumptuous and so abandoned as to make the proposal we have

just heard. I hold this project," he stated, " to be utterly subversive of the last remains of English liberty." Yet Great Britain did not lag behind other European States. The history of vital statistics is thus a short one, and, consequently, to glean further information of the populations of the past, we are compelled to resort to statistical assumptions based upon the very meagre data that exist.

It is this ignorance of the course of population growth, of the variation in birth- and death-rates, over any but a very short period of time, and that limited mainly to a century of rapid industrial expansion, that makes the study of the ' laws of growth ' so fascinating. Few workers have brought more originality to the study than Prof. Raymond Pearl. Approaching the problem first from the mathematical viewpoint (in conjunction with Prof. Lowell Reed), he concluded that a first approximation to the law was to be found in an equation of the form

$$y = d + \frac{k}{1 + e^{a_1 x + a_2 x^2 + a_3 x^3 + \ldots + a_n x^n}}.$$

So long ago as 1838, Verhulst, a Belgian mathematician, had used this same curve, which he called the ' logistic curve,' as an expression of the law of population growth. This was unknown to Pearl and Reed when working on the problem, and they reached the result independently from biological reasoning. Eliminating mathematical symbols, Pearl states his ' law ' as follows :

" Growth occurs in cycles. Within one and the same cycle, and in a spatially limited area or universe, growth in the first half of the cycle starts slowly but the absolute increment per unit of time *increases* steadily until the mid-point of the cycle is reached. After that point the increment per unit of time becomes steadily *smaller* until the end of the cycle. In a spatially limited universe the amount of increase which occurs in any particular unit of time, at any point of the single cycle of growth, is proportional to two things, namely : (*a*) the absolute size already attained at the beginning of the unit interval under consideration, and (*b*) the amount still unused or unexpended in the given universe (or area) of actual and potential resources for the support of growth."

Prof. Pearl shows that such a curve gives a good representation not only of the growth in body-weight of the rat and of the pumpkin, but also of the development of a population of yeast cells and populations of the fruit fly (Drosophila) kept under exact experimental conditions. Applying the equation to human populations, it is found that the curve fits the recorded enumerations with extreme accuracy. Unfortunately, in all cases the observed population-counts cover only a small part of the whole range of one cycle of growth. In the United States and in England and Wales it is the earlier part of the cycle for which observations exist. In France it is the late part of the cycle. What we require is a human population having census records covering an entire cycle of growth. This Pearl endeavours to supply by an analysis of the growth of the native population of Algeria, " the first and only example I have so far discovered of a human population virtually completing an entire single cycle of growth according to the logistic curve, and at the same time having definite census records covering practically the whole of the cycle." The ' fit ' of the curve to the observed enumerations is again a good one. At the same time, we must not surrender ourselves entirely because of this ' goodness of fit ' between the observed and the mathematically expected. Another curve of a flexible type may possibly fit the very limited observations equally well; but one has yet to be discovered based upon equally logical and justifiable reasoning.

In adopting any ' law of population growth ' it is essential to remember that it can be utilised for the estimation of past and future populations only over very short ranges of time. As Pearl points out, any alteration in the resources necessary for growth may entirely change the cycle along which a population is travelling. It was this change of resources that falsified (for the time being) the contentions of Malthus. He was unable to foresee the development of world-wide markets and the vast increase of food supplies, and thus the postponement of the pressure of population upon subsistence.

Pearl's experimental work is invariably stimulating, and his later chapters on density and population growth quicken one's interest. His data on normal sex behaviour cannot command the same respect. It is impossible to rid oneself of the conviction that no real assessment of the accuracy of the data is possible, and that a group of men aged from 50 to 75 years, even if of more than average intelligence, would not remember their average sexual activity per month in the different decades of life from puberty onwards. Even if the data presented are substantially correct, the ' exposure to risk ' incurred in all the social classes in this study is so great that one can scarcely credit the variation in sex habit as an important factor of the differential birth-rate.

The same question confronts one in a lesser degree in reading Pearl's work on alcohol and the

duration of life. Can one ever obtain trustworthy knowledge of the drinking habits of the individual? Pearl is satisfied that the information presented by him at least "is more accurate and comprehensive than any elsewhere available," and states that every critical safeguard of the accuracy of the records was adopted. He admits that it is by no means an easy matter to determine the precise effect of alcohol apart from other factors, and endeavours to eliminate the possible selective factor that determines whether a man is an abstainer or moderate drinker. For this purpose he compares pairs of brothers, one an abstainer and the other a moderate drinker. The moderate drinkers, he finds, are slightly the better lives. This is the same conclusion as that reached in the main study, that the moderate drinkers are as good lives as the abstainers, or even slightly better lives, while heavy drinkers are seriously penalised for their excesses as regards duration of life.

The study (and again more especially on its experimental side, of which a very detailed account is given) is full of interest and has been carried out with much care and labour. But it is not possible to feel satisfied that the selective factor has yet been proved to be non-existent, or that the last word has yet been said as to the effect of alcohol upon longevity—a dictum to which Prof. Pearl would be the first to subscribe. A. B. HILL.

Religion in a Barbaric Kingdom.

Religion and Art in Ashanti. By Capt. R. S. Rattray. With chapters by G. T. Bennett, Vernon Blake, H. Dudley Buxton, R. R. Marett, C. G. Seligman. Pp. xviii+414+116 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1927.) 30*s*. net.

WHEN a magnificent feast is given and the numerous dishes are all excellent, it is perhaps ungracious to complain that the disorder of the courses makes digestion somewhat difficult, and that the table decorations (the appendices), though interesting in themselves, have not been arranged so as to decorate the table. Yet the excellence of his material provokes this complaint against the arrangement of Capt. Rattray's book. It is somewhat disconcerting to find the ideas of the soul, disease, and medicine all discussed under "funeral rites." So far as practical field method goes we would not change this at all; Capt. Rattray has derived all his knowledge from the sound method of watching ceremonies and discussing them with well-chosen informants, but it would have helped us to understand better had the ideas of the soul been given earlier, and not as an interruption to a ritual which had already begun. For an appreciation of Ashanti social, economic, and political organisation (as for most other 'so-called' savage societies) this knowledge of the spiritual background of life is essential, because religious ideas permeate everyday life and there is no trace of the division into civil and religious life that we are accustomed to in Europe. For example, law is founded on religious sanctions, just as the curious treatment of a new-born infant depends on the beliefs concerning the soul and the ever-powerful influence of the dead.

It would seem that the one desire of the Ashanti is fertility, fertility of mankind and the fertility of the land, and for this end he must keep on good terms with the supernatural powers who are able to bless or blast the life source at every turn. No price, including human sacrifice, is too high to pay for the blessing, but for the Ashanti life is hard because of the multiplicity of supernatural powers. Capt. Rattray has defined these, not from any *a priori* conceptions of gods, demons or spirits, animism or *mana*, but from observation of ritual and the part the supernatural plays in the life of the individual. Thus there are the gods (*abosom*), including a High God in the sky, several gods, his children, all connected with water, an earth goddess, and possibly many others, the ancestral spirits (*samanfo*), and a vast class recognised by the Ashanti as *suman*, to which Capt. Rattray reluctantly gives the name fetish. If he could, he would abolish that word entirely; instead, he has striven to correct the absurdly erroneous ideas of fetishism that have done so much to vitiate all works on West Africa. Some of the *suman* are extremely powerful, and it may be difficult for the observer to differentiate between their cult and those of gods, whereas other *suman* appear to be specially endowed amulets or talismans.

This, however, does not exhaust the catalogue of supernatural powers; there are forest spirits (fairies), monsters and witches, and animals and plants may have souls, which may influence the life of man. The description of a funeral service held over a dead elephant is very interesting, as the attitude here shown towards animals raises points in connexion with totemism. The usual socio-religious complex known as totemism does not exist in Ashanti, but there are certain animals and plants connected with the *ntoro* divisions (not clan divisions); lists of these *ntoro* animals and of animals possessing souls for whom funerals are

necessary are not identical, though there are a few species common to both. Capt. Rattray does not appear to have followed up this possible connexion, and it is quite probable that it would not lead to any conclusions, but it is a nice indication of the mental attitude towards animals which makes totemism possible.

The king of Ashanti does not appear to be a divine king; rather does the divinity of the authority rest in the king's stool or throne. Much insight into the Ashanti religion and its relation to the kingship may be gained from the description of the Odwira ceremony, previously known as the Yam custom, and famous for the amount of intoxicating liquor drunk and of human blood spilt. These two features, though so horribly prominent to the first European observers, are merely incidents to the Ashanti in what was really an annual purification ceremony for the king and the whole nation before the new harvest might be eaten. The king honours the ancestral spirits, and the chiefs and people pay allegiance to the king. The gods, ghosts, and other spirits must eat, then the king, his chiefs, and people may do so. This ceremony, which lasted many days, must have been of great political and economic value to the kingdom. It seems a pity, however, to call it a "*rite de passage*," a title which so aptly classifies those ceremonies connected with transition periods in the life of the individual which mark the various phases of personal development, although M. Van Gennep himself, who coined the phrase, did include certain seasonal festivals under this heading.

The cult of the dead kings of the Ashanti suggests interesting politico-economic questions, for in addition to the extremely complicated beliefs concerning the soul, or rather the various souls that go to the spirit world (in the case of the king accompanied by widows and other attendants who are killed for that purpose), there is also a cult of the royal skeletons, to each of whom is appointed a living wife. Moreover, vast treasury in gold was owned by the dead kings and guarded by a standing army of about one thousand men. This money—for gold dust has its standard weights and values in Ashanti—could be 'borrowed' by the reigning king for ceremonies or national emergencies. The fact that the king must borrow and not merely take the royal treasure may have given stability to the government and added to the credit of the country.

It is to be hoped that Capt. Rattray may still be able to obtain further information concerning this primitive gold reserve. Was tribute paid to the dead and not to the living monarch, or was it divided between them? In what manner did the king make repayments to the coffers of the dead, and at what periods? Were the natural sources of gold controlled in any way, or might any man wash for alluvial gold? Numerous examples are given of fines which must be paid in expiation for breaking taboos or in the more ordinary course of justice, but it is not always clear if these were due to the king, clan chief, gods, or as compensation to the injured party. One notable example of direct taxation, however, is that half the bride-price of daughters of the royal house, as well as of granddaughters and great-granddaughters of chiefs, passes to the king.

Apart from the practical functioning of the gold reserve, there is an interesting question regarding its underlying purpose and possible origin, on which it may still be possible to throw light. Capt. Rattray has told us that when a commoner is buried, his wife provides some gold dust, or a small nugget, which is tied in the loin-cloth of the deceased. It is called *kra sika*, 'soul's money,' and is intended for the purchase of necessaries in the world of ghosts. Is it possible that the treasury of the kings originally served the same purpose, or that even quite recently, while fulfilling an entirely different function, the same belief was held with regard to it? It is to be hoped that in the forthcoming volume which Capt. Rattray promises us, he may be able to tell us still more about the economic side of this highly organised barbaric kingdom. All who have enjoyed Capt. Rattray's first work on Ashanti will appreciate this, his second volume, and will look forward eagerly to the publication of the third.

BRENDA Z. SELIGMAN.

Chinese Ornithology.

Bulletin of the Peking Society of Natural History. Technical Series, No. 1: *A Tentative List of Chinese Birds.* Part 1: *From Colymbiformes through Coraciiformes.* Compiled by N. Gist Gee, Lacy I. Moffett, and G. D. Wilder. Pp. viii +144. (Peking: Peking Society of Natural History, 1926.) n.p.

IN Great Britain it seems as if almost every nature-lover who can wield a pen writes, or tries to write, a work on British birds. In China the reverse is the case, and since 1877, when David and Oustalet brought out their "Birds of China," no one has attempted to compile another such

publication. Latouche is now engaged on "Birds of Eastern China," and both he and Lord Rothschild have written several valuable articles in the *Ibis* on the birds of Yunnan, whilst desultory articles on the avifauna of other portions of the great Chinese Empire have appeared from time to time in the same and in other journals. Messrs. N. Gist Gee and his collaborators are now bringing out a tentative list of the birds of the whole Chinese Empire, and we congratulate them very heartily on this part, the first, which has appeared in the *Bulletin of the Peking Society of Natural History*. The work is one which is very badly wanted, for however good David and Oustalet's work was when written, it is now long out-of-date, and a vast amount of ornithological work has been done since that time. The tentative list will, as its name implies, include all those birds which occur in the eighteen provinces of China, its islands, and in eastern Mongolia, east to Sakhalin.

The classification adopted is that of Knowlton in his "Birds of the World," and the nomenclature is taken from Hartert, "Die Vögel Paläarctischen," and other modern authors. No suggestion is made that the list is in any way complete but, such as it is, it is published as a working basis for further study and, in this respect, it is almost impossible to over-estimate its value to both present and future workers. The list contains the scientific, English and, wherever possible, the Chinese name of each bird, after which its distribution is given. The author of each scientific name is given, but no reference is made either to the first description or to later synonymy, an omission to be regretted, though the inclusion of these details would doubtless have at once overburdened the work and rendered it impossible to carry out.

It is out of place in reviewing a work of this nature to criticise minor details, and it may suffice to say here that as a whole the compilation appears to be excellent and thorough, and the fact that mistakes in nomenclatures and a few inaccuracies in geographical ranges naturally find their way into its pages will not in any way affect its immense usefulness and its great influence in furthering the cause of Chinese ornithology. It is a praiseworthy and very ambitious attempt to fill a greatly felt want, and one which we hope will probably inaugurate another cycle of ornithological research in China. The present volume contains the Colymbiformes, storks, herons, ducks, Accipitres, game birds, rails, waders, gulls, pigeons, and scansorial birds, leaving the great order of Passeres still to be dealt with.

Anatomies: Comparative and Human.

(1) *Vergleichende Anatomie der Wirbeltiere.* Von Prof. J. E. W. Ihle, Prof. P. N. van Kampen, Prof. H. F. Nierstrass, Prof. J. Versluys. Aus dem Holländischen übersetzt von G. Chr. Hirsch. Pp. viii + 906. (Berlin: Julius Springer, 1927.) 66 gold marks.

(2) *A Laboratory Manual for Elementary Zoology.* By Libbie Henrietta Hyman. Second edition. Pp. xviii + 182. (Chicago, Ill.: University of Chicago Press; London: Cambridge University Press, 1926.) 12*s.* 6*d.* net.

(3) *The Spiny Dogfish: a Laboratory Guide.* By Dr. Alvin R. Cahn. Pp. xiii + 94. (New York: The Macmillan Co., 1926.) 5*s.*

(4) *Necturus: a Laboratory Manual.* By L. A. Adams. Pp. viii + 72. (New York: The Macmillan Co., 1926.) 4*s.* 6*d.*

(5) *Anatomy of the Wood Rat: Comparative Anatomy of the Subgenera of the American Wood Rat (Genus Neotoma).* By A. Brazier Howell. (Monographs of the American Society of Mammalogists, No. 1.) Pp. x + 225 + 3 plates. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1926.) 22*s.* 6*d.* net.

(6) *An Atlas of Human Anatomy: for Students and Physicians.* By Dr. Carl Toldt, assisted by Prof. Alois Dalla Rosa. Adapted to English and American and International Terminology by Dr. M. Eden Paul. Revised edition in 2 vols. Vol. 1. First section, *A*: *The Regions of the Human Body*; *B*: *Osteology*; Second section, *C*: *Arthrology*; Third section, *D*: *Myology*. Pp. iv + 400. Vol. 2. Fourth section, *E*: *Splanchnology*; Fifth section, *F*: *Angeiology*; Sixth section, *G*: *Neurology*; *H*: *The Organs of the Senses*. Pp. ii + 401-985. (New York: The Macmillan Co., 1926.) 42*s.* net.

(1) THE German translation of a treatise on comparative anatomy by four Dutch zoologists is a welcome summary of the present state of vertebrate anatomy, which deals with vertebrates in the same way as, but more fully than, Gegenbaur and Bütschli have dealt with the animal kingdom as a whole. Some of the illustrations are borrowed from Bütschli's text-book, the merits of which have already been described in NATURE; and the rest of the 987 figures are drawn in the same clear semi-diagrammatic way. The volume is probably the best text-book of comparative anatomy. The chapter on the skeleton (by Prof. Versluys, of Vienna), dealing as it does not only with recent but also with fossil vertebrates,

is worthy of special note for its excellence and comprehensiveness.

(2) The fact that Hyman's "Elementary Zoology" is the second edition of a practical manual of which seven impressions have been sold in six years leaves no doubt as to its usefulness in the University of Chicago. It deals in a comprehensive way with the technique of the practical examination of the anatomy, embryology, and cytology of a large series of invertebrates and vertebrates. It has no illustrations.

(3) and (4) The guides to the dissection of the dogfish and Necturus are simple, clearly written dissecting manuals for elementary class work. They are both well done, but have no illustrations.

(5) Howell's work on the wood rat is an original memoir on the anatomy of a common American mammal. The author points out that while there are excellent accounts of the anatomy of such spectacular curiosities as the aye-aye and the marsupial mole, we are woefully ignorant of many of the common mammals. His book is one of a series that is being issued by the American Society of Mammalogists to make good this defect. The work provokes comparison with the investigations of the tree shrew and the tarsier respectively by Profs. Le Gros Clark and Woollard, recently published by the Zoological Society of London; and such a comparison reveals the curious fact that the American author has wholly neglected the central nervous system, to which the British anatomists devote particular attention.

(6) Toldt's well-known atlas of topographical anatomy is perhaps the most comprehensive of the many atlases now available for students, and as such is well worth making accessible in this second edition for English-speaking readers. While most of the illustrations are excellent, a few of the wood blocks seem to be worn out so that the detail is lost in the impressions made from them. Dr. Eden Paul's contribution to the volume is not altogether relevant: his reliance upon Macalister's text-book, which was an excellent guide more than thirty years ago, is not an adequate basis for the explanation of a modern atlas.

The Chemistry of Wood.

The Chemistry of Cellulose and Wood. By Dr. A. W. Schorger. (International Chemical Series.) Pp. xiv + 596. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 30*s*. net.

IN organic chemical industry there are many signs of wider and increasing activity. Synthetic alcohols are leading to new supplies of solvents and other products, and in addition the possibilities of wood as a chemical raw material are being realised. Within the last decade artificial silk from wood has become abundant and cheap, and is now being used to an extent never approached by the limited and costly natural silk. The saccharification of wood and cellulose has recently become prominent as a possible cheap source of power alcohol, acetone, glycerine, and other products of fermentation, and although not without technical difficulties, promises to open the way to new industries. In addition to these prospects there is every likelihood that wood cellulose will be pressed into use as a substitute for the more costly cotton cellulose in many existing industries such as film, celluloid, explosives and enamels.

Wood, unlike coal and oil, requires only land and the sun for its continuous supply. Fortunately, reafforestation is receiving active attention in Great Britain, as in the main timber-producing countries, and there is no doubt that many requirements can be assured with practically small land reservations. The chemistry of wood and wood cellulose is consequently of increasing importance. Considerable attention appears to have been directed to the subject by the study of wood as a source of explosives during the War.

Wood and its products are, however, complex and varied, and a systematic conception of their chemical and physico-chemical behaviour has been wanting. Dr. Schorger, Director of Chemical Research, C. F. Burgess Laboratories, has carried through successfully the difficult task of collecting the scientific data available on the chemistry of wood in a concise account, necessarily including some mention of cotton cellulose and its modified forms. It is made clear in the preface that the technical side of the subject is not the main theme, but the research student and worker will find the literature effectively summarised, while new prospects of research are to be found on almost every page of the book.

Broadly, the subject matter covers wood and the reactions of wood, lignin, hemicelluloses, gelatinised cellulose, oxy- and hydrocelluloses, the saccharification, distillation, and digestion of wood and wood celluloses, and analytical methods, concluding with a useful author and subject index. The many problems of chemical constitution, together with modern views on gelatinisation and other physical phenomena, are fully considered, while manufacturing processes concerned with wood and wood cellulose are adequately, although more generally, described.

In such a summary it is inevitable that occasional erroneous results can be found and additions suggested. Thus, Jentgen's statement that dry cellulose will take up 3 per cent. of moisture from all known drying agents is obviously incorrect and should be omitted. The following corrections might also be made: on p. 536 aniline hydrochloride to aniline acetete; on p. 578, under copper number, 451 to 541; and on p. 184, Irvine's formula for cellulose is incorrectly reproduced. The paper, printing, and binding are excellent, and the work is to be recommended as the most satisfactory survey of the subject in a convenient handbook form.

A. FORSTER.

Our Bookshelf.

Department of Scientific and Industrial Research. The Cleaning and Restoration of Museum Exhibits. Third Report upon Investigations conducted at the British Museum. Pp. v + 70 + 58 plates. (London: H.M. Stationery Office, 1926.) 5*s*. net.

CURATORS of museums as well as private collectors not infrequently find some or other of their charges incapable of resisting, unaided, the ravages of time in their many forms. In this volume, which amplifies two previous reports, Dr. A. Scott describes his experiences in the cleaning, restoration, and subsequent preservation of various exhibits from the British Museum and of some other well-known *objets d'art*. Sections of the book are devoted to prints and pictures, to stone and earthenware, to objects of silver, iron, lead, copper, bronze and wood, and to textiles; there are also described and illustrated some interesting 'fakes,' founded on a genuine basis and so cleverly executed as to deceive even experts until some abnormal feature of decay suggested the necessity for detailed scientific examination. The text concludes with some notes of a general character, dealing with apparatus, utensils, and media likely to be of value for specific purposes.

While the cleaning and restoring processes should preferably be left to skilled hands, the amateur, by adherence to the methods laid down, should be able to achieve satisfactory results. The timely admonition against the use of preparations of unknown composition is one which may well be extended to spheres other than that with which we are now concerned.

The efficacy of the methods adopted is illustrated by a number of well-produced, interleaved plates showing in many cases the various subjects before and after treatment, and on occasion some other point of particular interest.

Here, then, is a book almost unique of its kind and invaluable to those for whom it is primarily intended; further, it should serve, in these days of the revival of 'general knowledge,' to stimulate the interest of a larger sphere of readers in a number of cognate subjects.

B. A. E.

Handbook of Non-Ferrous Metallurgy. Prepared by a Staff of Specialists. Donald M. Liddell, Editor-in-Chief. In 2 vols. Vol. 1. Pp. xi + 692. Vol. 2. Pp. v + 693-1440. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 60*s*. net.

THERE are many encyclopædic text-books of metallurgy, and a new one must justify itself by fullness and accuracy of treatment. The present volumes are the work of a large number of contributors, and there is no attempt to give a critical survey of the subject. Instead, there is a series of monographs on the metals, most space being given to those which are of the greatest industrial importance. Each monograph is by a specialist, so that the information may be supposed to be abreast of modern practice. This appears to be true of the common metals, and such important processes as the electrolytic extraction of zinc are treated in detail. The term metallurgy has been interpreted by most of the writers as referring mainly to the extraction of the metals, and only in a few instances is there more than a brief outline of mechanical or thermal treatment or of the preparation of alloys. Such general processes as crushing, ore concentration, roasting, sintering, and electric smelting are considered in separate articles as well as incidentally under the heads of the several metals. An extensive and useful section deals with the materials of metallurgical construction. Metallography only receives limited attention, and the brief article on the subject is mainly confined to phase-rule questions, but a few of the authors give some account of the metallography of their special section. Throughout the greater part of the book theory is subordinated to practice, and it is mainly as a guide to current ore-dressing and smelting practice that it will be found useful. The least satisfactory section is that which deals with the rarer metals, in which there is now a great metallurgical interest.

The Geography of Witchcraft. By Montague Summers. (The History of Civilisation Series.) Pp. xi + 623 + 8 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1927.) 21*s*. net.

"THE Geography of Witchcraft," the title by which Mr. Summers distinguishes the second of his studies of witchcraft in this series, is something of a misnomer. Except that his chapters have geographical headings, his treatment is purely historical. Further, he deals only with Greece and Rome, England, Scotland, New England, France, Germany, Italy, and Spain. An adequate geographical study of witchcraft should surely go farther. Even within the boundaries of Europe he has omitted areas which are of first-rate importance in any investigations of the distribution of the belief and of special significance in relation to the question of origins. In Scotland, for example, where Mr. Summers notes that even the fairies have a sinister character, there seems to be a convergence of two lines of development, one coming from the north of Europe and the other from the south.

The explanation of the restriction which the author has imposed upon himself no doubt is to be found in the fact that his interest lies in the theological side of his subject. He has therefore confined his attention to those countries in which the witch is to be regarded as a subject under the ban of the Church and a heretic, rather than as a survival from an earlier stage of culture. In this volume, as in the preceding, due allowance must be made for the author's strong theological bias; but so far as the facts are concerned, his account for each of the countries with which he deals is comprehensive, detailed, and accurate to a degree beyond that attained by any other book on the subject.

A Botanist in the Amazon Valley: an Account of the Flora and Fauna in the Land of Floods. By Prof. R. Ruggles Gates. Pp. 203 + 11 plates. (London: H. F. and G. Witherby, 1927.) 7*s.* 6*d.* net.

THE opportunity of a voyage up the river Amazon so far as Teffé, which, including stays of a few days at Para, Manaos, and Teffé, occupied about six weeks, has led Prof. Gates to give an account of the general scenery and vegetation which can be seen from the deck of steamers and from his brief visits to terra firma. To any one making the journey by one of the Booth line boats and river steamers, this narrative by a botanist will be of interest, but for the serious student Prof. Gates adds very little to our knowledge, and he himself is undoubtedly the chief gainer by this very interesting opportunity, of which he appears to have taken full advantage, judging from his frequent allusion to his impedimenta for collecting, etc. The book appears to be the author's diary in print, so that much similar information is repeated; but a good many items will be of value to others who may make the journey.

We are surprised that Prof. Gates compares the huge leaves of the *Victoria Regia* with their vertically upturned edges to dinner plates; nor is he correct as to the colour of the flowers, since they are pure white at first and turn pink in the course of the day and then dull crimson as they fade. Two short chapters at the end of the book on palms and other trees of the Amazon, and on woods and timbers of this region, are of value.

Sternhaufen: ihr Bau, ihre Stellung zum Sternsystem und ihre Bedeutung für die Kosmogonie. Von P. ten Bruggencate. (Naturwissenschaftliche Monographien und Lehrbücher, Herausgegeben von der Schriftleitung der *Naturwissenschaften*, Band 7.) Pp. v + 158 + 4 Tafeln. (Berlin: Julius Springer, 1927.) 15 gold marks.

THIS is a very comprehensive monograph dealing with star-clusters and the work of various investigators on the problems of their distribution in space and of their structure. In Part 1 the author gives the general distribution of the clusters in the sky and describes the methods employed by Charlier, Kapteyn-Schouten, and Shapley for determining their distances. Parts 2 and 3 are devoted to investigations on the arrangement of the component stars of the clusters and the dynamical problems involved. The work of Eddington, Jeans, Shapley, and Von Zeipel naturally forms the framework of the chapters included. In Part 4 the author considers the question of star-clusters in relation to a general scheme of cosmogony. As this monograph is intended essentially for students, references to original papers are given in footnotes. In the list of catalogues of star-clusters, reference should have been made to that compiled by Melotte from the Franklin Adams Chart, and published as *Memoirs of the Royal Astronomical Society*, vol. 60.

Through Kamchatka by Dog-Sled and Skis: a Vivid Description of Adventurous Journeys amongst the Interesting and Almost Unknown Peoples of the most inaccessible Parts of this remote Siberian Peninsula. By Dr. Sten Bergman. Translated from the Swedish by Frederic Whyte. Pp. 284 + 16 plates. (London: Seeley, Service and Co., Ltd., 1927.) 21*s.* net.

IN this book Dr. Bergman describes several journeys which he and his wife took a few years ago in the interior of Kamchatka, when he was leader of a biological and ethnographical expedition sent by the Swedish Geographical Society. It is the best kind of travel book, with no tedious details of daily routine, but enough incidents of travel to illustrate the customs and habits of the people and the difficulties of the road. There is also much original matter in the account of visits paid to the Lamuts and Koryaks in the remoter parts of the peninsula, and to the degenerate and disappearing Kamchadals. The book is useful as giving a full and readable account of a part of Asia which is little known and seldom visited except by trappers and fur dealers. The maps and illustrations add to its value. Fuller accounts of the results of the expedition are now being published in Swedish scientific journals.

Delineations of American Scenery and Character. By John James Audubon. With an Introduction by Prof. Francis Hobart Herrick. Pp. xliv + 349. (London: Simpkin, Marshall and Co., Ltd., 1926.) 18*s.* net.

AUDUBON'S "Ornithological Biography," as he called the text in five volumes which accompanied his great work on "The Birds of America," contained a number of descriptive articles of a general value. Fifty-nine of these essays and two of his prefaces are reprinted in this volume, to which his biographer adds a short introduction. Most of the essays are sketches of pioneer life in the Ohio and Mississippi valleys, Labrador, Newfoundland, and New England between 1808 and 1834. A few treat more particularly of animal life. They were all written in the places and among the scenes they describe and portray vividly many aspects of life in America that have now passed, submerged in the flowing tide of population. Thus they fulfil the writer's aim, which was to record America as he saw it before man effected drastic changes on the face of the country. The volume is a useful contribution to American natural history and geography.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Actinium Series and the Order of Stability of Radioactive Isotopes.

ONE of the outstanding problems of radioactivity is the exact relation of the actinium to the thorium and uranium-radium disintegration series. That the actinium series starts at uranium I or an isotope of uranium, includes uranium-*Y* and ends at an isotope of lead after five α-particles have been expelled between protoactinium and the end product is regarded as proved by the experimental evidence. But the atomic weights of members of the series are not known; protoactinium is the only member of the series whose atomic weight might be determined by the usual methods, but this constant is still lacking owing to the very great difficulty of making a complete separation of protoactinium from its homologue tantalum. An investigation with the mass-spectrograph of uranium or of uranium-lead, leading to the discovery of isotopes not ascribable to the uranium-radium series, might also throw light on the atomic weights of members of the actinium series. This has yet to be made.

Failing experimental evidence, it may be asked if any useful purpose is served by attempts to predict what these atomic weights may be. As they lead not only to new values of these atomic weights but also to a generalisation with respect to the stability of radioactive isotopes which in part is applicable to isotopes of inactive elements, as I hope to show they do, I think they are justified.

I assume (*a*) that the actinium series starts from an isotope of uranium, ends at an isotope of lead, and includes the product uranium-*Y*, for all of which the experimental evidence is very strong; (*b*) that if an element of even atomic number has isotopes of odd atomic mass, these are likely to be one and three units less than the mass of its most stable isotope; (*c*) that the most stable mass of an element of odd atomic number is likely to be one unit greater than that of the most stable mass (of even number) of the element next below it. (In (*b*) and (*c*) I am merely applying to elements in the range of atomic numbers 82-92 what is obvious from F. W. Aston's results on elements in the range 34-80.)

Now the most stable isotopes of elements 92, 90, 88, 82, and 80 are known to have masses 238, 232, 226, 208, and 202 respectively. Therefore according to (*c*) the most stable isotopes of elements 93, 91, 89, 83, and 81 are likely to have masses of 239, 233, 227, 209, and 203 respectively. (This is certain for element 83 and very probable for element 81.) Can protoactinium have the atomic mass 233 assigned to the principal isotope of element 91? Now, so far as has been investigated, the most stable isotopes of elements 92, 90, 88, 86, 84, 83, 82, and 81 are either 'α-rayers' of long life or products which may be described as potentially 'α-rayers' (bismuth 209 being regarded as the parent of thallium's isotope 205, lead's isotope 208, the parent of mercury's isotope 204, etc.). Protoactinium, an 'α-rayer' with an estimated period of 10,000 years, is clearly in this class; actinium, a 'β-rayer' with a period of 20 years, is clearly not. The former may therefore have an atomic mass of 233, the latter may not have an atomic mass of 227; and these two statements are consistent with one another, since the former element is the parent of the latter by an α-particle change.

An alternative value for the atomic mass of protoactinium would be 235, since, as F. W. Aston's results show, an element of odd atomic number may have a second isotope two units greater in mass than that of the principal isotope. The value 233, however, leads to a value of 237 for the mass of that uranium isotope which is the head of the actinium series, a value consistent with assumption (*b*), whereas the value 235 leads to a value 239, which is not. Again, as the mass 227 may not be assigned to actinium, the mass 231 may not be assigned to protoactinium. If, therefore, the atomic mass of protoactinium is an odd number, that mass must be 233 if the assumptions I am making are valid. This value fixes the atomic weights of the remaining members of the series unless it can be shown that a further α-particle which has been overlooked, or a massive particle other than an α-particle, is expelled by some member of the series.

Formerly I regarded the actinium series as beginning on a uranium isotope of mass 239 or 235 and ending at a lead isotope of mass 207. This view was suggested by the fact that the transformations ionium to radium-*B*, radiothorium to thorium-*B*, and radioactinium to actinium-*B*, are all similar as regards the radiations expelled, and in that each product in these transformations has a period on the average 800 times smaller than that of its parent, and yet the average rate of decay of products of the first transformation is $7{\cdot}5 \times 10^3$ times that of the corresponding products of the second and that of the second about 40 times that of the corresponding products of the third.

I argued that as the factor $7{\cdot}5 \times 10^3$ corresponds to a difference in mass of the isotopes of 2, then its square root (of the same order as 40) corresponds to a difference in mass of 1. I concluded, therefore, that if x, $x-2$, $x-4$ represent atomic masses, and the first and second those of, say, ionium and radiothorium respectively, the atomic mass of radioactinium would be not $x-4$ but $x-3$.

This implies, I see now, that the decreasing order of stability of the masses is x, $x-2$, $x-3$, $x-4$. But if this order were x, $x-2$, $x-1$, $x-4$, as I hope to show it is, then the proper conclusion from this relation between the periods is that the atomic mass of the actinium product is $x-1$, not $x-3$. The mass of radioactinium should be therefore 229, not 227, and, in consequence, that of every actinium product should be 2 units higher than I formerly thought.

If protoactinium has an atomic mass of 233 the masses of actinium products of elements 92, 91, 90, 89, and 88 are known, and their stabilities may be compared with the corresponding products of the radium and thorium series. Two empirical relations appear to connect stability, as measured by half-value period, with mass.

I. For an element of even atomic number the masses of its α-ray and of its β-ray isotopes are in decreasing order of stability when arranged in the orders x, $x-2$, $x-1$, $x-4$, $x-3$, etc., and x, $x+2$, $x+1$, $x+4$, $x+3$, etc., respectively, x being an even number and the atomic mass of the stablest isotope.

II. For an element of odd atomic number the masses are in decreasing order of stability when arranged in the same order as the β-ray isotopes of an element of even atomic number; x the atomic mass of the principal isotope is, however, an odd number. (For all radioactive elements the isotope of mass x is an 'α-rayer'; for a comparison of its stability with that of its β-ray isotopes, however, it may be conventionally regarded as a 'β-rayer' of very long period and therefore of very great stability.)

For element 92 the decreasing order of stability is uranium I (238), actinouranium (237), uranium II (234); by rule I. it is 238, 236, 237, 234, 235. For element 91 the same order is protoactinium (233), uranium-Z (234), uranium-X_2 (234); by rule II. it is 233, 235, 234, 237, 236. For element 90 the order is thorium (232), ionium (230), radiothorium (228), radioactinium (229) for 'α-rayers'; by rule I. it is 232, 230, 231, 228, 229; for 'β-rayers' the order is thorium (232), uranium-X_1 (234), uranium-Y (233); by rule I. it is 232, 234, 233, 236. For element 89 the order is stablest isotope (227), actinium (229), mesothorium-2 (228); by rule II. it is 227, 229, 228, 231. For these four atomic numbers, then, the rules give values consistent with the known or assigned values of all the known isotopes.

A more general form of these rules holds for the isotopes of several of the inactive elements investigated by F. W. Aston. Granted that an element of even atomic number has one or more isotopes of odd mass number, then it is to be expected that (*a*) the even mass numbers may be arranged in order of decreasing stability in two series: one, in which the mass numbers increase uniformly from the mass number of the principal isotope, and the other in which the mass numbers decrease, (*b*) any odd mass number (capable of existing) when arranged with the even mass numbers in decreasing order of stability, follows the mass number one unit greater in an 'increasing' series and the mass number one unit less in a 'decreasing' series. For example, the experimental decreasing order of prevalence in Nature (here regarded as the criterion of stability) of the isotopes of selenium is 80, 78, 76, 82, 77, 74. The 'increasing' series is 80, 82, the 'decreasing' 80, 78, 76, 74, and the odd mass number follows 76, as it should according to the general form of the rule.

Again, the experimental order for the isotopes of xenon is 129, 132, 131, 134, 136, 128, 130, which is nearly consistent with the orders given by the rule: 129, 132, 131, 134, 136, and 132, 130, 128. Of the elements investigated by F. W. Aston the experimental order of decreasing stabilities of isotopes is consistent with those given by the rule for sulphur, selenium, krypton, neodymium, and lead, is nearly consistent for xenon, cadmium, and mercury, and is inconsistent for tin and the light elements magnesium and silicon.

In element 84, despite the fact that polonium has the longest period, the order of decreasing stability of the remaining isotopes is radium-A (218), thorium-A (216), actinium-A, radium-C' (214), and thorium-C' (212). By rule I. the atomic mass of actinium-A should, therefore, be 217, and this leads to a value for the atomic mass of 209 for the end-product.

In element 83 the stabilities of the three C-products may be compared first as 'α-rayers' and secondly as 'β-rayers.' According to the rules, in the former case an atomic mass of 213 or 211 is suggested for actinium-C; in the latter case a mass of 213. These values lead to values of 209 and 207 respectively for the atomic mass of the end-product.

In element 82 rule I. fixes the atomic mass of actinium-B as 211; for a mass of 213 the half-value period of actinium-B should be less instead of, as it is, slightly greater than that of radium-B; the value 211 leads to a value of the atomic mass of the end-product of 207.

Finally, in element 81 rule II. gives possible values of 209 and 207 to the atomic mass of actinium-C'', which lead to values of 209 and 207 respectively for the atomic mass of the end-product. On the whole, the application of the rules to these four elements, though not satisfactory, points to a value of the atomic mass of the end-product of the actinium series of 209 rather than 207. This is, of course, the value to be expected if protoactinium has an atomic mass of 233, and if there is no abnormal particle expelled by actinium-X or other member of the series.

A. S. RUSSELL.

Christ Church, Oxford,
Aug. 18.

On Incomplete Spawning and the Problem of Fertilisation in *O. edulis*.

DURING recent investigations on the relation of spawning in the native oyster (*O. edulis*) to external conditions, certain phenomena, which it is advisable to record early, have recently been observed.

At the end of the new moon tides at the end of July and in the beginning of August (1927), there was a fair to heavy general spawning of oysters (*O. edulis*) on the beds in the upper part of the Fal Estuary. In this general spawning it was observed that a large proportion of the spawning individuals had (apparently) failed to fertilise a large proportion of their eggs, varying in individuals from 20 per cent. to 60 per cent., with occasionally a higher proportion. The successfully fertilised eggs were found in the condition of development of 1, 2, or 3 days old embryos, while the unsegmented eggs showed at the same time great variation in size, and in many cases, but in small proportion, a variable number of nuclei to as high a number as 13. Unsegmented eggs containing many nuclei may be associated with either polyspermy, or with conditions which prevent segmentation after fertilisation, or may possibly also occur as a result of degenerative changes in the unfertilised egg.

It is a fact, however, that there has been a large wastage of oyster eggs on the Fal Estuary oyster beds at the critical spawning time in early August.

At the same time as it was found that a high percentage of eggs remained unsegmented, due apparently to not being fertilised, it was noticed that the percentage of incompletely spent female individuals had increased from an average of about 10 per cent. to 17 per cent. (in comparable samples each amounting to 700 individuals), so that eggs in considerable quantities have also been lost from an inefficient response to the spawning stimulus.

The incomplete spawning of female oysters has previously been shown to be not uncommon (*Jour. M.B.A.*, vol. 14, p. 974; 1927), and elsewhere (*Fish. Invest.*, London, vol. 6, 3 and 4; 1924) that unspent ova may either remain in the gonad to produce a 'curdled fish,' and become absorbed later, or be excreted in masses on to the shell and covered with a calcareous deposit to form what Mr. Haynes, I believe, was the first to describe as an 'excretion blister.' The large proportion of incompletely spawned females recently found among the Fal Estuary oysters is nevertheless unusual, as is illustrated by the occurrence of only 2 to 6 per cent. incompletely spent individuals in more than 7 comparable samples of 100 oysters examined at the same time from West Mersea, Essex. In one sample of 100 individuals from Thornfleet, West Mersea, however—and curiously on Aug. 2—there was the unusually high percentage for 1927 of 12 incompletely spawned. (These percentages are accumulative from the beginning of the spawning season.)

The incomplete natural spawning of female oysters can probably be explained satisfactorily as a result of normal natural causes, and is probably always relatively high in the Fal Estuary. It seems highly probable that the phenomenon is due to the occur-

rence of temperature fluctuations at about the spawning period. Thus, this year it was found that the temperature over the Upper Fal oyster beds fluctuates to an unexpected extent with the neap and spring tides; for example, on July 27 temperatures over the beds generally ranged from 62° to about 63° F., the temperature being about 62° at 8½ fathoms at about low water above Turnaware Bar. On Aug. 3 at the same station at the same depth at half ebb-tide the temperature was below 60° and less that 59° at 14 fathoms at the lower end of the oyster beds. A similar fluctuation was observed in the succeeding neaps and springs, and on Aug. 17 the remarkably low temperature of 57° was recorded in 14 fathoms at the lower end of the beds, with a corresponding reduction in temperature over the whole of the beds. It is clear, therefore, that at the spring tides relatively cold water sweeps directly into the Fal Estuary and over some parts of the oyster beds from the deeper parts of the English Channel, while during the neap tides the tidal oscillation of water is reduced and in summer weather the water becomes relatively warm. It is not possible, however, to discuss these matters and their bearing on spawning fully here.

In samples of oysters from the Fal Estuary, examined from one week to a fortnight after the abnormal spawnings were observed, individuals were found carrying normal shelled larvæ and at the same time a small proportion of much smaller and frequently abnormal shelled larvæ, the latter no doubt being the product of the fertilisation of scarcely ripe eggs; as the abnormal larvæ will probably not live, there will be additional loss of some of the eggs which were fertilised.

It would seem, therefore, that at the period of the new moon tides at the end of July in 1927 on the Fal Estuary oyster beds, there was a powerful stimulus exerted on oysters to spawn, and that a large proportion of those female oysters, which were approaching maturity, spawned either incompletely or apparently *before collecting sufficient sperm to fertilise their eggs*. Since normally segmenting embryos occurred alongside unsegmented eggs in the mantle cavity of the same individual, it is not necessary to infer that abnormal substances in the sea-water have interfered with and affected the process of fertilisation. On the other hand, the occurrence of large numbers of unsegmenting eggs in a high proportion of the spawning oysters on beds which are depleted in numbers necessarily raises the question as to whether enough male-functioning oysters exist in the locality to supply the relatively widely scattered females. It is possible that not enough sperm had been emitted by the oyster population to enable those females ripening at the end of July and in early August to collect a sufficiency to fertilise their eggs. The lack of sperm may be due either to a shortage of males or to an incorrect timing of the spawning of the males in relation to the maturing of the females.

There is, however, no means of testing these views in this or a similar occurrence until further researches show at least how and when the native oyster stores the sperm destined to fertilise its ova. Hoek, the great Dutch naturalist, found and figured in 1883 (*Tijd. Ned. Dierk. Ver*, Supp. Deel 1, Leyden) discrete sperm in the renal tubules adjoining the external genital aperture in a female oyster, but the precise situation of this functional spermatheca has not yet been defined, nor has the condition of this region been determined in a significant number of ripening females to *establish* the facts of the normal method of fertilisation in *O. edulis*. A spermatheca which should contain enough sperm to fertilise any number of eggs from half a million to a million or more, in oysters of 5 years of age or more, ought not to be difficult to demonstrate.

An additional point of interest arising out of the observations recorded above is that owing to the large number of oysters which have spawned incompletely, it is probable that there will be a slightly increased mortality, and also an unusual number of shells with excretion blisters in the form of subspherical calcareous projection containing rejected ova, as some newly formed ones have already been seen. From data which are being accumulated, evidence is being obtained that the incomplete spawning of females is a not uncommon cause of death, which will need to be considered carefully, in relation to occurrences of unusual mortality among oysters, especially when such occurs in seasons of abnormal weather.

J. H. ORTON.

Marine Biological Laboratory,
Plymouth, Aug. 21.

Published Values of the Velocity of Light.

SOME time ago, requiring a list of the determinations of the velocity of light made by different investigators, I, not unnaturally, referred to tables of this constant, some of those which were available to me being given by authorities of such high standing that their trustworthiness was, to my innocent mind, absolutely out of question.

As a result, I found myself led astray to such an extent (amounting to the withdrawal, at the eleventh hour, of a paper already set up in type and about to appear in a well-known scientific publication) that I feel it incumbent upon me to ask the hospitality of the columns of NATURE to reveal the almost incredible confusion existing in most works of reference dealing with this particular question, as a warning to the unwary about to put their trust in second-hand information, instead of referring to the original papers themselves, and at the same time to put a plea before those on high who, being busy (and human, despite their exalted state), are inclined to quote from memory, initiating thereby errors which are copied and recopied indefinitely, until they mislead the investigators themselves who have made the experiments of which they so lightly misquote the results!

The discovery took place when I noticed extraordinary discrepancies between a table of the values of the velocity of light, given by Prof. A. A. Michelson in the *Journal of the Franklin Institute* for Nov. 1924, and reproduced in NATURE for Dec. 6, 1924 (p. 831), and Table 166 of the "Recueil de constantes physiques," by Abraham and Sacerdote, an imposing volume of 753 pages in 4to, published under the auspices of the Société Française de Physique. I beg leave to reproduce here the relevant portions of these two tables (for convenience' sake I have given a number to each of the determinations):

Journal of the Franklin Institute.				"Recueil de constantes physiques."		
	Investigator.	Distance. km.	Velocity.		v (centimètres par seconde).	Auteurs.
1	Cornu	23	299,950	6	$3{\cdot}133\times10^{10}$	Fizeau, 1849.
2	Perrotin	12	299,900	7	3·004	Cornu, 1871–1874.
3	Michelson	0·6	299,895	8	2·9988	Perrotin, 1904.
4	Newcomb	6·5	299,860	9	2·980	Foucault, 1849–1862.
5	Michelson	35·4	299,820	10	2·9994	Michelson et Newcomb, 1885.
				11	2·9989	Michelson, 1902.

In order to dispel my perplexity, I had recourse to the original communications, memoirs, papers, etc., and to my amazement I found that of these 11 determinations, *only one* appears to be correctly quoted, or, at any rate, is in accordance with the original contributions!

(1) Cornu's value is 300,400. The value 299,950 is evidently the result of a later discussion of Cornu's own results. Apart from the fact that it appears questionable to quote as the result obtained by an investigator, a value to which he himself emphatically objected (*Rapports présentés au Congrès International de Physique*, 1900, vol. 2, p. 228), the value given is different from that given by Helmert (*Astronomische Nachrichten*, vol. 87, 1876–1878, p. 123) and from that of Listing as quoted everywhere else by Newcomb (*Astronomical Papers for the American Ephemeris and Nautical Almanac*, vol. 2, Pt. iii.), by Michelson himself (*Decennial Publications of the University of Chicago*, vol. 9, 1902, and *Phil. Mag.*, 6th series, vol. 3, p. 334), and by others, namely, 299,990. I have not yet been able to find Listing's original paper and cannot offer any reason for the discrepancy.

(2) The distance given is that between the Nice Observatory and La Gaude, determinations over which gave 300,032. The value given (299,900) was obtained between the observatory and Mont Vinaigre, a distance of 45,950·7 metres, not 12 km. (*Annales de l'Observatoire de Nice*, vol. 11, 1908).

(3) This value does not agree with any other value given in any contribution by Prof. Michelson, the existence of which I have been able to ascertain. It corresponds closely to (11) (see below).

(4) The distance is wrong: this particular value was obtained between Fort Meyer and the Washington Monument, a distance of 3721·2 metres, not 6·5 km. (*loc. cit.*).

(5) This value was correct at the time of publication. It has been since reduced to 299,802 (*Astroph. Jour.*, vol. 65, 1927, p. 2).

(6) Fizeau's result (for air) was given as 70,948 leagues of 25 to the degree. The "Nouveau Larousse Illustré," the standard French encyclopædia, gives 4444 metres for the value of the "lieue de 25 au degré." This gives 315,300 nearly (*Comptes rendus*, vol. 29, 1849, p. 90).

(7) Cornu's determination, as given, was obtained between Sept. 3 and 27, 1874. That obtained in 1871–1872, namely, 298,500, was altogether rejected (*Annales de l'Observatoire de Paris*, vol. 13, 1876).

(8) Perrotin's experiments giving this figure were made in 1902, not in 1904. It is only a preliminary result; the final value was 2·9990 (*Annales de l'Observatoire de Nice*, vol. 11, 1908).

(9) Foucault made no determination of the absolute velocity of light in 1849; all the work was done in the summer, 1862 (*Comptes rendus*, vol. 55, 1862, p. 501).

(10) With the exception that Newcomb did not co-operate in these experiments, that they were performed in 1879, and that the result was 299,910, the data given are correct (*Astronomical Papers for the American Ephemeris and Nautical Almanac*, vol. 2, Pt. iv.)!

(11) No determination appears to have been made by Michelson in 1902. The value 299,890 was adopted by him in a paper published that year, as representing the best value up to that time, and is the average of several determinations by Cornu (discussed by Listing), Newcomb, and Michelson (*Decennial Pub. Univ. Chicago*, 1902, and *Phil. Mag.*, 6th series, vol. 3, p. 334).

Nor is this all the tale: Newcomb (*loc. cit.*) states that Cornu's first experiments were made in 1874, and his final ones in 1878, and this is repeated by Michelson, by Preston ("The Theory of Light"), and by Cornu himself (*Rapports présentés au Congrès International de Physique*, vol. 2, p. 227). Here is a physicist misled into giving a year four years in error for the time of his own experiments!

Finally, Michelson gives, as having been *obtained* in 1925 (*Astroph. Jour.*, vol. 65, 1907, p. 12, first line of the first table), a result, namely, 299,802, which had already been *published* in 1924 (*loc. cit.* vol. 60, 1924, p. 256).

I shall not trouble readers of NATURE with the misprints which only offered a temporary check.

Some may think that I have been too exacting in respect of dates as they seem immaterial in the determination of a constant. Let it be remembered that a velocity involves the use of a unit of time, and that so long as this unit is provided by the rotation of the terrestrial globe, it is apt to vary, and this variation cannot be ignored in measurements involving an incredibly small fraction of a second of time (one fifteen millionth in the case of Foucault). In few cases only is the actual date given in the original contributions from the investigators; the average time of the year has often to be guessed.

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Prof. Lewis's 'Light Corpuscles.'

IN order to maintain his theory of light corpuscles (see NATURE, Feb. 13, 1926), Prof. G. N. Lewis has had to suppose that the absorption of a quantum, as an event, has a certain control over the emission of that quantum. This is repugnant to common sense, and remains so even when qualified in the way Prof. Lewis has been able to do.

To overcome this the following suggestion may be made. When two events are causally related, as, for example, the emission and absorption of a photon, it will depend upon certain conditions whether we can say that they are in causal contact; whether the interval between them is zero.

When, on investigation, it is found that the two events are the only two concerned in the relation, then we must suppose that they are in causal contact; this is what is supposed to happen when light is transmitted *in vacuo*. But when on analysis it is found that there are other events concerned, then it is by no means necessary that the two events first mentioned should be in direct causal contact. Thus it may be that the events can be arranged in series by their extensional relations, with the two original events as ends or termini; and in this case, even though each event may be in contact with the next in the series, the two ends will not be so related: and, what is more, their mutual relations will depend upon the intervening events.

This simple suggestion will easily account for the observed diminution in the velocity of light in a refracting medium, and we may hope for an intelligible explanation of the diffraction effects of a lens system. Thus the absorption-event at the photographic plate is not directly related with the emission-event at the distant star, nor is the interval between them zero; they are connected via the chain of events occurring within the lens system of the telescope, and these latter will presumably have an effect on the final absorption event, producing in fact the diffraction pattern that is observed.

At first sight this idea upsets the simple reversibility of the process, but not, I think, if we confine the postulated reversibility to pairs of events actually in causal contact; in any case it is more intelligible and more in accordance with the historical development of physics than the one it has been designed to replace or supplement.

WILLIAM BAND.

Physics Department,
University of Liverpool,
Aug. 18.

Penetration of Radio Waves.

IN a recent letter to NATURE (July 2) by two of the present writers, it was pointed out that information was lacking as to the extent to which radio waves could penetrate the earth. By the courtesy of Mr. J. H. Clark, Mr. H. K. Lidstone, and other officials of the famous Caribou Mine, Colorado, an opportunity was offered on Aug. 17 to make some satisfactory tests on this point.

Mr. Guy L. Allen, of Boulder, used a nine-valve (or tube) super-heterodyne Victoreen set which he had built himself, and with which he had heard Buenos Ayres, Madrid, Lima, and London. At a depth of 220 feet below the surface, and in a cross cut clear of wire, rails, and pipes, he readily detected K F E L Denver (248 metres), and the concert was well heard from the loud speaker by all present. On proceeding to a depth of 550 feet, carrier-waves were detected, yet no clear reception was possible in the morning. But in the evening at 9.20 the party returned to the 550-foot level, and at the end of a tortuous passage 80 feet distant from all wires and pipes, speech, music, and song from K O A Denver (326 metres) was heard from the loud speaker about as clearly as on the surface earlier in the evening. In both cases the reception was by loop, and in both cases maximum intensity was obtained when the loop pointed within a few degrees of Denver, about fifty miles away.

Previous experiments at the tunnel at Montreal, Canada, had shown that 40 metre waves were weak in penetrating power; that broadcasting waves were more efficient, while longer waves of 10,000 metres surpassed both.

Details of this experiment will be published in due course in a report of the Bureau of Mines.

A. S. EVE.
D. A. KEYS.
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Bureau of Mines,
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Pyrex as a Container for Radium Solution.[1]

SOME readers of NATURE may be interested to know that Pyrex glass is not suitable as a container for a solution of radium salt. About two and a half years ago, I dissolved salt containing 150 milligrams of radium and put it into a Pyrex bulb connected with a Toepler pump for removing the radon. Three months ago, when examining the bulb, I found it to be cracked in almost every conceivable direction. The bulb seemed airtight still, but the solution was immediately removed to a soft glass bulb for safety. On closer examination it was found that the cracks started from the inner surface of the bulb. Some had penetrated only slightly, and others were nearly or completely through to the outer surface. None extended below the level of the solution. They only appeared where the radon could be expected to collect in quantity in the evacuated region just above the solution. This indicates clearly that the cracks are caused by the bombardment of the inner surface by α-rays. How this starts a crack, and causes it to continue only so far as the bombardment by the α-particles extends, is not readily understood. This difficulty is not confined to a bulb containing solution, for I have also observed that Pyrex tubes used to store purified radon behave in a similar manner. It has been known for some years that quartz is affected similarly, a fact discovered, I believe, by Madame Curie. The accompanying photograph of the bulb (Fig. 1) shows many of the larger cracks.

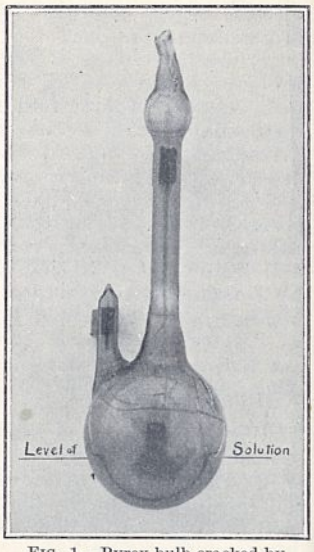

FIG. 1.—Pyrex bulb cracked by α-ray bombardment.

L. F. CURTISS.

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The Expert in the Civil Service.

MEMBERS of the professional, scientific, and technical classes in the Civil Service will welcome the leading article on "The Expert in the Civil Service" in the issue of NATURE of Aug. 27. The proposal for the appointment of a Royal Commission to examine and report on the present position of the professional worker in State service has the full support of the Institution of Professional Civil Servants, a body representative of the above classes. Indeed, since its inception in 1919, the Institution has been striving to obtain an official inquiry into the conditions governing the employment of its members in the Civil Service. The Institution is convinced that the improvement of the status of professional workers in the Service—the necessary precedent to fuller economic recognition—and freer access to administrative posts, will only be obtained by such an inquiry as is advocated. An impartial inquiry into the position of the professional and scientific classes in State employment is absolutely essential if the efficiency and well-being of the Service under modern conditions are to be maintained. The Council of the Institution reiterated last year its policy of pressing for a public inquiry, and welcomes the influential support of NATURE in the steps that will be necessary to bring to pass this long-desired event, which is of such importance in the interests of both the State and the professional worker.

F. A. A. MENZLER.
(Honorary Secretary.)

The Institution of Professional Civil Servants,
69 Victoria Street, London, S.W.1,
Aug. 29.

[1] Publication authorised by the Director of the National Bureau of Standards of the U.S. Department of Commerce.

Some Problems of Polar Geography.[1]

By Dr. R. N. RUDMOSE BROWN.

THE TASKS OF EXPLORATION.

THE existence of an Antarctic continent is still based on circumstantial evidence, and until more than some 5000 miles of its coastline, or only about 35 per cent. of the total length, are known, direct evidence of Antarctica will be lacking. It is not a little remarkable that all the exploration of the twentieth century has merely modified the probable outline of that continent as it was predicted by Sir John Murray in 1886. He had little but the reports of Ross, d'Urville, Wilkes, a few sealers, and the *Challenger* to go on, and, mainly on circumstantial evidence, he built his Antarctic continent. The one considerable change in that map has been the curtailment of the Weddell Sea and the removal of its southern extremity some four degrees north of Murray's position in lat. 82° S.

Most of the Antarctic 'lands,' and certainly nearly all those that may be classed as key positions to the coastline of Antarctica, date from last century, some of them from a hundred years ago. Coats Land, Wilhelm Land, and Oates Land are among the few exceptions. Enderby Land, the one certain or nearly certain land in more than 3000 miles of hypothetical coastline, has never been seen or seriously searched for since Biscoe found it in 1831. It should be the base of an expedition that is prepared to work westwards. Heavy ice congestion so far found by all vessels that have tried to push south between Enderby Land and Coats Land, suggests that this stretch of coastline will have to be put in by sledge journeys along the edge of the ice cap. The western shores of the Weddell Sea are another ice-girt region which no ship has been able to penetrate, a region of dangerous ice pressure. Here, too, the advance must be by land journey, but it should be relatively simple, since accessible bases are known in Oscar Land and adjoining parts of Graham Land. Lastly, there is the great gap south of the Pacific between Charcot and Edward Lands, which leaves ample scope for an attack from both ends. A minor problem in the outline of Antarctica for an expedition based on Edward Land is the determination of the eastern side of the Ross Sea and the elucidation of Amundsen's sighting of land to the south of Edward Land, the appearance of land which he called Carmen Land.

Even more important, however, than the discovery of the 'missing' stretches of the Antarctic coastline is the explanation of the structure of the continent and its former connexions with other lands of the southern hemisphere.

Graham Land and Victoria Land are both regions of lofty mountain ranges, but apparently of contrasted structure and diverse origin. The ranges of Graham Land, often called the Antarctic Andes, in stratigraphy and structure as well as in their eruptive rocks, bear so close a resemblance to the Cordilleras of South America that there can be no reasonable doubt that they were at one time connected and are in fact disunited parts of the same foldings. Nor does it appear doubtful, any longer, that the line of former continuity can be traced by a submerged ridge on which stand relics of the chain: in the South Orkneys, the volcanic South Sandwich Group and South Georgia, extending in a great arc between Trinity Land and Tierra del Fuego and sweeping well to the east of Drake Strait. There is no doubt of this line of connexion, but we are still uncertain if South Georgia, and even more so, if the Falklands are really fragments of the arc or relics of a lost South Atlantic Land.

The Antarctic Andes, or Southern Antilles, have been traced south-eastward but lost sight of at Alexander Island and Charcot Land, which in all probability are parts of the same formation. The great problem of the Antarctic is what happens to these ranges. On the opposite, or New Zealand, side of the Antarctic, the great fault ranges of Victoria Land show little if any resemblance in structure and origin to the Antarctic Andes. A great horst capped with horizontal layers of sandstone, probably of Permo-Carboniferous age, is associated with much evidence of volcanic activity, and seems to rise from a great peneplain of crystalline rocks which underlie the whole of that side of the Antarctic ice-sheet.

The structure of the Victoria Land edge of the Ross Sea is reminiscent of Tasmania and eastern Australia, and the suggestion of former continuity across the Southern Ocean receives further support from our knowledge of submarine relief between Antarctica and Australia.

The relationships between Antarctica and South Africa are still very obscure, since the African quadrant of the Antarctic, both by land and by sea, remains one of the least explored parts.

One suggestion is that the horst of Victoria Land is continuous with the Antarctic Andes. Certainly the direction of the Maud Mountains to the south of the Ross Sea supports this view, and evidence of great faults bounding the Andes may show that those ranges after all are not entirely different in nature from the ranges of Victoria Land. A second suggestion is that the Antarctic Andes reappear in the Ross Sea in the old crystalline rocks of King Edward Land—which as yet are but little known—and that these were once continuous with the folds of New Zealand. If this be true, the ranges of Victoria Land and the Maud Mountains probably swing across to Coats Land and may cause those vague shadowy shapes that a few of us who have seen Coats Land believe to exist in its far interior. Nothing is known at first hand of the structure of Coats Land, but rock fragments dredged in the Weddell Sea, and presumably

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

derived from Coats Land, suggest a closer relation with Victoria than with Graham Land.

In any case, it looks probable that our knowledge of Antarctica confirms the growing belief that the Pacific basin is girdled by a ring of fold mountains marking the course of a system of geosynclines. The remains of the borderlands of this Pacific geosyncline may possibly be found in small islands in that mysterious ice-bound region to the north of Edward Land which no ship has been able to penetrate.

Much has yet to be done in explaining the peculiar Antarctic blizzards which rank among the fiercest winds on the face of the globe. Dr. G. C. Simpson has given an explanation of these in the Ross Sea, but are the blizzards of Wilkes and Coats Lands, which occur under different topographical conditions, amenable to the same explanation, or has Prof. W. H. Hobbs found the solution in his theory of strophic winds associated with glacial anticyclones, a theory which he applies also to Greenland, where he is at present investigating it ?

A further important meteorological problem, with strong geographical bearings, is the alimentation of the ice-sheet. We know that it is wasting by the calving of icebergs, by surface ablation, and other processes, and that it has shrunk considerably since its Pleistocene maximum, but we are at a loss to explain satisfactorily how the precipitation in the heart of an anticyclone can ever have been sufficient to allow such an ice-sheet to grow. There is every reason to believe that during the great Ice Age, ice-sheets did not develop over the Arctic islands of Canada or over most of Siberia. The temperatures were low, but moisture was insufficient. Yet in the southern hemisphere the ice grew in the heart of a vast high-pressure area.

Still another problem is that of oscillation of climate as expressed by varying amounts of sea-ice and variations in the intensity of currents. R. C. Mossman and others have shown that there is a correlation between certain Antarctic records and those from places in the northern hemisphere. There seems to be every likelihood that before long general weather forecasts of real value will be possible for some months ahead. At Buenos Aires, for example, the high correlation coefficient of +0·88 is reached when the summer rainfall there is correlated with the temperature of the South Orkneys for the winter that began three and a half years earlier. In fact, statistical correlation indicates that a very cold winter at the South Orkneys will be followed after an interval of three and a half years by a drought over the Argentine cereal belt ; a very mild winter, after the same interval of time, by bountiful rains.

Lastly, there is great need of oceanographical work in high southern latitudes. This branch of research has been overlooked by most expeditions in their hurry to reach their southern bases. The employment of echo-sounding should, however, make it both easier and more accurate.

No pioneer problems of equal magnitude await the explorer in north polar regions. There is small likelihood that any new land of importance remains to be discovered. There is certainly no ' polar continent.' However, there are gaps to be filled. Nicholas Land, found by the Russians to the north of the Taimir peninsula in 1913, has still to be investigated. Its full extent and its relation to other Arctic islands are unknown. North-west of it the Arctic Ocean has never been penetrated except by the drifting *St. Anna* in 1912–14. We hope that Russian investigators of the coast of Siberia will include Nicholas Land within their scope of work.

Another problem of importance and far-reaching influence is the mysterious fluctuation in the extent of Arctic sea-ice. The fluctuations appear to be cyclic rather than progressive, but so far defy satisfactory explanation. Dr. C. E. P. Brooks has recently pointed out the influence of the amount of ice in the Labrador and East Greenland currents on pressure distribution and consequent amount of precipitation in the British Isles. Here at least is one direct link between the Arctic and the most important factor in our climate. But until we know more about Arctic climatic conditions and the distribution of ice in the Arctic basin, we are not likely to find the cause of these fluctuations.

Facts so far available point to a rotary surface movement with overflows from an overcharged Arctic basin, by the Greenland Sea and other less important outlets. This movement may account for the tendency of ice-bound vessels in the Arctic basin to take a peripheral drift. It may also explain the relatively smooth and unrafted ice reported from the vicinity of the Pole. Again, the heavy ice to the north of Greenland may be due simply to the heaping and rafting against the land of the pack that has been swept past the overflow of the East Greenland current. It cannot, however, be said that this circulation is proved.

Fluctuations in the amount of ice in the overflow currents may well be due to variations in the strength of these currents. These variations may be associated with departures from the normal in the amount of water poured into the Arctic basin from the great Siberian and American rivers, which in its turn depends on causes far removed from Arctic regions. The complexity of the problem is almost baffling, but even before the chain of cause and effect is traced, useful work could be done in looking for correlations.

Methods of Exploration.

In recent years the aeroplane has appeared in the Arctic, and Amundsen and Nobile have used the airship. It was inevitable that aviation should be tried in high latitudes, if for no other reason than its spectacular daring, but so far its success has not been marked. That, however, does not necessarily imply that aviation is never to be a serious help in polar exploration. Amundsen's flight in the *Norge* gave a probable confirmation of what had already been deduced from indirect evidence. He found no land where none was expected. He saw nothing but ice-covered sea. Moreover, a rapid flight over snow-covered land, even if the eye could distinguish that surface from ice-covered sea, would tell little

of importance. Byrd's flight to the Pole and back was of even less value to exploration, for on his track there was no possibility of land. The kind of exploration that is now required entails patient observation and accurate measurement. A quick-moving machine cannot help in this, and there is always the probability of mist to hamper the value and imperil the success of aviation in the polar summer. Amundsen himself admits that owing to "a tremendous sea of fog, in some places of extraordinary density" in the Beaufort Sea, he may have passed over islands of low altitude without seeing them. So that on the only part of its course where land can possibly exist, the flight of the *Norge* has left us where we were, and the field is clear for the next explorer.

Even for reconnaissance the aeroplane has doubtful value. So much depends on ground organisation, which never can be perfect in polar regions, and there is the even greater difficulty of satisfactory landing-places. In one respect, however, the aeroplane can be successfully used in polar work, that is in aerial survey of difficult country that lies within reach of a base accessible by sea transport and provided with a good landing-place. In the Antarctic, where I have pointed out the pioneer explorer still has ample scope, long-distance flights may be of some value. The ice-cap offers the prospect of better landing than the pack-ice. Yet in view of its great expanse there is even less chance of retreating on foot after a forced descent.

Settlement of Polar Lands.

During recent years, territorial claims have been made to all parts of Arctic regions that were not formerly subject to sovereignty, and even in the Antarctic great dependencies have appeared. This is an expression of the growing belief that polar regions are not merely desert wastes but have some economic resources of value to man.

There is no reason to suppose that the domestication of reindeer, starting with Siberian stock and gradually introducing the American caribou, will be anything but successful in most parts of the Canadian tundra, in the rich pasture lands of western Greenland, and the more restricted areas of Spitsbergen. All these regions have supported vast numbers of reindeer in the past, and should do so again if excessive hunting is curbed, wise game laws instituted, and the wolf exterminated, as Canada is endeavouring to do.

Alaska is said to have pasturage for 4,000,000 reindeer. Basing his estimate on this figure, Stefansson calculates that the Arctic tundras as a whole are capable of supporting about 100,000,000 reindeer and perhaps five times as many musk-ox. This is probably an over-sanguine estimate, for it must be remembered that the Alaskan herds are mainly in the more fertile valleys of the south and south-west, which have few, if any, equals in fertility in the tundras farther north; but even if we reduce the numbers considerably, say by so much as 50 per cent., there remains a possible food production from the waste Arctic lands equivalent to some 1,000,000,000 sheep, or more than ten times the total number of sheep that Australia now supports.

This would, of course, take many years to accomplish, and naturally will not occur until the temperate lands of the world are more fully occupied than at present. But gradually as world population multiplies and food production has to be increased, the lands that are not fit for cereal growth will command attention by their possibilities for pasturage. It is a geographical axiom that the herder must always give way to the tiller of the soil with his more intensive occupation. With the extension of dry farming, there seems little likelihood of any considerable areas of temperate lands in the long run being left to pastoral pursuits. But the Arctic tundras are entirely unsuited for agriculture by unfitness of soil and shortness of summer for ripening the grain. Their advantage as pasture land is that the farmer can never displace the herdsman. As the world's supply of beef decreases, the supply of venison and musk-ox flesh will come more into demand.

Up to the present, the tide of human migration has flowed and ebbed on Arctic shores and has been mainly a seasonal movement, marked even in the permanent residents by a great degree of nomadism. But eventually the tide of white settlement will definitely set northward, even to the Arctic seas, and in its flood destroy the present inhabitants.

It is no more presumptuous to forecast a scattered population of reindeer and musk-ox farmers in the 'barren lands' of Arctic Canada, the tundras of Siberia, and even in Greenland and Spitsbergen too, a hundred years hence, than it was a hundred years ago to suggest sheep farmers in the plains of Australia or wheat fields in the Peace Valley of Canada. Every land beyond the frontiers of settlement has been a 'never-never land' to unadventurous and unimaginative folk living in sheltered homes. But in most cases the prediction has been falsified.

The problem is one of considerable importance in the future of human settlement for two reasons. First, because there is no real evidence that the white races are suited for the tropics; that is to say, for permanent racial transference as apart from visits. All the evidence that is conclusive points the other way and suggests that only by a slow process of natural selection can the white races ever find a sure footing in the tropics. Long before that is achieved, the coloured races will have effectively occupied the warm lands. This means that the white races must turn, as in effect they have been turning for several centuries, polewards in their search for new homes. Secondly, the possibility of polar settlements affects, as I have tried to show, the future food production of vast areas which at present enter little into the economic life of the crowded populations of food-importing communities.

The only example of real Arctic colonisation that exists is that of the old Norse colonies in south-western Greenland founded in the tenth century. At their height the two colonies must have contained between 2000 and 3000 people, men, women,

and children, scattered in about 280 farms, where they kept cattle, goats, sheep, and horses, perhaps raised a few poor crops of little account, and hunted bears, reindeer, and seals. There is no need to recall the history of these settlements, how trade with Europe gradually ceased and how the Norsemen had entirely disappeared when late in the sixteenth century communications with Greenland were reopened.

Recent Danish researches at Herjolfsnes, near Cape Farewell, have discredited the old belief that the colonies disappeared either by Eskimo extermination or by fusion with the Eskimo races. It now seems clear, at least as regards Oesterbygd, that the Norse race maintained its racial purity and did not 'go native'. The general reluctance of the Nordic races to mix with widely divergent stock was as noticeable then as it has been in later centuries. Examination of skeletons in the churchyard of Herjolfsnes reveals the interesting facts that while clothes and ornaments, in graves of the fifteenth century, show little trace of Eskimo influence, the skeletons all show signs of rickets or other malformations and stunted growth, but no sign of racial mixture with the Eskimo. There is also a very high proportion of remains of infants and young people. Evidently, therefore, the Norse colonies, at least Oesterbygd, perished by exhaustion. Even if the climate were changing for the worst during the existence of these colonies—and such a change is by no means proved—there is no reason to suppose that the habitual meat diet failed. The cessation of communications with Europe cannot have affected the diet of the colonists to any great extent. The *King's Mirror*, describing conditions when the colonies were prosperous, notes that most of the settlers did not know what bread was. And what else could they get from Europe to vary their meat diet?

The conclusion is, therefore, that the Norse colonists in Greenland died out for want of new blood, or, in other words, that they were not acclimatised to their Arctic home. From this it might be argued that even the Nordics can never colonise the Arctic. Certainly no other race from temperate climates is likely to try, since the Nordics alone show that distaste for gregariousness and that capacity for enduring solitude which are essential qualities for the task. We may even grant them a greater measure of physical enterprise and love of wandering than other people.

The Greenland experiment is not, however, a sure criterion of Nordic unsuitability for the Arctic. The pastoral settlement, which is suggested, will be a slow colonisation, in which natural selection will have some say. Those suited will remain, others will move away or perish. But the colonists will not be cut off from the world: they will be in close touch with it. New blood will continually flow in their veins, so that the unchecked course of natural selection which operated in the old isolated Norse colonies and killed out the more nervous and imaginative type, a type that is least adapted to the Arctic, will not have free play. There is no reason why the race should become impoverished by the elimination of its most progressive element. Even though a diet solely of meat has proved wholesome enough in the case of Eskimo and some explorers, it will not be necessary for the Arctic colonists to subsist on it entirely: transport facilities will bring every variety of food to their doors. If the Norsemen suffered from insufficiency of certain ingredients in their diet, a similar fate will not be the lot of the colonists of the future. If they died out by lack of new blood and continual inbreeding, the Arctic settlers of the future will be able to avoid that disaster.

Such is the legitimate forecast, as I see it, of the *outer* rim of the Arctic of the future with its prosperous, though scattered, colonists of pastoral interests, and its fur farms here and there supplying high-priced Arctic furs in limited numbers. But the settlement must wait until the pressure of population on the world's resources is even greater than it is to-day. The remoter parts, those without rich tundra and the ice-covered seas and lands, must remain deserts, visited only by roving hunters and occasional explorers. In short, I see a shrinking of the Arctic wildernesses, but never their disappearance.

The Structure of Silicates.[1]

By Prof. W. L. Bragg, F.R.S.

At a time when the fundamental conceptions of the structure of matter are being changed so rapidly, when every six months witnesses the birth of a new analytical method of dealing with the very foundations of our physical science, the study of the crystal patterns of silicates must seem a trivial matter. Yet similar studies have played their part in the extraordinary development of physics in the last decade, and I hope that the refinement of our methods of analysis, such as is represented by the present examples, will in turn prove to be of use.

The results of the particular investigations which I propose to describe are interesting in themselves because the silicates form so large a proportion of the earth's solid crust, and certain artificial forms are so largely used for technical purposes. I think, however, that it is right to stress another aspect of this study. We are trying to improve the technique of the X-ray examination of solid bodies, to increase the resolving power of our instruments so that we can see finer detail and deal with more complicated structures. It is at present a tedious and difficult task to discover how the atoms are arranged in these bodies; even when some experience in handling them has been obtained, one has to devote much time and concentration to each particular case. Yet every solution makes the next problem easier to attack, and when we look

[1] Discourse delivered at the Royal Institution on Friday, May 20.

back on the last few years' progress, I think a very real increase in power of analysis is evident as the result of the efforts of many workers in this field.

It is this advancement of technique in which, personally, I am particularly interested. In trying to improve our instrument we examine with it from time to time a new type of solid body—these silicates being an example—and we describe what we see. I am not competent to discuss the discoveries we make; I can only hope that the casting of light at a new angle may be useful to those who have made a life-long study of these particular types of compound. I feel that my main contribution must be a demonstration of what knowledge it is possible to attain by careful X-ray examination.

The silicates present a highly interesting series of problems for X-ray analysis. The numerous crystalline forms have been carefully studied because of their importance to the mineralogist, and they show most interesting relationships and wide variation in composition. It is estimated that oxygen, silicon, aluminium, and iron by themselves compose about 87 per cent. of the earth's crust, and if we add four other elements, calcium, sodium, potassium, and magnesium, they amount together to 98 per cent. These are the elements that build up the compounds we are considering, and their relative proportions are a reflection of the fact that most of the earth's crust is composed of compounds of metals with silicon and oxygen.

The silicates occur as solid bodies, the atoms of which are arranged in crystalline patterns. These patterns are often very complex, and it would be difficult to attack them by general methods unless some guiding line could be followed through the intricate maze. Such a guiding line may perhaps be found in the peculiar part which the oxygen atoms play in building up the structure. Not only are the oxygen atoms the most numerous, but also they appear to be the most bulky of the units of which the pattern is woven, so that their predominant size and number make them force the other atoms to conform to certain simple and characteristic arrangements of oxygen atoms which we find occurring again and again as an underlying *motif*, throughout the range of such silicates as have yet been analysed. A few simple examples may help to illustrate this point.

Four spheres, packed together as tightly as possible, assume a tetrahedral arrangement with one sphere standing on three others (Fig. 1*a*). Six spheres when packed together take up a form where three of them lie on top of three others (Fig. 1*b*). Alternatively we may regard this arrangement as four spheres at corners of a square, with one above and one below this square (Fig. 1*c*), the second arrangement being identical with the first regarded from a different view point.

These very simple groupings of oxygen atoms, with an atom of some other element at the centre of the group, occur again and again in the silicates and in many other compounds. In many cases the group not only has a characteristic shape, but also a characteristic size, the distance between the oxygen atoms having a value of about 2·5 Å.U. to 2·7 Å.U. In the list of common elements given above it is only sodium, calcium, and potassium which appear to break up the regularity of this group, and to force the oxygen atoms apart if placed at the group centre. The other elements appear to fit comfortably into the interstices of the oxygen grouping. Since there is a common distance throughout between oxygen atoms, certain atoms of one group can at the same time form part of the next group, and so a continuous structure is built up which may be thought of as a pattern of oxygen atoms with the metal and silicon atoms in its interstices.

This predominance of the oxygen atoms greatly simplifies the analysis of the structures, and makes it easier to visualise the relationships between different types. All these bodies build up a crystalline pattern repeated again and again to space. Now the simplest types of pattern are those such as children are taught to make, when blocks of the same shape and size, but coloured differently, can be stacked together in geometrical designs. The silicates present rather a fascinating analogy to these kindergarten patterns, the oxygen atoms being the blocks and the other atoms the colouring agent. It is as if a complex pattern were embroidered by the other atoms upon a simple underlying fabric of oxygen atoms.

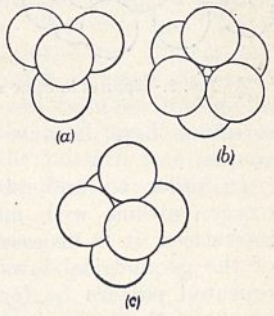

FIG. 1.—Groups of four, and of six, oxygen atoms. Such groups, with atoms of silicon or one of the metals at the centre, are repeated indefinitely in the silicate structure.

The two types of group, four-fold and six-fold, illustrated in Fig. 1 are composed of oxygen atoms equidistant from their neighbours. We have seen that they may be regarded as spheres compressed into the smallest possible space. Such an arrangement can be continued indefinitely, and if it is done regularly one or other of two characteristic groupings of spheres is the result. These are the well-known forms of cubic and hexagonal close-packing.

This close-packing of the oxygen atoms is a very simple arrangement, and it is interesting to find that a number of silicates are based on it. Its existence in a silicate can be surmised by noting how much volume there is to each oxygen atom in the whole structure. If the oxygen atoms are packed together closely, with 2·7 Å.U. between their centres, it is easy to calculate that each atom occupies a minimum volume of 14 (Å.U.^{3}). (If magnesium and iron are present, they expand this volume slightly by an amount for which allowance can be made.) Further, the refractive index, if ideal close-packing exists, must not be less than 1·7, as the oxygen atoms have a high refractivity.

Using these tests, it appears probable that certain compounds are based on one of the forms of close-packing, and we have examined some of these cases. The close-packing of the oxygen atoms is, however, exceptional, and although in most compounds the

fourfold and sixfold groups form the basis of the pattern, this pattern may be of an open type. The various forms of silica, to the investigation of which the Royal Institution has made so large a contribution, are beautiful examples of open patterns built of the four-fold groups, and other examples of these lace-work open patterns have been analysed. The closely woven patterns have been chosen for description here because their basis is the more simple.

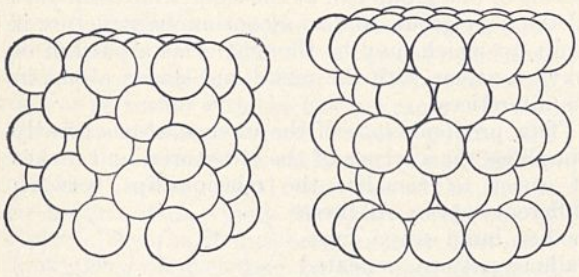

FIG. 2.—Spheres in cubic and hexagonal closest-packing.

In order to understand these frameworks of oxygen atoms, with metal atoms packed in the interstices, it is necessary to bear in mind some of the geometrical laws of pattern-making. If a repeated pattern be formed by stacking together blocks of the same size and shape, but different in colour, the unit of the pattern will be composed of a whole number of blocks. It is always possible to outline the pattern with a series of unit cells, each of which just contains one complete example of the pattern and no more. The unit cell may be a large and distorted one if the pattern is complex, but it must always obey one condition. If one corner is placed at the centre of a block, all the other corners will also be at centres. The crystals which are based on one of the close-packed arrangements of oxygen atoms must have a unit cell related to the close-packed arrangement in this way.

Disthene or cyanite, Al_2SiO_5, is an example of such a crystal. Its unit cell could not well be more irregular. Its edges, and the angles between them, are all unequal, as shown in Fig. 3.

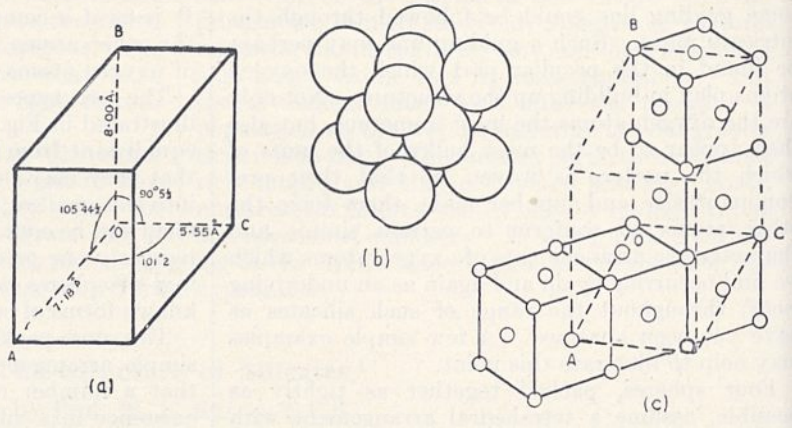

FIG. 3.—(*a*) shows the unit cell of disthene; (*b*) is a portion of the array of spheres in cubic close-packing; (*c*) shows to the same scale a more extended portion of this array, the centres of the spheres alone being indicated. The unit cell of disthene is also a unit cell (containing twenty points) of the cubic lattice; this is proved by the way in which OA, OB, OC correspond in length and direction in (*a*) and (*c*).

Yet its high refractive index (1·72) and small volume per oxygen atom (15·0 Å.U.^{3}) hint that the oxygen atoms are in one of the forms of close-packing. An X-ray examination has proved this to be the case. The packing turns out to be of the cubic type, and the way the disthene cell and the cubically arranged oxygen atoms 'fit together' is shown in Fig. 3. The cell of disthene contains twenty oxygen atoms, and the cell outlined in the right-hand figure contains exactly twenty close-packed spheres. This very complex pattern of disthene has to be woven into a basis of twenty oxygen atoms, since a multiple of five is demanded by the chemical formula. The irregular disthene cell is the way chosen by Nature of blocking out suitable groups of twenty oxygen atoms from the very simple cubic structure.

When the scattering of X-rays by the crystal is examined, the close-packed arrangement of oxygen atoms shows up strongly. We can consider the effect on the X-rays as composed of that due to the oxygen atoms on one hand, combined with that due to the atoms of metal and silicon on the other hand. The former leads to a simple and intense diffraction pattern, to be expected from a straightforward cubic face-centred lattice. The aluminium and silicon atoms, which form a complex embroidery on a large scale woven into the oxygens, give a complex diffraction pattern within that due to the oxygen atoms alone. Fig. 4 illustrates the point.

The complex inner pattern contains the information necessary to tell us where the aluminium and silicon atoms are. It is a difficult matter to unravel its story, but it is by no means so formidable as it would have been had we not known that the oxygen atoms are nearly in this simple arrangement, and that the aluminium and silicon atoms are somewhere within the four-fold or six-fold groups of oxygen atoms.

As another example of this pattern-weaving, the series of compounds Mg_2SiO_4, MgO_2H_2 $(Mg_2SiO_4)_2$, MgO_2H_2 $(Mg_2SiO_4)_2$, MgO_2H_2 $(Mg_2SiO_4)_4$ may be examined. The dimensional relationships between these crystals (the chondrodite series) have long aroused interest. If we measure the unit cells of the compounds we find that two axes, outlining one face, remain constant throughout all four crystals. The thickness of the cell measured perpendicularly to this face increases in regular steps in the last three compounds, as if blocks of magnesium silicate were being added on in a regular way. With the aid of X-rays this process can be followed out in detail, and some finer points of it are not without interest. All the compounds prove to be based on hexagonal close-packing, and with

the aid of this guiding feature, Mr. West and Mr. Taylor, who have been working on these crystals in my laboratory, have, in my opinion, succeeded in elucidating the approximate positions of all the

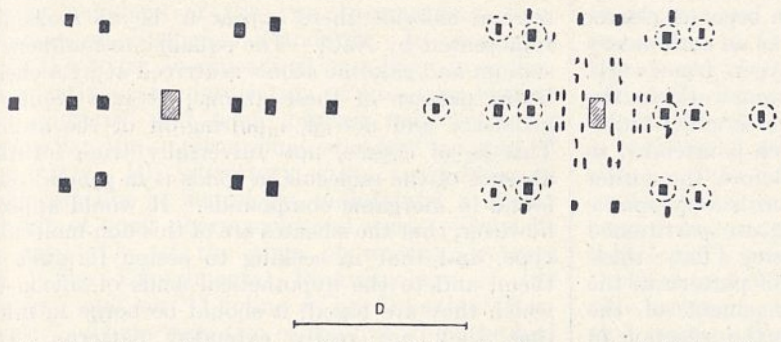

FIG. 4.—Rotation photograph around *b* axis of disthene (right) compared with ideal rotation photograph around cube edge for close-packed atoms (left).

atoms in these complex patterns. Their results are shown in Fig. 5.

These patterns are very formidable unless one has made a special study of them. However, the figures may perhaps make clear the main points. We have to explain the way in which the unit cell varies in size from compound to compound, and we have also to explain a curious complication. Whereas Mg_2SiO_4 and MgO_2H_2 $(Mg_2SiO_4)_3$ have a rectangular cell (orthorhombic), the other two compounds are built on a slant with the type of symmetry called monoclinic. The blocks are not clapped directly on top of each other, but are stepped sideways. It is fascinating (to the enthusiast) to see how naturally the results follow from the arrangements shown in the figure.

The circles in Fig. 5 represent the oxygen atoms which form the framework on which our whole structure is based. Two layers of such atoms are shown, representing two sheets of spheres packed closely, one lying on the other. Some of the oxygen atoms are linked together to form a group SiO_4 with a silicon (not shown) at its centre. These groups are shown as tetrahedra in the diagram, and six or three edges of each tetrahedron are drawn, depending on whether its apex is turned towards or away from the observer. The magnesium atoms are left out of the diagram for the sake of simplicity; the shaded pairs of oxygen atoms are to be labelled 'OH,' since they must belong to the hydroxyl groups.

Each crystal is a series of alternate strata of magnesium silicate and magnesium hydroxide. That part of it which is magnesium silicate is arranged exactly like the pure magnesium silicate shown in Fig. 5*a*. The layers of hydroxide cement together the blocks of magnesium silicate. In order to outline the unit cell of any of these patterns, we join up four points in the pattern which are exactly alike. The diagram will show that the measured unit cells, shown by dotted lines, are exactly those cells which satisfy these conditions. Chondrodite, MgO_2H_2 $(Mg_2SiO_4)_2$, must have a slanting cell, the next compound, humite, a long rectangular one, and the last, clinohumite, again a slanting cell. We were surprised in making our X-ray examination to find such a curious difference in the shape of the unit cell between humite on one hand and chondrodite and clinohumite on the other hand. When the pattern was put together, however, it was clear that such a difference followed naturally from the relative numbers of silicate and hydroxide strata.

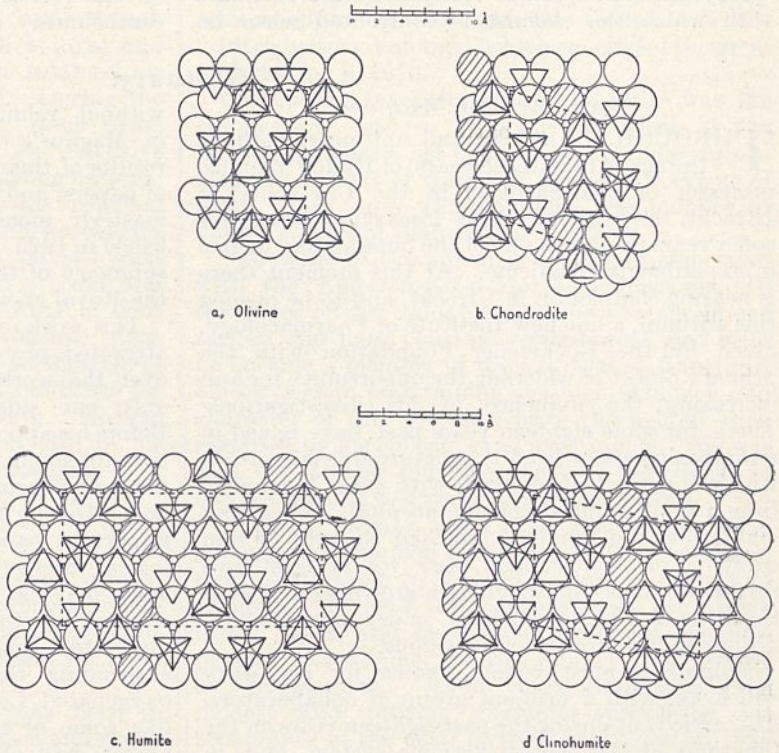

FIG. 5.—Atomic arrangement of the chondrodite series of minerals (after Taylor and West). Two layers of oxygen atoms in hexagonal close-packing are shown, projected on the plane (100) of each crystal. The *a* axes of the crystals are perpendicular to the plane of the diagram, and are practically identical for all the crystals. The diagram shows the identity of the vertical *b* axis in all the crystals, and the relationships in direction and length between the *c* axes.

Though very few examples of silicates have yet been analysed, the temptation to draw conclusions from them is irresistible. The most curious feature about the natural silicates is the immense variety in composition which occurs within one and

the same mineral species. Stupendous chemical formulæ have to be assigned in order to explain even approximately the relative proportions of the different elements in some well-known types.

It seems to me that the position becomes clearer when we consider the compounds as an embroidery of the metal atoms upon an oxygen framework. We may compare the oxygen framework to the steel girder system of a large ferro-concrete building in course of construction, which is intended to be divided into sets of flats. Before the girder system is filled in, its configuration is very simple indeed. Then certain blocks of it are partitioned off into sets of rooms, each comprising a flat; these flats are the more complex units of pattern in the crystalline structure. The arrangement of the rooms in each flat corresponds to the selection in our oxygen framework of certain spaces in which to put the metal atoms. We can go one step further, and rent our flats to families of slightly different composition, so that a census of the whole building shows a bewildering proportion of types of inhabitants difficult to represent by a definite family formula. This is really the state of affairs with which the chemist is confronted when he attempts to give a formula to many of the silicates.

Some of the very earliest structures which were analysed caused us to revise our ideas of what was meant by the 'molecule' of the chemist. In sodium chloride there appear to be no molecules represented by NaCl. The equality in numbers of sodium and chlorine atoms is arrived at by a chessboard pattern of these atoms; it is a result of geometry and not of a pairing-off of the atoms. This is, of course, not universally true, for this absence of the molecule in solids is in general only found in inorganic compounds. It would appear, however, that the silicates are of this non-molecular type, and that in seeking to assign formulæ to them, and to the hypothetical acids of silicon on which they are based, it should be borne in mind that they are really extended patterns. The relative numbers of their constituent atoms are characteristic of the extended pattern, and essentially a result of their solid state, so that it is doubtful whether a grouping of the atoms into molecules has in this case a meaning. It will be very interesting to see what further light the X-ray results can cast on the relationships in this fascinating series of compounds.

Obituary.

Prof. Rudolf Magnus.

THROUGH the sudden and untimely death, at the age of fifty-three years, of Rudolf Magnus, professor of pharmacology in the University of Utrecht, the world of science loses one who had for some years past been one of the outstanding figures in experimental medicine. At this moment there is nearing completion in Utrecht, and to be opened this autumn, a fine new Institute of Pharmacology, given by the Rockefeller Foundation with the primary object of widening the opportunity for and increasing the influence of his investigations. These, for some eighteen years past, have issued in an imposing series from the picturesque laboratory which Magnus had evolved, with great ingenuity, from a small monastic plague-hospital. The many who knew and admired him had thought of him carrying on his brilliant work for at least two further decades, and touching a growing circle with his ideas and his enthusiasm, under material conditions at last worthy of his genius.

Magnus is most widely known for the work which he, with a brilliant group of collaborators, has carried out during the past eighteen years on the functions of the central nervous system, and, in particular, on the reflex mechanisms involved in the assumption and maintenance of bodily posture, in normal relation to the earth's surface. He had spent several periods in British laboratories, with Schafer in Edinburgh, with Langley in Cambridge, and with Sherrington in Liverpool. From the last-mentioned association he received the stimulus which resulted in this best known and most important phase of his work. In Utrecht he had invaluable co-operation in this line of investigation from De Kleijn, Raademaker, and others; Dr. de Kleijn has won eminence as an otological surgeon without relinquishing his position as assistant in Magnus's department of pharmacology. The results of this work have appeared in a long series of papers, and have been embodied by Magnus in a masterly monograph on "Körperstellung," published in 1925. In the same year he gave a brilliant summary of the work in the Croonian Lecture to the Royal Society.

This work on the central nervous system, which attracted physiologists and neurologists from all over the world to Utrecht, represents, however, only one side of Magnus's scientific activity. Before his appointment to the Utrecht chair, he had been for a long term of years attached to the department of pharmacology at Heidelberg under Gottlieb. During this period he published a series of important papers of a more definitely pharmacological interest. Among the items of this earlier work may be mentioned his introduction of the method of studying the activity of mammalian unstriated muscle, by the simple technique of suspending the organ containing it in warm, oxygenated Locke-Ringer solution. Magnus, unlike some of the many who have since used it, always had clearly in view the true value and limitations of the method, and even in recent years his pupils were still busy with its application to isolated layers of the intestinal wall, with results leading to revision of his earlier conclusions as to the neurogenous nature of intestinal rhythm. By the use of this method also, in the Utrecht period, he and his pupils reached important conclusions concerning the significance of choline as a natural hormone of intestinal activity.

It is an astonishing fact, indeed, that Magnus made his Institute a centre of world interest in experimental neurology, without relaxing his

activity or his interest in ordinary pharmacology, He delivered his regular course on pharmacology, in a language newly acquired in middle life, served as a member of the commission for revising the Dutch pharmacopœia, and was one of the most active members of the two International Conferences on Biological Standards. In connexion with the latter he supervised important investigations on the standardisation of pituitary extract and digitalis, and made himself responsible for preparing the international standard sample of the latter. His laboratory, quite apart from its achievements in neurology, maintained a steady output of good pharmacological work. There lie on my table, at the time of writing, lectures on "The Experimental Pharmacology of the Lungs" and on "Choline as an Intestinal Hormone." These were two of the five which he had written for delivery in America on a visit projected for next year, and he had sent them to me for a final retouching, scarcely needed, of their English idiom. Presumably he had pressed himself too hard; but he left in good spirits for a holiday in Pontresina, where he died in his sleep after a day of active enjoyment.

Magnus was born in Brunswick, and, though domiciled since 1909 in Holland as a loyal and enthusiastic professor in Utrecht, he retained his German nationality and sympathies. During the War he returned to Germany for some years to conduct and organise research on defensive measures in chemical warfare. His strong national sentiment in no degree weakened his personal attachment to British colleagues, and he eagerly resumed the relations with British physiologists which had meant so much to him and to them, and had led them to regard him almost as one of their own community. He came as a welcome guest this spring to the fiftieth anniversary celebration of the Physiological Society, and was a candidate for election to its ordinary membership. Medical science has lost a great investigator, still in his prime, and a genial and inspiring personality.

H. H. D.

Mr. G. C. Champion.

THE death of George Charles Champion, coleopterist, on Aug. 8 at Horsell, Surrey, removes from the ranks of British entomologists one whose name has been a household word among them for more than half a century.

George Charles Champion, who was born in South London in 1851, began to collect and study beetles as a schoolboy, and before he was twenty years old he was recognised by the foremost coleopterists of that time as a field entomologist of more than ordinary energy and acumen. A large number of species were added by him to the British fauna previous to 1878, in which year he was offered a commission by the late F. DuCane Godman and Osbert Salvin to proceed to Central America and collect entomological material for the great faunistic work which they had recently commenced. Champion arrived in Guatemala early in 1879, and during the next two years traversed many hundreds of miles on horse- and mule-back, from the Pacific coast to the Polochic Valley opening into the Caribbean Sea. The number of insects of all orders collected by him and sent home in first-rate condition from Guatemala was truly enormous, and even greater success attended his researches in Chiriqui, Colombia, where his last two years in Central America were spent. An admirable itinerary of his travels in this region appeared in the *Entomological News* for 1907, which is reproduced with additions in the introductory volume of the "Biologia Centrali-Americana."

Champion returned to England in 1883, and at once found congenial work as sub-editor of the "Biologia," and private secretary to Messrs. Godman and Salvin. Besides preparing, with the able assistance of the late Mr. Arthur Cant, the vast mass of Central American Coleoptera for the collaborators in the section of the great work devoted to the Insecta, he was entirely or mainly responsible for eight volumes dealing with that order, in which upwards of 4000 species of beetles were described by him as new. Another volume on the Rhynchota is also due to him, and his share in the production of the "Biologia" is generously acknowledged by the late Dr. Godman in the "Introductory Volume," which concluded the great undertaking in 1915.

Champion's favourite group of beetles was the Heteromera, and in 1895 he published in the Belgian *Annales* a list of the Tenebrionidæ supplementary to that of the great Munich Catalogue of 1869, which more than doubled the number of known species of that extensive family.

The name of Champion is especially associated with the *Entomologist's Monthly Magazine*. To the pages of this valuable serial he was one of the earliest and most constant contributors, and after he became a member of the editorial staff in 1891, his services in maintaining the high standard and character of the magazine have throughout been regarded by his colleagues as inestimable. He was also, for the last four years, one of the editors of the *Annals and Magazine of Natural History*.

In 1891, twenty years after his election as a subscriber, Champion succeeded the late Ferdinand Grut as librarian to the Entomological Society of London. He held this onerous office for nearly thirty years, and in 1893 he produced the first printed "Catalogue" of the Library, followed by a "Supplement" seven years afterwards. His modest and retiring character prevented his acceptance of the chair of the Society, but in 1925 he was one of the vice-presidents. He joined the Zoological Society in 1888, and in 1897 the Linnean Society elected him one of its associates. At the jubilee meeting of the South London Entomological Society in 1922, he was the sole surviving original member, having taken a leading share in the inception of this flourishing association. Steady, thorough, and meticulously accurate in all his work, and at all times ready to assist his friends and colleagues to the utmost of his power, his death leaves a gap in the ranks of British entomologists which it will be difficult to fill.

J. J. W.

News and Views.

COMMENTS have recently appeared in the press on the possibility of a connexion between the total solar eclipse of June 29 and the unusually wet weather during this summer in Great Britain. It may, of course, be said at once that there is no scientific basis for the theory that the eclipse is responsible for the wet summer. It is impossible to disprove absolutely the theory, because we cannot make the experiment of having the year 1927 over again, but without an eclipse visible in England. It is, however, possible to give sufficient reasons to indicate the improbability of any connexion between the eclipse and the persistent wet weather. In the first place there are at least two solar eclipses every year and there are no corresponding wet periods in Britain: in fact, during the period 1881–1925, when there were 25 important total eclipses, the rainfall of the British Isles for each of the 6 months beginning with the month of eclipse was above the average in 63 cases, below the average in 83 cases, and equal to the average in 4 cases. In the month of the eclipse the rainfall was below the average in 16 cases, and above the average in 7, and equal to the average in 2; in the month following the eclipse month, rainfall was below the average in 12 and above the average in 13; in the succeeding month, *i.e.* the second month after the eclipse month, rainfall was below the average in 14 and above the average in 11. The effect of an eclipse, if it existed, could not therefore be of a general character, due to the earth's atmosphere being temporarily deprived of a portion of the solar radiation or emanation which it normally received.

IT has sometimes been suggested that there is a purely local connexion with weather confined to the part of the earth's surface where the eclipse occurs, due to that area being temporarily deprived of solar radiation. But the area is temporarily deprived of solar radiation every night for a much longer period than that involved in an eclipse; and if an eclipse produced wet weather, night ought to produce much wetter weather. There is no evidence of any such effect. The wettest years in Britain in the period covered by trustworthy general rainfall statistics have been 1872, 1879, 1903, and 1912: the three former years were not years of eclipse in Britain, while in the latter year a partial (nearly total) eclipse was visible. The driest years have been 1870, 1887, 1893, and 1921. The three earlier years were not years of eclipse in Britain, but in 1921 there was an annular eclipse. If the references to the weather of eclipse years in Britain are examined for the period before regular statistics were collected, it is found that they vary: some eclipse years were wet, some dry. In 764, when an annular eclipse occurred in June, the year is stated to have been one of drought after long and severe frost. In 1191, again a year of annular eclipse in June, the year is recorded as a year of famine. Mr. R. Nicholls, The Bungalow, Keele, Staffs., has written referring to some records from Croxden Abbey showing that the latter half of 1330, a year of total eclipse in July, was unusually wet. The year 1598 had a total eclipse in March and is recorded as a year of great drought with very hot August: 1652, a year of total eclipse in April, is recorded as a year of drought, with the "driest summer known in Scotland." In 1715 (total eclipse in May) a wet June to August followed a dry May. Thus recent statistics and historical notes indicate that the weather in Britain, in the years of eclipse visible in Britain, varies in the same way as it does in other years.

No paper which could be described as purely meteorological in character appeared in the programme of the Leeds meeting of the British Association. Meteorology had, however, a bearing on subjects discussed in at least three sections. In Section A, for example, there was Prof. J. J. Nolan's paper on "Ionisation in the Lower Atmosphere," while in the forestry sub-section of Section K, Dr. C. E. P. Brooks contributed a paper on "Forests and Rainfall"; there was also the combined discussion between Sections A, C, and K on "The Climates of the Past." Meteorology was in evidence throughout the meeting in the form of a demonstration of weather forecasting which was given daily in the Law Library at the Town Hall. This demonstration, indeed, has now become a feature of British Association meetings. It was arranged by the Meteorological Office, Air Ministry, in collaboration with the Signals Branch of the same department. Broadcast synoptic weather reports were received locally by radio twice daily, the observations being plotted on a chart of western Europe as they were received. From the synoptic weather charts thus constructed, forecasts for the Leeds area were prepared. The forecast was included in a local daily weather report, copies of which were distributed to the various section meeting rooms and to hotels and hostels where members were accommodated. The morning and afternoon synoptic charts were also reproduced on a large scale map in the Reception Room. In addition to the demonstration of weather forecasting, a comprehensive exhibit of instruments and diagrams was arranged, illustrating the various phases of meteorological work in Great Britain. Among the exhibits may be mentioned a series of five rain-gauges illustrating recent improvements in design, an exhibit illustrating the meteorological arrangements on the London-Continental air routes, and a series of stereoscopic cloud photographs taken from an areoplane.

THE most popular method of distributing electrical energy at the present time is by means of alternating currents. It is sometimes necessary, however, to have direct currents, as, for example, to charge accumulators for storage purposes, for various systems of electric traction, and for experimental purposes. This has led to the invention and perfecting of various types of rectifiers. There are mercury vapour rectifiers, thermionic rectifiers, electrolytic rectifiers, and, for small currents, crystal rectifiers.

There are also rectifiers of the mechanical type, as the commutators on direct current dynamos and rotary converters. Vibrating reeds also are sometimes used. A new and novel type of rectifier, described by Dr. J. Hartmann, of Copenhagen, to Section G (Engineering) of the British Association on Sept. 5, has now to be added to the list. It is called a jet wave rectifier. He invented the principle of it so far back as February 1907, but many difficulties had to be overcome in the college laboratory and municipal power station at Copenhagen before it could be put on the market. The rectifier utilises the fact that a jet of mercury or other conducting liquid when passing through an alternating current magnetic field assumes a wave shape which depends on the frequency of the current. If this jet is falling vertically and we have two conducting blocks, insulated from one another by a thin lamina of insulating material, the plane of which bisects the waves at right angles, then it can be adjusted so that for half the period the jet is in contact with one block, and for the other half in contact with the other block. Rectification can thus be obtained. It has been found that the corroding effects of the heavy sparks which ensue can be eliminated by making the commutation take place in hydrogen. By means of three such commutators working in series, Dr. Hartmann has constructed a rectifier which converts 100 kilowatts, at 550 volts, alternating power into direct current power with an efficiency of 92 per cent. The author's paper is a valuable one. It is being printed in full in *Engineering*, beginning on Sept. 9.

OUTDOOR substations for electric lighting supply are now becoming fairly common in England. We shall watch this new development with interest. The North Metropolitan Electric Supply Company's generating station at Brimsdown was the first to be provided with an outdoor switchgear station. It is interconnected with the Barking capital station of the County of London Co., Ltd. As the outdoor gear controls the supply, it is impossible for it ever to be completely shut down for cleaning or repairs. Consequently, repair work must be done when one set of the bus bars, which are at 33,000 volts, is 'alive.' To reduce painting to a minimum, it has been built of reinforced concrete, which is, unlike galvanised steel, impervious to the atmosphere. The circuit breakers are controlled electrically from inside the power house. In the *Electrical Review* for Sept. 9, outdoor substations of the North Metropolitan Co. at Cuffley, Hertford, Buntingford, and Royston are described. The Cuffley substation is connected with the radial feeder from Brimsdown to Hitchin at Potter's Bar. A second radial feeder commencing at Cuffley feeds in turn Hertford, Buntingford, and Royston, where the feeder is extended to the Shepreth substation of the Bedfordshire, Cambridgeshire, and Huntingdonshire Electricity Co. The switchgear is mounted on a pipe framework embedded in concrete. The transmission is partly by 33 kilovolt underground cables and partly by 33 kilovolt overhead lines. At each substation there are banks of step-down transformers. In certain cases power can be supplied to the main line through the low pressure side of the transformers. The five stations at High Barnet, Potter's Bar, Welwyn, Stevenage, and Knebworth form the first part of a large ring main distributing system, an incoming and outgoing feeder being provided at each substation.

DISEASES of the heart take a high place as a cause of mortality, the present figure for Great Britain, 142 deaths out of every 1000, being considerably more than cancer. Probably not less than 40 per cent. of all deaths from heart disease are of acute rheumatic origin, of which two-thirds is contracted in the years of childhood—5-15 years. The Ministry of Health has therefore been well advised to publish a series of studies on the subject, by Dr. Eastwood, Mrs. Forest Smith, Dr. J. E. A. Underwood, and Dr. J. Alison Glover, with a prefatory note by Sir George Newman (*Reports on Public Health and Medical Subjects*, No. 44. London: H.M. Stationery Office, 1927. 1*s*. 6*d*. net). The following statements (not advanced as 'conclusions') seem to emerge from the subject matter of the report. Acute rheumatism is probably a chronic progressive infection, thought by many to be due to a streptococus of the Viridans group, of low-grade, if of any, infectivity. Poverty and urbanisation are potent predisposing factors, but dampness of environment does not seem to be an important one. Focal sepsis, *e.g.* in decayed teeth and tonsils, is an important factor, and removal of unhealthy tonsils has considerable value in prevention. Once the child has sustained an attack, in order to minimise the risks of permanent damage to the heart and of recurrence at some future date, it requires (*a*) full in-patient hospital treatment for a period of from six to twelve weeks, and (*b*) special convalescent treatment and after-care for a further period of at least six months.

A VERY successful exhibition was organised by the British Aquarists' Association on Sept. 6-10 at the Chelsea Polytechnic, and save for a small experimental show last year was the first of its kind held in Great Britain, and the largest show yet held in the world except the Steinhart Exposition, Philadelphia, which was not confined to fishes. The arrangements were admirably carried out by a committee of which Dr. H. B. Jones is chairman and Mr. A. W. Croser honorary secretary. The primary object of the exhibition was to demonstrate to the public how aquaria may be set up with growing vegetation so as to be independent of change of water or artificial aeration. The difficulties of producing such an exhibition as this were exceptional, owing to the fragility of the tanks, the weight of water and shingle, the transport of live fish—especially tropical ones—the necessity of transferring them from the travelling cans to the show aquaria, and the fact that fish must not be subjected to any sudden change of temperature. The proceedings were opened by Mr. E. G.

Boulenger, who had acted as principal judge of the exhibits entered for the Haig Challenge Cup and numerous medals and diplomas. The Association includes members in Japan, China, America, and all over Europe; some of the fish on exhibition had travelled as far as from Glasgow. The 350 aquaria contained approximately 20,000 gallons of water, and about 8 cwt. of shingle, totalling a weight of nearly 176,000 lb. More than 20,000 aquatic plants, apart from those entered for competition, were used to furnish the tanks.

THE Herbert Spencer Lecture for 1927 was delivered at Oxford by Prof. S. Alexander, who took as his subject "Art and Instinct"; and the lecture has recently been published by the Oxford University Press, price 2*s*. net. Prof. Alexander raises the question as to whether there is a specific æsthetic emotion, or whether the æsthetic attitude is nothing but ordinary feelings or attitudes towards the subjects of art in a certain condition of refinement and complication. If the claim for a peculiar æsthetic emotion is to be maintained, it must be traced to some impulse in human nature. Herbert Spencer derived art from the play instinct, and Burke from the instincts of self-preservation and of society, including therein sex. After reviewing the attitude of Hume and Kant, Prof. Alexander submits that the æsthetic impulse and the æsthetic emotion accompanying that impulse are an outgrowth from the impulse of constructiveness, and are that impulse when it has become first human and next contemplative. With regard to instinct in general, he follows Prof. McDougall in his use of the word and also in looking upon constructiveness as an instinct. Between animal constructiveness and artistic production there is an intermediate stage of handicraft in which constructiveness remains practical but is humanised for a purpose. Purpose can only arise in a creature which possesses ideas and has memory.

PROF. ALEXANDER thinks that animals have 'construction' in a specific sense: in man it is more general, and might better be called 'synthesis' or 'constructional.' This synthesis, with its accompanying analyses, is the most obvious feature of science of all kinds, and so science may profitably be treated in its kinship with art; but while the lover of beauty adds his personality to Nature, the man of science sets himself by a supreme exercise of personality to keep his personality out. Constructiveness becomes art when it ceases to be merely practical. When an object has been constructed it is there to be observed and can be used as the satisfaction of the constructive-passion itself. The passion takes possession of its object and lifts it out of practical consideration. It is not play, for play is still the shadow of practice. It is the constructiveness of play from which art is descended, and not the playfulness of it. Artistic construction is compelled in the artist by the excitement which certain subjects provoke, and he is at a certain remove allied to his brother the nightingale and his humbler and dowdier brother the beaver. Yet art does add to the world a fresh reality even though based on ordinary reality. The lecture will interest all those concerned with psychology and with the theoretical and scientific aspects of art, but Prof. Alexander has not minimised the difficulties of the problem, and his readers cannot but feel that "much yet remains to be said."

AN illustrated pamphlet has been prepared by the Ministry of Agriculture in conjunction with the Home Office to indicate the nature of the risks associated with farm machinery and to afford guidance as to the precautions necessary to secure proper standards of safety in connexion with its working (London: H.M. Stationery Office. 9*d*.). Machinery of various types is considered, but stationary engines, transmission and barn machinery are dealt with in particular detail. Attention is directed to the importance of proper lighting and spacing in preventing accidents as well as to the necessity for efficient safety appliances, which may usually be obtained at a moderate cost. Steam boilers, electric and suction gas generating plants are briefly discussed and precautionary measures with regard to the storage of petrol or other inflammable spirit provided. Finally, the necessity for proper instruction of persons engaged in working the machinery, and the importance of having first aid requisites available is urged. A leaflet (No. 177) has also been added dealing with general precautions against accidents due to farm machinery.

SIR MURDOCH MACDONALD has been elected president of The Junior Institution of Engineers in succession to Engineer Vice-Admiral Sir Robert B. Dixon. Sir Murdoch will take office at a meeting to be held at the Caxton Hall, Victoria Street, S.W.1, on Friday, Nov. 18, when he will deliver his presidential address.

THE Air Ministry has announced that a strong earthquake was recorded at Kew Observatory on Sept. 11, at 11.21 P.M. Its centre is estimated to have been 1700 miles away from the Observatory. There were two further shocks of much smaller intensity in the early morning of Sept. 12. Press messages report the occurrence of a severe earthquake in South Russia with a centre in the Crimea.

THE study of the divining rod is being pursued by professors of geology and other men of science occupying positions of recognised importance in the universities of Central Europe. A meeting of the Internationaler Verein der Wünschelrutenforschers is to be held at Hildesheim in October next, when a series of experiments will be conducted under the supervision of Prof. F. Schoendorff. The results obtained will be published fully in the *Zeitschrift* of the Society.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A pathologist at the East Suffolk and Ipswich Hospital—The Secretary, The Hospital, Ipswich (Sept. 19). An

analytical chemist in the Medical Department of Tanganyika Territory with experience of foods and drugs analyses in a borough analyst's or similar laboratory—The Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, S.W.1 (Oct. 1). A microbiologist for research work on sewage disposal problems—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (Oct. 3). A junior technical officer for the Air Ministry Technical Development Staff—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (Oct. 5). A student probationer for work at the Plymouth Laboratory—The Director, Marine Biological Laboratory, Plymouth (Oct. 12). A physiological botanist and a biochemist for research work on cotton to be carried out at Coimbatore—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (Oct. 29). An agricultural botanist (male) as head of the biological department of the Seale-Hayne Agricultural College—The Principal, Seale-Hayne Agricultural College, Newton Abbot, Devon. A few civilian education officers, Royal Air Force—Secretary, Air Ministry, Adastral House, Kingsway, W.C.2.

Our Astronomical Column.

A NOVA OR VARIABLE IN AQUILA.—Plates taken at Königstuhl Observatory by Prof. Max Wolf on July 30 and 31 showed a star of the ninth magnitude in the position (1927·0) R. A. $18^h\ 52^m\ 11{\cdot}85^s$, S. Dec. $3°\ 24'\ 59{\cdot}8''$, which did not appear on twenty-five plates of the region taken between 1892 and 1926. On Aug. 17 its brightness had increased by half a magnitude. It appears on plates taken at Harvard Observatory on June 27, and also on one taken by J. Voute at Bandoeng on June 25, when its magnitude was 7·5, so that there appear to have been fluctuations of light. It was absent from a Harvard plate on June 8, being then below mag. 11·5. It was brighter visually than photographically in August, being fully of magnitude 8.

Prof. Wolf considered that the spectrum was of nova type on Aug. 17. P. Guthnick and R. Prager examined the spectrum with the 122cm. reflector at Babelsberg on Aug. 19, when the hydrogen line H was seen and also numerous absorption bands. Bright lines were suspected in the yellow and green, but they may have been merely the spaces between absorption bands. The character of the object as a nova is not yet definitely established; it may be an irregular variable. It is well placed in the evening sky and within reach of small instruments, so it should be followed.

GALE'S COMET.—Mr. H. E. Wood, who has just returned to Johannesburg after a visit to England, has sent some further observations of Gale's comet, made there by Dr. Innes; he has deduced from them an elliptical orbit, with a period of 11·86 years, equal to that of Jupiter. Dr. A. C. D. Crommelin has re-examined the orbit, using an arc extending from June 22 to Aug. 9, and confirms the ellipticity, the period found being 13·1 years, and perihelion passage June 14; the other elements do not differ much from the parabolic ones lately given in this column. The period indicates that it is a member of the Saturn family, of which only three members were previously known; these are 1846 VI. (Peters) 1858 I. (Tuttle), and 1913 III. (Neujmin); their periods are 13·38, 13·51, and 18 years. Tuttle's is the only one that has been seen at more than one apparition. The addition of another member to this small family is therefore of considerable interest. Since it was bright enough to be detected by Mr. Gale with a binocular, it is rather surprising that it escaped detection at earlier returns; but the brightness of comets is subject to capricious variations, so it may have had an unusual increase of light at this apparition.

METEORIC FIREBALLS.—Mr. W. F. Denning writes: "Reports have been received of two very large meteors observed from Somerset on Sept. 7 last. The first was noticed at $6^h\ 3^m$ P.M. (G.M.T.), when the *sun was shining*. It moved in a direction from east to west in a perfectly horizontal flight occupying about 7 seconds and was of a bluish-green colour. The object was very bright, and distinctly outlined on the clear blue sky. There was no train left. It was seen by Mr. J. E. D. Beresford, Henstridge, Somerset.

"The second meteor was observed at $9^h\ 25^m$ P.M. (G.M.T.), and was a very fine object which traversed a nearly horizontal course from north to south, and showed a slight inclination toward the horizon immediately below the planet Jupiter. Its path was about 25° and duration of flight 3 seconds. It left a bright train of sparks. The observation was by Mr. A. Vowles, Minehead, Somerset.

"These brilliant meteors may very possibly have been derived from one or more of the systems which supplied the numerous fireballs reported from various parts of England in September 1926. Further observations will enable this point to be definitely ascertained."

According to letters which have appeared in the *Times*, these objects were observed over a wide area including Heathfield (Surrey), Seaford and Arundel (Sussex), Carisbrooke (Isle of Wight), Portland (Dorset), and Dinard.

EXCEPTIONAL STARS.—Prof. H. N. Russell contributes a paper on this subject to the *Scientific American* for September. He notes that stars that differ from the general run, either by great brilliance or extreme faintness, are of special interest, and the most likely to add to our knowledge.

The stars of exceptional brilliance (absolute, not apparent) can now be detected by spectral peculiarities, or if Cepheid variables, by their period of light-change. The article states that the most luminous known star is a variable, S Doradus, in the lesser Magellanic Cloud, at a distance of 100,000 light-years; at brightest it gives 500,000 times the sun's light; one star in 200,000 gives 10,000 times the sun's light.

The extremely faint stars are much more common in space; but the difficulty of finding them is that they are only visible when they are near neighbours of the sun; even then they are generally very faint objects on photographic plates. They are singled out by their large apparent motions, which are revealed by comparing two plates of different date in a Blink micrometer. The most extreme of them was recently discovered in Virgo by Prof. Max Wolf at Heidelberg. Its proper motion is 4·84″ a year, and Van Maanen has found that its parallax is 0·404″ which makes it the third nearest star known, if we group Proxima and Alpha Centauri as one system. Its apparent magnitude is 13·5, from which it is calculated to give one fifty-thousandth of the sun's light or one twenty-five-thousand millionth of the star in Dorado.

Research Items.

POTTERY FROM TRUXILLO.—The Field Museum of Natural History has issued as No. 1 of Volume 2 of its *Memoirs in Anthropology* a preliminary report by Prof. A. L. Kroeber on a journey of archæological exploration in Peru on behalf of the Museum in 1925. Most of the exploration was carried out in the coastal areas of central and southern Peru; but this first part of the report deals only with the pottery art of the northern coast region in the vicinity of Truxillo. Here are the important prehistoric sites of Chanchan and Moche, the former the largest ruin in Peru, the latter containing the highest pyramid, at least in the northern part of the country. Adjoining Truxillo to the north is the valley of Chicama, from which many of the specimens examined may have come though now labelled Truxillo. Truxillo is one of the centres yielding the Chimu type of pre-Hispanic pottery, for long the type, apart from Inca, best known outside Peru. Two varieties are recognised, one red and white classified by Uhle as proto-Chimu, the other black (sometimes coloured) known as Chimu. Three other types are also distinguished, which seem to point to an intercalation of influence from Tiahuanaco between the two styles. Nothing of true Tiahuanaco style or of red-white-black geometric has been discovered north of Truxillo. Prof. Kroeber's researches have been directed towards the problem whether the proto-Chimu style died out under outside influence, or whether it survived, as seemed likely, in attenuated form and was revived as late Chimu; but he has not arrived at more than tentative conclusions. He is inclined to regard the three colour geometric as later than Tiahuanacoid, while Dr. Uhle is disposed to regard it as earlier. His investigations lead to the conclusion that the proto-Chimu and Chavin styles are contemporary pre-Inca, showing traceable relations with the northern interior. Three colour geometric, a problematical middle Chimu, and the tripod and modelled styles are Tiahuanacoid and presumably pre-Inca, while late Chimu probably began in pre-Inca and continued into Inca and colonial times.

SUTHERLANDSHIRE SALMON.—In a report on the salmon from the River Hope and Loch Hope in Sutherland (*Fisheries, Scotland, Salmon Fish.*, 1926, 7. Edinburgh and London: H.M. Stationery Office), Mr. G. H. Nall remarks on the results of the examination of 187 sets of scales collected during the years 1920–1925. A striking feature was the large percentage of fish that had spent three years in the river as parr, being 42·47 per cent., as against 6 per cent. among fish examined in 1920 from Thurso Bay. A further interesting point was the unusually large proportion of fish whose scales bore spawning marks. Amongst these was a male salmon, taken from Loch Hope on Aug. 17, 1921, weighing 17¾ lb., which after spawning in its sixth year had returned to the sea, where it remained for two years before once more entering fresh water to spawn in its ninth year. This is the first example known to the Scottish Fishery Board of an Atlantic salmon, after once spawning, missing two complete years before returning from the sea to spawn in the third year, presuming that the scale reading was correct.

THE CALIFORNIAN SARDINE.—The sardine fishery in California which originated as a great fishery during the stress of war, has undergone striking development, and the industry has shown a vitality which augurs well for its permanence so long as the raw material is obtainable. The amount caught exceeds by far that taken of any other species in California, and there appears at present no other which is capable of the tremendous yield, unless it be the unused anchovy. It has been recognised by the Fish and Game Commission of California, from experience with older fisheries, that rational use demands a knowledge of at least two things. There must, above all else, be information from time to time regarding the manner in which the species is withstanding the strain of the fishery. But there must also be an understanding of the natural changes in abundance which inevitably occur, so that these may be distinguished from the effects of overfishing and also may be foretold and understood. Based on such knowledge, regulation and exploitation may be rational and restrained. *Fish Bulletin*, No. 11 (California State Printing Office, Sacramento, 1926), includes five papers which are the first of a proposed series describing the initial results of the attempt of the Commission to establish a logical and adequate system of observation of the important fisheries of the State. Students interested in the collection and interpretation of statistical data on commercial landings of fishes will find much instructive information in these papers, including a study of the adequacy of various systems of sampling sardines which are used at Monterey.

THE LIMITS OF GROWTH.—In an essay (pp. 36. Jena: Gustav Fischer, 1927) on the limits of growth, Prof. Richard Hesse seeks to establish the thesis that body-size is a function of the surface of the gut. He brings forward many examples from the lower Metazoa in support of his view, *e.g.* the varying extent of the branches of the gut in ectoparasitic trematodes of different sizes, to show that in the organisms cited progressive increase in the gut surface, produced by branching, is associated with progressive increase in the size of the body. He cites a series of earthworms with a similar purpose, pointing out that the increase of gut surface is brought about chiefly by the formation of a typhlosole. In the small *Allolobophora tetrædra* this is a simple elevation, but in the stout *Lumbricus terrestris* the typhlosole is strongly developed and much folded. Prof. Hesse does not remark upon the absence of typhlosole in the largest of all known earthworms—*Megascolides australis*—which may attain a length of seven feet. The intestine in this worm is large, and possibly its surface, even in the absence of a typhlosole, is as proportionate as in Lumbricus to the size of the body, but it would be interesting to have data on this point.

FORAMINIFERA OF THE GENUS LEPIDOCYCLINA.—In the *Proceedings of the U.S. National Museum*, No. 2680, vol. 71, art. 8, Dr. T. Wayland Vaughan, of the Scripps Institution of Oceanography, La Jolla, California, describes some large and interesting foraminifera of the genus Lepidocyclina belonging to the sub-genus Lepidocyclina in which the two initial embryonic chambers are characteristically of equal or sub-equal size, and are separated by a straight wall. *Lepidocyclina Forresti* is a new species from the Oligocene, originally found near Lynch Point, Antigua, where it was collected by Mr. W. R. Forrest in great abundance, packed closely in a cream-coloured, finely granular limestone. The species seems to have a wide range in the Antigua formation. Both microsphæric and megasphæric forms occurred, the former having a diameter of 18 mm., the latter 9 mm. to about 13 mm. A new variety of *Lepidocyclina Mantelli* (Morton) Gümbel is also described, and the

question raised as to whether the traditional form is the true *L. Mantelli* or the new variety, which apparently occurs in the original locality of that species. Good microphotographs of all the forms studied, including surface views and sections, are given.

ANIMAL LIGHT AND SYMBIOSIS.—Prof. Paul Buchner ("Tierisches Leuchten und Symbiose," pp. 58. Berlin: Julius Springer, 1926) has published an address on this subject which he delivered at Lund in 1925. He points out that the history of the subject is short, for it began some fifteen years ago with an observation by Dubois on the luminous secretion of the boring bivalve *Pholas dactylus*. Prof. Buchner considers first the light-producing organs of Pyrosoma, in which, as Pierantoni showed, the presence of micro-organisms is clearly demonstrable. The spores of this organism can be traced through the follicle cells surrounding the egg into transport cells, which are later found interspersed among the cells resulting from the discoidal cleavage of the egg, which occurs while the egg is enveloped by the follicle cells. When the first four individuals (ascidiozooids) of the new colony are formed, the new luminous organs, a pair in each individual, are formed from the symbiont-laden cells, that is, from maternal body cells. Examples are given of infection of the eggs of insects, *e.g.* Aleurodes, by transported symbionts. The luminous organs of fishes (*e.g.* Anomalops) and those of cephalopods are described. Special attention is directed to those of *Sepia elegans* and *S. officinalis*—the organs known as accessory nidamental glands. These exhibit gland-like invaginations which form intertwining blind tubes in the lumen of which the bacteria live. Three kinds of tubular ingrowths are distinguished—white, yellow, and orange, but only the yellow ones send out light. Their bacteria are being investigated by cultural methods. The author has appended references to the original memoirs cited and has added remarks on many of them. The address gives a clear, concise, and interesting review of the present position of the subject.

DROSOPHILA CRIPPLES.—A Mendelian character which is of especial interest on account of its wide range of variation has been studied by Prof. Taku Komai (*Memoirs Coll. Sci., Kyoto Imp. Univ.*, Series B, vol. 2, No. 5) in Drosophila. This mutation expresses itself in a number of abnormalities of the middle and hind legs and its expression varies according to the condition of the food. The abnormality is called 'crippled' and is recessive, but it may fail to appear even in the homozygous state. The pairs of legs are quite differently affected, the front legs remaining unaltered. When the condition appears in the hind legs (crip.-h), one or more segments of one leg are shortened, crooked, twisted, or otherwise modified. When it appears in the middle legs (crip.-m), one of them is reduplicated, small or absent. High or low temperature increases the percentage of crip.-h. The latter also appear more frequently in the early part of a culture, while crip.-m flies only appear towards the end. This is due to some change in the condition of the food. Thus under certain conditions of the food, the hind legs (right or left) are affected, while under different conditions the middle leg is affected in a totally different way, but only one gene is involved. The reduplication of the middle legs takes various forms, some of which are exceptions to the rules of reduplication formulated by Bateson. The division of the legs may be either in the dorso-ventral or the antero-posterior plane.

JAPANESE LAND MOLLUSCA.—Dr. H. A. Pilsbry, who has made special study of the Japanese mollusca, has now begun a series of papers, the object of which will be to revise various ill-understood groups as opportunity offers. The first part (*Proc. Acad. Nat. Sci. Philad.* vol. 79) deals first with the group of *Eulota fiscina* Fulton, which he places in a new sub-genus, Karaftohelix. This differs somewhat in its anatomy, as shown in text figures, from Eulota proper. These forms are not directly related to any of the Japanese species southward, but are traceable to a separate migration from the mainland. The second portion of the paper treats of the races of *Eulota* (*Euhadra*) *callizona* Crosse, of which the distinctions, based solely on shell characters, are illustrated on two plates.

VOLCANIC ROCKS OF UPPER BURMA.—Continuing his investigations of the previously little known volcanic rocks of Burma, Mr. H. L. Chhibber describes a series of typically 'Atlantic' types of late Tertiary to recent age from a region some seventy miles north of Mandalay (*Trans. Min. & Geol. Inst. of India*, **21**, 1927). The stratigraphy and tectonics were studied jointly with Prof. L. D. Stamp. The older lavas have been completely altered by weathering, but appear to have been basic. These are followed by doleritic or teschenitic intrusions, including a probable laccolith. Finally come the younger lavas, forming a plateau. Like many of the Carboniferous lavas of the Midland Valley of Scotland, these rocks contain purple augite. They range in composition from olivine basalts to mugearites, and thus offer a remarkable contrast to the typically 'Pacific' rocks of comparable age which occur in the Lower Chindwin district fifty to sixty miles to the west. The latter rocks were recently described by Mr. Chhibber in the *Journal of the Burma Research Society*.

THE ATLANTIS PROBLEM.—The most plausible hypothesis yet advanced in explanation of Plato's account of Atlantis appears to be that of Paul Borchardt, argued at length in *Petermanns Mitteilungen*, 1927 (1), and briefly summarised in the *Geographical Journal* for Sept. 1927. The main block of North Africa is identified with Atlantis itself, and the Sea of the Atlantes with an inland gulf once connected with the Mediterranean and now represented by the depressed belt of the Shotts which stretches inland from the Gulf of Gabes. This tract is known to have been the seat of a former civilisation, and is, moreover, still subject to tectonic disturbances. It is thought that the lesser island of Atlantis with the legendary capital and temple may have been situated within the interior basin, a view that fits in with the description by Herodotus of Lake Triton with its temple-crowned island. The destruction of the island by earthquake would be a startling event, but not one beyond the limits of credibility. If Borchardt's hypothesis is sound, the "Pillars of Hercules" referred to by the Egyptian priest must have been wrongly interpreted by the Greeks. With this exception—and some confusion as a result of translation is not unreasonably to be expected—the details described by Plato are satisfactorily accounted for.

AIR RESISTANCE FOR SPHERES.—In the issue of the *Physikalische Zeitschrift* for July 1, Dr. O. Flachbart gives an account of recent observations of the resistance of a smooth sphere of 24·2 cm. diameter in the wind channel at Göttingen. These experiments do much to clear up the differences which at present exist between the results of work done on this subject in the various aerodynamic laboratories. The sphere was supported entirely by suspending wires attached to a round rod 2 cm. in diameter and 30 cm. long which projected from the sphere in the down-stream

direction. The results obtained differ materially from those found at Göttingen in 1923 with the suspending wires attached to the sphere itself. They show the great influence small irregularities in the surface of the sphere such as projecting eyelets or wires or encircling rings and turbulence produced in the air by even thin wires or meshes up-stream have on the resistance.

THE EARTH'S ELECTRIC FIELD.—Dr. H. Benndorf communicated to the Vienna Academy of Sciences on Mar. 24 an outline of a new theory of the electric field of the earth which he has worked out with the view of indicating how the present aimless measurements may be replaced by more systematic ones. He takes a surface at a height H of 20 or more kilometres above that of the earth, at which it may be assumed that practically the whole of the electric charge of the earth and atmosphere lies beneath it. The electric field E_H at this surface may be taken as uniform. If λ_H is the conductivity and $\bar{\lambda}_H$ the mean conductivity of the atmosphere at this height, the mean earth current z is $E_H\bar{\lambda}_H$ per sq. cm., and may vary with world time but not with local time. In a tube of flow extending downward from the surface H, if at any level the field and conductivity are E and λ, $E\lambda = z$ and the two equations give $E = (z/\bar{\lambda}_H)(\lambda_H/\lambda)$ in which the first factor depends only on world time and the second on local time. A comparison of this result with observations leads the author to believe that the daily variation of the field over the oceans is a measure of the daily variation of the total earth current, and that the theory is likely to present a picture of the phenomena of atmospheric electricity correct in its main features.

THE ISOTOPES OF LITHIUM.—M. Max Morand has given an account in the March-April number of the *Annales de Physique* of a new investigation of the isotopes of lithium. Guided largely by theoretical considerations, he has designed and built a tube in which the source of positive ions, a fine point covered with a layer of salt and raised as usual to a high positive potential, gives off a homogeneous directed pencil of charged particles of considerable intensity, which are analysed magnetically. In the case of lithium he was able to separate the isotopes, and to measure simultaneously on two galvanometers the currents due to Li_7 and Li_6, which were present in the ratio of 15 to 1 required by the chemically determined atomic weight. The mass of metal which can be deposited in this way is still small, and only of the order of 10^{-5} gm. for the more abundant component, but M. Morand believes that with improvements in the apparatus it will be possible to increase the yield considerably.

MAGNETIC INDUCTION IN SHEET STEEL.—It is of the greatest importance to electrical manufacturers to know the magnetic induction produced by given magnetising forces in the sheet steel used in the cores of coils. A paper (No. 545) on this subject by R. L. Sanford and J. M. Barry, of the Bureau of Standards, Washington, which has just been published, will prove of great value to designers. The Burrows' permeameter is the standard instrument in the United States for the magnetic testing of sheet steel. The Fahy Simplex permeameter has advantages in the way of simplicity and convenience of operation. Its accuracy, however, has been doubted, and comparisons made over a period of four years of results obtained by the two instruments have failed to throw light on the discrepancies. The present investigation was undertaken to decide which instrument was the better and to find out the conditions under which the best results could be obtained. The authors prove that the differences between the results are mainly due to lack of uniformity in the physical properties of the materials under test. The simplex permeameter is less sensitive to this than the Burrows, but no inherent errors were detected in either instrument. The want of homogeneity in ordinary commercial samples of sheet steel will, in the great majority of cases, be less than in the samples used by the authors. Tests made with the Burrows' permeameter are in general satisfactory. To remove uncertainty, the uniformity of the specimen should be tested, but in many cases it is not convenient to do this. The authors conclude that for the normal routine induction testing of sheet steel, the Fahy Simplex permeameter is the best apparatus at present available, The specimens tested should be made up of 10 strips not less than 3 centimetres wide.

'ARCING' IN SWITCHES.—Electrical engineers have devoted great attention to the problem of suppressing 'arcing' in switches and to appliances for breaking the electric current in a circuit. They distinguish between an arc and a spark. In an arc, the flow of current depends mainly on the ionisation of the vaporised material of the electrodes, whilst in a spark it depends mainly on the ionisation of the gas surrounding the electrodes. The spectrum of the arc exhibits the spectrum of the electrode material and is practically independent of the surrounding medium. In a paper by Sven Norberg in the March issue of the *Journal of the Swedish General Electric Co.*, a careful study is made of the breaking characteristics of switches both in air and oil. He finds that the length of the arc in air is roughly 100 times greater than in oil. In designing a 'circuit breaker,' the final length of the arc is much the most important factor. As we generally want to break the circuit quickly, the distance of the break should not be much greater than the length of the arc. To reduce the length of the arc it is advisable to have two or more breaks in series. With four breaks, for example, the length of the arc is reduced to at least one quarter its value. With an ordinary lamp load, the length of the arc is not affected by the speed of the break, but with an inductive loading the length of the arc increases with the speed of the break. A current of air or oil against the arc assists in extinguishing it. A magnetic 'blow out' acts in quite a different way from ordinary blowing. It does not affect the length of the arc, but it much increases the breaking speed. The conclusions arrived at in this paper show that the designer has mastered the electrical side of the problem, but much remains to be done before the mechanical side can be perfected.

CARBONISATION OF LANCASHIRE COAL.—The Department of Scientific and Industrial Research has issued a pamphlet (Physical and Chemical Survey of the National Coal Resources. Paper No. 9. London: H.M. Stationery Office. 1*s.* 6*d.* net) on the Lancashire Coal Field dealing with the Ravine seam (Part 2). This reports carbonisation trials in continuous vertical retorts made at the Greenwich Station with the use of increasing proportion of steam. The yields of products show a general approach to those reported in similar tests made on a good South Yorkshire coal, but difficulty was experienced owing to injury to the retort walls, ascribed to the nature of the ash. The report was supplemented by tests made on the coke when gasified in a blue water gas plant and in a suction gas producer and by trials of both coal and coke as fuel for a Lancashire boiler. In all cases the ash of the coal gave trouble either by attack on refractory material or by clinker formation. The report is one of the most comprehensive studies of a British coal in use which has been published.

Calcium Therapy.

THE subject of calcium therapy was discussed at the recent meeting at Edinburgh of the Section of Pharmacology and Therapeutics of the British Medical Association. Such a discussion must, of necessity, cover a certain amount of ground in which the interest is primarily clinical; nevertheless it furnishes an interesting summary of the present state of knowledge of calcium metabolism.

Evidently the interest of those working on the subject has, for the moment, three main foci, namely, the elucidation of the actual physical and chemical conditions in which calcium circulates in the blood and exists in the tissues; the point in the system of bones, blood, and tissues, at which the parathyroid hormone exerts its influence; and the relationships existing between, on one hand, ionic calcium, and on the other, the negative ions—chiefly, of course, Cl'—in tissues and fluids.

In spite of the adverse criticism which they have received, Vines's earlier results seem to have shown quite clearly that about 60 per cent. of the blood calcium is in a state which differs, chemically, from the remaining 40 per cent. Other workers, using different methods, have extended and amplified this conclusion. It appears that, of the 10 mgm. present in 100 c.c. of normal serum, 6 mgm. is diffusible through a collodion membrane, while 4 mgm. is combined, perhaps with protein or lipoid, in such a way as to be non-diffusible. While interest, for the moment, centres round the diffusible form, there is evidence that the non-diffusible, no less than the diffusible, is liable to variation in such circumstances as parathyroidectomy, or the administration of parathyroid extract.

Of the diffusible calcium, probably 2 mgm. or so is in ionic form. It has been suggested that the remaining 4 mgm. may be combined with some substance of properties comparable, in this connexion, to those of citric acid. Quite probably, all three forms (if there be but three) are in equilibrium: variations in the amount of any one form must be reflected in variations in that of the others. It was, for example, pointed out that in prolonged diffusion experiments actually more than 60 per cent. of the total calcium passes into the diffusate, owing to the breaking up of the diffusible into the non-diffusible form.

Certain views[1] concerning the relationship of the parathyroids to calcium metabolism, implied rather than explicitly stated during the discussion, may be put into a fairly definite form.

It has been clearly shown that injection of parathyroid hormone increases blood calcium without increasing absorption or diminishing excretion of the metal by the alimentary canal, since the typical rise can be obtained in anæsthetised, eviscerated animals. This rise must, therefore, occur at the expense of calcium either of the bones or of soft tissues, or of both. The hormone, in fact, must mobilise calcium from some reserve store. It appears that in certain cases of so-called 'renal infantilism'—a state in which nephritic changes accompany failure in body development—there occurs both a high level of blood phosphate, and a hypercalcæmia, associated with severe rachitic changes in the bones. A case was also described in which the bony changes known as 'osteitis fibrosa' were accompanied by a blood calcium level of 17 mgm. per cent., and the appearance of very definite adenomatous tumours of the parathyroids. It has been stated that young animals, fed on a calcium-poor diet, show definite parathyroid hypertrophy.

Taken together, these observations seem strongly to suggest that, whatever the immediate source of the blood calcium, any prolonged rise in its amount results in the draining of the element from the bones, and that the action of the parathyroid hormone is in favour of such a transference. A consideration of the relative amounts of calcium in the bones and the circulating fluid makes it obvious that only after a prolonged demand would any measurable effect be produced on the relatively enormous calcium store of the bones. It is well known that cardiac and nervous tissues are extremely sensitive to $Ca^{\cdot\cdot}/K^{\cdot}$ balance, and it is difficult to imagine that any marked or prolonged rise in blood calcium would take place entirely at the expense of the soft tissues. Such data as are available suggest that calcium is concerned with the maintenance of cell surface structures; it is hard to picture such structures parting with calcium without the occurrence of marked disturbances.

The evidence concerning the point of action of vitamin *D* is, at present, meagre, and the subject still obscure. Some observations suggest that it promotes calcium absorption, possibly by some influence on the *p*H of the intestinal tract. Obviously any agency tending to shift the reaction to, or to retain it at, the acid side of neutrality would favour the existence of soluble rather than insoluble calcium compounds. Such an explanation would, however, place the vitamin in the same category as a phosphate-rich diet, which increases the rickets-producing power of a calcium-poor diet by hindering the absorption of the element. Evidence of the action of vitamin *D* on the mechanisms of bone formation, such as the phosphate esterase of Robison, is so far lacking.

Little light can at present be shed on the difficult question of the relationships of $Ca^{\cdot\cdot}$ and Cl' ions, and of *p*H, in blood and tissues. It is suggested that the treatment of certain conditions, such as the œdema of nephritis, by calcium chloride depends as much on the readjustment of the $Na^{\cdot}/Cl'$ ratio as on any effect of calcium *per se*; it is well known that tetany is favoured by an increase, and tends to be relieved by a decrease of the alkali reserve, though Collip has shown that both in tetany and in hypercalcæmia there is a terminal uncompensated acidosis. E. H.

[1] A similar view has been expressed to the writer, independently, by Mr. Hoyle, of the Pharmacological Laboratory, Cambridge.

Congress of the History of Medicine.

THE sixth International Congress of the History of Medicine was held during the week July 18-23 under the presidency of Dr. J. G. de Lint, lecturer on the history of medicine in the University of Leyden. The meetings during the first three days were held at Leyden and the rest of the week at Amsterdam. The attendance was larger than at any previous congress organised by the International Society of the History of Medicine. No less than twenty countries, among which Germany and Austria figured for the first time, were represented, so that the Congress, as many of the speakers remarked, was for the first time really international. Owing to the simultaneous annual meeting of the British Medical Association at Edinburgh, where a section of the history of medicine had been inaugurated, only a few British representatives, including Sir D'Arcy Power, Dr. Charles Singer, and Dr. J. D. Rolleston were present.

As on previous occasions, a great variety of subjects was discussed. Nearly ninety papers in all were presented to the Congress, but in the absence of their authors many had to be taken as read, and no speaker was allowed more than ten minutes for his communication. Anthropology was represented by papers by Dr. M. A. van Andel on folk medicine in myths and legends; by Prof. A. W. Niewenhuis, on the views of primitive races on the sexual life of mankind; and by Dr. V. Bugiel, on the personification of disease in Polish folklore. Classical antiquity was represented by papers on doctors and public opinion in ancient Rome, by Dr. R. Neveu; medical athletics in antiquity, by Prof. W. Haberling; ancient medicine and philosophy, by Dr. J. H. Lulofs; and terra cotta statuettes illustrating diseases from the Graeco-Roman museum at Alexandria, by Dr. Angelica Panayotatou. Papers on medieval medicine included communications by Prof. Karl Sudhoff on medicine in the twelfth and thirteenth centuries; by Dr. A. C. Klebs on a Catalan plague tract of April 1348; by Prof. P. Capparoni on a manuscript from the school of Salerno and an Italian translation of the thirteenth century of the "Thesaurus Pauperum," by Petrus Hispanus; by Prof. H. E. Sigerist, on St. Sebastian; and by Dr. J. D. Rolleston, on St. Blaise. Contributions to the history of anatomy consisted of papers on the development of anatomy in Spain shortly after Vesalius, by Dr. F. Lejeune; Van Calcar's original drawing for the title-page of Vesalius's *Fabrica*, by Dr. Le Roy Crummer; and an unknown portrait of Vesalius, by Dr. F. M. G. de Feyfer.

Several communications dealt with the history of pharmacology, such as Johannes Mathaeus Faber's work on belladonna, by Dr. F. B. Kilmer; the origin of druggists' shops, by Dr. A. Schmidt; the deontology of the druggist in past ages, by Dr. O. van Schoor; and the title-pages of some old herbals and pharmacopœas published in Holland, by Dr. H. Cohen.

As was to be expected, many papers were devoted to Boerhaave, such as Boerhaave's prescriptions for some English patients, by Mr. C. J. S. Thompson; Boerhaave in Italy, by Prof. A. Castiglioni; Boerhaave's letters to J. B. Barraud, by Dr. E. Darmstaedter; and La Mettrie's translation of Boerhaave's Aphorisms, by Drs. Laignel Lavastine and J. Vinchon. Homage was also paid to Boerhaave's memory by a visit immediately after the opening ceremony to his tomb in the Peterskerk, by the inauguration of a memorial tablet in the house in which he died, and by the decoration of his statue with a wreath, on which occasion Dr. W. H. Welch, professor of the history of medicine at Johns Hopkins University, delivered an encomium on this great Dutch physician and clinical teacher.

Other papers relating to Dutch medicine apart from those on Boerhaave were Holland's contribution to clinical thermometry, by Dr. E. Ebstein; the first professor at the University of Leyden, by Dr. J. E. Kroon; Dutch hospitals as seen by a Frenchman, by M. Fosseyeux; and the history of spectacles in the Netherlands, by Dr. H. Weve.

The executive committee spared no pains to make the Congress a success by the arrangement of receptions, exhibitions, visits to places of interest, and the delivery of special addresses. Receptions were given by the Burgomasters of Leyden and Amsterdam, by the Minister of Public Instruction and Fine Arts at The Hague, by Mr. and Madame Fokker at Boerhaave's house, and by the Burgomaster of Enkhuisen during a trip on the Zuyder Zee, which included a visit to the picturesque inhabitants of Volendam. Drs. B. W. T. Nuyens, F. M. G. de Feyfer, J. van du Hoeven, and A. J. Lamers arranged a remarkable collection in the Municipal Museum at Amsterdam consisting of pictures by Rembrandt, Jan Steen, Teniers, and other works from various Dutch galleries, sculpture, books and *incunabula* illustrating the history of medicine. An interesting exhibition of instruments made by famous Dutch physicists in the seventeenth, eighteenth, and commencement of the nineteenth centuries was held at the physical laboratory of the University of Leyden, where Dr. C. A. Crommelin, the assistant director, gave an address illustrated by portraits of Huyghens, the Musschenbroeks, and other contemporary Dutch scientific workers. The same evening addresses illustrated by kinematograph films were given by Drs. A. Scherbeck and W. H. van Seters on the work of Leeuwenhoek and Swammerdam. Lectures were also given on the history of the treatment of nervous and mental diseases, by Dr. C. O. Ariëns Kappers; the doctor in caricature, by Mr. C. Veeth; and the bier of the surgeons and druggists preserved in the church at Wokkum, by Dr. J. B. F. van Gils.

The proceedings terminated with a banquet, when the speakers consisted of the president of the Congress, the president of the Society, Dr. Tricot-Royer of Antwerp, the president-elect of the next Congress, Prof. Pietro Capparoni, and Dr. J. D. Rolleston, chosen by lot to propose the health of the ladies.

The next Congress will be held at Rome in 1930, but the International Society of the History of Medicine will form a section in the Congress of the History of Science to be held next year at Oslo.

University and Educational Intelligence.

AN institute for research in medicine is to be founded at Heidelberg. According to the *Chemiker-Zeitung*, the building will be erected near the projected thermal bath and will contain special departments for research in pathological physiology, serum investigation, etc., and for the study of physics and chemistry as applied to medicine.

THE Albert Agricultural College, Glasnevin, Dublin, which has been engaged in agricultural teaching and research since 1851, has recently been reorganised so as to accommodate the enlarged Agricultural Faculty of University College, Dublin (National University of Ireland), and will henceforth be under University control. The following appointments have been made: Director and professor of agriculture, Prof. J. P. Drew; professor of plant pathology, Dr. P. A. Murphy; lecturer in animal nutrition, Mr. E. J. Sheehy; lecturer in agricultural chemistry, Mr. Geo. Stephenson; lecturer in agricultural botany and bacteriology, Mr. M. J. Gorman; lecturer in plant breeding, Mr. M. Caffrey; lecturer in horticulture, Mr. G. O. Sherrard.

THE British Institute of Philosophical Studies has arranged courses of lectures for the Michaelmas term by Prof. S. Alexander on "Value" (Truth, Goodness, Beauty); Mr. John Hobson on "Economics in relation to Ethics"; Prof. Leonard Russell on "The Approach to Philosophy"; Mr. Sydney E. Hooper on "Introduction to Philosophy"; and Dr. William Brown on "Psychology". In the Lent term the Hon. Bertrand Russell will lecture on "The Philosophy of Physics," and Dr. Morris Ginsberg on "Social Psychology". In the Summer term Prof. Clement C. J. Webb will give a course of four lectures on "The Philosophy of Religion," and Prof. C. Lloyd Morgan a course of six lectures on "Mind in Nature". A full syllabus can

be obtained on application to the Director of Studies, 88 Kingsway, London, W.C.2.

THE tutorial system of Oxford and Cambridge has, for many years, been well known in academic circles in the United States, its merits having been canvassed by returned Rhodes scholars and others, and somewhat similar systems having been introduced in Harvard and other American universities. The Harvard system is described in the January and April numbers of *The Educational Record*. Its main features are: each student at the end of the first year of his four-years' course is assigned to a tutor, who becomes thenceforth his adviser in all his studies; the tutors, at first chiefly young men, are now holding positions of all grades, from assistant to full professor; at least half of them combine tutoring with course lecturing; the number of pupils to a tutor who devotes his whole time to tutoring varies from 25 to 45. Conferences between tutor and pupil, commonly lasting an hour, take place once a week or fortnight in the second year, and once a week in the third and fourth; normally the students meet their tutors singly; the conferences are not in the nature of private lectures, most of the talking being done by the student, and have as little as possible to do with the ground covered in the courses taken; attendance by the student is entirely optional. The objects of the system are thus summed up: to devote more attention to the undergraduate as an individual, to treat him as a whole being (not, as under the American 'credit' system, as a conglomeration of intellectual fragments), to make him more largely educate himself, and to provoke in him an interest in so doing. It has increased the annual college teaching costs by about 45 dollars for each student.

EDUCATION in Finland is dealt with in a series of articles written by various authors for "Finland, the Country, its People and Institutions" (Otava Publishing Company, Helsinki, 1927), and issued as a separate pamphlet of fifty pages. This symposium, well printed in excellent English, and illustrated, comprises chapters on the elementary school system, secondary education, adult education, athletics, seats of learning, and the technical university. To the student of school systems the history of education in Finland is interesting, especially on account of the extraordinarily important place assigned to language teaching and the predominance in educational theory and practice of the influence of Uno Cygnaeus, the 'father of the elementary schools.' Swedish, for centuries the official language of the country, Finnish, the mother-tongue of the bulk of the population, at least two of the great languages of the world, whether classical or modern, and, until recently, Russian, have all been included in the ordinary grammar school curriculum. The genius of Uno Cygnaeus, an enthusiastic follower of Pestalozzi, made a deep impression on his contemporaries and is to-day inspiring a movement towards a closer connexion with practical life, alike in elementary and secondary schools. Adult education is promoted by many agencies and is encouraged by State grants amounting, for the year 1926, to ten million marks. In 1920, Parliament decided to make the State directly responsible for the development of public libraries, and set up a libraries board, on which various educational organisations are represented, and a bureau, and divided the country into districts for propaganda and advisory work, with a library advisor in each. The principal seat of learning is the University of Helsinki (Helsingfors), a State institution. There are also two private universities, a commercial high-school, and a State technical university.

Calendar of Discovery and Invention.

September 18, 1883.—On Sept. 1, 1883, W. R. Brooks, at Phelps, N.Y., detected a comet which became an object of great interest owing to its identification with the Pons comet of 1812. This identity appears to have been first announced by the Rev. George M. Searle of New York in a letter published on Sept. 18.

September 19, 1648.—In Nov. 1647, a month after the death of Torricelli, Pascal suggested to his brother-in-law, Perier, the experiment of carrying a Torricellian tube up a mountain and noting the variation in the height of the mercury. It was not found possible to make the experiment until Sept. 19, 1648, when a party ascended the Puy de Dôme, near Clermont, equipped with a tube. At starting, the mercury stood at 26 in., but at the summit it had fallen to 23 in., "the party being greatly pleased at this, as indicating the relation between the height of the mercury and the height of the station."

September 20, 1849.—A patent of considerable interest in the early history of the applications of electricity is that of Staite and Petrie, E.P. 12,772, of Sept. 20, 1849. A method was devised to overcome the injury which the iridium sustained when fused by a discharge between two carbon electrodes, and consisted in allowing the discharge to take place between an iridium rod and the grains or powder of the iridium it was desired to fuse.

September 21, 1812.—On this date Count Francesco Zambeccari, accompanied by Vincenzo Bonaga, ascended near Bologna in a balloon of the Montgolfier type, heated by a lamp of the design of J. N. von Laicharding, an Innsbruck professor of natural history. The lamp burnt oil or spirit and was claimed to decrease the danger of fire to which the Montgolfier type of balloon was naturally subject. The wind blew the balloon against a tree, the branches of which upset the heating apparatus, the lamp exploded, the balloon crashed, and Zambeccari was killed.

September 22, 1859.—The publication of Rankine's work, "The Steam Engine," marks an epoch in the application of scientific principles to practical work. In his preface, dated Sept. 22, 1859, Rankine wrote: "The principles of thermodynamics, or the science of the mechanical action of heat, are explained in the third chapter of the third part more fully than should have been necessary but for the fact that this is the first systematic treatise on that science which has ever appeared, the only previous source of information regarding it being detached memoirs in the transactions of learned societies and in scientific journals."

September 23, 1846.—The planet Uranus, before its actual discovery by Sir William Herschel in 1781, had been observed as a fixed star on at least seventeen other occasions, beginning with Flamsteed in 1690. In the close study following its recognition as a planet, many irregularities were discovered which were outside the admissable limits of error. The investigations of Adams and Leverrier showed that no explanation of the motions of Uranus was admissible except that of a planet exterior to Uranus. It was at the Observatory of Berlin that the good fortune of discovering the new planet, Neptune, fell to the chief assistant, J. G. Galle, on Sept. 23, 1846.

September 24, 1852.—One of the earliest successful dirigibles was that of Henri Giffard, a Frenchman who, in 1852, invented a spindle-shaped gas-bag, propelled by a 3-h.p. steam engine. The ship was about 140 ft. long and 40 ft. diameter, and contained 88,000 cubic feet of gas. The bag was enclosed in a net from which was suspended a spar 66 ft. long. The engine car hung from the spar. A short journey was made in the airship on Sept. 24, 1852, when a speed of about 3 miles an hour was attained. W. C.

Societies and Academies.

LONDON.

Institute of Metals (Derby, annual meeting), Sept. 6.—L. Aitchison: Metals in modern transport (Lecture). In general, the properties that lead to the greatest employment of the non-ferrous metals and alloys are: (1) A high resistance to corrosion. (2) High values of thermal or electrical conductivity. (3) A low value of specific gravity. In addition, the properties of ease of machining, ease of cold working, and simplicity of casting contribute to the wider usefulness of the materials. A high resistance to corrosion is a conspicuous feature of nickel and its alloys; this property is of service in cupro-nickel condenser tubes. The alloys of copper are for this reason also used in condenser tubes and turbine blading, and gun metal and phosphor bronze castings. Metals having a much lower specific gravity than iron and steel and mechanical properties comparable with those of the ferrous metals are of great importance in transport systems. The alloys that are actually employed are those based upon aluminium and magnesium. The alloys of aluminium at the present time are much more extensively employed than the alloys of magnesium. A variety of aluminium casting alloys can be employed, and are more or less interchangeable, but the majority of the wrought parts are made in duralumin. They are used in rail coaches and food containers, in constructing panels and structural sections in tramcars, motor-cars, and motor buses, in automobile engines and in aircraft. Various kinds of non-ferrous metals having tin, or lead, or copper as their basis are used as anti-friction materials.

Sept. 7.—Marie L. V. Gayler: The under-cooling of some aluminium alloys. The effect of under-cooling on the macro- and microstructure of some silicon-aluminium and copper-aluminium alloys has been studied. It was not possible to under-cool 'modified' silicon-aluminium alloys systematically; the curves of solubility represented by the 'modified' diagram correspond closely to the supersolubility curves of the 'normal' alloys.—A. R. Raper: The equilibrium diagram of copper-tin alloys containing from 10 to 25 atomic per cent. of tin. The alloys have been examined both by thermal and micrographic analysis. The $\alpha+\beta-\beta$ boundary shows a sudden change in direction at 580°, which together with other micrographic evidence favours Stockdale's view of a polymorphic change of the β constituent. The eutectoid point is at tin 16·15 (or 73·15 per cent. copper by weight), the temperature of the inversion being 520°. The 'transformation' curve has been determined carefully by thermal analysis; the slight horizontal at about 610° exists from tin 22·5 to tin 25 at a temperature of 638°. Evidence for a new eutectoid at tin 23 has been obtained.—F. Hargreaves: Effect of work and annealing on the lead-tin eutectic. A marked softening action of work at air temperature on the lead-tin eutectic is found. In the case of 78 per cent. reduction in thickness, the Brinell hardness is reduced from about 14 in the chill-cast condition to 4·2 when tested immediately after hammering. This value is actually lower than that of either constituent in the pure state.—W. Hume-Rothery: Researches on intermetallic compounds (vi.). The reaction between solid magnesium and liquid tin. The reaction has been studied between 250° C. and 350° C. When a rod of magnesium is stood in a limited quantity of molten tin, the magnesium dissolves until the liquid reaches the equilibrium composition at the particular temperature concerned. Since, however, true equilibrium requires the compound Mg_2Sn (probably Mg_4Sn_2) as the phase in equilibrium with the liquid, a further reaction of the type, solid magnesium + liquid = solid magnesium stannide, tends to take place. When sufficient magnesium has dissolved to give the liquid the equilibrium composition, all further direct reaction is stopped by a thin film of magnesium stannide which shows no appreciable thickening even after three weeks at the above temperatures. On the other hand, a few large crystals of magnesium stannide are sometimes formed by a slow reaction. This is probably the ordinary phenomenon of crystal growth due to surface energy effects, since the thin surface film has a high surface energy and so tends to form a more compact mass. But any solution at one point exposes more magnesium to the action of the liquid, and so the reaction gradually proceeds.—W. T. Cook and W. R. D. Jones: The copper-magnesium alloys (Part 2). The ductility of these alloys depends primarily on the forging temperature. If this temperature be low, the elongation and the reduction of area are impaired seriously, and the values are not restored by subsequent heat-treatment. The mechanical properties of copper-magnesium alloys containing up to 11 per cent. copper are not improved by simple heat-treatment, which causes a general decrease in test values. The addition of copper to magnesium up to about 2 per cent. is beneficial. Beyond this amount the increase in tenacity is small, whilst there is a regular decrease in ductility and a proportional increase in specific gravity. There is no advantage in adding more than this amount of copper to magnesium either for castings or for forgings.

Sept. 8.—C. J. Smithells, W. R. Pitkin, and J. W. Avery: Grain growth in compressed metal powder. The changes which take place in certain properties of bars of pressed tungsten powder when the temperature is gradually raised have been investigated. These changes are attributed to grain growth, which begins at a temperature determined by the particle size of the powder and the pressure used in forming the bar. Using powders with mean particle size 0·6-3·5μ, and pressures 8-32 tons/sq. in., the temperature at which grain growth could first be detected varied from 1100° K. to 1500° K.—C. H. M. Jenkins: The constitution and physical properties of some of the alloys of copper, zinc, and cadmium. The general results indicate that the use of cadmium-bearing zinc does not produce any marked alteration in the physical properties of the brass. Additions of cadmium up to 1 per cent. by weight cause an improvement in the tensile strength, generally accompanied by a reduction in elongation. The effect is most noticeable in the cast 70:30 brass, and is less pronounced in worked material.—H. Sutton and A. J. Sidery: The protection of aluminium and its alloys against corrosion. The resistance of aluminium, duralumin, and of certain other aluminium alloys to corrosion by sea-water is considerably increased by anodic oxidation and the subsequent application of a grease, such as lanoline. Electro-deposited coatings of zinc, 0·005 in. thick, afforded better protection to aluminium than did coatings of cadmium of similar thickness, but the two types of deposit appeared to give an approximately equal protection when applied to alloys of aluminium. Unsatisfactory results were obtained from nickel deposits of normal thickness.—H. Sutton and J. W. W. Willstrop: The nature of the film produced by anodic oxidation of aluminium. The metallic aluminium is volatilised in dry hydrogen chloride. The films isolated from treated commercial aluminium sheet are usually of a grey colour, due to traces of carbon left behind when the aluminium sublimes as chloride, and they contain elementary

silicon. Films varying in thickness from 0·033μ to 2μ have been obtained, the thickness of the film produced by the usual standard treatment being about 1μ. From the volume of gas evolved by treated aluminium when heated *in vacuo* to 1200° C., the film is shown to consist of oxide and not of hydroxide.—W. **Hume-Rothery** and S. W. **Rowell**: The system magnesium-cadmium. The equilibrium diagram of the system magnesium-cadmium has been investigated by thermal and microscopic methods. The system contains a solid solution based on cadmium and denoted α, a definite intermetallic compound $MgCd_2$, and a solid solution in magnesium denoted β. The solid solution α extends from 0 to about 24 atomic per cent. magnesium at most temperatures. The compound $MgCd_2$ does not form any solid solutions, whilst the β solid solution extends from about 40 to 100 atomic per cent. magnesium. The β solid solution undergoes a transformation at temperatures about 200° to 250° C., but the maximum temperature of this change is at 54 atomic per cent. The change seems to be of the same nature as that of the β brasses. Prolonged annealing is necessary to attain equilibrium in the solid alloys in the neighbourhood of the compound $MgCd_2$.—Cyril S. **Smith**: Note on cathodic disintegration as a method of etching specimens for metallography. Silver-copper alloys are particularly suited for etching by this process, which causes staining of the copper-rich constituent as well as removal of the silver.

PARIS.

Academy of Sciences, Aug. 17.—**Akimoff**: Fourier-Bessel transcendentals with several variables.—F. **Gonseth** and G. **Juvet**: The metric in space of 5 dimensions of electromagnetism and of gravitation.—B. **Cabrera** and A. **Dupérier**: The paramagnetism of the palladium and platinum families.—A. **Duboin**: The application to the oxides of iron and neodymium of a general method of synthesis of silicates.—Georges **Lumet** and Henri **Marcelet**: The utilisation of marine animal oils and fish oils in motors. These oils have been used to work a Diesel-Hindl motor without special adjustment. The power of the motor was practically unchanged when the fish oils were substituted for gas oil. Corresponding with the lower calorific value, more fish oil than gas oil was required. The only difficulty was caused by the higher viscosity of the fish oils, and this was overcome by a preliminary heating.—J. **Dadlez**: The proportion of nitrous fumes in the neighbourhood of an arc lamp used for medical treatment. Under normal conditions the amount of oxides of nitrogen produced are without danger, but in a small room efficient ventilation must be provided.

Aug. 22.—A. **Lacroix**: The lithological constitution of the volcanoes of the central southern Pacific. The volcanic islands in the southern Pacific Ocean can be grouped under three lithological series, nephelinic, intermediary, and without nepheline. The strict classification of eruptive rocks into a Pacific type and an Atlantic type cannot be maintained in this form.—**Riquier**: The numerical resolution of certain systems of integral algebraical equations with any number of unknowns.—C. **Sauvageau**: The continuous growth of certain annual Pheosporeæ.—Charles **Nicolle** and Charles **Anderson**: The experimental transmission of the spirochæte of Spanish recurrent fever by *Ornithodorus moubata* and the mechanism of this transmission. *O. moubata* is capable of transmitting not only the Dutton spirochæte of which it is the natural transmitter, but also two others, one of which is allied to the Dutton spirochæte, the other quite different. The mechanism of transmission in these cases is the same; it is a natural transmission.—Georges J. **Remoundos**: A new generalisation of the Picard theorem.—Léon **Pomey**: The existence of non-linear differential and integral equations (with any number of variables) of which solutions exist in the same domain as the coefficients (normal non-linear equations).—J. A. **Lappo-Danilevski**: The algorithmic resolution of the problem of Poincaré concerning the construction of a monodrome group of a given system of linear differential equations.—Miron **Nicolesco**: Bipoint functions and conjugated areolairely functions.—René **Lagrange**: Certain suites of polynomials.—**De Fleury**: The forms of the combustion chambers in internal combustion motors and their effect on endurance. The best practical constructive solutions of the problem tend towards very high compressions, with explosion chambers possessing a high ratio of surface to volume for combustibles such as petrol liable to develop an explosive wave.—F. **Gonseth** and G. **Juvet**: Schrödinger's equation.—W. **Kopaczewski** and M. **Rosnowski**: Electrocapillary phenomena and the ions.—Tr. **Negresco**: The quantitative sensibility of the lines of the spectrum. The sensibility of any given line in the spectrum, in a given source of emission, depends uniquely on its intensity in the spectrum of the pure metal obtained under identical conditions.—Henri **Marcelet**: The determination of some physical constants of marine animal oils. The data given for thirty different oils include the heat of combustion, flash point, specific gravity, and viscosity.—A. P. **Rollet**: The behaviour of various metals in the electrolysis of water by the alternating current.—Mme. N. **Demassieux**: The action of oxalic acid upon some soluble salts of lead.—W. **Ipatieff** and W. **Niklaeff**: The action of hydrogen upon tin salts at high temperatures and pressures. At 300° C., with hydrogen under 38 atmospheres pressure, hydrated tin oxide is reduced to the stannous state; at 350° C. and 50 atmospheres, the reduction goes further to metallic tin. Stannic sulphate (302° C. and 50 atmospheres) gives stannous sulphate in solution and crystals of stannous sulphide.—L. **Hackspill** and E. **Rinck**: The reciprocal displacement of sodium and potassium from their chlorides. An experimental study of the reaction $KCl + Na = NaCl + K$.—André **Léauté**: The low temperature distillation of long flame coals agglomerated by tar or a tar oil. The experiments described were directed towards the determination of the best proportion of oil or tar giving a hard solid residue.—Pereira **de Sousa**: A new deposit of intrusive rocks containing sodium in Portugal.—J. **Lacoste**: The experimental determination of the dynamic magnification of seismographs with platform.—L. **Petitjean**: A periodicity and symmetry of the rainfall curve at Algiers. Application to the prediction of dry and rainy periods in Algeria.—Cam. **De Bruyne**: Contribution to the study of the nutritive process of the oosphere of the Abietineæ.—H. **Colin** and A. **Augem**: The nature and metabolism of the glucides in the Iris.—F. **Vlés** and A. **de Coulon**: The interpretation of the curves of the receptivity index of mice for grafts of tumours.—S. **Voronoff**: The results of the grafts on the flock of sheep of the Gouvernement général d'Algérie.

SYDNEY.

Linnean Society of New South Wales, July 27.—H. J. **Carter**: Australian Coleoptera: notes and new species (No. 5).—G. H. **Cunningham**: The Gasteromycetes of Australasia (9): Keys to the genera and species of the Lycoperdaceæ. The ontogenetic position of each of the genera is discussed and an artificial key based on structural similarities and differences is

proposed.—J. R. Malloch: Notes on Australian Diptera (No. 11). A full account is given of the Australian Calliphoridæ, and the family is divided into Calliphorinæ, Metopiinæ, Sarcophaginæ, Chrysomyiinæ, and Rhiniinæ.—A. M. Lea: Descriptions of new species of Australian Coleoptera (Part 19). Two new genera and 38 new species of beetles of the family Curculionidæ, mostly from Queensland, are described.—J. McLuckie and A. H. K. Petrie: The vegetation of the Kosciusko Plateau (Part 1). The plant communities. Three zones are recognised: alpine, subalpine, and montane. The three great types of communities are (*a*) Eucalyptus forest, represented by the *E. coriacea*, *E. Gunnii*, and *E. stellulata* consociations; (*b*) grassland represented by the Poa consociation and the Poa-Celmisia association; (*c*) the marsh vegetation. The factors controlling the timber line and the interrelations of the communities of the marsh vegetation are also discussed.

Official Publications Received.

BRITISH.

Jamaica. Annual Report of the Department of Agriculture for the Year ended 31st December 1926. Pp. 29. (Jamaica, B.W.I.: Government Printing Office, Kingston.)

Canada. Department of Mines: Geological Survey. Summary Report, 1925, Part C. (No. 2118.) Pp. 175c. Summary Report, 1926, Part B. (No. 2127.) Pp. 57B. Memoir 151, No. 132 Geological Series: Minto Coal Basin, New Brunswick. By W. S. Dyer. (No. 2115.) Pp. ii+42. 15 cents. Memoir 152, No. 133 Geological Series: St. Urbain Area, Charlevoix District, Quebec. By J. B. Mawdsley. (No. 2120.) Pp. ii+58. 20 cents. (Ottawa: F. A. Acland.)

The North of Scotland College of Agriculture. Calendar, Session 1927–1928. Pp. viii+122. (Aberdeen.)

Nigeria. Annual Report on the Agricultural Department for the Year 1926. Pp. 20. (Ibadan.)

Report on the Administration of the Meteorological Department of the Government of India in 1926–27. Pp. 17+3 plates. (Simla: Government of India Press.)

Western Australia: Geological Survey. Bulletin No. 85: A Geological Reconnaissance of part of the Ashburton Drainage Basin, with Notes on the Country southwards to Meekatharra. By H. W. B. Talbot; with an Appendix on the Minerals of the Ashburton and Gascoyne Valleys, by Dr. Edward S. Simpson. Pp. 113+5 plates. (Perth: Fred. Wm. Simpson.)

Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C. Syllabus of Classes, Session 1927–1928. Pp. 119. (London.)

Union of South Africa: Department of Agriculture. Science Bulletin No. 60: Some Changes occurring during the Ripening of Grapes. (Third paper.) By P. R. v. d. R. Copeman. (Division of Chemistry Series No. 75.) Pp. 19. (Pretoria: Government Printing and Stationery Office.) 3*d*.

Aeronautical Research Committee: Reports and Memoranda. No. 1075 (Ae. 257): Lateral Stability at Low Speed. By S. Scott Hall. Part i: Measurement of Rolling Moments for Three Wings at Low Rates of Roll; Part ii: Pressure Measurements on a Wing whilst Rotating at Low Speeds. (A.2.a. Stability Calculations and Model Experiments, 120.—T. 2382.) Pp. 13+20 plates. 1*s*. net. No. 1083 (Ae. 262): The Influence of the Airscrew on the Aircraft Characteristics of a Standard Bristol Fighter Aeroplane. By W. G. Jennings. (A.4.c. Full scale Work-Airscrews, 37.—T. 2393.) Pp. 4+8 plates. 4*d*. net. No. 1085 (Ae. 264): Lift and Drag of the Bristol Fighter with Fairey Variable Camber Wings. By E. T. Jones, L. E. Caygill and Dr. R. G. Harris. (A.3.b. Aerofoils with Flaps or Warped, 27; A.4.b. Full scale Work-Parts of Machines, 29.—T. 2412.) Pp. 12+10 plates. 9*d*. net. (London: H.M. Stationery Office.)

The University of Leeds. British Association for the Advancement of Science, Leeds Meeting, 1927. University Reception, Tuesday, September 6th, 1927, 8 p.m.-10.30 p.m. Pp. 27. (Leeds.)

FOREIGN.

University of Colorado Bulletin. Vol. 27, No. 6, General Series No. 243: Catalogue, 1926–27; with Announcements for 1927–1928. Pp. 439. (Boulder, Colo.)

Proceedings of the Imperial Academy. Vol. 3, No. 6, June. Pp. xv-xvi+307-385. (Tokyo.)

Nauka Polska: La Science Polonaise. Tom 8. Pamiętnik II Zjazdu Naukowego odbytego w Warszawie w dniu 2-3 Kwietnia 1927 Roku: Mémoire du II Congrès scientifique tenu à Varsovie les 2 et 3 Avril 1927 pour étudier la question de l'organisation de l'enseignement supérieur en Pologne. Pp. 97. (Warszawa: Im. Mianowskiego.)

Agricultural Experiment Station, Michigan State College of Agriculture and Applied Science. Technical Bulletin No. 80: Virus Diseases of Raspberries. By C. W. Bennett. Pp. 38+11 plates. Technical Bulletin No. 81: Storage and Transportational Diseases of Vegetables due to Suboxidation. By Ray Nelson. Pp. 38+8 plates. Technical Bulletin No. 82: Commercial Casein. By A. C. Weimar and John Taylor. Pp. 16. Technical Bulletin No. 83: A Study of the Sanitary Significance of Air in relation to Ice Cream. By F. W. Fabian. Pp. 30. Circular Bulletin No. 102: Farm Lease Systems in Michigan. By F. T. Riddell. Pp. 18. Circular Bulletin No. 105: Sweet Corn. By G. E. Starr. Pp. 19. Special Bulletin No. 166: Studies in Orchard Management, with Special Reference to Cherry Production. By A. J. Rogers, Jr. Pp. 43. (East Lansing, Mich.)

Department of the Interior: Bureau of Education. Bulletin, 1927, No. 3: School Hygiene and Physical Education. By Dr. James Frederick Rogers. Pp. 20. 5 cents. Bulletin, 1927, No. 8: Recent Movements in City School Systems. By W. S. Deffenbaugh. Pp. 26. 5 cents. Bulletin, 1927, No. 9: Medical Education, 1924–26. By Dr. N. P. Colwell. Pp. 14. 5 cents. (Washington, D.C.: Government Printing Office.)

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 550: Application of the Algebraic Aberration Equations to Optical Design. By I. C. Gardner. Pp. 71-203. 45 cents. Scientific Papers of the Bureau of Standards, No. 552: Transmission of Sound through Building Materials. By V. L. Chrisler. Pp. 225-235. 5 cents. (Washington, D.C.: Government Printing Office.)

Agricultural Experiment Station of the Rhode Island State College. Bulletin 208: The Production of Gas by *Salmonella pullorum*. By Kenneth Goodner and Henry G. May. Pp. 12. Bulletin 209: The Degree of Response of Different Crops to various Phosphorus Carriers. By Burt L. Hartwell and S. C. Damon. Pp. 20. (Kingston, R.I.)

Diary of Societies.

TUESDAY, SEPTEMBER 20.

INSTITUTE OF MARINE ENGINEERS (at Olympia), at 3.—E. F. Spanner: The Case against the Airship.—A. C. Hardy: Motor Ships in relation to World Trade Routes.

FRIDAY, SEPTEMBER 23.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South Midland District Meeting) (at Building Research Station, Garston, near Watford), at 11 A.M.

SATURDAY, SEPTEMBER 24.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Eastern District Meeting) (at Herne Bay), at 11 A.M.

CONGRESSES.

SEPTEMBER 15–17.

ANNUAL CONFERENCE OF WOMEN ENGINEERS.

Saturday, September 17, at 2.15 (at Crosby Hall).—Miss Iris Cummins: Water Power and the Electrification of the Irish Free State.

SEPTEMBER 18–OCTOBER 3.

INTERNATIONAL CONGRESS OF THEORETICAL AND APPLIED LIMNOLOGY (at Rome). In four sections: Physics and Chemistry, Geology and Hydrography, Biology, and Applied Limnology.

SEPTEMBER 20–22.

IRON AND STEEL INSTITUTE (Autumn Meeting) (at Royal Technical College, Glasgow), at 10 A.M.—*Papers to be submitted*:—D. F. Campbell: High-Frequency Induction Melting.—H. A. Dickie: Magnetic and other Changes concerned in the Temper-Brittleness of Nickel-Chromium Steels.—Prof. C. A. Edwards and K. Kuwada: The Influence of Cold-Rolling and Subsequent Annealing on the Hardness of Mild Steel.—A. B. Everest, T. H. Turner, and D. Hanson: The Influence of Nickel and Silicon on an Iron-Carbon Alloy.—C. S. Gill: The Effect of Varying Ash in the Coke on Blast-Furnace Working.—D. Hanson: The Constitution of Silicon-Carbon-Iron Alloys, and a New Theory of the Cast Irons.—E. G. Herbert: The Work-Hardening of Steel by Abrasion.—K. Honda and K. Takahasi: On the Quantitative Measurement of the Cutting Power of Cutlery.—E. H. Lewis: The Use of Silica Gel as a Medium for Drying Blast.—T. Matsushita and K. Nagasawa: The Mechanism of Tempering of Steels.—T. W. Robinson: The Economic and Social Development of the American Iron and Steel Industry.—Dr. W. Rosenhain and D. Hanson: The Behaviour of Mild Steel under Prolonged Stress at 300° C.—J. H. Smith and F. V. Warnock: A Testing Machine for Repeated Impact, and a Preliminary Investigation on the Effects of Repeated Impact on Lowmoor Iron.—J. H. Whiteley: The Solution of Carbon in α-Iron and its Precipitation.—F. Wüst: A Contribution to the Theory of the Blast-Furnace Process.

SEPTEMBER 23–26.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (at Trinity College, Cambridge).—Subjects for discussion: Report of the Public Libraries Committee of the Board of Education (A. E. Twentyman and Lieut.-Col. L. Newcombe); Recent Developments in connexion with the Science Library, South Kensington (Sir Henry Lyons); Information, Organisation, and Statistics in Industry (Major L. Urwick, S. J. Nightingale, H. Quigley, W. Wallace, A. E. Overton, F. W. Tattersall); Patent Classification (A. R. Wright, A. Gomme); Problems of the Information Bureau (A. F. Ridley, P. K. Turner, Dr. J. C. Withers); Photographic Reproduction of Printed and MS. Material (N. Parley, Sir William Schooling, R. H. New); Standards of Book Selection in Science and Technology (Sir Richard Gregory).

SEPTEMBER 26 AND 27.

CERAMIC SOCIETY (Refractory Materials Section Meeting) (at Town Hall, Bournemouth), at 10 A.M.—A. T. Green: A Consideration of Steel Works Refractories.—W. J. Rees and W. Hugill: Note on Silica Bricks made without Added Bond.—R. S. Troop: Some Experiments in the Drying of Clays.—W. C. Hancock: Crushing Strength of Unfired Fireclay Bodies.—A. E. J. Vickers: Determination of Iron Silicates.—Prof. D. A. Moulton: Refractory Material used as Mortar for Laying up Refractories.—Dr. A. F. Joseph: Characterisation of Clay.—A. J. Dale: Effects of Temperature on the Mechanical Properties of Silica Products.