NATURE

SATURDAY, FEBRUARY 3, 1923.

CONTENTS.

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

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

NO. 2779, VOL. 111]

The Science and Practice of Pure Milk Supply.

II.

IN last week's article on this subject emphasis was placed on the importance of the consideration that efforts to secure pure milk satisfying scientific conditions should not, if possible, be permitted to reduce the total quantity of milk available for public use. There is little doubt that immediate action to enforce the supply of milk from non-tuberculous cattle would have this effect, and thus action beneficent in its intention would be inimical to the public welfare.

There is every reason for excluding from milking herds all cows with diseased udders, or which can be shown to be giving milk containing tubercle bacilli. It is advisable to encourage farmers to clear their herds of tuberculosis, and to give special certificates to farmers who sell milk only from cows proved free from tuberculosis by the tuberculin test. It may be desirable to go further than this for small herds of cattle, with a limited supply; for a single diseased cow in a small herd is much more dangerous to human consumers than when the bacillary milk is diluted in a vaster volume of milk. There are those who regard the imbibition of small quantities of tubercle bacilli in milk as a valuable means of securing partial human immunity; but even if this be accepted as possible, the toleration implied by it of tuberculous infection of unknown dosage is unscientific, and the only sensible plan is to pasteurise milk from untested herds. Every human being receives tubercle bacilli of human origin in small doses, and the prevention of human tuberculosis may be said to consist—on the side of infection—in preventing too frequent or massive infection, beyond the powers of personal resistance. This is much more important for young children than for adults, whether the tuberculous infection is derived from milk or from a consumptive human patient,

Pasteurisation then is a chief means of protection against the occasional dangers of milk. It is not an alternative to the hygiene of the cow and of the cow-shed, of transport, of sale, and of domestic storage. It is supplementary to them and aids their action. Nor can pasteurisation be said to encourage the continuance of a dirty milk supply. Milk which is dirty does not keep well after pasteurisation, and is thus commercially unprofitable. The methods of pasteurisation have improved, the flash method having been replaced by the "holder method" of pasteurisation, which makes it more likely that the milk will all be subjected to the temperature decided upon. Pasteurisation is still in process of improvement, as there is reason to think that in practice

some of the milk may escape too soon from the heating process. Even so the danger of tuberculosis, etc. has been greatly reduced, for dosage of infection is an essential element in the result. The temperature prescribed in the recent Order of the Ministry of Health is not less than 145° F. and not more than 150° F. for at least half an hour, the milk to be immediately cooled to a temperature of not more than 55° F. It is also laid down that any sample of pasteurised milk taken before delivery to the consumer shall not contain more than 30,000 bacteria per c.c. nor any bacillus coli in one-tenth of a cubic centimetre.

It is unfortunate that, in the somewhat hesitating and tentative regulations of the Ministry of Health, it has not been regarded as advisable to regulate the conditions of commercial pasteurisation, which is practised on a large scale without any special certificate being asked for by the producer. It is probable that at the present time most of the milk coming into London is pasteurised, though not always satisfactorily. In American cities such pasteurisation is subject to rigid supervision, an automatic gauge of the temperature of pasteurisation being kept for official inspection: and the system now inaugurated in England, in which it will be possible for vendors to pay for a certificate of permission to sell "pasteurised" milk, while their neighbours are selling pasteurised or partially pasteurised milk without such a certificate and without disclosure of the fact that the milk has been treated by heat, is obviously a system which should not continue. The uncertified and undeclared pasteurisation has real possibilities of mischief; for it leads the unsuspecting purchaser to subject the milk to repeated heating to its detriment. Such doubly-heated milk is liable to produce scurvy and rickets. This naturally leads to the consideration of the drawbacks to pasteurisation of milk. The evidence goes to show that pasteurisation as defined above, followed by rapid cooling, does not spoil the milk. Such milk, like dried milk, has not been shown to produce scurvy: and any fear on this point is averted by the use of fruit juice in small quantities. Although the vitamin-content of milk treated on the "holder" system has not been adequately investigated, experimental observations quoted in the October issue of the *Scottish Journal of Agriculture* show that there need be little apprehension on this head, especially if the precautionary use of fruit juice is adopted. The admirable results of feeding infants on dried milk confirm this opinion.

The general enforcement of pasteurisation of milk is called for in the public interest, and there can be little doubt that step by step this will come into operation. It is the most practical method of State regulation; and it secures immediate safety against serious risks of infection when carried out satisfactorily. For many years efforts to improve the sanitary conditions of the farm and the cow-byre have been made, but with results which are quite incommensurate with the expense involved. By dirt tests, bacterial counts, insistence on cooling of the milk at the farm, and allied measures, both the wholesale purchaser of the farmer's milk and the sanitary authority can do much to increase its cleanliness; but pasteurisation is the essential safeguard in the public interest. Attacks on pasteurised milk are not justified scientifically, and they imply, if successful, a continuance of the supply of infective milk, with the dangers at present associated with its consumption. Pasteurisation is already enforced in a considerable number of American cities, and we would welcome action on the part of the British Government which would permit large local authorities in this country to aid the milk industry and to safeguard the public health by enforcing the pasteurisation under satisfactory conditions of the local milk supply.

The pasteurisation of milk supplies carries with it the distribution of milk in sterilised sealed bottles, which is an important safeguard against domestic contamination, a chief source under present conditions of mischief.

The Ministry of Health has issued regulations also as to superior qualities of milk, which may be described as Certified, Grade A or Grade A (tuberculin tested). Grade A milk is described in the official notice circulated with these regulations as "superior to the ordinary milk of the country and reasonably safe under all ordinary circumstances." Evidently certification of such milk must be made with fear and trembling. According to the schedule of conditions imposed, the cows have not been proved to be free from tuberculosis by the tuberculin test, the chief test imposed being a trimestrial examination of the herd by a veterinary surgeon, who orders the exclusion of any animal "showing evidence of any disease which is likely to affect the milk injuriously." American experience has shown that even with tuberculin testing, it is necessary to pasteurise the Grade A milk supplied for children's hospitals: and the above certificate for Grade A milk cannot be regarded as conferring anything approximating to the security for the consumer which efficient pasteurisation provides. The above-quoted definition conduces to furious thought. We must regard the "ordinary milk of the country"—the milk with which the vast majority of children are supplied—as not "reasonably safe." If so, and it is so, why does the Ministry of Health stop short of a simple regulation requiring

pasteurisation of the mass of publicly supplied milk and thus at once ensuring safety from the chief dangers of our milk supply? Why also does it not insist on declaration of pasteurisation when this has been done commercially apart from any regulations for certifying pasteurised milk?

Physics and Psychics.

(1) (*Psychical Research*). *The Goligher Circle, May to August 1921.* Experiences of Dr. E. E. Fournier d'Albe. With an Appendix containing Extracts from the Correspondence of the late Dr. W. J. Crawford, and others. Pp. 81 + plates. (London: J. M. Watkins, 21 Cecil Court, 1922.) 7s. 6d. net.

(2) *The Case against Spirit Photographs.* By C. Vincent Patrick and W. Whately Smith. Pp. 47. (London: Kegan Paul and Co., Ltd., 1922.)

(3) *Cold Light on Spiritualistic "Phenomena": An Experiment with the Crewe Circle.* By Harry Price. Pp. 15. (London: Kegan Paul and Co., Ltd., 1922.) 6d. net.

(1) IN this book Dr. Fournier d'Albe records his experiments with the Goligher medium and Circle, undertaken to corroborate, if possible, the remarkable results claimed by the late Dr. Crawford. In order to explain certain alleged occult phenomena ("raps," "levitations," etc.) obtained with this medium, Dr. Crawford postulated as the agents invisible entities which he called "operators," and believed to be departed human beings (spirits). The *modus operandi* of the "operators" is as follows: From the medium's body, metamorphosed from her "flesh," a substance, indifferently called "plasm," "ectoplasm," "psychic fluid," etc., emanates as an extensible rod, the proximal end of which retains connexion with the medium's body, the distal free end being provided with a "suction grip" to hold, and move, objects. Dr. Crawford not only photographed this "psychic stuff," but also in June 1920 *saw* it and *felt* it wriggling up the medium's legs like a snake. Shortly after this experience he committed suicide, and his researches ceased. Some ten months later Dr. Fournier d'Albe takes up the broken threads. The séance room he describes as feebly illuminated by a one candle-power gas-burner, enclosed in a box with red glass sides so arranged that the medium is in comparative darkness, the floor, the legs of the members of the Circle, and even some of their hands, being in total darkness. Kathleen Goligher, the medium, is seated at one end, so to speak, of the circle of sitters, her father being almost invariably next her.

Dr. Fournier d'Albe placed at the bottom of an empty decanter a glass button, a peg, and a cork, and asked the "spirits" to remove the cork by means of a "psychic structure," but leave the other objects in the decanter. The "spirits," apparently unable to discriminate between the objects, remove the button. Dr. Fournier d'Albe next placed with the button a drop of mercury in the decanter, and requested the "spirits" to remove the former only. After repeated attempts they gave it up, saying, through raps, that they would try again another day. They did—and succeeded. Lastly, to prevent both inversion of the decanter and substitution, Dr. Fournier d'Albe asks them to remove the button from a decanter containing water. After several trials the "spirits" rap out the message that they cannot do so, as the water dissolves the "psychic structure."

By this time the experimenter is becoming disillusioned. Nor are his suspicions allayed by the chiffon-like appearance of the shadowgraph which he took of the "ectoplasm." Finally, when Dr. Fournier d'Albe unmistakably felt muscular movements of both father and daughter going on in unison with the movements of a "levitated" table, when, a little later, he saw a "levitated" stool balanced on the foot of the medium's outstretched leg, he thought it time to conclude the experiments. He sent the medium a cheque, stating he desired no more sittings as, after three months' experimenting, he had gathered no definite evidence in favour of the psychic origin of the phenomena. However, he was persuaded to attend one more sitting at which a great effort was to be made to produce evidential phenomena. Dr. Fournier d'Albe assented, stipulating that the medium's feet be tied to the chair, and her arms held. This was agreed to, but, as is always the case at séances when trickery is precluded, there were no spiritualistic phenomena of any kind, no levitation could be obtained—not even the faintest rap.

Dr. Fournier d'Albe is to be congratulated on his exposure of this notorious medium and Circle. But let the reader be under no misapprehension: although Dr. Fournier d'Albe says Dr. Crawford's experiments are invalidated he yet sees nothing in his own dealings with the Golighers to make him doubt the genuineness of the "spiritualistic phenomena" of Madame Bisson and her medium Eva C. We wonder if he holds the same opinion now that the "phenomena" of this French medium have been dismissed as a "clumsy hoax" by a committee of professors who recently witnessed them.

The book contains an appendix dealing with the correspondence of the late Dr. Crawford and others which the reader cannot afford to ignore, as it furnishes a good insight into the reasoning capacity and "scientific method" of spiritualists.

(2) The authors describe the many methods of taking spirit-photographs, enumerate the devices of mediums for deceiving the public, and, finally, state why they decline to accept the phenomena as genuine. "Of all spiritualistic phenomena," says Mr. Smith, "spirit-photographs are the most obviously fraudulent."

The general argument of believers in spirit-photography is as follows: The ether waves that affect the eye (light) constitute but a small proportion of the complete wave-scale. The photographic plate is sensitive to infra-red and ultra-violet waves, and to X-rays, to all of which the retina is indifferent. Why, therefore, should not the photographic plate respond to "spirit" emanations? The reasoning, while not altogether unsound, calls to mind the advice in the cookery book in the recipe for hare soup—first catch your hare!

The type of spirit-photograph with which this work principally deals is, in the jargon of the cult, an "extra." A bereaved individual gives the spirit-photographer (medium) a description or a portrait of the departed one from whom he wants a sign. After payment of fees he sits for his portrait, which is duly presented with an extra figure thereon that the victim imagines to represent his lost one. Spiritualists claim that hundreds of "extras" have thus been recognised, which only shows how much the psychology of deception accentuates the truism—the wish is father to the thought. The spirit-photographer Buguet was eventually detected and sentenced to twelve months' imprisonment and a heavy fine; yet, despite his confession of guilt and his description of how he had faked the "spirits" on his photographs, witness after witness came forward and swore to having recognised the "extras."

Mr. Patrick, in a careful analysis of "Fairy Photographs," recently published by Sir A. Conan Doyle, directs attention to the many suspicious points demanding further explanation, and he does not hesitate to label the fairies as "fakes."

If only those who desire to receive communications from the unseen would first read this book one of the most pernicious forms of parasitism extant would disappear.

(3) Mr. Price's remarks are significant, as he is a member of the Society for Psychical Research—a society not notoriously addicted to hypercriticism of occult phenomena. To him is due the credit of exposing Mr. Hope of Crewe, the last and most elusive of the three leading British spirit-photographers. Vearncombe had been detected substituting plates. Mrs. Deane, a member of, and strongly recommended by, the "British College of Psychic Science," has also been proved to have tampered with plates. Remained only Mr. Hope and his assistant Mrs. Buxton. To him comes Mr. Price craving a "spirit extra," and armed with a set of four plates secretly marked by X-rays with a stencil design in such way that, *after development*, the whole set of plates would show the complete design, any lacunæ in the latter proving substitution. As a result, Mr. Hope is found "guilty of deliberately substituting his own plates for those of a sitter."

The question which the reader will ask after perusal of these three works is not—Why are there so many deceivers? but Why are there so many dupes? Money—whether fees for "extras" and "psychographs" or substantial royalties for books—may explain the former, but wherefore the victims? The secret, we opine, lies in a defect of education. The young are taught to think, but not *how* to think. It is of minor import whether the conclusions in which thoughts terminate are or are not in accordance with fact. What is of vital importance is the character of the mental processes. It is wrong thinking rather than wrong thoughts that so often mars the individual, undermines society, and imperils the State. *Circumspice!* So long as the young growing child does not learn *how* to think, there will inevitably be an undue proportion of grown-ups whose pitiful logic consists in drawing false conclusions from unsound premises, and to whom error appears as truth provided it be shouted sufficiently loudly and frequently.

C. MARSH BEADNELL.

A Great American Agricultural Cyclopædia.

(1) *Cyclopedia of Farm Crops: A Popular Survey of Crops and Crop-making Methods in the United States and Canada.* Edited by L. H. Bailey. Pp. xvi+699+25 plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1922.) 25*s.* net.

(2) *Cyclopedia of Farm Animals.* Edited by L. H. Bailey. Pp. xvi+708+25 plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1922.) 25*s.* net.

DR. L. H. BAILEY has edited more agricultural books than any other man living, but he can never have excelled the two volumes that constitute this Cyclopædia. One volume deals with crops: the other with animals. Of agricultural crops there are in the United States between one and two hundred, quite apart of course from the innumerable plants coming within the province of the horticulturist. In these volumes a generous view is taken, and room is found for medicinal plants and plants yielding fibre, paper, oil, dyes, etc., which would not usually be included in an agricultural list. The animals are less

numerous, but even here the list is much larger than would have been expected, and is made to include pets, fish, game, and productive insects, as well as the usual poultry and live-stock. The volumes are the direct descendant of the well-known Cyclopædia of American Agriculture, which has run out of print and by reason of the cost will not be reprinted *in extenso*.

(1) The plan of the volume dealing with crops is to start with an account of the life processes of the plant, well written by W. J. V. Osterhout, followed by descriptions of the effects of stimulation by artificial light, weak poisons, and electricity; then to deal with insect and fungoid pests, and afterwards with plant breeding. The more technical part commences with accounts of the general principles of crop production and farm management, rotations, the growth of crops under cover, etc., and finally comes the long list of field crops, each of which is dealt with in detail.

More than a hundred experts have contributed to the volume and they have amassed a wealth of interesting material, much of which seems very strange to English readers. How many agriculturists in this country are familiar with the agricultural process of "singeing the cholla"? This operation is described in connexion with the cactus which constitutes a considerable part of the vegetation in the southern part of the range country, New Mexico and Arizona. Unfortunately the natural cacti are in the main spiny, and the attempts to introduce spineless forms useful to stock have not proved particularly successful. Nothing daunted, however, the American ranger has proved equal to the situation; by means of a gasoline blow-lamp the spines are singed off, with the result that the cacti become much relished by live-stock and are literally devoured, the prickly pears being eaten nearly to the ground, while only the trunks and woody branches of the chollas (*Opunta fulgida*) remain.

Turning to agriculture proper, the most important and most distinctive crop of the United States is maize, there always called "corn." It is described as of Mexican origin and related to Mexican grass teosinte (*Euchlæna Mexicana*). The annual value of the crop exceeds that of any other in the States, and is estimated at more than a billion dollars: the most important individual States are Illinois, Iowa, Nebraska, Missouri, Kansas, and Indiana; the least important are Montana and Wyoming. The yield varies from less than 10 bushels per acre in Florida to 35 or 36 bushels per acre in Connecticut, Massachusetts, Maine, and Pennsylvania. Its different varieties are, to a greater extent than those of any other crop, capable of adaptation to local conditions; some mature in seventy or eighty days, and are thus suited to the short seasons of the North; these attain a height of 3 ft. or 4 ft. only. Others found in the South have a growing season of six months, and may reach a height of 20 ft. or more. The crop fits well into rotation farming, and therefore is assured of a permanent place in agriculture.

Another highly important crop is wheat, the area of which increased greatly in the States during the period in which it was shrinking here. Wheat is, however, essentially a pioneer crop, and it tends to shift towards the newer countries. Thus, during the past fifty years the centre of wheat production in the United States has moved westwards more rapidly than has the centre of the population. In 1850 New York was one of the great wheat-growing States; now it produces only a little more than 1 per cent. of the United States crop. Later on, Southern Wisconsin and Northern Illinois became the chief wheat States; now Kansas and North Dakota take the lead. Plant breeders and seedsmen have been busily occupied with the crop, and an immense number of different varieties have been grown: so far back as 1895 the U.S. Department grew more than 1000 different sorts for several years, though a number were found to be identical, and only about 250 were of any value to American growers. Since then the varieties have increased considerably.

Unlike Great Britain, the United States has a large area of spring-sown wheat, and, moreover, much of its wheat is grown under drier conditions than prevail here. There are still sections of the semi-arid country where no rotation is adopted and where wheat simply alternates with summer fallow, though, as Dr. Lyttleton Lyon points out, this will probably before long be replaced by a rotation including perennial grass or leguminous crops left down for some years. Elsewhere in the corn belt much of the spring wheat supply alternates with maize, though the winter wheat is usually grown in a rotation—maize, maize, oats, wheat, clover. This is somewhat of the same type as British wheat growing, with the substitution of wheat or oats for the first maize crop and roots for the second. The harvesting, however, is carried out altogether differently, and we have in this country nothing approaching the "Header" or the "Combine" now in use in parts of the States.

As the book is written for American agriculturists there is no specific account of British crop production. There are, however, casual references, not all of which are accurate. Thus, it is stated that spurrey is cultivated by dairy farmers in Great Britain, which we believe is not the case.

(2) The volume on animals is equally rich in stores of interesting and valuable material. It is gratifying to a native of Great Britain to find how large a part is played by animals which originated here: horses,

sheep, cows, pigs as used on the best farms have been distributed from this country, which still fortunately retains its best studs. British readers will turn with much interest to the account of the bison, which, it is suggested, has agricultural possibilities. It is not in itself a particularly tractable animal; the young calves are ready to fight within a few minutes of birth; but it crosses with the domesticated cow to produce a hybrid known as the "cattalo," which is said to offer possibilities.

Altogether the volumes will be found of much value to the student of agriculture, and they reflect great credit alike on the editor, the contributors, and the publishers. E. J. RUSSELL.

History of Electrical Science.

Bibliographical History of Electricity and Magnetism, Chronologically Arranged. Compiled by Dr. P. F. Mottelay. Pp. xx+673. (London: C. Griffin and Co., Ltd., 1922.) 42*s.* net.

THE title of this book and its subtitle, "Researches into the Domain of the Early Sciences, especially from the Period of the Revival of Scholasticism, with Biographical and other Accounts of the most Distinguished Natural Philosophers throughout the Middle Ages," well describe the contents. Every scientific man is interested in the early days of science, and most of them know a few traditions about its history. It will be a boon to them to find out how far these traditions are justified by the facts, and this book of Dr. Mottelay's, whose death we had recently to deplore, will be of the greatest assistance to them. The volume gives very complete references to all the discoverers of the laws of electricity and magnetism and the writers on these subjects. The author starts from the dawn of authentic Chinese history (2637 B.C.) and ends with Christmas day 1821, when Faraday converted electrical into mechanical energy by causing a wire carrying a current to rotate in a magnetic field.

Many photographic reproductions are given of pages from ancient books and manuscripts. In particular the reproductions of pages from the "Epistola . . . de magnete" of Petrus Peregrinus (1269) taken from the Bodleian MS. and from an almost illegible MS. in the Bibliothèque Nationale at Paris are extremely interesting.

Roger Bacon, a contemporary of Peregrinus, describes him as a "thoroughly accomplished, perfect mathematician." He wrote the earliest-known treatise on experimental science and gave the first description of a pivoted compass. A full description is given of Dr. Gilbert's (1600) "De magnete . . .," in which reasons are given for supposing that the earth is a magnet. Sir Isaac Newton in a private letter (1716) seems to have partially anticipated Franklin's discovery that a lightning flash was electrical in origin. He writes: "I have been much amused by ye singular φενομενα resulting from bringing a needle into contact with a piece of amber or resin fricated on silke clothe. Ye flame putteth me in mind of sheet lightning on a small—how very small—scale." It is not generally known that the great French physicist and mathematician Poisson described the method of obtaining the horizontal value of the earth's magnetic field in absolute measure (1828). Sturgeon mentions that Snow Harris, who used strips of copper for his lightning conductors, carried the lightning conductor of a small man-of-war through the powder-magazine!

This volume deserves a place in every scientific library. To electrical engineers of all nationalities it makes a special appeal. A. R.

Organic Chemistry.

(1) *Grundlegende Operationen der Farbenchemie.* Von Prof. Dr. H. E. Fierz-David. Zweite verbesserte Auflage. Pp. xiv+266. (Berlin: J. Springer, 1922.) 300 marks; 12*s.*

(2) *Organic Chemistry.* By Prof. W. H. Perkin and Prof. F. S. Kipping. Entirely new edition. Part 1. Pp. xi+681+xx. (London and Edinburgh: W. and R. Chambers, Ltd.; Philadelphia: J. B. Lippincott Co., 1922.) 8*s.* 6*d.* net.

(3) *Trattato di chimica generale ed applicata all' Industria.* By Prof. E. Molinari. Vol. 2: Chimica organica. Parte seconda. Terza edizione riveduta ed amplicata. Pp. xv+625-1406. (Milano: Ulrico Hoepli, 1922.) 48 lire.

(1) THE first edition of Dr. H. E. Fierz-David's volume on the chemistry of dyeing has been translated into English, and is by now well known to English chemists connected with the manufacture of synthetic dyestuffs and to students of chemistry preparing for that branch of industry. It is a book which has supplied a distinct and ever-increasing demand.

The preface to the new German edition is interesting in so far as the author, who thought fit to suppress certain processes in the interest of the home industry, now finds that these methods with little modification are common to all countries manufacturing "intermediates," and that there is nothing which he has described which will affect the Swiss colour-makers.

(2) The text-book of organic chemistry by Perkin and Kipping is too well known in our universities and colleges to need more than a brief reference to the new edition. It contains some important additions, notably

chapter 42, in which an account is given of the use of catalysts in organic chemistry, the hardening of oils, Thiele's theory and the cracking of petroleum. An extension of the sugar group is given in chapter 39. No doubt in a future edition of the book these somewhat incongruously grouped subjects will be allotted their proper places.

Minor modifications and additions are the explanation of the reactions which occur in the preparation of formic acid and of allyl alcohol from glycerol and oxalic acid in accordance with Chattaway's work and Werner's method for the preparation of methylamine from formaldehyde. Some parts of the chapter on the terpenes have been modified, and several new synthetic products have found a place.

(3) Prof. Molinari's organic chemistry, which was translated into English by T. H. Pope, constitutes vol. 2 of his treatise on chemistry. Since its first appearance a second and third edition of the organic section have appeared, the last being so much enlarged as to necessitate a division into two parts, each of substantial dimensions. The first part has already appeared in its English dress, and no doubt the second part, the subject of the present notice, will soon follow. Although this treatise has already been reviewed in these columns (NATURE, May 12, 1921, p. 325), it may be again stated that the organic section is in many respects unique. As the title states, it deals with general chemistry and chemistry applied to industry. The industrial part is not merely a bare text-book outline of the process, such as the text-book compiler occasionally introduces from conscientious motives, but without either knowledge of or interest in the subject. The descriptions are such as might be found in a specialised treatise dealing with the processes and are illustrated by excellent diagrams and drawings of apparatus, often with cost of plant and appliances. Moreover, analytical methods and figures are given with numerous statistics of imports, exports, and prices.

Such a comprehensive combination of the theory and practice of chemistry is in itself illuminating, and one may turn over page after page and find a store of information, of which the non-technical chemist has probably never heard. It gives a clear picture, more impressive indeed than the splendid "Dictionary of Applied Chemistry," of the invasion of industry by science and the widespread extent of that invasion. It is a treatise upon which both author and publisher and also the translator may be congratulated, and one feels sure that the friendly appeal of the publisher attached to the volume by a slip of paper in which he "offre questo volume in omaggio con la preghiera di raccomandarlo agli amici e favorirne la diffusione" will find a favourable response. J. B. C.

Our Bookshelf.

The Old English Herbals. By Eleanour Sinclair Rohde. Pp. xii + 243. (London: Longmans, Green and Co., 1922.) 21*s.* net.

THE subject of herbals has always attracted students of botanical history. The beauty of their figures, the quaintness of their language, their appearance as the herald of the scientific development of botany, their appeal to the folklorist and designer, have all combined to create a demand for these books. Dealers have not been backward in reflecting the extent of this demand in the prices they have put upon them.

It may be doubted, however, whether the scientific student of the history of science will pay quite the same importance to these herbals as is attached to them by the collector. Undoubtedly the manuscript herbals and some of the earlier printed herbals represent a stage in the development of science. For the most part, however, their preparation has demanded little thought—except from the illustrator—and no general ideas. Some of the most picturesque of them are even behind the scientific development of the time in which they appeared.

Some years ago Mrs. Agnes Arber, in her admirably illustrated and arranged work on "Herbals," produced a scholarly general account of these books. Miss Rohde confines herself to those of English origin. The choice is, perhaps, unfortunate in one important respect since, in fact, few of the herbals which had any influence on the course of botany were produced in this country. On the other hand, her choice has provided an admirable opportunity for giving a picture of the attitude towards botanical studies in this country in the sixteenth and seventeenth centuries. The book, too, is packed with a good selection of the very quaintest quotations, by which the sternest critic will be at once charmed and disarmed. If they are not always relevant they are always entertaining. No reviewer will put down the volume without the feeling that whatever its faults he has been presented with a most readable and entertaining book, and after all, what are books for save to be read and to entertain? The would-be writer of the slashing article—if any of that iron breed yet survive—will find that Miss Rohde has smiled him into good humour long before he has turned the second cover. The illustrations, too, are excellent, the volume is remarkably cheap, and the bibliography useful.

Essentials for the Microscopical Determination of Rock-Forming Minerals and Rocks. By Dr. A. Johannsen. Pp. vi + 53. (Chicago: University of Chicago Press. London: Cambridge University Press, 1922.) 11*s.* net.

PROF. JOHANNSEN has deserved well of petrologists. The present publication by him comprises some half-a-dozen tables, explained and illustrated by notes and diagrams. The minerals are classed in the first place according as they are opaque or transparent, isotropic or uniaxial or biaxial, uncoloured or coloured, and pleochroic or non-pleochroic, and to each of these divisions is allotted a table. In the tables the aniso-

tropic minerals are arranged vertically in the order of their birefringence indicated in the central column; and laterally from the centre outwards, according to their refractive indexes shown at the top of the table. The range of the refractive index of each mineral is given by a horizontal line, somewhat in the same manner as in the "Petrographic Methods" of Dr. Holmes.

Comparatively little use is made of the optic axial angle, though even a rough estimate involving no elaborate procedure or calculations may be quite useful. Another observation which can be made without difficulty is whether the direction of maximum absorption coincides with the fast or the slow direction of vibration. The sections dealing with the felspars, pyroxenes and amphiboles are excellent, but the use of the term melatope (p. 32) for the point of emergence of an optic axis in interference figures should have been explained.

The concluding pages are devoted to the author's new quantitative classification of igneous rocks, which is based on the "mode," the actual minerals present, instead of on the "norm." Most petrologists in this country believe, however, that any quantitative system of classification is essentially misleading.

J. W. EVANS.

Annuaire pour l'an 1923 publié par le Bureau des Longitudes. Pp. viii+654+A118+B12+C16+D72. Supplément à l'Annuaire du Bureau des Longitudes pour l'an 1923: Distribution des pluies en France. 15 planches. (Paris: Gauthier-Villars et Cie, n.d.) 6.50 francs.

THIS very handy little volume is now widely known, and the issue for 1923 shows no falling off in its general utility; it contains all the usual calendar information, and has tables and descriptive matter dealing with all classes of heavenly bodies; there are also physical, mensurative, and geographical tables. The only point in these tables that seems to call for some criticism is the section relating to comets. The orbits given are in many cases by no means the latest or most accurate available; the latest return of Encke's referred to is that of 1914, though it has been seen since then, in 1918 and 1921. The date given for the perihelion passage of the comet Pons-Winnecke in 1921 is June 20, which is eight days too late; it is also curious that this comet is called simply Winnecke's, forgetting that it was first found by the French astronomer Pons, and that its periodicity was known long before Winnecke found it in 1858.

The special essay contained in this volume is by M. G. Bigourdan on the climate of France; it contains many tables and diagrams, and discusses the different types of climate belonging to different regions, and also the diurnal and annual variations in cloud, rain, etc. M. Bigourdan describes the system of weather forecasts by wireless, which are now distributed daily, and should be of great service to agriculturists.

There are obituary notices of Gabriel Lippmann and Jules Carpentier, both of whom died last year.

The small suggestion may be made that the leaves of the book should be cut, as is usually done in volumes of this character, where ease of reference is a desideratum.

A. C. D. C.

Common Stones: Unconventional Essays in Geology. By Prof. G. A. J. Cole. (Common Things Series.) Pp. 259. (London and New York: Andrew Melrose, Ltd., n.d.) 6*s.* net.

PROF. COLE'S twenty essays on common stones are written with a literary grace and charm which should give this book a firm place among British popular presentations of science. It should do to-day the service which Kingsley's "Town Geology" did for an earlier generation. The volume sketches the modern theories of rock formation, on which the author writes with the knowledge of an expert, while his references to the field occurrence of the rocks make the reader share with him the pleasure of many field days. The chapters which deal with sedimentary petrology are especially useful; one of the most attractive is that on soils, as might be expected from the head of a Geological Survey which has devoted especial attention to agricultural geology.

Advanced students would profit by reading these essays, for they quote much new information and many unfamiliar instances; the author, for example, lays stress on the origin of oolitic structures by chemical processes, and on the formation of corries by nivation instead of by glacial erosion; he rejects some conclusions based on the low ash content of anthracite; in emphasising the need for safeguarding our future coal supplies he remarks wittily that a century hence a chapter on coal would be out of place in his volume, as coal would then be regarded as a precious and not as a common material.

The humanistic feeling shown in this book by its high literary quality and its frequent reference to the early founders of geology would make its perusal of special benefit to science students in view of the growing specialisation in their preliminary education.

Kincardineshire. By the late George H. Kinnear. Pp. xi+122. (Cambridge: At the University Press, 1921.) Price 4*s.* 6*d.* net.

KINCARDINESHIRE, though one of the smaller of the Scottish counties, is a compendium of Scottish geographical types, for it includes typical areas of highlands, lowlands, and of the eastern coastal districts. Kincardine is interpreted as "the end of the high lands" and it is used for various localities in Scotland; the name is appropriate to this county, as it includes the eastern end of the Grampians. The chief lowland area is the plain known as "the Howe of the Mearns" which is the eastern end of the Vale of Strathmore. The coast is very variable in character, and unusually picturesque; part of it consists of soft beds which are undergoing rapid abrasion by the sea; elsewhere occurs an alternation of hard rocks which project in headlands such as that surmounted by Dunnottar Castle, and of soft bands which have been worn back into bays. The interest of the coastal scenery is enhanced by the numerous stacks and caves. The headlands act as groynes, and their protecting effect was shown in the case rendered classic by Lyell, who recorded the destruction of the village of Mathers on a single night in 1795 owing to the sea breaking through a ledge of limestone which had been weakened by quarrying. Fishing villages are numerous along

the coast, and one of them, Findon, has given its name to the "finnan haddock." The population is lowland and included the ancestors of Burns. The sections on the geology and meteorology of the country are well up-to-date; the author, for example, attributes the mild climate of Scotland to the south-west winds and not to the discredited Gulf Stream.

Zeitschrift für angewandte Geophysik. Unter ständiger Mitarbeit zahlreicher Fachgenossen. Herausgegeben von Dr. Richard Ambronn. Vol. i., Part I. Pp. 32. (Berlin: Gebrüder Borntraeger, 1922.) 20*s*.

WHILE the attention of geologists is justly turned to physical considerations, in view of our immense ignorance of the inner constitution of the earth, it may be questioned if it is wise at the present time to inaugurate a special journal for geophysics. The first part of the *Zeitschrift für angewandte Geophysik* is issued under the editorship of Dr. R. Ambronn, of Göttingen, by one of the most enterprising firms in Germany. Its thirty-two pages are priced at twenty English shillings, which puts it beyond the reach of scientific men who are also taxpayers in our islands. We cannot help feeling that the money would be better spent in supporting and, if necessary, enlarging the scope of one of the German geological journals that have already won a world-wide reputation.

Dr. Ambronn shows how the measurement of radio-activity, of variations in gravity from point to point, of the increment of temperature with depth, and of the propagation of earthquake waves, subjects that truly belong to the domain of geophysics, find their applications in the search for ore-bodies, basins of light minerals, such as rock-salt, and of petroleum. Abstracts are given of papers which deal with these or similar subjects; but they will surely fall under the watchful eye of the editor of the *Geologisches Zentralblatt*, to mention only one well-known journal. We compliment Dr. Ambronn on his energy, but not on his adding yet another care to our librarians, however casually his new periodical may appear.

G. A. J. C.

Essays on the Depopulation of Melanesia. Edited by Dr. W. H. R. Rivers. Pp. xx+116. (Cambridge: At the University Press, 1922.) 6*s*. net.

IT is difficult to lay too much stress on the practical value of this small collection of essays written by members of the Melanesian Mission and others. The fact that the volume is edited by the late Dr. W. H. R. Rivers is a guarantee both of accuracy and impartiality. Sir Wm. Macgregor and Mr. C. M. Woodford, who write from the point of view of the official, and Dr. Speiser of Basle, who writes as an anthropologist, fully bear out the contentions of the members of the Mission. The authors, without exception, agree that depopulation in Melanesia is to be attributed largely to the breaking up of custom which has followed contact with the white man. When the spiritual power of the chief has been discredited in the eye of the native by the white man, the temporal authority, which is based upon it, fails to preserve traditional law, order, and morality. Dr. Rivers, in a concluding essay, however, suggests that the most important factor is psychological. The native, he maintains, has lost all interest in life through the suppression of customs such as head-hunting, with which have disappeared a large number of closely related social activities. His suggestion that total suppression of such customs could be avoided by substitution of harmless elements is deserving of careful consideration.

Quaker Aspects of Truth. By Dr. E. V. Brown. Pp. 156. (London: The Swarthmore Press, Ltd., n.d.) 5*s*. net.

THE little book under notice consists of a series of lectures illustrating simply the Quaker attitude to various problems. In the chapter on biological foundations, the author attempts to show that the fundamental doctrines of Quakerism, *i.e.* the acknowledgment of no final authority, whether Church or Bible, except the Word of God in the heart, are more in accord with the teachings of biological science than the dogmas of any other religion. The point of view is interesting, although it is doubtful whether the teachings of science, as such, are usefully fitted on as justification for a body of religious beliefs.

The author develops his contention that the Quaker ideal is Christianity from which all accretions in the form of Hebrew, Greek, and Roman sources have been eliminated. He also discusses the Quaker attitude towards war.

The essays all set forth high moral ideals, for the value of which the moral life of the believer in them is the sole criterion.

Chemistry of To-day: The Mysteries of Chemistry lucidly explained in a Popular and Interesting Manner free from all Technicalities and Formulæ. By P. G. Bull. Pp. 311. (London: Seeley, Service and Co., Ltd., 1923.) 8*s*. 6*d*. net.

ACCORDING to the preface, this is not intended as a text-book, but as an attempt to give some account of modern chemistry to the general reader. It should fulfil this object: the style is bright and interesting, the matter appears to be accurate, and an extensive field is covered—very superficially for a text-book, but probably adequately for the intended reader. There is perhaps too great a tendency to "sensational" topics—the frontispiece representing a well-known man of science "bombarding" atoms half the size of himself with "nuclei of helium" as big as cricket balls, and producing a pyrotechnic display, is an example of what we mean by this criticism. There are good half-tone plates, but the line-drawings are poor.

The Psychology of Society. By Morris Ginsberg. Pp. xvi+174. (London: Methuen and Co., Ltd., 1921.) 5*s*. net.

IN short compass Mr. Morris Ginsberg discusses critically with admirable lucidity the psychological basis on which much recent treatment of social problems is founded. He has a keen eye for essentials, and a sense of perspective. He presents tersely and fairly the salient arguments of writers who count and pronounces clearly and courteously well-considered judgment. A little book but a good one.

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 Spectrum of Neutral Helium.

AT the end of his letter to NATURE of January 13, p. 46, Dr. Silberstein appends a note to the effect that he has been able to express the diffuse series HeD′ in the form

$$n = 109723\{1/2^2 + 1/10^2 - 1/9^2 - 1/m^2\}$$

with errors of 0·7Å for the second line, and of between 0·1Å and 0·35Å for the next ten. May I be allowed to offer the following remarks:—

(1) A formula determined on a definite hypothesis, as here, ought to reproduce the wave-lengths within observation errors or at least be able to account for deviations from them. According to the data given the deviations amount to between 100 and 200 times the possible errors (700 for the second). The usual empirical formula reproduces all the lines within these limits, except the first, the O − C errors being 0·000 for $m = 2, 3, 4$ and the largest for higher values of m being 0·02. The limit is definitely within ± 0·1 of 27175·68 I/Å, in other words, $N(1/2^2 + 1/10^2 - 1/9^2)$ must have this value. This, of course, is possible by an empiric choice of N, but it would probably upset even the rough agreement when this is used in the last term N/m^2.

(2) That the diffuse singlet series HeD′, and indeed also the diffuse doublet HeD″, can be represented roughly in the form $A - N/m^2$, is due to the fact that for this special series the denominator in the empirical formula, $m + 0{\cdot}996369 + 0{\cdot}002917/m$, is necessarily very close to a whole number, and its deviations therefrom produce comparatively small effects when m becomes large. A similar arrangement in the cases of S′, S″ or P″ would be found impossible.

(3) But the most fatal objection is that $N(1/2^2 + 1/10^2 - 1/9^2)$ must also be the first term of the p' sequence, which is at least numerically represented by $p'(m) = N/(m + 1{\cdot}014593 - 0{\cdot}004392/m)^2$. Here again the denominator is nearly an integer (though further from it than in $d'(m)$), and no doubt it could also be represented by N/m^2, with greater deviations than in the case of d', but the first term would then be $N/2^2$ and not $N(1/2^2 + 1/10^2 - 1/9^2)$.

It is perhaps a difference in temperament, but to me Dr. Silberstein's note appears rather to weaken than to give a "much stronger support" to his proposed theory. However, I am not here discussing his hypotheses, one objection to which I raised in a letter to NATURE on September 2 last (p. 309) which Dr. Silberstein has not dealt with.

W. M. HICKS.

January 15.

Some Experiments on Rate of Growth in a Polar Region (Spitsbergen) and in England.

IN a recent paper (Journal Mar. Biol. Assoc., vol. 12, 1920, p. 355) attention was directed by me to the lack of critical evidence bearing on the theories offered to explain (*a*) the abundance of life in polar regions, and (*b*) the occurrence of several generations of a species living side by side in polar waters. Murray and Loeb and others have suggested that an explanation of these phenomena may be found in a greatly retarded rate of growth which, it is *postulated*, must occur in the low temperatures prevailing in these regions. The present writer urges (*a*) that we know nothing about the rate of growth of organisms in polar regions, and (*b*) that the kind of metabolism of animals in polar regions—and in deep-sea situations—is not necessarily the same as that in temperate or tropical regions. A given organism may be regarded as a machine, but it is perhaps derogatory to the kind of machine one is dealing with to assume that other life-machines existing under totally different conditions are necessarily governed by identical applications of the same laws; for example, it does not necessarily follow that because the rate of metabolism in tropical or temperate animals falls off rapidly with decreasing temperatures approaching 0° C., that metabolism in polar animals is necessarily of the slow rate of temperate animals at polar sea-temperatures. No reason has yet been shown that adaptation of metabolism cannot occur; on the contrary, there is every reason to expect such adaptation.

The following experiments on the rate of growth in marine organisms at Spitsbergen—designed to obtain information on these problems—have given, however, mainly a negative result, but as in one case a positive result—yielding a much greater rate of growth than has ever been suspected—has been obtained, it is worth while recording the result now. It is hoped to write a fuller account later, giving details of the apparatus used, in the Journal of the Marine Biological Association.

In 1921 simple experiments on rate of growth were carried out in 7 fathoms of water close to Anser Island in Klass Billen Bay, Spitsbergen, by the biologists of the Oxford Spitsbergen Expedition, and mainly under the direction of Mr. Julian Huxley and Mr. A. M. Carr Saunders. The present writer had hoped to carry out the experiments under personal supervision, with the promised help of Dr. Hoel of the Norwegian Fishery Board, but circumstances nullified these arrangements.

Two pieces of apparatus were used—a galvanised iron-wire network cage of ⅝-inch mesh and 5 feet by 4 feet by 9 inches was tarred and moored to the bottom of the sea after putting a large number of dried oyster shells inside it; and a floating tarred wooden raft with strings of shells attached was anchored in the sea near the cage. The apparatus was put in the sea on June 27, 1921; the raft and shells were inspected by Mr. Huxley on July 16, and—owing to the illness of Mr. Carr Saunders—finally hauled by Mr. R. W. Segnit, geologist, and Capt. Johannsen on August 24, 1921.

On July 16 Mr. Huxley found practically no growth on the raft nor on the shells on the raft, but the cage was not hauled. On hauling the cage on August 24 the sea-urchins shown in Fig. 1 were found *inside* the cage. The door of the cage, which only covered the central portion of one long face of the cage, was found to be closed and *laced* as had been previously arranged on putting the cage in the sea. The astonishing sight of the relatively large sea-urchins inside the cage attracted attention at once, and a fruitless examination of the cage was made for any means of access greater than the mesh of the cage. The conclusion was therefore drawn that the urchins must have entered the cage while small, *i.e.* of a diameter upwards to about 1·6 cm., and grown to the size observed, *i.e.* upwards to about 2·9 cm. in diameter—excluding spines—within 58 days.

This result was regarded as very important, and a confirmatory experiment tried again at the same spot in 1922, under the direction and by the kindness of Mr. J. Mathieson, of the Scottish Spitsbergen Syndicate scientific staff. When Capt. Johannsen

hauled the cage in 1922, however, no urchins were found this time in the case, and no growth observed on the cage or shells.

In 1921 Mr. Mathieson took a few sea-temperature observations which confirm the general indication that no higher sea-temperatures than 4° C. prevailed during the course and in the locality of the experiment.

The almost complete absence of growth on July 16, 1921, on Mr. Huxley's inspection is not significant, as I have found that failure to infect shells obviously with growth may occur in a similar period at Plymouth. The absence of growth, other than the sea-urchins, on August 24, 1921, may or may not be due to slow rate of growth and cannot be discussed adequately here, but at Plymouth the writer has found that in a period of 3 to 6 weeks in summer experimental shells may become covered with extensive growths of marine organisms, some of which may indeed have already attained sexual maturity. There is no doubt that the Spitsbergen sea-urchins were browsing on the oyster shells in the cage. An analogous result has also been obtained in cage experiments at Whitstable, where more than twenty relatively large starfishes (*A. rubens*), of a diameter of upwards to 16·8 cm. as measured from tip to tip of alternate arms, have been found on different occasions inside cages exactly similar to that used at Spitsbergen. In these cases there can be no doubt that the starfishes were attracted to the cage by the dead or dying animals inside the cage.

The rate of growth of sea-urchins in temperate waters under natural conditions is not known with accuracy, but Elmhirst estimates (see NATURE, November 18, 1922)—and I agree—that *E. esculentus* (which is a large species) may grow to a diameter of 4 cm. in one year. In a similar cage experiment on oysters at Whitstable a sea-urchin, *E. miliaris* (a relatively small species which does not attain more than about one-fourth the size of *E. esculentus*), was obtained on March 11, 1921, of a diameter of 2·7 cm. (excluding spines) after the cage had been in the sea 65 days, giving a minimum growth in the period of 1 cm. in diameter. On another occasion specimens of *E. miliaris*, of a diameter of upwards to 3 cm., were taken from the bottom of a floating coal-hulk, the *London City*, moored at Brixham, on August 1, 1911, after that vessel had been in the water after cleaning since April 1910. These sea-urchins were therefore rather more than one year old. The sea-urchins from the Spitsbergen cage experiment have not yet been definitely identified, but they probably grow to about the same size as *E. miliaris*.

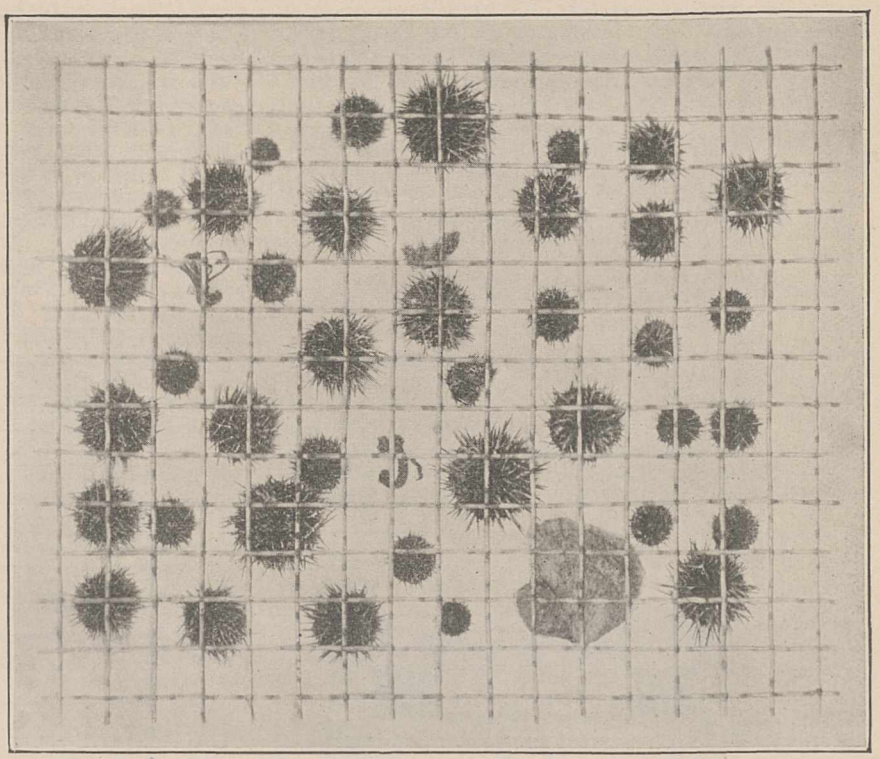


FIG. 1.—Photo[1] of sea-urchins from the cage experiment at Spitsbergen, 1921, seen through a grating of the same mesh as the cage. (⅓ natural size.)

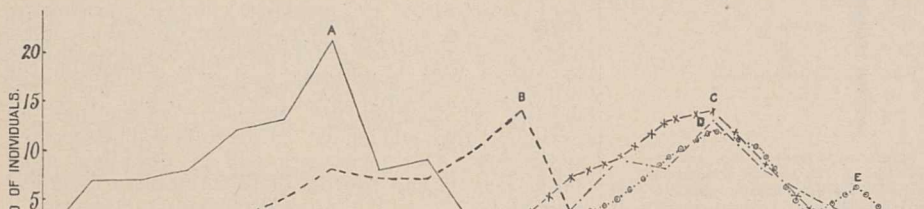


FIG. 2.—Showing[1] rate of growth of a fixed population of marked cockles (*Cardium edule*) kept in a box with perforated sides and top fixed to the bed of the River Yealm, near Plymouth. The box was visited at intervals of one month, and the cockles measured.

A, size of cockles, August 16, 1919; B, September 12, 1919; C, October 11, 1919; D, November 10, 1919; E, December 10, 1919.

Note the practical cessation of growth after about October 11.

Other marine animals—for example, cockles—grow shell very rapidly in English waters in the warm months of the year, and may add from 4 to 6 mm. in length to their shell per month for 6 or 7 months. (See Fig. 2, which shows some unpublished results of experiments in 1919–20 on growth in a fixed population of marked cockles kept in a perforated box fixed to the bed of the River Yealm, near Plymouth.)

Thus the growth of the Spitsbergen sea-urchins compares favourably in rate with that of calcareous marine animals in England, and indicates a rate of growth in marine animals generally in polar regions

[1] The writer is indebted to Mr. A. J. Smith for the photo (Fig. 1), and to Mr. E. Ford for the lettering in Fig. 2.

not previously anticipated; but further experiments are required to confirm the result obtained before drawing the important conclusions it appears to warrant.

It is hoped to repeat this experiment and others at Spitsbergen in the future; but it is desirable that other workers more favourably situated should also carry out similar experiments extending over a longer period.

The actual outlay of expenses for the experiment in 1921 was borne by the Marine Biological Association, and in 1922 by a Government Grant from the Royal Society, but in both years essential help was provided by the Scottish Spitsbergen Syndicate and its scientific leader, Mr. J. Mathieson.

J. H. ORTON.
Marine Biological Laboratory, Plymouth,
December 15.

Separation of Mercury into Isotopes in a Steel Apparatus.

BY 305 hours of repeated fractional vaporisation from a steel trough in a vacuum at low pressures we have obtained a difference of 0·1 unit in the atomic weight of mercury without other cooling than that given by ice. The trough holds 190 c.c. of mercury, but another larger apparatus has been constructed in which the capacity is 10 kilos. In this the mercury

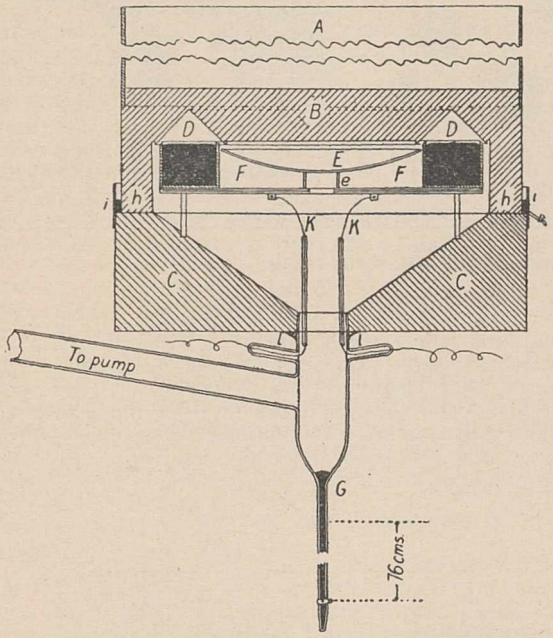


FIG. 1.—Steel apparatus for the separation of mercury into isotopes by vaporisation. *A*, Cylinder for ice; *B*, circular condensing roof, made of steel; *CC*, drain for the light fraction, made of steel; *DD*, annular steel trough holding 190 c.c. of mercury; *E*, watch glass with hole in centre, supported on a short glass tube *e*; *FF*, heating element made of calorised wire and supported on glass rods; *G*, collecting tube made of glass; *hh*, ground joint; *rr*, mercury seal; *KK*, platinum wires; *L*, ground joint and sealing wax.

is heated by an insulated wire which lies in the bottom of the trough, the insulation being obtained by a coating of magnesium oxide, which is covered with a steel sheath. This wire is produced by the General Electric Company.

The details of the apparatus are exhibited in Fig. 1. By means of the tube *G* the sample may be divided into as many fractions as is desired. In the newer form of apparatus the wires used as leads to the heating coil pass through insulators in the bottom steel plate, and not through the upper part of the tube *G*. The principle of the apparatus is that the lighter molecules, which vaporise more rapidly, strike the slanting roof above *D*, and collect in drops. These drops do not fall back into the trough of mercury, but roll down the slanting ceiling until they reach its edge, when they drop into the inverted cone in the lower steel plate, and then into the glass tube *G*, which has a capillary of 800 mm. length at the lower end.

The progress of the separation was followed by the use of Fig. 2, due to Mulliken and Harkins, and it was

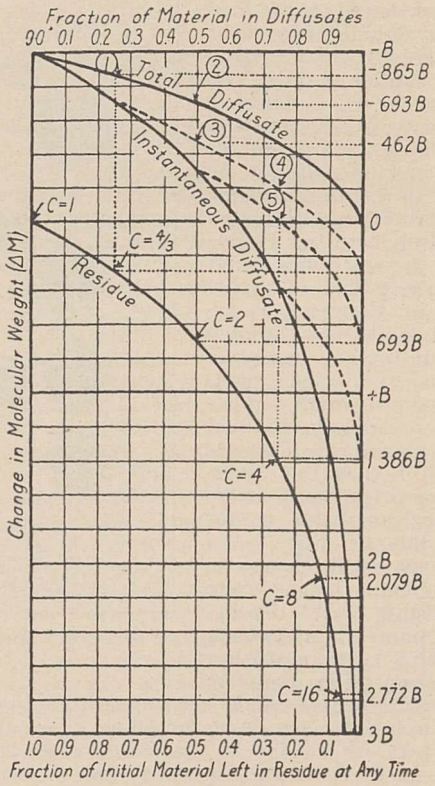


FIG. 2.—Generalised diagram showing atomic or molecular weight of fractions obtained during a 100 per cent. efficient diffusion or irreversible evaporation of a mixture of isotopes.

found that the efficiency of the process is quite constant and equal to about eighty per cent. It may be stated that Dr. Mulliken is also separating the isotopes of mercury in this laboratory, using the method of evaporative diffusion, which has an extremely high efficiency. His results will be reported separately. Our own work will be described more fully later, in the Journal of the American Chemical Society.

WILLIAM D. HARKINS.
S. L. MADORSKY.
The University of Chicago,
December 22.

The Rule of Priority in Nomenclature.

As a teacher of palæontology and keeper of palæontological collections, I may perhaps be permitted to bring forward for discussion some trenchant points which seem to call for immediate action.

The rule of priority was originally intended to be a help in clearing away obscurity in nomenclature, but it is now seen that the strict observance of this rule is having a reverse effect.

The notice by E. H.-A. and A. E. of Cushman's "Shallow-water Foraminifera of the Tortugas Region" (NATURE, June 3, p. 708) is timely, for there they point out, "It appears to be undesirable to complicate synonymies by the revival of early names." They also deprecate the resuscitation of "Discorbis" for "Discorbina," and "Quinqueloculina" and "Triloculina" for "Miliolina." These minor differences in the plans of growth are not generic, for we find them, as often as not, slipping past the boundaries we have set for them.

Names of genera, especially those of the mollusca, are out-of-date in textbooks almost before they reach the hands of our students. Thus Pleurotoma of Lamarck was changed, after many years of usage, to Turris of Bolten, through the unfortunate discovery of a catalogue in which genera were denoted by a known species, *Turris babylonica*, which happens to be first on the list. As a case in point, the student gets familiar with Turris, but in a few months the teacher has to inform him that Turris is not only extremely restricted but unrepresented in Australia, and the genus has been split up, not into subgenera, but into many new genera. Museum labels to the number of several hundreds have to be rewritten, and almost before the ink is dry another change may be made.

The rule of priority is a good one within bounds, but should there not be a retrospective limit placed on many groups, dating say from the time when they were first written upon with authority? This limiting date might well be settled by a conference of workers in those particular groups. In some instances this has been done, and flagrant offences against reason have been prevented. Thus, in 1916 a motion for the suspension of the rule in regard to the genera Holothuria and Physalia was passed by an American conference. In one case "Holothuria" was the name given in 1758 to the "Portuguese Man-of-War," and later, in its familiar sense, to the Bêche-de-Mer, by Bruguière in 1791. According to the rule, "Holothuria" or "Bêche-de-Mer" being invalid was to be superseded by "Physalia," the name accepted previously for the "Portuguese Man-of-War." "Holothuria" would have become "Boadschia" of Jaeger, 1833, and "Physalia" would have become "Holothuria"!

Even the indispensable and invaluable "Index Animalium" of Chas. D. Sherborn will not entirely remove our troubles, for doubts will arise as to an author's meaning on account of bad figures and descriptions. It is, therefore, of paramount importance that a consensus of opinion be obtained for each group as to specific limitations and interpretations of authors' names, and thus prevent those feelings of despair which overtake the specialist, and more especially the general worker, at the present time.

F. CHAPMAN.

National Museum, Melbourne.

Selective Interruption of Molecular Oscillation.

In NATURE of July 22, 1922, vol. 110, p. 112, correspondence occurred regarding the possibility of selectively interrupting haphazard molecular oscillation by means of special apparatus, narrower in certain specific directions than the mean free path of the gas in which it was immersed. In view of the fact that such methods have now been independently put forward by Mr. H. H. Platt in America (U.S.A. Patent, 1,414,895), the following aspect of the problem may be of interest, particularly since the possibility would appear to be rendered very much more clear by so regarding it. Fig. 1 represents a portion of a cone longer than that previously considered, its diameter, however, still being considerably less than the mean free path of the gas concerned, so that molecules of the latter may frequently cross from side to side without intermolecular interruption.

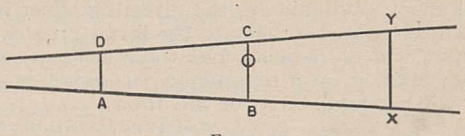


FIG. 1.

Let O be any little circle (or sphere if three dimensions are being considered) in this cone, and consider those molecules proceeding from collision, necessarily with equal probability of motion in all directions, outwards from the circle. If BC be drawn through the centre of O, parallel to the top and base of the cone, and if AD and XY be drawn equidistant from BC, then, provided regular reflection be presumed to occur as an average effect (compare *Phil. Mag.*, 1922, 43, 1954), it will readily be seen that of the molecules issuing from collision in circle O in any representative period of time, the ratio of the number of those crossing XY to the number of those crossing AD, however far (within free path distances) from BC these lines may be situated, will always be very considerably greater than the ratio of the length XY to AD (*Phil. Mag.*, *loc. cit.* p. 1052).

If the gas is assumed to be initially of the same concentration throughout, and two dimensions only are being considered, then the number of molecules crossing these lines in any representative period of time will either be proportional to their lengths, or a change of concentration must occur. It has been shown that of the molecules proceeding from collision in circle O, an undue proportion will cross XY as compared with AD, and this is true (1) for all relative positions of AD and XY within free path distances from O, (2) for any and every position of O in the cone.

It follows, therefore, that molecules starting, with equal probability of motion in all directions, from collisions in the cone, will create a "condensation" or a disturbance of concentration towards the wider portion of the cone. The same effect may obviously be proved fully for three dimensions in a similar manner, and is really identical with that dealt with in the paper to which reference has been made, since

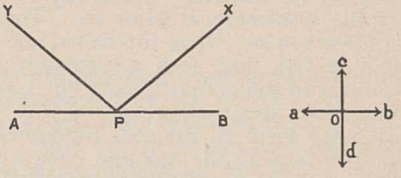


FIG. 2.

the whole cone is merely an extension of the one there described, sections ABCD and CDXY both being identical with the figure ABCD of the original paper.

Subsequent intermolecular collision in the cone cannot destroy the excessive downward bias so created, since this will merely be transferred to the other molecules concerned.

Fortuitous rebound from the walls, instead of regular "reflection," may be shown to lead to the same effect. If the wall AB be presumed to be ideally smooth, then a molecule approaching along path XP (Fig. 2) will be "reflected" along PY, receiving an impulse from the wall in the direction *oc*, the wall itself receiving the equal and opposite impulse in the direction *od*. If the wall be irregular, or owing to

thermal oscillation, or adsorption, or many other causes, it may in addition exert an impulse on the molecule in the direction *ob*, receiving the equal and opposite impulse along *oa*, or it may exert an impulse along *oa*, receiving one along *ob*. Should the former lateral effect predominate, the directing effect of the cone will be *increased*; should the latter predominate the effect will be reduced, but there is no reason to suppose that, in any representative period of time, either will predominate over the other.

ARTHUR FAIRBOURNE.

King's College, University of London,
Strand, W.C.2.,
January 1.

Sir Isaac Bayley Balfour.

ALL botanists and lovers of flowers will mourn the death of the Edinburgh professor, who served science and horticulture as few men have ever done. The occasion seems opportune to relate an incident comparatively unimportant in itself but in a manner typical. Many years ago a beautiful Primula, called by Greene *P. rusbyi*, was discovered in the Mogollon Mountains of New Mexico. Later, in the Sandia Mountains of the same State, one of my students found an apparently distinct species, which I named *P. ellisiæ*. These primroses occupied distinct and isolated mountain ranges, but were so similar, at least in the herbarium, that a German writer pronounced them identical. No one, so far as could be learned, had seen more than one of them alive, and it was the living plants we needed to settle the matter. I was able to procure seeds of *P. ellisiæ* for Prof. Bayley Balfour, and in 1921, when my wife and I visited him in Edinburgh, he not only had *ellisiæ* in full flower, but also *rusbyi*, the seeds of which he had secured from some other collector. It was a dramatic moment when the Professor held the two pots, one in each hand, and pointed out that the plants were quite distinct. Thus, in Edinburgh, we learned a lesson in New Mexico botany, which we had never been able to learn when resident for years in that region. No doubt others could relate parallel experiences.

T. D. A. COCKERELL.

University of Colorado.

Age and Area in Natural Selection.

THE account in NATURE (December 2, vol. 110, p. 751) of the discussion at Hull on "The Present Position of Darwinism" has interested me greatly. Of course I realise that such an account must be summary and omit much that is said, but I am struck by the fact that apparently none of the speakers mentioned what seem to me two fundamental and even fatal objections to the Age and Area hypothesis as a subject for the theory of Natural Selection.

In the first place, the fact that "genus" is a very inexact term, largely dependent on the "personal equation," seems to be completely overlooked. Some of us tend to large genera, some to small. In his article in the *Nineteenth Century*, Dr. Willis refers to a genus of more than 1500 species. In my opinion, to call such a group a genus is positively grotesque; it includes probably scores of what I would call genera. I can juggle the genera of echinoderms (my own special group) so as to lend apparent support to the Age and Area hypothesis, or I can re-define them so as to contradict it strongly, and in either case I can quote high authorities or give excellent reasons for my course.

In the second place, the Age and Area hypothesis really explains nothing. It merely restates in a more or less tabular way what every taxonomist, who has given any attention to distribution, knows is often the case. I say "often" because, as some of those who took part in the discussion at Hull pointed out, there are many cases of distribution which do not fall in with this tabulated arrangement. No *causal* connexion between age and area is brought out in the proposed hypothesis. The only causal factors suggested are time and an inherent tendency to diversification, and surely both of these are given abundant play in the theory of Natural Selection.

I note with interest, perhaps I might say amusement, the statement by Mr. Cunningham that Natural Selection is "as extinct as the dodo." It may be in the land of its birth, but it is still very much in evidence in America. Nearly every systematic zoologist whom I know personally believes in it as a factor in evolution, though the importance attributed to it may vary greatly. Prof. E. G. Conklin of Princeton, certainly one of our foremost zoological thinkers, has just completed a course of Lowell Institute lectures in Boston on "The Revolt against Darwinism," in which he has most clearly and emphatically stated his strong conviction, not only that such revolt is unjustifiable, but that Natural Selection is the most important theory that has yet been proposed for helping us to understand adaptation. It surely seems a little rash to call Natural Selection, or anything else, "extinct" because it has disappeared from one's own horizon. Horizons contract with increasing near-sightedness.

HUBERT LYMAN CLARK.

Cambridge, Mass., U.S.A.,
December 22, 1922.

The Cause of Anticyclones.

MAY I be allowed to suggest that the region of an anticyclone finds its most likely interpretation as an area hemmed in by cyclone systems. I agree with Mr. Dines (NATURE, December 23, vol. 110, p. 845) that it is the mass of air over the area that is important. It is a matter of personal observation that, as Mr. Dines says, "the steady and persistently high barometric pressure that has prevailed over southern England during most of the autumn" has been associated with the overlapping high overhead *here* of the margins of cyclone systems that were simultaneously from west to eastwards on our north and on our south respectively. The phenomenon of contrary currents at *high* elevation is an inseparable feature, in my experience, of anticyclonic conditions.

May it not be a conditional factor of these anticyclonic high pressure areas (?) the "mass" of air being piled to excess and held *in situ* by the conflicting winds of over-reaching cyclone lips. The play of antagonistic forces of movement and of their accompanying contrasts of humidity and temperature may be answerable for all other anomalies of anticyclone areas. What are wanted are observations of winds of *highest* elevation, which are only to be obtained by the method of employing a projected telescopic image of the sun, which renders visible and legible the "wind-billows" of individual strata of movement.

CATHARINE O. STEVENS.

The Plain, Boar's Hill, Oxford,
January 16.

The Name of the Pond Snail.

IN NATURE for January 13, p. 49, two writers of authority call this snail *Limnæa peregra*. The word "peregra" is not Latin—a fact which at one time had penetrated to the consciousness of most conchologists and malacologists but appears to have been again forgotten.

F. A. B.

Medical Education.

I REGRET that I have not the time to do justice to Sir Archdall Reid's last letter, which is supposed to deal with the above subject (NATURE, January 13, p. 50). It is, as I expected, really an attempt to open up another discussion on evolution. Now since Sir Archdall confesses to having already spent eighteen months vainly trying to find out what biologists mean, it seems inadvisable to begin again; for his letter indicates a very imperfect acquaintance with biologists and their work.

To my mind it is an amazing suggestion that zoologists and botanists are incapable of teaching evolution, and it is illuminating indeed to find that men are to come after them "who have observed, with a minuteness and accuracy impossible to workers among plants and animals." I shall be glad to meet the gentlemen when they arrive. Meanwhile, until these Supermen appear, it is highly desirable that first-year medicals, raw youths from school, should make their first acquaintance with the animal world through less expensive material than human bodies, and should approach a great profession with, what practice and theory have shown to be, the best introduction.

W. J. DAKIN.

Department of Zoology, University,
Liverpool, January 17.

An Overlooked Feature in Four-legged Tadpoles of *Rana temporaria*.

ALL accounts of the metamorphosis of the common frog leave it to be tacitly inferred that when the front legs make their way through the operculum branchial respiration ceases, and that thenceforth breathing is effected by the lungs, skin, and mucous membrane of the mouth. It appears to have been entirely overlooked that from the time of the acquisition of free front legs until the tail is completely absorbed, and the little anurous frog leaves the water, branchial respiration continues, water being drawn through the nostrils into the mouth, and *discharged from the opercular chamber through a pair of crescentic apertures, one on each side immediately anterior to the base of the front leg.*

FIG. 1.—Ventral view of four-legged tadpole of *Rana temporaria* when absorption of tail is nearly completed. The arrows mark the exits of the water from the opercular chamber.

In July 1922 I was watching some tadpoles that had just acquired their front legs, and was keeping them in a shallow dish of pond water in which was a certain amount of suspended, finely divided solid matter. I observed that the tadpoles did not come to the surface of the water to breathe, but continued sitting at the bottom; and that the respiratory movements of the sides of the head were still proceeding in regular rhythm, but now were confined to the region posterior to the gape of the mouth, whereas prior to the appearance of the front legs the movements extended up to the extreme anterior end. Closer attention enabled me to detect minute solid particles occasionally entering the nostrils, and two fairly steady currents of water issuing from the posterior end of the head, one in front of the left and the other in front of the right leg.

On killing a few specimens I found a crescentic, slightly thickened lip bounding the anterior margin of each of these opercular openings, and was able to lift the flaps and pass bristles in at each, and out through the mouth, and conversely. This condition persisted until the absorption of the tail was completed.

Fearing that I might have encountered an abnormal family of tadpoles—they were rather unusually late in the season—I examined preserved specimens of which I have scores, collected years ago, in my laboratory for teaching purposes, and found exactly the same state of affairs in every one at this stage of development.

To make assurance doubly sure I had vertical longitudinal series of sections cut through four specimens; and these fully confirm the naked-eye observations.

I have little doubt that others have noticed the thickened crescentic lips of the two opercular apertures; for in a figure published by Milnes Marshall, and in another by Howes ("Atlas of Practical Elementary Zoology," 1902 ed., Pl. ix. Fig. xiv.) it is indicated. Probably it has hitherto been mistaken for a line of fusion between the body wall and the remnant of the operculum left after the front legs have penetrated it.

OSWALD H. LATTER.

Charterhouse, Godalming,
January 12.

Smell and Specific Gravity.

IN the course of some other experiments which are being undertaken in the Psychology Department of the University of Edinburgh, a number of subjects were requested to arrange in serial order, according to smell, phials containing oil of cedar (C), origanum (O), sandalwood (S), and terebene (T). Twenty-two experiments were made in all, and tend to confirm the observations made by Haycraft, Cohn, Zwaardemaker, Heyninx, and others, with regard to odour and chemical constitution.

The serial arrangement was made, not according to the affect (pleasantness or unpleasantness) nor to the intensity, but according to "pitch," or "heaviness and lightness," "dulness and sharpness" of the sensation. The number of votes cast for the position of each substance in the series was as follows:—

	1	2	3	4
S	16	4	1	1
C	4	11	4	3
O	2	6	10	4
T	...	1	7	14

A serial arrangement according to specific gravity is thus represented by the voting: sp. g. S = 0·974-0·980, C = 0·939-0·96, O = 0·890-0·90, and T = 0·862-0·868. In nine out of twenty-two experiments the series was arranged without any error. The number of cases in which three of the osmyls were placed correctly was as follows: SCO 10, COT 9, SCT 14, SOT 15. SC and OT were correctly placed relatively to each other in 17 instances, CO in 14, SO and CT 19, and ST (the two extremes) in 21 out of the 22 experiments.

The serial arrangement as recorded above is therefore by no means entirely due to chance, and the number of errors made diminishes the greater the difference between the specific gravities of the substances employed. As the above substances of the terpene group are not compounds but complex mixtures, moreover, as the subjects without any further explanation were only instructed to smell and arrange them in a series, the results are sufficiently striking.

J. H. KENNETH.

Edinburgh University,
January 10.

Greek Geometry, with Special Reference to Infinitesimals.[1]

By Sir T. L. HEATH, K.C.B., K.C.V.O., F.R.S.

GREEK geometry passed through several stages from its inception to its highest development in the hands of Archimedes and Apollonius of Perga. The geometry which Thales brought from Egypt early in the sixth century B.C. was little more than a few more or less accurate rules for the mensuration of simple figures; it was the Greeks who first conceived the idea of making geometry a science in and for itself. With Pythagoras and the Pythagoreans, who represent the next stage after Thales, geometry became a subject of liberal education. Apart from special discoveries such as those of the theorem of the square on the hypotenuse, the equality of the three angles of any triangle to two right angles, the construction of the five cosmic figures (the five regular solids), and the incommensurability of the diagonal of a square with its side, the Pythagoreans invented two methods which remained fundamental in Greek geometry, that of proportions (though in a numerical sense only) and that known as application of areas, which is the geometrical equivalent of the solution of a quadratic equation.

By about the middle of the fifth century the Pythagoreans had systematised the portion of the Elements corresponding to Euclid Books I., II., IV., VI., and probably III.

In the second half of the fifth century, concurrently with the further evolution of the Elements, the Greeks attacked three problems in higher geometry, the squaring of the circle, the trisection of any angle, and the duplication of the cube. Hippias of Elis first trisected any angle by means of his curve, the *quadratrix*, afterwards used to square the circle. Hippocrates of Chios, who also wrote the first book of Elements and a treatise on the squaring of certain lunes, reduced the problem of duplicating the cube to that of finding two mean proportionals in continued proportion between two straight lines, the first solution of which was by Archytas, who used a wonderful construction in three dimensions. Democritus, among many other mathematical works, wrote on irrationals; he was also on the track of infinitesimals, and was the first to state the volume of any pyramid and of a cone.

The fourth century saw the body of the Elements completed. Eudoxus discovered the great theory of proportion set forth in Euclid Book V. and the "method of exhaustion" for measuring curvilinear areas and solids. Theætetus contributed to the content of Book X. (on irrationals) and Book XIII. (on the five regular solids). This brings us to Euclid (*fl.* about 300 B.C.).

To the third century B.C. belong Aristarchus of Samos, who anticipated Copernicus; and Archimedes, who, with Apollonius following after twenty years or so, concludes the golden age of Greek geometry.

To come to the history of infinitesimals. The Pythagoreans discovered the incommensurable and maintained the divisibility of mathematical magnitudes *ad infinitum*. The difficulties to which the latter doctrine gave rise were brought out with incomparable force by Zeno in his famous Paradoxes and in other like arguments. Zeno's Dilemmas profoundly affected the lines on which mathematical investigations developed. Antiphon the Sophist, in connexion with attempts to square the circle, declared that by inscribing successive regular polygons in a circle, beginning with a triangle or square and continually doubling the number of sides, we shall ultimately arrive at a polygon the perimeter of which will coincide with that of the circle. Warned by Zeno's strictures, mathematicians denied this and substituted the statement that by following the procedure we can draw an inscribed polygon differing in area from the circle by as little as we please. Similarly they would never speak of the infinitely great or infinitely small; they limited themselves to postulating that by continued division of a magnitude we shall ultimately arrive at a magnitude smaller than any assignable magnitude of the same kind, and that by continual multiplication of any magnitude however small we can obtain a magnitude exceeding any assignable magnitude of the same kind however great. On this safe basis Eudoxus founded the whole of his theory of proportion and the method of exhaustion.

It has been remarked that the method of exhaustion, though a conclusive method of proof, requires previous knowledge of the result to be proved, and is of no use for discovering new results. This is scarcely true because, before the proof by *reductio ad absurdum* is applied, the area or volume has to be *exhausted*, and this process often indicates the result. The process means a summation of a series of terms; and there are different classes of cases according to the nature of the series to be summed. In one case (Archimedes' quadrature of a parabolic segment) the summation is that of the geometrical progression $1+\frac{1}{4}+(\frac{1}{4})^2+\ldots$. Archimedes sums this, nominally, to n terms only. He says nothing about taking the limit when n is increased indefinitely, but merely declares that the area of the segment, which is actually $A\{1+\frac{1}{4}+(\frac{1}{4})^2 + \ldots$ *ad inf.*$\}$, is $\frac{4}{3}$ A, where A is the area of a certain triangle. It seems plain, nevertheless, that Archimedes found his result by mentally taking the limit. Other series summed by him are arithmetical progressions and the series of the squares of the first n natural numbers. In these cases Archimedes sums two series representing respectively figures circumscribed and inscribed to the figure to be measured, and then states a certain intermediate quantity to be the actual area or content required. Here again Archimedes, though he does not say so, states what is in fact the common limit of the two sums when the number of terms in the series is indefinitely increased, and a factor common to all the terms is at the same time indefinitely diminished. The result is actually equivalent to integration. There are some six cases of the kind depending on the integrations $\int x dx$, $\int x^2 dx$, $\int (ax+x^2)dx$ and $\int \sin\theta d\theta$ taken between proper limits respectively.

The reasons why the Greeks were so limited in the number of integrations which they could directly effect were that they had no algebraical notation and

[1] Abridged from the presidential address to the Mathematical Association, January 2.

had not discovered the modern developments of certain functions as series; nor had they discovered that differentiation and integration are the inverse of one another. There is little trace in Greek geometry of considerations corresponding to the differential calculus; the only case that seems certain is that of the subtangent property of a spiral which must have been obtained by the consideration of the instantaneous direction of motion, at any point on the curve, of the point describing it. If, as is probable, Apollonius, in his treatise on the *cochlias* or cylindrical helix, dealt with tangents to the curve, he would no doubt determine the direction of the tangent at any point in the same way.

But the Greeks were by no means limited to what they could obtain by direct integration. They were very ingenious in reducing an integration which they could not perform directly to another the result of which was already known. This must have been the method by means of which Dionysodorus found the content of an anchor-ring or tore and Pappus obtained his theorem which anticipated what is known as Guldin's theorem. In the matter of the anchor-ring the Greeks also anticipated Kepler's idea that the content is the same as if the ring be conceived to be *straightened out* and so to become a cylinder. The Method of Archimedes is mostly devoted to the reduction of one integration to another the result of which is known, but is remarkable also as showing how he obtained certain results otherwise proved in his main treatises. The method was a mechanical one of measuring elements of one figure against elements of another, the elements being expressed as parallel straight lines in the case of areas and parallel plane sections in the case of solids. This point of view anticipated Cavalieri. The elements are really infinitesimals, indefinitely narrow strips and indefinitely thin laminæ respectively, though Archimedes does not say so. But Archimedes disarms any criticism that could charge him with using infinitesimals for proving propositions by carefully explaining that the mechanical procedure does not constitute a proof and is only useful as *indicating* the results, which must then, before they are definitely accepted, be proved by geometrical methods, that is, by the method of exhaustion.

The Disappearing Gap in the Spectrum.[1]

By Prof. O. W. RICHARDSON, F.R.S.

II.

TURNING to Fig. 1, B, which is repeated here for convenience of reference, this shows the various outposts where from time to time spectral lines have been located. It will be seen that there is still a considerable gap between 16·35, the limit obtained with the vacuum grating at the L series of aluminium, and 17·39, the limit with the crystal spectrometer at the L series of zinc. Between these limits no spectral lines are known, but there is evidence of the excitation of such lines, and data have been obtained for the high-frequency limits of spectra in this region.

This evidence depends upon considerations of a somewhat different character from those dealt with so far. If we consider any typical characteristic X-radiation of an element, for example, the K-radiation, it is found to consist of a number of spectral lines which are denoted by the symbols K_α, K_β, K_γ, in order of ascending frequency. In general there are more than three lines, but we shall adopt the symbol K_γ for the line of highest frequency which is observed, and we shall denote its frequency by ν_{K_γ}. These lines can be excited in an element by a stream either of high-frequency radiation or of high-velocity electrons reaching it. In either case the lines are not excited separately, but the whole group K_α-K_γ appears simultaneously. It is found that there are simple and important restrictions on the radiation frequencies and on the electron energies which are capable of

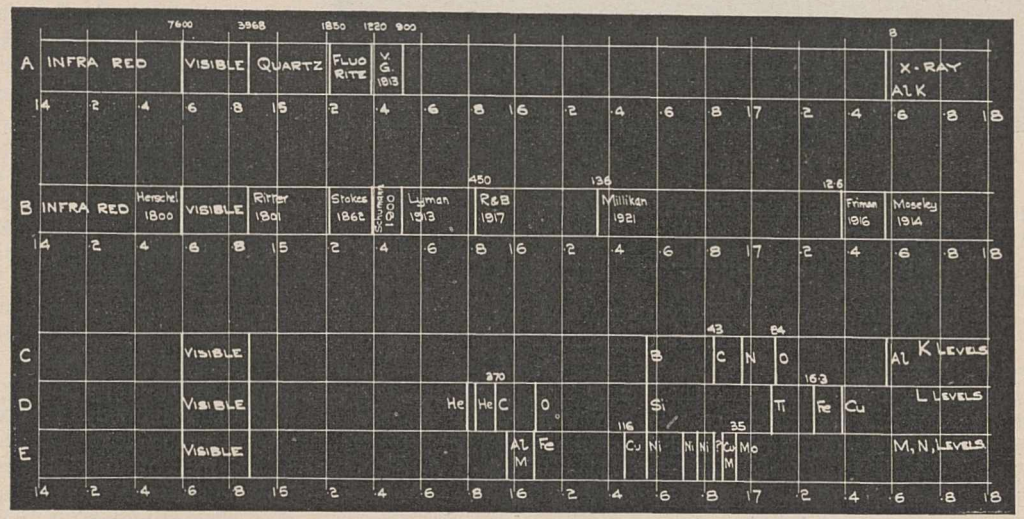


FIG. 1.

[1] Continued from p. 121.

exciting these lines. Thus it is found that there is a critical radiation frequency ν_c, which is very nearly equal to, but just greater than, ν_{K_γ}, and unless the incident radiation stream contains components the frequencies of which are at least as great as ν_c, the K series will not be excited. There is a precisely analogous limitation on the electron energies which cause the generation of the characteristic radiations. Thus there is a critical electron energy eV_c, where V_c denotes the critical potential difference through which the electron of charge e has to fall in order to gain this energy, which is connected with the critical frequency ν_c by the quantum relation $eV_c = h\nu_c$, and if the energy of the impinging electrons is equal to, or greater than, eV_c, the characteristic radiations will be excited, otherwise they will not. Furthermore, if we measure the absorption of radiations of different frequencies by the element under consideration, we find that, corresponding to the excitation of the characteristic rays, there is a sudden increase in absorption at the critical frequency ν_c. There is also a discontinuity in the ionisation of the element at the same frequency.

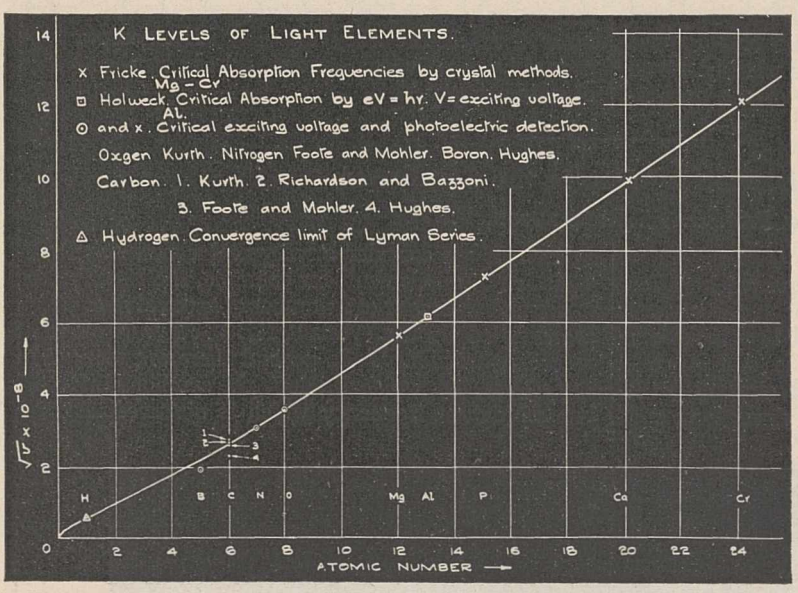


FIG. 4.

There is definite evidence from X-ray phenomena that the critical energy eV_c measures the work which has to be done in removing an electron from its position in the normal atom to a point outside the atom. The characteristic rays are emitted when the gap thus created is subsequently filled up, the different lines arising according to the origin of the electron which fills the gap. If, measured in terms of energy, it is from a near location, we get a low-frequency line such as K_α; if it is from a location near the surface of the atom, a high-frequency line such as K_γ arises.

Thus critical energies such as eV_c give a direct measure, in terms of energy, of the *levels* of the different electrons in the atom. Alternatively, the corresponding critical frequencies ν_c are the *limits* of the relevant X-ray spectra. If we can determine these limits we shall have found the high-frequency ends of the various spectra. While these ends are not, strictly speaking, spectral lines, for the heavier elements at any rate, they are very close to the highest-frequency emission lines in the spectra. Furthermore, according to modern spectroscopic theory, they give us the fundamental data on which the formulæ for the spectral series are based.

It is a curious fact that evidence of the existence of such levels in the gap between what are ordinarily termed the X-ray and the ultra-violet spectra should have been produced independently and almost simultaneously by a number of investigators scattered all over the world. These include Foote and Mohler in Washington, Holtsmark in Christiania, Holweck in Paris, Hughes in Kingston, Ontario, Kurth in Princeton, and myself and Bazzoni in London. While the details of the apparatus used by the different workers vary considerably, the principle involved in most of them can be made clear by reference to Fig. 2 (p. 119). Let the element under test forming the anode A_1 be bombarded by a powerful electron current from the hot cathode F. Then any radiation generated at A_1 can pass between the charged plate condenser P, where any ions present will be removed from it, into the chamber on the left. If the rather complicated apparatus shown in the left-hand chamber is removed and replaced by a plate on which the radiation falls and by a second electrode, the radiation can be detected by the photoelectric electron emission it produces at the plate and measured by the current which flows between the two electrodes, the plate being negatively charged. Let this current be measured and divided by the thermionic bombarding current for a series of different potentials applied between F and A_1; then if there is a sudden generation of characteristic rays from A_1 at some critical potential V_c we should expect an increased rate of rise of the photoelectric current with applied potential to set in at V_c. Thus, briefly stated, the experimental method is to plot photoelectric current per unit thermionic current against primary bombarding potential and to look for discontinuities in the resulting diagram. These discontinuities should occur at the critical potential differences V_c corresponding to the energy levels eV_c and to the frequency limits ν_c equal to eV_c/h.

This general type of method leaves much to be desired, but it seems the most practicable procedure at the present stage of the subject. It is open to the general objection that discontinuities in functional diagrams are often merely indications of faulty experimenting, and the evidence that such discontinuities as are observed are really due to the excitation of X-rays is quite indirect and inferential. It is hoped later, however, to make good this deficiency by supplying a direct test of the frequencies of the radiations generated; for example, by using the magnetic spectroscope which was used for determining the end of the helium spectrum, and by other methods.

Fig. 4 shows the square roots of the critical fre-

quencies of the light elements for K-radiations plotted as ordinates against the atomic numbers as abscissæ. The values for all the elements from magnesium to chromium which are amenable to crystal methods have been determined accurately with crystal gratings by Fricke, who measured the wave-length at the absorption discontinuity. They all lie on a curve which is almost a straight line through the origin, and a few of them are shown thus, x. The aluminium value ⊡ is practically identical with Fricke's for the same element and was obtained by Holweck by measuring the voltage V_c on an X-ray tube for which the absorbability in aluminium of the total radiation is a maximum. This method contains features which, though found separately in the method used by Fricke and in the photoelectric methods, are not common to both, and the agreement will no doubt tend to promote confidence in the photoelectric methods. The points for oxygen (Kurth), nitrogen (Foote and Mohler), carbon (Foote and Mohler, Hughes, Kurth, Richardson and Bazzoni), and boron (Hughes) have all been obtained by photoelectric methods. The hydrogen point △ is the limit of the Lyman series which should correspond to the K level for hydrogen. It will be seen that the hydrogen, nitrogen, and oxygen points practically fall on a smooth curve which is continuous with the curve for the elements from magnesium to chromium. There is some disagreement in the case of carbon, but three of the points are very close to the same curve. The only notable deviation is the low value given by Hughes. The boron value also falls below this curve but there is, so far as I am aware, no known reason why the frequencies should be a smooth function of atomic number for these very light elements.

The next lower critical frequency for any element will presumably be that pertaining to the L group, or the highest L critical frequency if there is more than one. The square roots of a number of such critical frequencies for elements from boron to copper as given by photoelectric methods (boron and carbon, Hughes; carbon, oxygen, aluminium, silicon, titanium, iron, and copper, Kurth) are shown thus, x, in Fig. 3 (p. 120). These frequencies should be somewhat higher than those of the corresponding lines, and it will be seen that the observed points from aluminium to copper are all about the same distance above the broken projection of the curve through the values for the L_{α_1} lines for the elements from zinc to zirconium obtained by crystal measurements. This affords additional justification for extrapolating from the zirconium to zinc L_{α_1} values to the value for the L_α line for aluminium as was done in interpreting Millikan's vacuum grating data. It will also be observed that the values of the limits for boron, carbon, and oxygen given by the photoelectric methods are either very close to the values for the shortest lines in the L spectra found by Millikan or have a somewhat higher frequency. These properties are in harmony with those found in what is more usually regarded as the X-ray region. It should be added that data for elements between sodium and chlorine have been given by Mohler and Foote, which fall on or below the L_α curve as drawn in Fig. 3. These data, however, have been obtained by the electron bombardment of vapours, in many cases of compound vapours, and it is not improbable that the values for these will be different from those for the solid elements. Some of these data also appear to refer to radiation potentials, which correspond to lines, rather than to ionisation potentials, which correspond to limits.

Just as in the case of the L_α lines, the L limits for the light elements from helium to magnesium do not change smoothly with increasing atomic number as do the limits for the heavier elements. In fact the frequency for helium as obtained either by direct determination of the end of the corresponding spectrum or from the ionising potential is higher than that of succeeding elements until carbon is reached.

In the case of a number of elements ranging from aluminium to molybdenum, critical potentials have been observed (by Kurth and by Richardson and Bazzoni) at values corresponding to frequencies well below those which characterise the L spectra. The connexion with the generally recognised X-ray series of the heavier elements has scarcely yet been worked out in sufficient detail for the precise group allocation of some of these to be determined with certainty.

Turning to Fig. 1, C, D, and E show, on the same scale as in A and B, the position of some of the spectral limits given by these photoelectric methods. It will be seen that a majority of them lie in the gap between 16·35 and 17·38 in which so far no spectral lines, either X-ray or ultra-violet, have been detected by grating methods. If the interpretation of these photoelectric determinations as the ends of the various spectra is substantiated, it will have to be admitted that the gap in the spectrum between the ultra-violet and the X-ray region about which I have been speaking is not merely disappearing but has actually disappeared.

Obituary.

PROF. JOHANNES ORTH.

PROF. JOHANNES ORTH, whose death is announced, was born in 1847 at Wallmerod in Nassau. He received his medical and scientific training chiefly at Bonn, where he studied pathology under Rindfleisch, whose assistant he afterwards became. Later, he was appointed assistant to Virchow in Berlin. In 1878 he was appointed professor of general pathology and pathological anatomy in Göttingen and afterwards received the title of *Geh. Med.-Rat.* In 1902, on the death of Virchow, he was elected to the chair of pathology in the University of Berlin, and since then his energies have been devoted chiefly to the development of the Institute of Pathology, which was founded and equipped by Virchow.

Orth was the author of numerous papers on pathological subjects, and also of several books, the two most important of which were his "Compendium der pathologisch-anatomischen Diagnostik," which was translated into English in 1878, and his "Lehrbuch der speciellen pathologischen Anatomie," published in 1893. Orth was undoubtedly a pathologist of great eminence and made many valuable contributions to his subject, but his reputation rested rather on his powers as a teacher and expositor and on his width of knowledge

than on any discovery in a special department. He was essentially a disciple of Virchow and a follower of his methods.

MR. E. W. NELSON.

THE science of oceanography and the scientific study of fisheries have lost a devoted and able worker by the tragic death of Mr. E. W. Nelson, the scientific superintendent of the Fishery Board's marine laboratory at the Bay of Nigg near Aberdeen, who was found dead in his laboratory on the morning of January 17. He had been appointed in September 1921 to succeed Dr. T. Wemyss Fulton in the service of the Fishery Board for Scotland, and he was proving himself a very effective investigator of Fishery problems. He was much liked and respected by his staff, and every one was looking forward to the work that he would do, especially as regards the physical conditions of the sea in their relation to fisheries, for it was in the bearings of physics on biology that he was most interested. He had an ingenious mind, more of the mathematical than of the biological order; though he was a keen naturalist as well. He was particularly well suited for the post that he held and he seemed to be very happy in his work.

Mr. Nelson was educated at Christ's College, Cambridge, and he was working at Plymouth Biological Station when he was chosen in 1910 to be a biologist to the British Antarctic Expedition led by Capt. Scott. He made an elaborate biological survey around the Cape Evans station, and Scott speaks in his "Journals" very appreciatively of his enthusiasm, carefulness, and practical ingenuity. Mr. Nelson was one of the thirteen men who stayed at Cape Evans for a third year under the command of Surgeon Atkinson. During the war Nelson served in the Royal Naval Division.

Mr. Nelson was a pleasant and cheerful personality, very kindly, though fond of an argument, very keen about his own work, but delightfully willing to help others, not wearing his heart on his sleeve, but full of good-will.

DR. TALFOURD ELY.

DR. TALFOURD ELY, whose death was recently announced at the age of eighty-six, was a nephew of Frank Ely, the dramatist, and great-nephew of Sir T. N. Talfourd, author of "Ion." During the greater part of his life he was closely connected with University School and College, London. He was vice-principal and classical tutor at University Hall, classical master at University College School, and secretary of the College. This last post he resigned in order to study archæology at Berlin, where he worked with Ernest Curtius, Kirchof, Robert, Furtwängler, and Waltenbach, and became acquainted with other leading scholars. He travelled largely in Europe, and had an exciting adventure at Olympia with brigands whom he routed. In his later years he was connected with many learned societies—the Antiquaries, Hellenic, Royal Archæological, and others. The literary works by which he will be best known are "A Manual of Archæology" and "Roman Hayling," embodying the results of his own excavations at Hayling Island, besides many papers on archæology.

THE death of Miss Charlotte Sophia Burne has left a gap in the ranks of English students of folklore. A native of Shropshire, she edited with additions the collections of Miss G. F. Jackson, which were published under the title of "Shropshire Folklore," one of the best local manuals. Her later years were spent in London, where she became a pillar of strength to the Folklore Society, serving on the council and as president. In 1914 the Society published her admirable "Handbook of Folklore," but the main work of her later days was the collection of a great mass of materials for a new edition of John Brand's "Observations on Popular Antiquities," which was intended to become an encyclopædia of English folk beliefs. When her health broke down the task of editing this work was undertaken by Dr. E. Sidney Hartland.

Current Topics and Events.

THE centenary of the death of Edward Jenner on January 26, 1823, was celebrated by the Academy of Medicine in Paris on Tuesday, January 23. At 3 P.M. a large meeting was held at the Academy in the Rue Bonaparte, when the president, M. Chauffard, gave a short address, which was followed by a long, critical, and yet eulogistic speech by M. Lucien Camus, and by communications on the subject of vaccination in detail from MM. Pierre Teissier, Jeanselme, d'Espine, and Sir St. Clair Thomson. The fine large hall of the Academy was crowded, the French Minister of Health, M. Strauss, and Madame Curie being present, in addition to other distinguished people. The busts of Jenner and Pasteur were placed on the right and the left of the platform. After the ceremony a number of mementoes of Jenner in the form of letters by him, and of old cartoons commemorating or deriding vaccination, were shown in one of the halls of the Academy. The president announced that communications in honour of the event had been received by him from learned societies in many parts of the world. Sir Ronald Ross, a foreign associate of the Academy, who represented the British Ministry of Health, handed in also a letter from the president of the Royal Society, and other British societies were represented by Sir St. Clair Thomson and by Dr. R. O. Moon. Sir Almroth Wright, another foreign associate of the Academy, was also present. After the ceremony the president and council of the Academy, in honour of the commemoration, gave a dinner at the Club de la Renaissance Française.

BY the will of the late Prof. Emil Chr. Hansen, director of the Physiological Department of the Carlsberg Laboratory, Copenhagen, and his wife, a fund bearing his name was established in 1911 providing

for the award on Prof. Hansen's birthday, May 8, at intervals of about two or three years, of a gold medal bearing his effigy, and accompanied by a sum of at least 2000 kroner, to the author of a distinguished publication on some microbiological subject that has appeared in recent years in Denmark or elsewhere. The medal was awarded in 1914 to Dr. Jules Bordet, Brussels, for researches in medical microbiology, and in 1922 to Dr. M. W. Bejerinck, Delft, for researches in general microbiology. This year it is proposed to award the medal to an author of experimental researches in marine microbiology. The award is made by a committee consisting of the Danish trustees of the fund together with at least two foreign microbiologists. The committee is composed this year of Prof. C. O. Jensen, director, Serum Institute of the Royal Veterinary and Agricultural College, Copenhagen; Dr. Johs. Schmidt, director, Physiological Department of the Carlsberg Laboratory, Copenhagen; Prof. S. P. L. Sörensen, director, Chemical Department of the Carlsberg Laboratory, Copenhagen; Prof. H. H. Gran, University of Christiania, Norway, and Prof. C. A. Kofoid, University of California, Berkeley, U.S.A. Further particulars may be obtained from the president of the Board of Trustees, Emil Chr. Hansen Fund, Copenhagen (Valby).

THE question of training in Illuminating Engineering was discussed at the last meeting of the Illuminating Engineering Society, an introductory paper being read by Mr. C. E. Greenslade and Mr. J. E. S. White. The authors discussed in some detail the planning of courses on illumination at technical colleges, pointing out that special attention should be given to practical applications of light, and that the aspects of lighting considered by architects should be dealt with besides purely technical matters. It was also suggested that occasional popular lectures on the subject would be helpful, and that such lectures would be particularly useful in schools, so that children might grow up with an appreciation of the benefits of good lighting. It was pointed out that there is a need for a suitable text-book for students as most of the works available are somewhat elaborate, and that hints to lecturers on demonstrations and series of suitable lantern slides would also be valuable. The discussion was opened by Dr. F. T. Chapman, of the Board of Education, who suggested methods of improving the treatment of illumination in existing courses, and Mr. Gaster mentioned that the Society had issued a circular to technical colleges offering the co-operation of the Illuminating Engineering Society in the framing of syllabuses and, if necessary, the provision of lecturers. In almost all cases replies received had welcomed co-operation of this kind.

THE presidential address of Capt. H. Riall Sankey to the Institute of Industrial Administration on "Training for Administration in Industry," which was delivered on October 10 last at the London School of Economics, has recently been published in the number of the *Journal of Industrial Administration* for Nov.-Dec., 1922. It gives a brief review of the work of the Institute, and also contains the announcement that, at the instance of its advisory council, the Institute has prepared an examination scheme with the view of the award of diplomas and certificates in connexion with subjects bearing on the administrative side of the work in industry. The scheme is shortly to be put into force, when it is proposed to hold examinations in eight groups of subjects, namely: (1) design, specifications, and inspection; (2) factory planning and plant management; (3) estimating, production methods, and rate fixing; (4) production control (scheduling and regulation); (5) employment administration; (6) materials and purchasing; (7) stores and transport management; and (8) production statistics and costing. The examination questions will be framed in relation to the administrative, in contradistinction to the strictly technical, aspects of the subjects enumerated above. Honours and pass certificates will be issued for each group of subjects, and it is intended at a later date to award diplomas to those who hold the qualifying number of certificates (the precise number has not yet been determined).

AN article which appears over the initials H. B. in *Le Temps* of January 2, discusses the findings of the International Commission which, in September last, visited the sites at Ipswich on which Mr. Reid Moir claims to have found evidence for Tertiary Man. The investigations of the International Commission, which consisted of MM. Lohest, Fourmarier, Hamal-Nandrin and Fraipont (Belgium), MM. Capitan and Breuil (France), Messrs. MacCurdy and Nelson (U.S.A.), and Messrs. Reid Moir and Burkitt, afforded an exceptionally favourable opportunity for a careful examination and discussion of the evidence. The findings of the Commission, therefore, must carry great weight. According to the writer in *Le Temps*, the report presented to the International Institute of Archæology in Paris stated that the members of the Commission were unanimously of the opinion that Mr. Reid Moir's specimens from the base of the "Crag" were genuine artifacts and were found in deposits which were undoubtedly undisturbed, and belonged, beyond question, to the Upper Pliocene. After a careful examination of the characteristics of the specimens, in the course of which all giving rise to any doubt were set aside, the Commission held that they could have been produced by no natural cause and that their distinctive features were comparable with those of Mousterian implements about which there was not the least doubt. The writer concludes that we must inevitably accept the existence of man at Ipswich in the Pliocene period of the Tertiary epoch,—possibly not man himself as such nor even a direct ancestor, but a being who, in virtue of this industry, merits a place in the *genus homo* among the precursors of man; and that the evidence carries back the first appearance of this being on the globe well beyond the 125,000 years at which Osborn dates the beginning of the Pre-Chellean Age.

THE annual report of the National Union of Scientific Workers shows that the Union has increased

its membership to 826 with a corresponding improvement in its financial position. The formation of three special sections with activities connected with Government service, with industrial service, and with universities is probably a step in the right direction. In the first service there is stated to be profound dissatisfaction, partly due to the inadequate position, responsibility and freedom of initiative of scientific workers and partly to the operation of the "Geddes Axe." It is suggested that at the bottom of the discontent of scientific officers in Government departments is the totally inadequate understanding of science by officials, holding executive positions, originally appointed to the Civil Service on examinational efficiency in every side of education but science. The University Section would seem to have a definite function in respect to the teaching, pay, position, and free research hours of university teachers; it seems doubtful policy to merge it into a general education section to consider the whole "tree" from the infants' school to the universities. The Industrial Section has to deal with such matters as the pay, position, and unemployment of scientific workers in industry; the problems are so intricate that any standardising and grading of salaries as well as of the qualifications of those employed would seem impossible. Success is probably bound up with propaganda as to the important economic results likely to ensue from the due employment of properly qualified scientific workers in various sides of economic life. We note in this connexion the amalgamation, so far as their aims are concerned, of the Union with the British Association of Chemists and its friendly co-operation with many other professional bodies.

THE announcement has been made of a gift of 5000*l.* by a donor, who at present wishes to remain anonymous, to the Rowett Research Institute for Animal Nutrition at Aberdeen. This sum is intended to found a library and to provide for making statistical records.

A LECTURE on "Intersexuality and the Determination of Sex" will be delivered by Prof. Goldschmidt, of Berlin, in the Zoology Department, University of Liverpool, on February 15, at 7.30 P.M. An open invitation is extended to all who are interested. Further information can be obtained from Prof. W. J. Dakin, University, Liverpool.

NOTICE is given by the Iron and Steel Institute that the council of the Institute is prepared to consider in March applications for grants from the Carnegie Fund, in aid of research work on some subject of practical importance relating to the metallurgy of iron and steel, or allied subjects, and that special application forms may be obtained from the Secretary of the Institute. The results of research work must be communicated in the form of a report.

A JOINT dinner, to be called the "Ramsay Chemical Dinner," arranged by the Society of Chemical Industry, the Institute of Chemistry, the Society of Dyers and Colourists, the Glasgow University Alchemists' Club, the Andersonian Chemical Society, and the Ardeer Chemical Club, will be held in Glasgow on Friday, February 23. The dinner will take the place of the social functions previously held separately by the various societies in Glasgow and, it is hoped, will promote recognition of the importance of chemistry. Application to attend must reach Dr. J. A. Cranston, Royal Technical College, Glasgow, not later than February 16.

WE have received a copy of a list of the products manufactured by the British Dyestuffs Corporation Ltd., which is made up in the form of a diary. Classified lists of dyes, colours for special purposes, such as soap, film, and foodstuff colouring, are given, and lists of chemicals for research work (under the heading Association of British Chemical Manufacturers), microscopic stains, and indicators, are included. The volume is very convenient, and is a welcome indication of the progress made in the synthetic chemical industry.

THE second course of training for seed analysts will commence in July at the Official Seed Testing Station, Cambridge, and will last four to five weeks. The course is limited to those who are nominated by seed firms, recommended by universities or agricultural colleges, or otherwise show their fitness for such training. At the conclusion of the course, an examination is held which is also open to nominated candidates who have not taken the course of instruction. Applications must reach the Secretary, National Institute of Agricultural Botany, by May 1 next.

THE following lecture arrangements of the Royal College of Physicians of London have been made: Dr. W. G. Savage will deliver the Milroy Lectures on February 22, 27, and March 1. The subject will be "Canned Foods in Relation to Health." The Goulstonian Lectures will be given by Dr. G. Evans on March 6, 8, and 13. The subject will be "The Nature of Arterio-Sclerosis." Dr. A. J. Hall will deliver the Lumleian Lectures on March 15, 20, and 22, taking as his subject "Encephalitis Lethargica (Epidemic Encephalitis)." The lecture hour in each case will be 5 o'clock.

MR. G. A. DUNLOP, keeper of the Warrington Museum, sends his report for the two years ending June 30, 1922. During the latter year the number of visitors amounted to 82,815, being an increase of more than 50 per cent. as compared with the previous year. We infer that the increase consists largely of children, since a serious attempt has been made to bring about a closer connexion between the schools of the town and the museum. A special advisory committee has suggested a scheme for the utilisation of the museum in the teaching of general and local history to the school children. Unfortunately the scheme is not given in the report.

MESSRS. H. F. AND G. WITHERBY announce for publication this month "A Biology of the British Hemiptera-Heteroptera," by E. A. Butler. The work will include a complete list of British families, subfamilies, genera, and species, arranged according to Oshanin's "Katalog" (1912), and many illustrations.

A LIST (No. 31) of second-hand books of science, mainly natural history, botany, and gardening, has just been issued by Mr. R. S. Frampton, 37 Fonthill Road, N.4. Upwards of a thousand titles are given, and the prices asked appear very reasonable.

THE latest catalogue (No. 439) of Mr. F. Edwards, 83 High Street, Marylebone, W.1, is devoted to atlases and maps and books of geographical interest. As is usual with the catalogues issued by this bookseller, the present list contains many rare and scarce items, which are fully described.

MR. E. G. WHITE, the third edition of whose "Voice Beautiful in Speech and Song" was noticed in NATURE of December 30, p. 871, objects to the remark of the reviewer "that I regard the vocal cords 'as strings,' whereas the whole book is written for the precise purpose of showing that they are not strings." In stating that Mr. White regards them as strings the reviewer adopted the argument in Chapter III. of the book, but he did not say that Mr. White actually believed the "vocal cords" to be strings. As to the view that the theory of sinus tone production "is not supported by a particle of evidence," Mr. White refers to evidence "that it is possible to speak and sing when both vocal cords have been excised," but no physiologist would accept this as conclusive. He detaches from the notice of the second edition of his book, in NATURE of April 17, 1919 (vol. 103, p. 124), the words "there is much to admire in this book," but omits to add that the reviewer "J. G. M." entirely rejected his thesis, remarking, "Over and over again he furnishes what he regards as evidence in support of his thesis, but the conclusion, almost invariably, is in the opposite direction." To this it may be added that the supposed evidence never points in the direction of the sinuses.

Our Astronomical Column.

CALENDAR REFORM.—Somewhat of a deadlock has been reached in the matter of calendar reform, owing to the unwillingness of a considerable section to abandon the free week, which has now been running uninterruptedly for some 3000 years, by the introduction of days that would not count in the week or month. Rev. D. R. Fotheringham, editor of the *Chaldaean*, proposes a scheme in No. 17 of that journal which would retain the fixed calendar, without interfering in the least with the succession of weekdays. He proposes to make an ordinary year exactly 52 weeks or 364 days. This could be divided into 4 quarters, in each of which the lengths of the months would be 30, 30, 31 days; or if preferred, there could be 13 months of 4 weeks each: every fifth year (the last digit of which was 0 or 5) would have an extra week; unless the year was divisible by 45, in which case there would be no extra week. There would thus be 8 extra weeks in 45 years, the average length of the year being 365·2444444 . . . days. The true length of the tropical year is 365·242199, so that the error is 0·00224 days, or 1 day in 446 years; this is a trifling amount and could be corrected by dropping the extra week once in 3000 years, in addition to its normal dropping every forty-fifth year.

The proposed calendar would satisfy the following desiderata, assuming that the extra week is always reckoned at the end of the year: (1) any particular calendar date would always be on the same day of the week; (2) the interval in days between two dates in the same year would always be the same; (3) the fact of the sequence of weekdays going on unchanged would be likely to remove opposition from ecclesiastical and other quarters. The two chief objections to our present system from the astronomical point of view are the irregular lengths of the months, and the occurrence of the leap-day early in the year. The latter flaw is not due to Julius Caesar, for he made March the first month, as the prefixes Septem-, Octo-, etc., still remind us; so that he saw the advantage of putting the leap-day at the end.

THE POSITION OF THE SOLAR APEX.—The positions derived for the solar apex, or point to which our system is tending, from the study of the stellar proper motions, have been far less accordant than one could wish; it has been found indeed that they differ systematically according to the faintness of the stars the motions of which are utilised. The late Prof. Kapteyn suggested that this discordance might be due to the imperfect correction of systematic errors in the older catalogues; this would affect the proper motions deduced from comparison of these catalogues with modern ones, and the effect on the position of the apex would be greatest for the stars with smallest motions. Now a determination of the apex from the radial velocities of stars is independent of this source of error, and is therefore a useful check. M. J. S. Paraskevopoulos, of Athens Observatory, uses the radial velocities of the stars in Voûte's Catalogue, together with 537 additional ones recently published from Victoria, B.C. His results, given in *Astr. Journ.* No. 813, are :—

	North Stars.	South Stars.	All Stars.
R.A. of Apex	271°·4	272°·2	271°·6 ±3°·0
N. Decl. of Apex	31°·6	29°·6	30°·3 ±3°·0
Sun's velocity km./sec.	20°·7	25°·4	23°·33±1°·03

The apex accords well with that usually adopted, but the velocity is somewhat greater.

LOST PLANET RECOVERED.—Planet 132, Aethra, was discovered by the late Prof. Watson of Ann Arbor on June 13, 1873. It was one of 22 found by him between 1863 and 1877; he was not content merely with finding them, but he also determined their orbits and perturbations, and at his death left a trust fund to secure that the necessary calculations and observations should continue to be made on these planets after his death. Aethra appeared to be the most interesting of them all from its large eccentricity and small perihelion distance; however, in spite of constant endeavour it remained lost from 1873 till now. On December 12, 1922, M. B. Jekhowsky, of Algiers Observatory, found a planet of mag. 10·5 in R.A. $5^h\ 56·1^m$, N. Decl. 18° 27′ with daily motion $-1·3^m$, S. 21′. It was independently found at Simeis on December 19 by M. G. Beljavsky. An approximate orbit by M. Jekhowsky makes it highly probable that it is the lost Aethra, a conclusion which Dr. Luther has reached independently. As further observations are desired, the following predicted positions (from *Astr. Nach. Circular*) may be useful. January 24, R.A. $5^h\ 11·5^m$, N. Decl. 4° 33′; February 1, R.A. $5^h\ 10·6^m$, N. Decl. 3° 0′. The period comes out as 3·89 years if we assume 13 revolutions since 1872, but the assumptions of 12 or 14 revolutions would give $4·2^y$ and $3·6^y$ respectively. The elements deduced in 1873 were: Period 3·926 years, eccentricity 0·3314, perihelion distance 1·664, longitude of perihelion 151° 56′, ascending node 259° 40′, inclination 23° 42′.

Research Items.

DECIPHERING CHARRED DOCUMENTS.—Mr. Raymond Davis, of the Bureau of Standards, Washington, finds that the written and printed matter of papers that have been thoroughly charred, as, for example, by being heated in an iron box or safe, may be deciphered by placing the charred sheet in contact with a fast or medium plate for a week or two in the dark and then developing as usual. There appears to be an emanation that affects the plate except where the charred ink acts as a protective coating. It is curious that films need a much longer contact than plates, and that sometimes the effect is reversed unless the film is previously washed and dried.

THE GYPSIES OF TURKEY.—Prof. W. R. Halliday has collected from a wide range of literature an account of the Turkish gypsies in the Journal of the Gypsy Lore Society (3rd series, vol. i., part 4). The conventional estimate of the number of these people in modern Turkey is 200,000, but there is no accurate material for forming any conclusion which possesses the slightest value. The more rigid Osmanli hates them as infidels and dreads them as magicians, and the Christian view of the gypsy's irreligion and genial roguery is illustrated from the folk tales. This feeling is based on the laxity of their religious observances, for in this area religious rule has the added sanction of corresponding with racial or natural cleavage. This thievish habit and way of life have naturally made them unpopular, and it is widely believed in Turkey that they dig up graves and eat corpses, a belief probably based on their habit of eating carrion. It is also stated that they drink annually a secret potion, the composition of which is known only to the oldest and wisest of the tribe, which secures immunity from snake-bite. They are also said to furnish the most expert executioners in Constantinople, but this is scarcely credible. Their employment as bear-leaders is reflected in the dislike shown towards black and brown bears, and to the use of the skins of these bears by furriers in Constantinople.

CERCARIÆ FROM INDIAN FRESH-WATER MOLLUSCS.—Maj. R. B. Seymour Sewell has given an account (*Ind. Journ. Med. Res.*, vol. x., Suppl. Number, 1922) of the anatomy and biology of 52 cercariæ, which he has preferred to designate by numbers as he considers that at present the basis of specific distinction is vague. The majority of the fresh-water molluscs are born in May-August, live for approximately two years, and then die from natural causes. The vitality of heavily parasitised specimens is considerably impaired. The maximal periods of miracidial infection occur in May-June and in September-October, that is, just before and just after the monsoon season. During an examination of nearly 4000 fresh-water snails a double infection—two forms of trematodes developing simultaneously in the same snail—was met with only in eighteen cases, namely in sixteen *Melanoides tuberculatus* and two *Indoplanorbis exustus*, the two most widely distributed species of mollusc in India. Cases are comparatively common in which one form of trematode was found developing from parthenitæ (sporocysts or rediæ) while another was found encysted in the tissues. Maj. Sewell records that on several occasions he observed in sporocysts (producing cercariæ XV., closely related to *Cercaria vivax* Sonsino) the occurrence of miracidia—some of which were still in an incomplete state of development and enclosed in a thin capsule, but others were swimming freely in the cavity of the sporocyst. The sporocyst and redia are not sharply demarcated stages; it is easy to form a graded series beginning with an undoubted sporocyst which appears to be devoid of all structure, passing through forms—in which excretory and certain other organs are partly developed—which might be considered either as sporocysts or as rediæ, and ending with undoubted rediæ with well-developed alimentary canal, a complicated excretory system, definite nervous system and genital organs, and active locomotor processes.

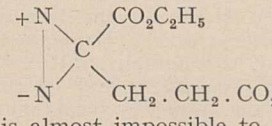
GEOLOGY OF NEW ZEALAND.—The latest view as to the grouping and correlation of the much-discussed strata of New Zealand is embodied in one of the pamphlets conveniently extracted from the *New Zealand Journal of Science and Technology* (vol. 5, No. 1, 1922). In this Mr. P. G. Morgan, director of the Geological Survey, gives geological maps of both the great islands, printed clearly in black and white, on a scale of 1 inch to 40 miles. If these were not so economically printed back to back, they might well be mounted by their fortunate possessor and coloured according to the international scheme. The divisions of the Maitai systems (formerly held to be Triassic and Jurassic, but now shown to be Permo-Carboniferous) are still undecided; but it is clear that the grouping of these rocks on the geographical axis of the southern island is not a tectonic feature, their general strike being north-westerly. In the epoch of their deposition, New Zealand lay on the margin of Gondwanaland, and it seems reasonable to suggest that the strike of the Maitai systems, when they came to be folded, was determined by the pressures from the south that crumpled the beds in Jurassic times in the coast-ranges of the Cape Province of S. Africa. As Mr. C. A. Cotton has pointed out ("The Outline of New Zealand," *Geographical Review*, vol. 6, p. 320), the present form and features of New Zealand have been largely determined by faulting, with the formation of blocks of uplift and depression. The dominion is developing its culture on a mere fragment of land left among the deeps.

PALÆONTOLOGICAL RESEARCH IN CHINA.—The third Asiatic Expedition of the American Museum of Natural History has been co-operating with the staff of the Geological Survey of China, and, in view of the interest taken in their joint researches, Mr. J. G. Andersson, with his colleagues of the Chinese Survey, have issued a brief summary of the results of the Survey's operations so far as carried out (Bull. Amer. Mus. Nat. Hist., xlvi. art. 13). The fossil invertebrates are being worked out by Dr. A. W. Grabau, now palæontologist to the Geological Survey of China. At present these have been obtained almost exclusively from the palæozoic deposits, and will be described in the near future in a work devoted to Chinese palæontology, initiated by Dr. V. K. Ting, the director of the Geological Survey of China, and entitled "Palæontologia Sinica." Of considerable interest is the discovery of the first Eurypterus in China in the coal measures of the Kaiping basin in strata of Lower Permian age. Coal deposits are plentiful and range from Palæozoic to early Tertiary. By far the most interesting among the plant beds of China are the Permo-Carboniferous coal series, while those of the Jurassic of northern China come next in importance, and the Oligocene flora of Fushun, in Fengtien, is the most representative of the Tertiary beds. Of the fossil vertebrates the principal description hitherto has been that of Schlosser, who, however, procured his material from Chinese medicine shops. Mr. Andersson has now

brought together extensive collections. The Hipparion clays of northern China prove the richest deposits so far. The north China loess but rarely contains fossils. One of the commonest is the egg of a big ostrich, *Struthiolithus chersonensis*. There is also an elephant, doubtfully referred to *Elephas namadicus*. No undisputed proof of the existence of Palæolithic man has as yet been obtained, nor of any Older Neolithic culture.

INDUCTION MOTORS AS SYNCHRONOUS MACHINES.—In the *Journal of the Indian Institute of Science*, vol. 5, part 4, p. 37, there is an interesting and useful paper by S. V. Ganapati and R. G. Parikh on induction motors used as synchronous machines. From the point of view of the engineer of the supply station the large "wattless" current taken by induction motors is a serious drawback to their use, and methods are sometimes employed to penalise consumers in proportion to the amount of wattless current they take. The authors have experimented on induction motors by supplying their rotors with direct current and thus converting them into synchronous machines. They found that they were more unstable than ordinary synchronous motors, as a relatively small decrease in the exciting current caused them to fall out of step. They find also that, for heavy loads, this method involves a sacrifice of efficiency and only a slight diminution of the wattless current. It is also necessary to adjust the excitation to the load and hence it is unsuitable for fluctuating loads. The advantages of synchronous operation are only pronounced at times of light load.

POSITIVE AND NEGATIVE VALENCES.—The *Recueil des Travaux chimiques des Pays-Bas*, which was founded in 1882 and of which the forty-first volume has just been completed, is now to assume an international character, since it has been arranged that the *Recueil* will henceforth contain articles in French, English, and German. With this announcement there has been circulated a double number for September and October 1922, in which this policy has been put into operation. The issue contains the papers read at an International Congress of Chemistry held at Utrecht on June 21-23, 1922. It includes 14 papers, of which three are in English, four in French, and seven in German. The three Russian authors contribute two papers in French and one in German, while the Swiss contribution also appears in French. Perhaps the most interesting of these papers is the one in which Prof. W. A. Noyes discusses the question of positive and negative valences. He puts forward as evidence of the real existence of oppositely polarised atoms the production of an optically active form of the diazo compound



where it is almost impossible to find a satisfactory explanation of the optical activity except by supposing that the two nitrogen atoms differ sufficiently to destroy what would otherwise be a plane of symmetry of the molecule. The question of free radicals is also discussed in two papers by Prof. Walden and Prof. Schenck.

STRESSES IN BEAMS, RINGS, AND CHAINS.—The honorary members' lecture to the Junior Institution of Engineers for the year 1922 was delivered by Prof. E. G. Coker, who chose for his subject "that branch of the elasticity and strength of materials which deals with the stress distributions in curved beams, rings, and chain links." The lecture is printed in the Journal of the Institution, Part 6, vol. xxxii., and forms a valuable résumé of the application of the optical properties of transparent bodies to the determination of the stresses in these bodies. It is pointed out that in plain stress, all materials which fulfil the primary conditions of elasticity are stressed in precisely the same manner under similar conditions of shape and loading, and so the stresses can be found by observation on transparent material like nitro-cellulose. The cases dealt with are the straight beam subjected to bending moment (to show that when the beam is unsymmetrical about the plane of bending, the usual formula giving the stress in terms of the change of the curvature is not correct), discontinuities in beams, short beams, beams of constant curvature under uniform bending moment (as being of theoretical interest), the crane hook, circular rings, elliptical link with and without stud, circular link with straight sides, and various kinds of piston rings. The mathematical treatment is indicated, while in two appendices is given in brief the mathematical theory of stresses in curved beams (Andrews and Pearson) and of stresses in curved links (Pearson-Winkler theory). Prof. Coker's lecture is a record of important researches on an important subject, to which he and his assistants have made very considerable contributions. It is of interest to note his opinion "that the stress distribution in complicated bodies . . . is one which still demands a very large amount of study by analysis and experimental research."

THE FINITISTIC THEORY OF SPACE.—The logistic mathematicians are very boastful of their claim to have solved the paradoxes of Zeno by their new definition of infinity as a compact series. Their doctrine, however, is not unchallenged. Dr. Petronievics in his "Principien der Metaphysik" has put forward the theory of the finiteness of the number of points in space. His argument is set forth from the point of view of mathematics, metaphysics, and also what he terms hyper-metaphysics, and historically it is claimed to be as old as Pythagoras. A clear, concise, and easy account of the doctrine is given in "Die Lehre vom diskreten Raum in der neueren Philosophie," by Dr. Nikola M. Poppovich (Wilhelm Braumüller, Wien und Leipzig, 1922). It is the thesis for the doctorate of philosophy awarded by the University of Berlin the year preceding the war. Dr. Poppovich reviews the whole problem of the principle of the continuity and discreteness of space from ancient to modern times. The theories fall for him into three types. The first he names the infinitistic realistic, it includes Bolzano and Cantor; the second, the infinitistic idealistic, includes Leibniz and Kant, and in the nineteenth century is represented by Renouvier; the third is the finitistic realistic doctrine of Petronievics. According to this last there is a clear distinction between real and unreal points. The essence of the doctrine would seem to be that the compact series which separates two points is not a series of real points in the sense in which the two definite points are real. The compact series has no other function than that of holding the two real points apart. Thus, to take our own illustration (if we are rightly interpreting the doctrine) the integers 1, 2, in the numerical series are separated by an infinite, *i.e.* a compact, series of fractions, but this series is unreal, *i.e.* imaginary; it serves the single purpose of preventing the two units falling into one identity. The theory leads Dr. Petronievics to affirm the absoluteness of Euclidean space.

The Lourenço Marques Meeting of the South African Association.

THE twentieth annual meeting of the South African Association for the Advancement of Science was held at Lourenço Marques, in the Lyceu, on July 10-15, under the presidency of Dr. A. W. Rogers. The meeting was well attended and was very successful. About fifty papers were read. An official welcome was given by the High Commissioner for Moçambique and the Mayor of Lourenço Marques. There were various visits and excursions to places of local interest, both on the Bay and inland, and an official banquet was given to members at the new Polana Hotel.

A popular lecture, illustrated by lantern slides, was given by Mr. C. Graham Botha, Keeper of the Archives at Cape Town, on "The Early Development of South Africa."

The South Africa medal and grant were awarded to Dr. I. B. Pole Evans for his contributions to botanical science in South Africa.

The presidential address by Dr. Rogers dealt with "Post-Cretaceous Climates of South Africa." Four types of evidence on which recognition of former climates depend were discussed. These were the character of the rocks during the period concerned, the shapes of the land surface resulting from long duration of more or less constant climatic conditions, the distribution of animals and plants, and the historical records of man; the lithological evidence is the most important for all but relatively recent times. Each of these factors was considered in detail as regards South Africa, the evidence being considered from post-Cretaceous times only. Historical records of the past climate in South Africa apply closely to present-day conditions, allowance being made for the progressive settlement of the country. From personal survey work Dr. Rogers concluded that in certain districts no deterioration of climate or marked loss of water has taken place during the last fifty years. The various lines of evidence point to the conclusion that during post-Cretaceous times the climate of South Africa has fluctuated within rather narrow limits; that there has not been a Pluvial period, if by that term is implied a long period of much greater rainfall over the whole country; that a general lowering of temperature in the Pleistocene may have given the Karroo and Southern Kalahari rivers longer periods of flow, but that this more humid era in those regions had come to an end long before human evidence can be drawn upon for an account of it; and that South Africa, like North Africa, the Americas and Australia, bears evidence to a shifting of the climatic belts in the Pleistocene and subsequent times.

The presidential address to Section A on "The Rôle of Astronomy in the Development of Science," was given by Dr. M. A. Peres, Director of the Campos Rodrigues Observatory, Lourenço Marques. He summarised ably some of the chief discoveries and laws in astronomical science, and showed their influence on subsequent research in other branches of physical science. Thus, astronomical observations led to the formulation of the laws of Newton, which opened a vast field of other researches. Similar astronomical observations leading to the work on the velocity of light were the first step towards wireless telegraphy. The indebtedness of optics especially, to astronomical research, was also indicated, and it was pointed out that the chief confirmation of Einstein's theory was dependent on astronomical observations.

"The Influence of Mineral Deposits in the Development of a Young Country" was chosen by Dr. E. T. Mellor as the subject of his presidential address to Section B. This was first illustrated by reference to the Tsumeb Mine in South-West Africa and Broken Hill in Rhodesia. The Tsumeb Mine brought about the building of a railway from the coast to the mine, 350 miles away. The Broken Hill Mine practically determined the course of the main line of the Cape to Cairo railway. The railway system of the Union of South Africa has been influenced by the goldfields of the Witwatersrand. The tracing of the extension of these gold reefs eastwards, the location and exploration of new coalfields, and systematic boring for possible oilfields, all depended on an adequate geological survey. The extension of the Witbank coalfield, though proved and ready for easy exploitation, is suspended because of lack of transport and a market. The connexion of mining developments with research in other sciences was considered, and it was shown that in the gold industry South Africa possesses a field sufficiently extensive and stable to exert more than a temporary influence on the country generally.

The presidential address to Section C was given by Prof. D. Thoday, and dealt with "Carbon Assimilation" in plants. The great advances in the knowledge of the subject due to the work of Blackman in Cambridge and Willstätter in Berlin were summarised, attention being directed to the work done on pigments. The rôle of iron and of magnesium were also discussed. The application of the subject with special reference to South African conditions was detailed. The plants of the open veld are exposed to the full blaze of the sun through most of the year, and this is more than sufficient to enable an ordinary green leaf to assimilate all the carbon dioxide that it needs. Paler green or golden leaves demand more intense light than dark ones for their full activity. Consequently, veld plants have paler leaves, and in extreme cases the leaves are almost greenish yellow. Particulars of internal structure affecting depth of colour were also discussed, as were leaf forms and patternings, and it was emphasised that such features are not merely adaptations to a dry climate but that their effects on photosynthesis of carbon dioxide are probably of equal significance.

The presidential address to Section D was delivered by Dr. Annie Porter, her subject being "Some Modern Developments in Animal Parasitology." After a general introduction dealing with degrees of parasitism, specificity and the like, recent advances in protozoology were first considered. Attention was directed to the conflicting opinions as to the existence of races of *Entamœba histolytica*. The work of Taute and Huber on the non-identity of *Trypanosoma rhodesiense* and *T. brucei*, as shown by direct inoculation of the human subject with game trypanosomes, was discussed, and attention was directed to work on induced herpetomoniasis in vertebrates. Flagelloses of plants were described, especially those due to herpetomonads, some of which had been proved capable of infecting mammals; also the spirochætes, amœbæ, and other parasitic Protozoa found in plants and their reactions on their hosts were noted. Recent work on neuromotor apparatus in Protozoa, and on various organisms and filterable viruses associated with infective (spirochætal) jaundice, trench fever, and typhus were discussed. In helminthology the interesting life-histories of schistosomes in various snails, of Clonorchis in snail, fish and man, of Paragonimus in snail, crab or crayfish and man, and recent work

on the life-histories of such organisms as *Fasciolopsis buski*, Heterophyes, Ascaris, and Strongyloides were detailed. In entomology hyperparasitism and its possible applications, Stomoxys as the transmitter of North African trypanosomiasis, the rôle of *Trombidium akamushi* in river fever in Japan, and the part played by various ticks in a peculiar form of human motor paralysis in America were among the topics discussed. In conclusion, some of the sociological applications of parasitology were mentioned, and the need of more provision for research work was emphasised.

The presidential address to Section E, by Senator A. W. Roberts, related to "Certain Aspects of the Native Question." The changes in national life and in the mental attitude of the native, due to gradual disappearance of the old tribal system, were discussed. The growing desire for individual possessions and the movement among the younger generation of Bantus for racial solidarity were considered as natural steps in the evolution of a race. The immigration of the native into industrial areas, the change in habit and in outlook, the bad features of location life, and the need for proper housing were emphasised. The history of native education was traced, and it was shown that the system in vogue at present had served its purpose. New ideals in native education should be in the direction of material progress, better means of agriculture, and village and home industries. The principles of good citizenship need impressing on the native as well as on the white. The extension of opportunities of work for educated natives and their feeling regarding their present economic limitations were discussed. The political future of the native and the extension to other areas of the system successful in the Transkei were considered. Mutual understanding between white and native is necessary.

The presidential address of Dr. J. Marius Moll to Section F was entitled "Certain Mental Disorders which may be regarded as Preventable." Mental disorders were considered in two groups—the "intoxication" psychoses caused by a poison in the wide sense and producing changes in the brain, and "germ" or "functional" psychoses where no causative poison occurs, no microscopic alterations, and no dementia. The intoxication psychoses due to other illnesses, *e.g.* enteric, were briefly noted. Alcoholic insanity, with its great danger of recurrences, was considered. In the case of inmates of native mental hospitals in South Africa, dagga (*Cannabis indica*) may be an important etiological factor. Syphilis is decreasing in South Africa. Malaria is not only a factor in some cases of insanity but also in intellectual retardation and enfeeblement in the country. Dementia precox is serious, 21 per cent. of the admissions to mental hospitals in the Union being due to this. The work on internal secretions and on psychopathology was mentioned. In the germ psychoses the personality of the patient is the main factor. The rôle of sex-complexes was shown to have been overrated by Freud and some of his followers. The reciprocal reaction between the personality and the circumstances of a patient had to be reckoned with. The need for study and adoption of the principles of mental hygiene was urged. Heredity was a serious factor in insanity. If segregation and non-propagation of the mentally unfit were enforced the future incidence of this condition would decrease by 50 per cent.

It is only possible to notice some of the interesting papers read before the various sections. Nearly half of the papers were contributed to Section D. In Section A a useful paper was read by Mr. R. H. Fox on the waterworks department of the Antofagasta (Chile) and Bolivia Railway Company.

In Section B, Mr. B. J. Smit contributed a paper on his investigations of different methods of testing Babcock milk-bottles; the volumetric method was preferred. Mr. C. O. Williams continued his account of experiments on the chemical control of cattle-dipping tanks; the addition of coal-tar disinfectants to arsenical dips was uneconomical. Dr. P. A. Wagner described various specimens of Descloizite from South-West Africa.

In Section C, Prof. G. Potts continued his account of experiments on the pollen of the pepper tree as a cause of hay fever in Bloemfontein. Prof. J. W. Bews and Mr. R. D. Aitken discussed the measurement of the hydrogen ion concentration in South African soils in relation to plant distribution. Mr. Aitken also described the effect of slope exposure on the climate and vegetation of a hill near Maritzburg. Mr. A. J. Taylor dealt with the composition of some indigenous grasses both from the chemical and the botanical aspects. The economic values of the grasses were indicated.

In Section D, Mr. J. Sandground read a short paper on *Aphelenchus phyllophagus*, parasitic in chrysanthemums, noting its effects in South Africa. Prof. E. H. Cluver dealt with the effect of temperature on the rate of growth in young animals; the greatest increase in weight occurred during the cooler months. Mr. A. D. Stammers described keratomalacia among rats suffering from deficiency of vitamin A. Dr. C. P. Neser sent an interesting paper on the blood of equines. Prof. E. Warren described and illustrated the early stages of development of the non-aquatic tadpole of *Anhydrophryne rattrayi*; predetermination of sex occurred in the eggs. Prof. J. E. Duerden discussed old and new views on the origin of feathers from scales. Prof. Duerden and Mr. R. Essex described the degeneration of limbs in species of Chamæsauran lizards. Prof. Duerden and Mr. V. FitzSimons recorded a series of variations found by them in the tenth rib of the penguin. Dr. F. G. Cawston described and exhibited specimens of Mollusca from lagoons in Natal. Prof. H. B. Fantham continued his account of some parasitic Protozoa found in South Africa, noting the occurrence of herpetomonads in cabbage plants. Prof. Fantham and Miss E. Taylor described the continuation of their researches on Protozoa found in some South African soils. Mr. C. B. Hardenberg discussed economic entomology in Moçambique. Dr. L. Soromenho described, from the hygienic point of view, various native wines and spirits made in Moçambique. Dr. M. M. Prates presented a contribution to the study of human parasitology in Moçambique, and he also described the various diseases of the eyes occurring there. Mr. J. Hewitt discussed ancient southern land connexions of Africa. The section considered favourably a draft bill for the establishment of a national park and game reserve under the direct control of the Union Government.

In Section E, Rev. C. Pettman contributed further remarks on Hottentot place-names. Rev. H. L. Bishop read interesting papers on Si Ronga proverbs and folklore and on the descriptive complement in Si Ronga. Madame V. Gomes discussed the N and L intervocalic in archaic Portuguese. Prof. W. A. Norton dealt with Dr. Theal's historical work on South-East Africa, and pleaded for a continuance of such work. He also exhibited a glossographic map of South Africa.

In Section F, Mr. C. G. Botha illustrated the early history of the Cape Province by a consideration of

Dutch place-names. Mrs. Mabel Palmer discussed some Australian proposals for a wage varying in proportion to the size of the family. Mr. F. S. Livie-Noble outlined some practical applications of modern psychology. There was a discussion, opened by Captain A. Cardozo, on the currency problem in Moçambique.

The next annual meeting of the Association will take place in July 1923 at Bloemfontein, under the presidency of Prof. J. D. F. Gilchrist. H. B. F.

Mental Character and Race.

IT is a commonplace of anthropological study that, in investigating the customs of primitive races, the difference in level of culture between observer and observed entails a difference in mentality and outlook which it is one of the aims of anthropological training to overcome. But it is also a matter of common observation that this same difference exists, if in a lesser degree, between peoples at the same stage of civilisation, and even between individuals or groups of individuals forming part of the same people or nation. The works of travellers, geographers and historians, both ancient and modern, abound in characterisations of the mental qualities of the various peoples of the world, both civilised and uncivilised; but when the ethnologist comes to the investigation of the problem of racial differences in mental qualities, he is confronted with a two-fold difficulty. On one hand he is, at present, for the most part, dependent upon empirical observation from which it is difficult to eliminate the personal factor, and, on the other hand, it is not clear how far, if at all, mental characters can be correlated with the physical characters upon which the ethnologist bases his classification of races. In the solution of this problem it is essential that the anthropologist should secure the co-operation of the psychologist, and it was with this object that a discussion on "Mental Character and Race" was held in a joint session of the Anthropological and Psychological Sections at the meeting of the British Association at Hull in September last.

The discussion was opened by Prof. J. L. Myres, who said that the principal consideration to be submitted to psychologists and ethnologists alike was that in many individuals in any modern society of mixed ancestry, dispositions and faculties differ. Such mental qualities are inherited like physical qualities and characters. It might be assumed that they stood in some direct relation to some element in the nervous system. Further, some mental qualities seemed to be associated with some physical characters, as for example a "fiery" temperament with red hair. Some of these physical characters are racial, or (like red hair) seem to result from crossing of racial elements. The analogy from the artificial selection of the breeds of domesticated animals indicates that it is possible to enhance or combine mental qualities. It did not always happen that the individual exhibited the characteristics desired, as in the case of the "gun-shy" pointer, and the "gun-shy" member of a military family. It would appear, however, that the hypothesis of correlation and transmissibility of psychical characters stands the test of practice in domesticated animals, the nearest analogue to the long domesticated animal man, a single species broken up into strongly marked racial strains.

Prof. Myres went on to point out that the older ethnologists characterised racial types by mental as well as physical characters, and quoted as an example the character of the Northern Mongols in Keane's "Man, Past and Present." He pointed out that such a characterisation included: (*a*) a description of mere psychological reactions to external stimuli conceived as characteristic of the racial strain and capable, like brachycephaly, of being used to refer an individual to his racial type; (*b*) a description of social reactions (*e.g.* "sense of right and wrong") in which a social, cultural element was introduced. The individual has a post-natal experience as well as a pre-natal equipment, and in investigation it might be difficult to eliminate disturbing factors. Prof. Myres stated, however, that he himself had found that the offspring of British fathers and Greek mothers brought up in a Greek environment differed as markedly from pure Greeks in their attitude towards discipline and labour as they did in physique, temperament closely following breed.

Modern ethnology, relying on analogue and experiment, had made most progress in the department of sense perception; but even here one of the first results had been to show how intimately the social factor was involved, as for example in inducing a native to give a fair trial to an experiment beyond his social horizon and in eliminating the disturbing factor of an inadequate language, *e.g.* in the case of colours.

In summing up the problem, Prof. Myres said that the ethnologist, and, in particular, the social anthropologist, must define more clearly the elementary terms in their characterisation, while the psychologist must go further in laboratory work on such complex manifestations as the "sense of right or wrong," irrespective of race or breed.

Dr. C. S. Myers, president of the Psychological Section, said that the chief determinants controlling mental characters were heredity and environment. On the physical side environment—climate, temperature, food supply, and the like—acted directly and indirectly, especially on the internal secretions which affect the functions of the emotions. Environment must have played an important part in producing such differences as distinguished Americans, Australians, and New Zealanders; but it was not known with certainty how these differences came about, nor how permanent they were likely to be. Different parts of the same country exhibited distinguishing characteristics. In England, for example, Yorkshire and Wales had for long been noted for musical ability. What did this mean in terms of race? Where there was lack of ingenuity or artistic skill, were these qualities latent, awaiting the encouragement of a more favourable environment? Rivers had shown that contact of culture produced something new, and apparently the same applied to an individual.

Dr. Haddon said the results of the psychological observations made by the Cambridge Expedition to the Torres Straits had been largely negative. A scheme should be worked out for the observation of the emotional content of the attitude of primitive peoples towards their own ceremonies.

Dr. Cyril Burt said that experimental tests of intelligence and other inborn mental capacities usually yield a correlation of about 0·5 between the performances of parents and those of their children. Thus, mental qualities seem to be inherited to much the same degree as physical. Small but distinct and constant differences are discernible between the averages for different nations and races. On the whole, however, individual differences tend almost to swamp the group differences. On the temperamental side,

group differences are possibly larger; and there is some evidence to show that differences of so-called temperamental type may be associated with racial differences (*e.g.* the so-called "objective" type with Nordic physical features and the so-called "subjective" type with Mediterranean).

Mr. Fallaize pointed to the persistence of certain mental qualities in different races noted by the older travellers and historians.

Dr. Shrubsall said that he had observed that the children of Chinese fathers and English mothers in London schools, brought up in much the same environment as English children, were intellectually as quick as the latter but showed no inclination to take part in games. Among English children differences in pigmentation appeared to be associated with differences in direction of aptitude.

In summing up the discussion, Mr. H. J. E. Peake, the president of the Anthropological Section, said that while no very definite conclusion had been reached, it was clear that the aim of investigators must be to eliminate the personal element, while psychologists should endeavour to break up mental characters into such simple factors as might be subjected to reaction tests, as courage had been shown to be the reaction to danger.

Scientific and Industrial Research.[1]

THE Committee of the Privy Council for Scientific and Industrial Research has issued its seventh annual report, with that of its Advisory Council, covering the year 1921–1922. The first few pages deal with the income and expenditure of the Department of Scientific and Industrial Research, and with its efforts to observe the spirit of national economy. It is pleasing to record that the Geddes Committee on National Expenditure has not found it necessary or expedient to recommend any reduction in the estimates beyond that proposed by the Department itself. The total expenditure during the financial year 1921–1922 was nearly 525,585*l.*, made up of 190,024*l.* at the National Physical Laboratory (nearly 100,000*l.* being recovered in fees, etc.), 46,616*l.* at the Fuel Research Station, 57,423*l.* for the Geological Survey and Museum, 10,323*l.* at the Building Research Station, 17,750*l.* at the Low Temperature Research Station, 21,464*l.* on the work of the Co-ordinating Boards and Committees, 5988*l.* on minor research programmes, 86,355*l.* (from the million fund) in grants to the Research Associations, 8287*l.* in grants to other bodies, 43,793*l.* in research studentships, and 37,561*l.* on administration at headquarters.

By far the major portion of the report, however, deals with the plans and achievements of the various research organisations associated with the department. Considerable interest will be awakened in the twenty-four industrial research associations, twenty-two of which are already in active operation. A few of these associations have now been in existence long enough to have produced results of practical value, examples of which are given. Thus, the British Portland Cement Research Association has been able to effect considerable economies in fuel in many works through the results of its researches on rotary kilns and advice on scientific management. The British Scientific Instrument Research Association has introduced a new polishing powder and an abrasive for the production of lenses and prisms, by means of which grading and hand work are eliminated, and much time is saved. The British Cotton Industry Research Association has produced an instrument for the testing of yarns, continuous lengths being examined instead of short pieces as hitherto, with the result that important variations have been revealed in certain yarns, which are introduced by the method of spinning. Finally, the Linen Industry Research Association has developed a pedigree strain of flax seed which gives much higher yields of fibre than any existing variety, and has discovered methods whereby flax and hemp may be distinguished at all stages of manufacture. It is obvious that these are not isolated pieces of work, but rather the first-fruits of a considerable harvest which has been patiently husbanded by the research associations, and it is no secret that a mere catalogue of the further results which have been published in the scientific press since the report was written would occupy considerable space.

The value of co-operation between the research associations is emphasised again. Several instances are mentioned of two or more associations attacking a common problem, the most interesting cases being those in which the participants are respectively consumers and producers of the materials investigated. Mutual efforts of this kind must result in improvements in useful commodities and possibly in a lowering of the cost of production.

Considerable space in the report is also devoted to the work of the co-ordinating research boards, which more directly serve national interests. Attention is directed to the commendable willingness of the Service departments to enlist the co-operation of outside bodies and to arrange for the open publication of the results of the work undertaken when these are of sufficient general interest. The co-ordinating research boards consider an enormous variety of problems in physics, chemistry, and engineering, including radio-telegraphy, the liquefaction and storage of gases, the deterioration of fabrics used by the fighting services, adhesives, and lubrication, and the report mentions several of the results obtained. Furthermore, public interest should be aroused in the work of the Fuel Research Board, which has issued most valuable information in a number of publications which have already been noted in these columns; *e.g.* in NATURE of November 25, 1922, p. 718, when the report on experiments on low temperature carbonisation was discussed. The work of the Food Investigation Board is also of common interest, and important advances are reported in the study of cold storage, and the bacteriology of canned meat and fish.

A useful discussion of the terms "pure" and "industrial" research is given, the distinction being mainly a question of the source from which the impulse to the conduct of research is derived. It has been all too common on the part of workers engaged in "pure" research for a very few problems to be pursued through all inviting ramifications, with the result that while certain small areas may be very thoroughly cultivated, the worker remains unimpressed by the vastness of the unexplored territory outside his own subject. The problems facing any one industry are much more varied than is frequently imagined, and the gaps in scientific knowledge which they reveal are often astonishing. For example, the Cotton Research Association finds it necessary

[1] Report of the Committee of the Privy Council for Scientific and Industrial Research for the Year 1921–22. (Cmd. 1735.) Pp. iv+123. (London: H.M. Stationery Office, 1922.) 3*s.* net.

to study the fundamental properties of single cotton hairs, the existing data being very scanty; the Photographic Research Association is investigating the properties of silver haloids and gelatin; the Portland Cement Research Association is endeavouring to ascertain the exact nature of the compounds constituting Portland cement; and the perfection of an abrasive and a polishing powder by the Scientific Instrument Research Association followed an investigation of the primary phenomena of grinding and polishing.

Two interesting examples of the interplay of "pure" and "industrial" research are given. On one hand, the knowledge gained by an investigation into the fundamental physiology of living and dead food-stuffs has cleared up the mystery of the "brown-heart" of apples, which has caused severe losses in shipments from Australia. The "disease" has been attributed to insect injury in the orchards, but is now known to be due to the effect of the carbon dioxide engendered by the fruit itself in the badly ventilated holds of the ships. On the other hand, the study of the structure of coke at the Fuel Research Station has led to the conclusion that carbon in this form is a vitreous substance of great hardness, which profoundly affects the problem of the allotropy of this element. Some of the results obtained were described in NATURE of January 27, p. 133.

The industrial research associations are comparatively young bodies, but such as have already issued reports on investigations undertaken have given ample justification for their existence.

The Gold Coast Survey.

THE Survey Department of the Gold Coast, which was closed during the war, was reopened in 1920 by the present Governor, Sir F. G. Guggisberg, who had formerly initiated the survey of a considerable portion of Nigeria. The long cessation of survey work on the Gold Coast had left matters in a backward state. To cope with immediate needs the department was strengthened, and it is believed that by 1924 the lost ground will have been regained and the country will be provided with a modern survey department. Lieut.-Col. R. H. Rowe is in charge of the new department, with Maj. G. H. Bell at the head of the field-work. The survey parties are organised in three sections which refit in England from July to September, when they leave for the Gold Coast in order to take full advantage of the "dry" season. Each section is divided into several completely equipped "field camps," under European surveyors.

The country that has been surveyed during the last two field seasons has been mainly dense tropical forest, presenting great difficulties to the surveyor. Lines must often be cut through the forest in order to reveal the surface features. Even in the dry season there are climatic difficulties. From December to March the harmattan frequently occurs and obscures the vision. At other times the dry winds warp and split the woodwork of boxes, instruments, and tent-poles. The surveyors, of course, have to face malaria and other forms of sickness.

An important part of the new Survey Department is the Survey School at Odumase for the training of native surveyors. A three years' course in the school, followed by four years' service with the Government, qualifies a native to start in private practice. There are apparently good openings in this profession for African surveyors.

FIG. 1.—A field survey camp on the march.

In addition to the Topographical branch of the survey there are two others—the Cadastral and the Records and Reproduction branches. In the Cadastral branch a great deal of work on land surveys and town plans has been done. The Records branch is gathering material for gazetteers and handbooks of the country, and the Reproduction section is engaged in printing road-maps, statistical maps, and diagrams. The topographical sheets of the survey on a scale of 1 to 125,000 are not being printed in the colony, but by Messrs. W. and A. K. Johnston (see NATURE, November 11, p. 647), to whose courtesy we owe the accompanying illustration (Fig. 1). About 15,000 square miles have already been surveyed, and it is expected that the present season's field-work will practically complete the maps of the Gold Coast Colony itself and also a large area in Ashanti.

Paris Academy of Sciences.

BONAPARTE AND LOUTREUIL FUNDS.

GRANTS for research from the Bonaparte and Loutreuil funds have been allocated as follows :

Bonaparte Fund.—Six applications have been examined and two grants are recommended :

(1) 5000 francs to the Association lyonnaise pour le développement des recherches de paléontologie humaine et de préhistoire, for carrying on excavations in the celebrated prehistoric deposits of Solutré.

(2) 2000 francs to Charles Le Morvan for completion of the publication of the systematic and photographic map of the moon.

Loutreuil Fund.—Thirty-one applications were considered and grants were recommended as follows :

(1) The National Museum of Natural History : 8000 francs to Désiré Bois for the publication of the first two parts of a guide to the collections of cultivated plants at the museum.

(2) The central council of observatories : 1000 francs to the National Observatory of Besançon for the acquisition of an Abraham oscillograph ; 3000 francs to Auguste Lebeuf, for the purchase of an oven required for researches relating to the simultaneous action of temperature and pressure on chronometers, for aviation purposes.

(3) Council for the improvement of the École polytechnique : 6000 francs to Alfred Perot, for the construction of an apparatus designed for the verification of a formula given by the Russian physicist, W. Michelson.

(4) National Veterinary School of Alfort : 1600 francs to the school, which, together with balance of 8000 francs remaining from the sum granted in 1920, is allotted as follows :—5000 francs to Adrien Panisset and Jean Verge, for researches on the chemicotherapy of the infectious diseases of domestic animals ; 2000 francs to Edouard Bourdelle and André Rochon-Duvignaud, for researches on vision in animals ; 2000 francs to Albert Henry and Charles Leblois, for researches on the etiology, pathogeny, and treatment of parasitic cutaneous affections of domestic animals ; 600 francs to Gabriel Petit, for the purchase of a microscope.

(5) National Veterinary School of Lyons : 4000 francs to François Maignon, for the continuation of his researches on organozymotherapy and for a study of the physico-chemical constitution of the diastases and the mechanism of their action ; 4000 francs to Joseph Basset, for the purchase and feeding of experimental animals required for testing two new methods of producing immunity ; 2000 francs to G. Marotel, to allow him to continue his researches on the treatment of mange in the dog by a new method.

(6) National Veterinary School of Toulouse : 2500 francs to Charles Besnoit for an experimental study of the methods of intensive application applicable in bovine surgery, and for printing a phototype catalogue for general use ; 2000 francs to Jean Lafon, for completing the previous grant of 3000 francs for the purchase of an Einthoven string galvanometer ; 1000 francs to Charles Hervieux to enable him to pursue his researches on the transformation in the animal organism of pyrrol groups contained in food, and the elimination of these groups by the urine ; 1000 francs to Charles Besnoit and Victor Robin, for a study of the contagious diseases of poultry in the S.W. region.

Independent Grants.—1000 francs to Julien Achard, for completing his monograph on the Madagascan coleoptera of the family of Scaphideideæ ; 6000 francs to the Association amicale des élèves de l'École nationale supérieure des Mines for a study of the methods and apparatus for the control of combustion, especially as regards the estimation of carbon dioxide in flue gases ; 5000 francs to the École supérieure de perfectionnement industriel as a contribution to the expenses of this institution ; 2000 francs to Wilfred Kilian to assist the publication of a geological bibliography of the south-east of France ; 5000 francs to Emmanuel de Margerie, for the preparation of the publication of a tectonic map of Eurasia ; 15,000 francs to Jean Mascart, for the publication of a part of the astronomical work of Luizet ; 3000 francs to M. Mugnier-Serand for his researches on atmospherics in wireless telegraphy and their application to the prediction of storms ; 15,000 francs to the Academy of Sciences for the publication of the catalogue of scientific periodicals in Paris libraries.

University and Educational Intelligence.

BIRMINGHAM.—The twenty-third yearly meeting of the Court of Governors is to be held on February 8, and a summary of the events of the past academic year will be presented in the reports of the council and principal (Mr. C. Grant Robertson). The number of students during the past session showed a slight falling off, and the proportion of women increased, except in the Faculty of Medicine, in which it was lower than it had been for some years. It is hoped to repeat, during the present session, the post-graduate course on "The Medical Aspect of Crime and Punishment," for qualified practitioners, which was given last year by Drs. Maurice Nicolls (lecturer in psychotherapy), Hamblin Smith, W. A. Potts, and Percy T. Hughes. Sir Frederick Mott has been appointed, for three years, lecturer in morbid psychology. A Board of Research in Mental Diseases, on which the University and the Asylums Committee of the City Council are represented, has been formed. Sir Frederick Mott is honorary director of research, and the funds are being supplied by the Asylums Committee of the City Council. The most urgent need of the University at present is the removal of the biological group of sciences to new buildings at Edgbaston. This would set free room at Mason College which is urgently required for the Faculties of Arts and Medicine. Reference is made to the successful work of the Workers' Educational Association, and the importance of the co-operation of the University in that work:—"It is essential that the educational work should be controlled by the Universities, if only to secure the right standard . . ., and the need of additional qualified University instructors . . . is already apparent."

Mr. A. W. Nash has been appointed senior lecturer in petroleum technology under Prof. R. R. Thompson. Mr. Nash has had experience in petroleum production and refining in Persia, Russia, and other parts of the world.

CAMBRIDGE.—Sir Alfred Yarrow has offered money for a three-year studentship in Assyriology to provide for the training of a suitable student in a subject which has for the time vanished from the University. He and Lady Yarrow further offer, "if the student prove himself a competent scholar and is prepared to continue the study of Assyriology," to establish with a stipend of 500*l.* a year an "Eric Yarrow lectureship for the study of Assyriology" in memory of Sir Alfred's son, who fell in the war.

A new University lectureship in Psychopathology is advertised as vacant.

Prof. Zschokke, head of the faculty of zoology in the University of Basle, will lecture this term on the European fauna.

The governing body of Emmanuel College offers to a research student commencing residence at the

College in October 1923, a studentship of the annual value of 150*l.*, which shall be tenable for two years and renewable, but only in exceptional circumstances, for a third year. The studentship will be awarded at the beginning of October, and applications should be sent so as to reach the Master of Emmanuel, The Master's Lodge, Emmanuel College, not later than September 18.

LONDON.—The Senate has resolved to increase the annual grant to the Marine Biological Association, Plymouth, from 25*l.* to 50*l.* for the next five years.

The following doctorates have been conferred :—*D.Sc. in Embryology* : Mr. G. S. Sansom, an internal student, of University College, for a thesis entitled "Early Development and Placentation in *Arvicola* (*Microtus*) *amphibius*, with special reference to the Origin of Placental Giant Cells." *D.Sc. in Physiology* : Dr. G. V. Anrep, an internal student, of University College, for a thesis entitled "The Metabolism of the Submaxillary Gland."

Dr. Eustace E. Turner has been appointed demonstrator in the chemical department of the East London College.

ST. ANDREWS.—Principal J. C. Irvine, Dr. William Low, and Dr. Angus MacGillivray have been appointed representatives of the court of the University on a standing joint-committee constituted by the court and the directors of the Dundee Royal Infirmary for the purpose of recommending suitable candidates on the occurrence of vacancies in the chairs of clinical medicine in the University, and also of harmonising the activities of the University and the Infirmary in matters common to both. Prof. D'Arcy Thompson has been reappointed representative of the court on the council of the Scottish Marine Biological Association.

MAJOR-GEN. SIR GERALD ELLISON will unveil the war memorial of East London College on Wednesday, February 7, at 3 P.M.

A SWEDISH professor of education, contrasting Swedish and American schools, remarked that in his own country the word "teacher" is not a noun feminine as it is in America. That the criticism is not without some foundation is shown by the statistics published in Bulletin, 1922, No. 8, of the United States Bureau of Education. The number of men students enrolled in normal courses in all normal schools and teachers' colleges in 1919–20 was 19,110 out of a total of 135,418, or 14 per cent ; in teachers' colleges the percentage was 18, in state normal schools 13, in city and county normal schools 6, and in private normal schools 9. Comparative tables of statistics of the five years 1899–1900, 1904–5, 1909–10, 1914–15, and 1919–20 give the numbers of women students in normal courses as 45,394, 49,346, 68,815, 80,347, 116,308, representing the following percentages of the total numbers of students in such courses : 65, 76, 78, 80, 86. The teachers' colleges referred to, 46 in number, are institutions having a four-year course above the secondary school and granting a degree. Of the total number of men students in normal courses (19,110), more than half (9763) were enrolled in these colleges. It is true that a very large proportion of the teachers in American schools have not passed through normal schools and that the percentage of men teachers is not necessarily the same as the percentage of men students in teacher-training institutions. Statistics of City School Systems 1919–20 (Bulletin, 1922, No. 17), however, tell a similar tale. They show that the percentage of men teachers in city schools (including schools in towns having a population of 2500 or more) is 11, while in city elementary schools the percentage is only 4. It is probably safe to assume that rural schools would show an even lower percentage.

Societies and Academies.

LONDON.

Royal Society, January 25.—Sir Charles Sherrington, president, in the chair.—A. V. **Hill** : The potential difference occurring in a Donnan equilibrium and the theory of colloidal behaviour. Loeb has shown experimentally that there is a potential difference between a colloidal solution of a protein and a crystalloid solution with which it is in equilibrium across a membrane, impermeable to the protein, but permeable to the other bodies involved. It varies in the same general manner as the osmotic pressure, the viscosity and the swelling. The variation can be deduced, in general, from the theory of the Donnan equilibrium. One of the chief arguments employed by Loeb, however, is incorrect. Loeb shows that the potential difference observed experimentally agrees very exactly with that "calculated" from the difference in hydrogen ion concentration, also observed experimentally. This is a necessary consequence of the manner in which the observations were made.—E. F. **Armstrong** and T. P. **Hilditch** : A study of catalytic actions at solid surfaces. X. : The interaction of carbon monoxide and hydrogen as conditioned by nickel at relatively low temperatures. A practical synthesis of methane. A mixture of equal volumes of carbon monoxide and hydrogen passed over nickel at temperatures 220-280° C. was largely transformed into methane and carbon dioxide :

$$2CO + 2H_2 = CO_2 + CH_4.$$

This action affords the simplest and most economical means of producing methane in quantity, since a suitable gas mixture exists in ordinary commercial water-gas when the latter has been freed from catalyst poisons by removal of sulphur compounds. The experimental data obtained are compatible with a combination of the "water-gas reaction" with the normal hydrogenation process. Thus, of two volumes of water-gas ($2CO + 2H_2$), one molecule of carbon monoxide and a molecule of water interact and yield a molecule each of carbon dioxide and of hydrogen, the latter, with the balance of hydrogen present in the original gas, furnishing sufficient hydrogen for the normal hydrogenation of a second molecule of carbon monoxide.—J. **Holker** : The periodic opacity of certain colloids in progressively increasing concentrations of electrolytes. The method of testing the effect of common salt on the typical emulsoid colloid, serum, was described. Into each test-tube was pipetted 0·5 c.c. of undiluted serum and to each was then added 2 c.c. of solution of sodium chloride, which progressively increased in concentration in each successive tube. The tubes were shaken and placed in a thermostat at 40° C. for four hours. Then the opacity of the solution was determined. The phenomenon is periodic and is given by colloids of both the emulsoid and suspensoid type, and by animal, vegetable, and mineral colloids. It is also given by certain mixtures of simple aqueous solutions of inorganic salts. Emulsoid colloids tend to give many oscillations of low amplitude. Suspensoid colloids tend to give few oscillations of high amplitude. The phenomenon is not an optical interference of the light scattered by colloidal particles, but is a definite oscillatory change in the physical condition of those particles.—E. K. **Rideal** and R. G. W. **Norrish** : The photochemistry of potassium permanganate. Pt. I : The application of the potentiometer to the study of photochemical change. Pt. II. : On the energetics of the photodecomposition of potassium permanganate. The electrode potential of potassium permanganate when illuminated with ultra-violet light from the mercury vapour lamp undergoes a change (*ca* 0·25 volt) and

recovers slowly in the dark. This change is correlated with a photochemical decomposition of the permanganate, made apparent by the separation of a precipitate of the composition $K_2O . 2MnO_2$, and the formation of a sol of MnO_2. Illumination establishes a photochemical stationary state, KOH being simultaneously produced by the decomposition, and removed by combination with the colloidal MnO_2. This involves an alteration of the P_H of the solution, which causes the electrode potential changes. The decomposition is monomolecular over the range of concentrations investigated. The decomposition of acidified permanganate under identical conditions is of zero order, due to non-formation of colloid. The photoactive radiation lies in the ultra-violet absorption spectrum of potassium permanganate, and the Hg line at 3128 ÅU is considered the chief agent. The quantitative absorption of radiant energy is in agreement with the Einstein Law of Photochemical Equivalent, a result of special interest as the first instance of its application to solutions.—E. A. **Fisher**: Some moisture relations of colloids. Pt. I.: A comparative study of the rates of evaporation of water from wool, sand and clay. Curves obtained by plotting rates of evaporation against water contents are discontinuous. Each portion of the rate curve can be expressed by a simple type of equation connecting rate of evaporation with water content. The rate curves obtained are similar in type in the cases of wool (wholly colloidal with a cellular structure), quartz sand (wholly non-colloidal with a granular structure), silty soil (notoriously feeble in colloid properties), and heavy clay sub-soil (typically colloidal in behaviour). The so-called shrinkage of wool on drying is really a deformation and not a volume shrinkage. The absorption of water by wool is attributed primarily to a filling up of fine pores of various shapes and sizes; the vapour pressures of wool-water systems are determined by the diameters of the pores that are full of water.—R. **Whytlaw-Gray**, J. B. **Speakman** and J. H. P. **Campbell**: Smokes. Pt. I.: A study of their behaviour and a method of determining the number of particles they contain. The smokes were produced (*a*) by the arc discharge in air, (*b*) by volatilisation and condensation, (*c*) by chemical action. In each case highly dispersed systems of very minute particles were obtained. Examined in an ultra-microscope of the slit type, the life-history of a smoke falls into two main periods:—(*a*) An unstable period in which the number of particles diminishes rapidly with time. (*b*) A stable period in which the decrease in number is slow. During the first period the increase in size is very marked; the changes are not due to evaporation but to a process of aggregation, which produces complexes of different structure depending on the nature of the dispersed substance.—R. **Whytlaw-Gray** and J. B. **Speakman**: Smokes. Pt. II.: A method of determining the size of the particles they contain. A filtration method is used which enables the concentration in weight of the suspended solid matter in rapidly changing smokes to be determined with an accuracy of about 3 per cent. A given volume of smoke (usually 1 litre) is filtered through small tubes containing asbestos, and the increase in weight is ascertained by a micro-balance sensitive to 0·0002 mgm. Filtration takes about five minutes. Curves have been obtained showing the variation in weight concentration of the smoke over periods of 0-6 hours. Knowing the weight and the number of the particles in a given volume, the average mass of a smoke particle at different periods can be calculated and the growth followed quantitatively. Assuming the density of the particle to be that of the substance in bulk the average radius can be evaluated. All the weight-concentration curves show an initial rise, and this fact, in conjunction with ultra-microscopic observations, renders it probable that all these clouds contain in the early stages a large number of invisible particles of a microscopic size.—R. C. **Ray**: The effect of long grinding on quartz (silver sand). When quartz (silver sand) is ground for a long time the density of the ground substance is lower than the one which has not been subjected to grinding. The fall of density shows that as much as 25·7 per cent. of the material is converted from the crystalline to the vitreous condition. This value agrees fairly with that derived from the molecular heats of solution.

Geological Society, January 10.—Prof. E. J. Garwood, vice-president, and afterwards, Prof. A. C. Seward, president, in the chair.—W. J. **Sollas**: Man and the ice-age. Four ancient coast-lines of remarkably constant height have been traced around the Mediterranean Sea and along the western shores of the North Atlantic Ocean. These, with their associated sedimentary deposits, form the successive stages of the Quaternary system; namely, the Sicilian (coast-line about 100 metres); the Milazzian (coast-line about 60 m.); the Tyrrhenian (coast-line about 30 m.); and the Monastirian (coast-line about 20 m.) The Sicilian deposits contain a characteristic cold fauna. The fauna of the Milazzian is warm-temperate and of the Tyrrhenian and Monastirian still warmer. The three lower coast-lines correspond with the three lower river-terraces of the Isser (Algeria), the Rhône, and the Somme. Hence it may be inferred that the position of the river-terraces has been determined by the height of the sea-level. The climate of the Quaternary age was, on the whole, warm-temperate or genial, but interrupted by comparatively short glacial intervals. It is now possible to assign the palæolithic stages of human industry to their place in the Quaternary system: thus the "Strepyan" or pre-Chellean is Milazzian in age, the typical Chellean, Tyrrhenian, the evolved Chellean, Acheulean, and Lower Mousterian, early Monastirian, and the Upper Mousterian, Aurignacian, Solutrian, and Magdalenian, later Monastirian. The coast-lines of the Northern Hemisphere appear to have their counterparts in the Southern Hemisphere. The Quaternary movements are probably due to a general deformation of the globe involving eustatic changes in the level of the sea.

Optical Society, January 11.—C. **Davidson**: On the amount of the displacement in gelatine films shown by precise measurements of stellar photographs. A stellar photograph consists of a number of minute discs scattered over an otherwise transparent plate. The purpose of the photograph is to determine with precision the relative positions of these discs. In the trigonometrical method of determining stellar parallaxes photographs of a selected region are taken at two epochs about six months apart when the earth is at opposite sides of its orbit. A new star will show a displacement relatively to the distant stellar background. A series of such photographs give equations from which the parallax and proper motion are determined. After the computed quantities have been taken out, each plate will show a small residual error made up of errors of measurement, observing, etc., and film displacement. From a discussion of many plates from Greenwich it appears that the average probable error of the measured position of a star on a single plate is ±0·0008 mm. Film displacement being only a part of the total it follows that this must be the upper limit of the probable error of film displacement. In the Kapteyn system of observation, the photographs at the two epochs are taken on

the same plate, which is stored away during the interval and developed after the second exposure. It was arranged that the images fell near each other (within 1 mm.—they were, however, too small for the Ross effect to come into action) and only the small differences separating the images were measured, any film displacement which would affect both images equally, consequently disappearing. This method has now been given up in favour of single plates, but a number of the Kapteyn pairs have since been measured treating each photograph as a separate plate. From a discussion of the residuals of some 300 plates the film error is ±0·0003 mm.

The Faraday Society, January 15.—Sir Robert Robertson, president, in the chair.—E. W. J. **Mardles**: Study of the reversible sol to get transition in non-liqueous systems. Pt. 1: The change of viscosity with time during gelation. The viscosity value of a sol during its gelation is dependent on the method and conditions of its determination, and since the system is heterogeneous, it loses its real significance. The change of apparent viscosity with time during the gelation of a sol of cellulose acetate in benzyl alcohol can be expressed by an empirical formula. The temperature, when the rate of gelation becomes nil, is regarded as the maximum gelation temperature, since above it the sol is relatively stable with time and below it a part or whole of the dispersed particles aggregate to form a gel structure. The relation between the maximum gelation temperature and concentration resembles that between temperature and the saturation concentration for crystalloids. Pt. 2: Viscosity changes associated with the gel to sol transition. These have been measured at various temperatures and with different concentration systems of cellulose acetate in benzyl alcohol. The viscosity at first rapidly diminishes, the rate of change becoming smaller until a constant value is obtained. The minimum temperature at which there is a complete return to the original viscosity of the sol without mechanical treatment is termed the minimum solation temperature. Mechanical treatment hastens solation in the same way that it retards gelation. The time taken for a system to attain constant viscosity or mobility depends on the previous treatment of the gel. The hysteresis effect observed during the sol⇌gel transition can be measured by the difference in the temperature of minimum solation from that of maximum gelation, and the cause of it has been ascribed to the different conditions of the particles in the gel and sol state.—E. W. J. **Mardles**: Changes of volume and refractive index associated with (*a*) the formation of organosols and gels; (*b*) the reversible sol to gel transition. In general, the volume changes are largest (*a*) at the lower concentrations, (*b*) with the best solvents and optimum solvent mixtures, and (*c*) at higher temperatures. They are much smaller than those observed by other workers for hydrosols and gels. The reversible sol to gel transition is associated with a small volume change which varies with time as in the case of the Tyndall number changes. There are also indications of a change of refractive index corresponding to the volume and Tyndall number changes during the reversible sol to gel transition.—E. W. J. **Mardles**: The scattering of light by organo-sols and gels of cellulose acetate. Measurements of the change with temperature of the Tyndall number of sols and gels of cellulose acetate in benzyl alcohol during the reversible sol to gel transition show that with fall in temperature of the sol the rate of change is small until a certain critical temperature, after which it increases with acceleration. Eventually there may be a point of inflexion on the curve, the position of which depends on the rate of cooling, and is determined by the formation of a firm jelly structure which inhibits the development of opalescence. The Tyndall number of a gel is a function of the mechanical treatment as well as rate of gelation and it varies with time, the rate of change rapidly diminishing in absence of mechanical treatment. A gel tends to increase its Tyndall number, and mechanical treatment may induce opalescence. The Tyndall number-concentration curve contains a maximum which tends to disappear at higher temperatures, thus the size of the particles in a gel structure is a function of the concentration and the temperature at which it was formed. The curve resembles Tammann's curve relating the number of crystallisation nuclei, or rate of crystallisation, with the degree of supersaturation.—J. R. **Partington** and W. J. **Shilling**: The variation of the specific heat of air with temperature. The velocity of sound in the gas contained in a large silica tube arranged as an electrically heated furnace was measured at intervals of approximately 100° C., from room temperature up to 1000° C. The values obtained up to 700° C. lie practically on the line given by $C_v = 4{\cdot}849 + 0{\cdot}000358T$ grm. cal. Above 700° C_v appears to increase more rapidly with temperature, but at present the values above 800° are uncertain.

Royal Anthropological Institute, January 16.—Dr. F. C. Shrubsall, treasurer, in the chair.—Mr. M. **Addison**: Human heads carved in steatite from Sierra Leone. The Mende tribes, in whose territory the heads were obtained, know nothing of their origin, but although the heads exhibit certain characteristics, such as nose- and ear-rings and long drooping moustaches, which do not occur among the inhabitants of the district at the present day, it is not probable that they are of a very high antiquity, their age possibly being two or three hundred years. Among the Mende the heads are used for magical purposes, and, placed on mounds in the fields, are thought to increase the fertility of the crops.—F. W. H. **Migeod**: The Bedde group of tribes of Northern Nigeria. Though extending from Lake Chad as far as the City-State of Hadeija the Bedde are not a well-known people. They have the legend that they originated in Yemen in Arabia and that they were the first people driven out of Arabia in consequence of their refusal to accept Mohammedanism. The Western-most branch of the Bedde, the Awuyoka, have a list of kings going back to the 12th century. The language shows no traces of an Arabian origin. The Bedde live in round huts grouped in compounds, and formerly all the towns were surrounded by a rectangular mud embankment, but most of the defensive works are now in ruins. Swords, spears, and bows and arrows are the offensive weapons. Children are named by the father, but there are fixed names for twins, male and female. Marriage may take place into any family. Corpses are buried on the right side with head to the south and so facing east, the hands being drawn down and placed together. The Bedde seem to be very superstitious and to believe in omens. They are divided up into animal tribes such as Leopard, Hippopotamus, etc., which form a bond outside family life. No worship is offered to the tutelary animal, but it must not be killed or eaten by those who bear its name. The people now nearly all wear gowns of cotton like the Hausas or Bornuese. They slash or cut their faces with a main design and subsidiary marks. The men shave their heads but the women indulge in fancy head-dressing. They are not a short race. They usually have broad faces, some being very broad across the cheek-bones, and usually have heads low above the ears and receding foreheads; but there is great variety.

Royal Microscopical Society, January 17.—Prof. F. J. **Cheshire**: The early history of the polariscope and the polarising microscope (presidential address). The early history of double refraction, from 1669, when Bartholinus first received specimens of spar from the Bay of Roërford in Iceland, up to 1808, when Malus, by a happy chance, made the wonderful discovery of polarisation by reflection, and the identity of the light thus produced with the refracted beams given by Iceland Spar, was discussed. The difficulty was considered of explaining double-refraction on Huygens' undulatory theory, disposed of by Fresnel in 1821, who abandoned the theory of longitudinal vibrations, and substituted transverse ones for them, after having proved, with Arago in 1816, that oppositely polarised beams do not interfere in the same way that Young had shown beams of ordinary light do. The work of Brewster and Biot was referred to, and some account given of the extraordinary amount of work done between Malus's discovery in 1808, and the invention of the Nicol prism in 1828, from which date the modern microscope dates. In the early days the polarising microscope was employed primarily for the examination of general objects, whereas the application of the petrological microscope to the systematic study of rock-sections dates no further back than 1870. Various forms of polariscopes, including a remarkable one invented by Airy in 1831, were described, and possibilities of further improvements discussed. It was urged that the work of Herapath and others in the production of artificial tourmalines should be again taken up. Finally, to meet the present difficulties of supplying students' microscopes it was urged that teachers and manufacturers should come to an agreement as to the simplest possible designs with which the students' work could be done.

PARIS.

Academy of Sciences, January 8.—M. Albin Haller in the chair.—A. **Haller** and R. **Lucas**: Study of the absorption in the ultra-violet of a series of derivatives of camphor. Certain derivatives of camphor of the type $C_8H_4\begin{cases}C=CH.R\\ |\\ CO\end{cases}$ show anomalies in their optical properties (dispersion, molecular refraction, rotatory power) compared with the corresponding reduction products. Seven substances of the first type and two of the second have been studied from the point of view of their ultra-violet absorption spectra, and the results given in the form of the curves suggested by Lord Rayleigh.—P. A. **Dangeard** and Pierre **Dangeard**: The vitality of Aucuba leaves preserved in a vacuum. An adult leaf of Aucuba placed in a vacuum and exposed to light during six months preserved all its cells alive, and no important difference could be detected between the structure of these cells and that of the leaves remaining on the tree.—Th. **Anghelutza**: The representation of functions of one real variable.—Gaston **Julia**: Rational substitutions with two variables.—J. F. **Ritt**: Rational permutable functions.—G. V. **Pfeiffer**: A special method of integration of partial differential equations of the first order.—Torsten **Carleman**: The effective calculation of a quasi-analytical function, the differentials at a point being given.—Emile **Borel**: Remarks on the preceding note of M. Torsten Carleman.—Paul **Dienes**: Transfinite series of real numbers.—Tadé **Wazewski**: Measurable *ensembles*.—G. **Bratu**: Curves defined by recurrent series.—J. **Chuard**: Some properties of cubical networks traced on a sphere.—David **Wolkowitsch**: The infinitely small movements at a point of an elastic body admitting a plane of symmetry. Charles **Frémont**: The influence of the velocity of impact in the calibration of dynamometer springs. The experiments were arranged with falling weights so chosen that the product of the weight by the height fallen remained constant. The deflections of the spiral spring increased as the velocity of impact diminished: the anomalous result is due to the inertia of the spring.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the third quarter of 1922.—R. **Lucas**: Natural and magnetic rotatory power. If a substance possessing natural optical activity is suitably placed in a magnetic field, the substance acquires a complex rotatory power. The question as to whether there is simple additivity of the two rotatory powers, or whether the two phenomena exert a mutual influence on each other is investigated mathematically, and the conclusion is arrived at that the change in the natural rotatory power produced by the action of the magnetic field would be too small to put in evidence experimentally.—A. **Catalán**: The structure of the arc spectra of the elements of columns VI and VII of the periodic table.—G. **Reboul** and P. **Blet**: The different aspects of the electrical discharge in crystals.—A. **Grumbach**: Batteries with fluorescent liquid. If two platinum electrodes dip into a fluorescent solution and one of them is illuminated, an electromotive force is produced which varies with time. Some experimental results with solutions of uranine in water are given proving that Goldmann's explanation of the phenomenon is inadequate.—A. **Bigot**: The action of heat on kaolins, clays, etc. Ceramic plastic materials, under the action of heat, harden without dehydration and without change of volume. The colloidal plasticity is reduced by this heating.—Roger G. **Boussu**: A method for studying the velocity of formation of precipitates.—F. **Bourion**: The normal acids of Berthelot and the theory of ions.—Henri **Bénard** and Albert **Laborde**: The estimation of albumen by nephelemetric methods.—Mlle. S. **Veil**: The evolution of the molecule of ferric-hydroxide in water: the dehydration of ferric-hydroxide by ignition or by heating with water in sealed tubes to temperatures between 120° C. and 210° C. has been co-ordinated with the changes produced in the magnetisation coefficient.—B. **Bogitch**: The removal of sulphur from metals by lime. A study of the decomposition by lime, in the presence of carbon, of some metallic sulphides dissolved in the fused metal. Copper, nickel, iron, and manganese were studied, the action of lime and basic slag being examined separately. A mixture of lime and fluorspar gave the best results.—Mlle. de la **Paulle**: The estimation of potash as alum.—R. **Douris** and G. **Beytout**: The mercuric compounds of hexamethylene-tetramine.—Carl **Störmer**: Results of the photogrammetric measurements of the aurora borealis of March 22-23, 1920. The greatest altitude measured was 750 kilometres; in no case was the height less than 100 kilometres.—Octave **Mengel**: New seismotectonic views, resulting from the earthquakes felt between August and December 1922, in the eastern part of the Pyrenees.—M. **Stefanescu**: The growth in two opposite directions, and the marks of friction and pressure, of the molars of mastodons and elephants.—L. **Joleaud**: Sub-fossil hippopotami of Madagascar and the recent geographical connexions of this island with the African continent.—Albert **Baldit**: The undulatory movements of the atmosphere and their utilisation in aviation without a motor.—Jean **Mascart**: The quantity of heat received by the earth in the course of the seasons.—F. **Diénert**: Considerations on the formation of springs.—J. **Cluzet** and A. **Chevallier**: The use of thorium emanation in inhalation. By utilising radiothorium from the sludge

derived from the Echaillon springs, thorium emanation has been used directly by inhalation, and the therapeutic results obtained proved to be comparable with those given by other methods of treatment.—Jean **Bathellier**: The fungus gardens of *Entermes Matangensis*. These ants cultivate fungi (identified as a Xylaria) in special chambers.—G. **Marinesco**: Oxidising ferments and thermogenesis.—F. **Vlés**, J. **Dragoin**, and M. **Rose**: Researches on the hydrogen-ion concentration arrest of egg division in the sea urchin.—L. J. **Simon** and L. **Zivy**: The mixture of tartrates and phosphates regarded as buffer substances. The antagonistic action of calcium chloride.—Emile **Misk**: Tin in the human organism. Reference is made to the frequent presence of traces of tin in preserved foods. Tin appears to be present in the human body, the largest proportion being found in the liver. From the physiological point of view it is interesting to note that the body appears to contain normally at least as much tin as zinc.—Boris **Ephrussi**: The spermatogenesis of *Balanus perforatus*.—A. **Trillat**: The different properties of dry or liquid bacterial dusts.—C. **Levaditi** and S. **Nicolau**: Inoculation of the herpetic virus in the genital organs of the rabbit. Transmission of the herpeto-encephalitic infection by sexual contact.

Official Publications Received.

Memoirs of the Asiatic Society of Bengal. Vol. 8, No. 1: Ismailitica. By W. Ivanow. Pp. 76. (Calcutta: Asiatic Society of Bengal.) 2 rupees; 3*s*.

City and County of Bristol: The Bristol Museum and Art Gallery. Report of the Museum and Art Gallery Committee for the Year ending 30th September 1922. Pp. 23. (Bristol.)

Diary of Societies.

MONDAY, FEBRUARY 5.

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

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. H. E. Griffiths: The Relation of Diseases of the Gall Bladder to the Secretory Function of the Stomach and Pancreas.

SOCIETY OF ENGINEERS, INC. (at Geological Society), at 5.30.—A. Collis-Brown: Practical Notes on Inspection.

INSTITUTE OF TRANSPORT (at Institution of Electrical Engineers), at 5.30.—H. N. Gresley: Wagon Stock on British Railways.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—J. Coxon and others: Discussion, The Supply of Steady D.C. for Telephonic and other Purposes.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Miss May Sinclair: Primary and Secondary Consciousness.

ROYAL SOCIETY OF ARTS, at 8.—Dr. H. P. Stevens: The Vulcanisation of Rubber (Cantor Lectures) (1).

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Engineers' Club, Coventry Street), at 8.—G. T. Bray and F. Major: The Estimation of Fat in Casein.—Dr. E. Fyleman: Explosions in Liquid Air Rectification Plant.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.30.—Presidential Address to Students and Presentation of Prizes.

TUESDAY, FEBRUARY 6.

AIR CONFERENCE (at the Guildhall, E.C.), at 10.30.—Maj.-Gen. Sir W. J. Brancker: The Position of Air Transport To-day.—Comdr. C. D. Burney: A Self-supporting Airship Service. At 2.45.—Air Vice-Marshal Sir W. G. H. Salmond: The Progress of Research and Experiment.—Col. A. Ogilvie: Gliders and their Value to Aeronautical Progress.—C. R. Fairey: Seaplanes.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Annual General Meeting) (at the Holborn Restaurant), at 2.30.—Prof. W. E. Garner: Theory of Combustion of Gaseous and Liquid Fuels.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—R. D. Oldham: The Character and Cause of Earthquakes (2).

ROYAL SOCIETY OF ARTS (Dominions and Colonies and Indian Sections), at 4.30.—Sir Richard A. S. Redmayne: The Base Metal Resources of the British Empire.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—The Secretary: Report on the Additions made to the Society's Menagerie during the months of November and December 1922.—E. G. Boulenger: Account of Experiments on Amphibians and Insects at Vienna.—C. A. A. Dighton: Coat-colour in Greyhounds.—E. L. Gill: The Permian Fishes of the Genus Acentrophorus.—Dr. C. F. Sonntag: The Vagus and Sympathetic Nerves of the Terrestrial Carnivora.—E. P. Allis, Jr.: The Postorbital Articulation of the Palato-quadrate with the Neurocranium in the Cœlacanthidæ.—Dr. G. S. Giglioli: The Linguatulid Arachnid, *Raillietiella furcocerca* (Diesing, 1835), Sambon, 1922.—Rita Markbreiter: Some *Microfilaria* found in the Blood of Birds dying in the Zoological Gardens, 1920–1922.

INSTITUTION OF CIVIL ENGINEERS, at 6.—D. H. Remfry: Wind-Pressures, and Stresses caused by the Wind on Bridges.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Major O. Rutter: The Natives of North Borneo.

RÖNTGEN SOCIETY (at Institution of Electrical Engineers), at 8.15.

WEDNESDAY, FEBRUARY 7.

AIR CONFERENCE (at the Guildhall, E.C.), at 10.30.—General Discussion on the Papers read in the morning of February 6. At 2.45, General Discussion on the Papers read in the afternoon of February 6.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. G. Keynes: Chronic Mastitis.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—G. V. Douglas: The Geological Results of the Shackleton-Rowett (*Quest*) Expedition.

NEWCOMEN SOCIETY (at Alpine Club), at 5.30.—G. P. Baker: East Indian Cotton Prints and Paintings of the 17th and 18th Centuries.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—J. Hollingworth: The Measurement of the Electric Intensity of Received Radio Signals.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (Annual General Meeting) (at Chemical Society), at 8.—Presidential Address.—O. Jones: Notes on the Examination of Preserved Meats, etc.—E. Griffiths-Jones: Titanium in Nile Silt.

ROYAL SOCIETY OF ARTS, at 8.—C. R. Darling: Electrical Resistance Furnaces and their Uses.

FELLOWSHIP OF MEDICINE (at Royal Society of Medicine), at 8.30.—J. P. Lockhart-Mummery: Diverticulitis.

THURSDAY, FEBRUARY 8.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. I. M. Heilbron: The Photosynthesis of Plant Products (2).

ROYAL SOCIETY, at 4.30.—Prof. L. Bairstow, Miss M. B. Cave, and Miss E. D. Lang: The Resistance of a Cylinder moving in a Viscous Fluid.—G. I. Taylor: The Motion of Ellipsoidal Particles in a Viscous Fluid.—L. F. Richardson: Theory of the Measurement of Wind by Shooting Spheres Upward.—Prof. W. E. Dalby: Further Researches on the Strength of Materials.—L. C. Jackson and Prof. H. Kamerlingh Onnes: Investigations on the Paramagnetic Sulphates at Low Temperatures.—L. C. Jackson and Prof. H. Kamerlingh Onnes: Investigations on the Paramagnetism of Crystals at Low Temperatures.—Prof. E. Wilson: The Susceptibility of Feebly Magnetic Bodies as affected by Tension.—W. D. Womersley: The Specific Heats of Air, Steam, and Carbon Dioxide.

WOMEN'S ENGINEERING SOCIETY (26 George Street, W.1.), at 6.15.—E. W. C. Kearney: The Kearney High-speed Railway.

OPTICAL SOCIETY (Annual General Meeting) (at Imperial College of Science and Technology), at 7.30.—Sir Frank Dyson: Large Telescopes (Presidential Address).—Discussion on paper by F. W. Preston: The Properties of Pitch used in Working Optical Glass. A new *prismatic astrolabe* designed at the Admiralty Research Laboratory exhibited and described by Commdr. T. Y. Baker.

CAMERA CLUB, at 8.15.—C. H. L. Emanuel: Notes of a Collector of Prints and Drawings.

INSTITUTE OF METALS (London Local Section) (at Institute of Marine Engineers, Inc.), at 8.30.—Miss M. L. V. Gayler: The Investigation of the Constitution of Alloys.

FRIDAY, FEBRUARY 9.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary.

PHYSICAL SOCIETY OF LONDON (Annual General Meeting) (at Imperial College of Science and Technology), at 5.—Sir William Bragg: The Crystalling Structure of Anthracene.—Capt. H. Shaw and E. Lancaster-Jones: The Eötvös Torsion Balance.—H. W. Heath: Demonstration of the Flame Phone.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. L. R. Rawling: Remote Effects of Gun hot Wounds of the Head.

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

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Adjourned Discussion on Symposium of Papers on Indicators:—L. Pendred: The Problems of the Engine Indicator.—Prof. F. W. Burstall: A New Form of Optical Indicator.—W. G. Collins: Micro-Indicator for High-Speed Engines.—H. Wood: R.A.E. Electrical Indicator for High-Speed Internal-Combustion Engines, and Gauge for Maximum Pressures.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Prof. F. C. Lea: The Effect of Temperature on the Properties of Engineering Materials.

PHILOLOGICAL SOCIETY (at University College), at 8.—J. Hodgkin: Macaronic Poetry.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir John Russell: "Rothamsted" and Agricultural Science.

PUBLIC LECTURES.

SATURDAY, FEBRUARY 3.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—F. Balfour-Browne: Insect Pests and their Control.

MONDAY, FEBRUARY 5.

KING'S COLLEGE, at 5.—N. B. Jopson: The Original Home of the Slavs.

UNIVERSITY COLLEGE, at 5.—Sir John Russell, and staff of the Rothamsted Experimental Station: The Micro-Organic Population of the Soil (succeeding Lectures on February 7, 12, 14, 19, 21, 27, March 1, 5, and 7).

TUESDAY, FEBRUARY 6.

GRESHAM COLLEGE, at 6.—W. H. Wagstaff: Geometry (succeeding Lectures on February 7, 8, and 9).

WEDNESDAY, FEBRUARY 7.

KING'S COLLEGE, at 5.30.—Dr. J. S. Haldane: The Fundamental Conceptions of Biology.

THURSDAY, FEBRUARY 8.

UNIVERSITY COLLEGE, at 5.30.—G. A. Sutherland: The Acoustics of the Auditorium. (Succeeding Lectures on February 15 and 22.)

CENTRAL LIBRARY (Fulham), at 8.—Mrs. G. Skelton: Women and Industry.

FRIDAY, FEBRUARY 9.

UNIVERSITY COLLEGE, at 8.—Miss E. Jeffries Davis: The Evolution of London (succeeding Lectures on February 16 and 23).

SATURDAY, FEBRUARY 10.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—E. Lovett: Household Appliances of a Hundred Years Ago.