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The China Indemnity Bill.

CHINA is perennially a land of contrasts. This holds not merely in material things that strike the eye—such as nodding the head to say no, shaking it to say yes; putting on the roof of a house before laying its foundation; ending the book on the page where ours begins—but in spiritual things also, such as being content with an ethical system rather than a religion, but making its practice an inalienable part of the inner man. Nor does the spirit of contrast end here. It affects, to his surprise, the foreigner, and in particular the Englishman, who lives and works in China. Day by day in business matters he is inconvenienced by Chinese unpunctuality, by their waste of time, their avoidance of definite statement, their shrinking from responsibility, their superstitions; but when challenged as to the outcome of it all, he acknowledges, as recently a Consul-General did at a social gathering, that though he is at times annoyed or angry with them, yet when he thinks of the Chinese, he remembers mainly their honesty, their habitual courtesy, their good humour, so that liking and even affection becomes his ultimate attitude.

Another aspect of this spirit is presented by the *Times* of August 9, which includes both an article from a correspondent entitled "A Way to help China" and a leader on "Chinese Problems." The latter, while indicating how important to British trade would be even a slight improvement in China's present political conditions, supports the views expressed by its correspondent as to the value of co-operation, and declares "the line of action he proposes will lead to success. Others will mean confusion and failure." The contrast seen here amounts to this, that while our contemporary, by means of letters from its well-informed correspondent in Peking, has continuously pointed out the increasing antagonism, amounting even to danger to life, which foreigners at present experience in China, the article in question, which advocates as its one aim the cultivation of Anglo-Chinese friendship, is commended as being "an admirable and directly practical way of making British influence felt in China in its most fruitful form."

We now turn to the way there proposed for helping China: to devote to education practically the whole—or say nine-tenths—of the British quota of the Boxer Indemnity Fund, amounting to 400,000*l.* a year and payable until 1945. The article first directs attention to certain defects in the China Indemnity Bill, which in the House of Commons has passed its second reading and the report stage: its purposes are as yet indefinite, but an amendment, tabled in fact by members drawn from all three political parties, proposes that these

purposes, like those adopted by Japan and the United States in the same matter of indemnity remission, shall be defined as "educational or cultural." This amendment will probably be adopted, for Great Britain, pressed by both the United States and Japan in the Chinese markets, cannot afford to take a lower line, even in name, than they. In that case, the Advisory Committee which the Bill proposes to set up to advise the Foreign Secretary will have to be constituted accordingly, and should contain not only persons having knowledge and experience of educational and medical work, but also, in view of the great and increasing importance of female education, a Chinese woman, who, like her compatriot proposed to be included on the Committee, should favourably impress Chinese opinion by appropriate scholarship and educational experience.

To us, the article is of particular interest, because it boldly states that there is only one way to help China permanently and radically: that is, by education, and, moreover, an education which includes science. This assumes that no ground more favourable than education exists for the promotion and exercise of friendly relations between British and Chinese. The field includes, of course, such institutions and activities as universities, colleges and medical schools, and the promotion of scientific research in them and in related institutions. If the right method be adopted, it will be possible to bring home to the Chinese, who are both a shrewd and a responsive people, the value to China of including in the curriculum of higher education, as well as the study of science, that of letters, and of making it possible for Chinese youth to acquire some of the characteristics which mark the traditions of Public School education in England at its best—its spirit of initiative, of independence of character, of the desire for corporate well-being and voluntary service.

As there is only one way of radically helping China, so there is only one method of making this help permanent. The method is that of co-operation. This should be full and continuous, alike in formulating any general plan and in carrying it out in detail. To ensure that co-operation should be of this kind, at once real, and personal, and officially recognised, an indispensable condition is that an admixture of Chinese and British members should be an element in the constitution of the Foreign Office Advisory Committee, the local Committees in China, and the Boards of Management of all aided institutions, whether under Chinese or British management. This principle has been initiated and commended by the foresight of the Foreign Office in arranging for the inclusion on the Advisory Committee of "at least one citizen of the Republic of China." It remains to extend the principle and to apply it comprehensively. Local Education Committees, which would act under such general regulations as the Advisory Committee will draw up, might be formed in each of China's eighteen Provincial capitals, the Chinese and the British Chambers of Commerce there each nominating one-third of the members, the remaining third being partly *ex officio* and partly co-opted or nominated. In the case of Provinces not having a British Chamber of Commerce, it would not be difficult, by nomination or co-optation, to provide the necessary third, since not more than four members at most would be required. A similar method might be employed in providing the admixture of representatives upon Boards of Management of higher educational institutions, wherever situated.

The Advisory Committee as the central authority would itself deal with central institutions such as universities, and with central activities such as medical work, scholarships, and Chinese students. As to these activities, it may be noted: that the Anglo-Chinese community, in all their representations to the British Government, have emphasised the high value of British medical work, of which they are rightly proud; that scholarships stand for the Chinese tradition by which learning opens the way to distinction and a career; and that Chinese expenditure on students, which would involve a Chinese Institute in London and a subsidised hostel, would tend, by means of mutual international intercourse and understanding, partly to open the world to China and partly to open China to the world.

If some Anglo-Chinese critic should object that the Chinese are not ripe for this equal hand of fellowship, the answer must be: first, that nothing is so uplifting as this gesture, provided it be continued long enough to show that it is real; and next, that not even the keenest detractor of China will deny the pervasiveness among her people of the characteristic of responsiveness. In this the Chinese are faithful to the teaching of their great sage, who, when Lao-Tzū challenged his great maxim, "Return good for evil," by asking, "With what then will you recompense kindness?" replied, "Recompense injury with justice, and recompense kindness with kindness."

This then is the way to help China: by cultivating, on both sides, the power to forget past injury; by enabling each nation to realise, through real and comprehensive co-operation in education, the best characteristics of the other; and by both fully accepting the truth that education, while it is always a venture of faith, holds, as no other movement does or can, the promise of the future.

Probability in Theory and Practice.

Assurances sur la vie: calcul des primes. Par Henri Galbrun. (*Traité du calcul des probabilités et de ses applications,* par Émile Borel. Tome 3: *Les Applications de la théorie des probabilités aux sciences économiques et biologiques,* fascicule 1.) Pp. vi+311. (Paris: Gauthier-Villars et Cie, 1924.) 35 francs.

Éléments de la théorie des probabilités. (Cours de la Faculté des Sciences de Paris.) Par Prof. Émile Borel. 3e édition revue et augmentée. Pp. vii+226. (Paris: J. Hermann, 1924.) 18 francs.

THE treatment of the subject of probability has developed in recent years mainly in its application to statistical research, and a large amount of work has been produced in attempts to express frequency distributions or correlation surfaces in mathematical terms or in measuring correlations and periodicity. In all these researches a practical object was to be attained, and there is almost unlimited scope for further development, but there still remain two classes of books on probability, which are exemplified by Prof. Borel's "elements" and Dr. Galbrun's actuarial text-book, which are but slightly connected with modern statistical work.

Prof. Borel's book is an excellent example of the treatment of probability which begins with games of chance and drawings from urns; it leads, through the approximations to factorials, to the normal curve of error. Prof. Borel discusses geometrical problems, shows the Gaussian treatment of errors of observation, gives Bayes's theorem, and then indicates the promised land of statistical investigation and tells us of some of the many fascinating places we may find there. But he leaves us, as it were, at Mount Horeb. The book is already known in its earlier editions as a good text-book on the subject within the limits indicated, but it ends at the point where many modern readers begin to be most interested.

Dr. Galbrun's subject, in some respects, begins after the interest of most readers has expired, for actuaries are bound to assume that they know the probabilities of death in order to make their calculations, and modern work has been mainly concerned in finding ways of interpreting the statistics on which the probabilities are based. Unlike the well-known English text-book writers, however, Dr. Galbrun attempts to bridge this gap, as he discusses the "errors" involved in some of the probabilities, endowments, and annuities with which he deals, and it is this part of his work that calls for special comment. In statistical work it is customary when calculating a coefficient of correlation, or a mean, or some other function, to set out after the result the probable error of the figure reached as some indication of the deviations that will arise in such cases, and the natural course would appear to be to adopt some such method in dealing with the values that an actuary requires. The matter is, however, more complicated than that of the means to which we have referred. There are not only the deviations that arise in the original statistics, but also, even if the true probabilities of death in the future were known, there would be deviations from these probabilities just as there are deviations from the probability of a head falling in a coin-tossing experiment where the probability is known. Dr. Galbrun does not attempt to give the probable errors of various actuarial functions, but makes estimates of what we may call a "safety margin" which will cover 99 per cent. of the cases. This margin could, in theory, be used as a loading to the premiums charged, but if it were used for small classes of business it might, by increasing the premiums, reduce the amount of business and so render the loading insufficient on the theory adopted. Any such loading must, in practice, be regarded somewhat broad-mindedly, and Dr. Galbrun has not striven after extreme accuracy but has used rather rough approximations.

We may now turn for a moment to some other points in the work. In many ways it follows familiar lines, with an unfamiliar notation, and the methods of working out the values of annuities, assurances, and premiums require little comment. We are a little surprised, however, to find that in the evaluation of certain complicated benefits, Lubbock's formula is used, so that a number of differences have to be calculated and the arithmetic becomes troublesome. The customary method in Great Britain of using Simpson's or some similar rule seems preferable. In a few cases, also, Dr. Galbrun spoils his effect a little by using an approximation when an accurate result presents no real difficulty, and we would willingly have given up some of the work on survivorship annuities for a concise treatment of apportionable annuities.

The book concludes with an appendix of thirty pages discussing mathematically the application of the law of error to the probabilities of death, and in this connexion we would throw out a word of warning. The probability of dying in a year at the ages that are most important in practice are small (they are less than 0·02 at ages under 55), and when the probabilities become relatively large, as in extreme old age, the number of cases becomes small. It follows, therefore, that the normal curve of error should only be used with a certain amount of discretion. Partly, no doubt, owing to the series in which the particular volume is included, and partly, possibly, owing to Dr. Galbrun's

personal inclination, his book is more mathematical and less clearly identified with the business of life assurance than the English text-books. The actuary on the Continent is less obviously the man of business than the actuary in England.

As we have seen, Prof. Borel indicates at the end of his book the interesting developments which lie outside its scope; it is not belittling, but appreciative, to say that there is room for similar development beyond where Dr. Galbrun's book ends, and that comparatively little has yet been done.

Electrical Instruments.

(1) *Electrical Measuring Instruments.* Part 1: *Commercial and Indicating Instruments.* By Dr. C. V. Drysdale and A. C. Jolley. Pp. 440. (London: Ernest Benn, Ltd., 1924.) 55*s.* net.

(2) *Electrical Vibration Instruments: an Elementary Text-book on the Behaviour and Tests of Telephone Receivers, Oscillographs, and Vibration Galvanometers.* (Engineering Science Series.) By Prof. A. E. Kennelly. Pp. xi+450. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1923.) 30*s.* net.

(1) IN the preface to their book on "Electrical Measuring Instruments," the authors state that "some apology would seem to be necessary for issuing yet another book on electrical instruments." It is true that a certain number of books of varying merit have appeared within the last few years, but the authors need be under no apprehension as to the need for the book which they have just published.

A book on electrical measuring instruments such as that which has been produced by Messrs. Drysdale and Jolley is of permanent value. It contains a fund of information about their design, the materials used in their manufacture, and the precautions that should be taken to secure accuracy, which will render it of very great value to instrument makers and electrical engineers. If one tests the book by looking for information on the less-known instruments, one seldom fails to find it. The only serious criticism which may be offered is the comparatively meagre information given about the qualities of cobalt steel. This material is being used in increasing quantities in Great Britain, and a large amount of research work on it has been carried out within the last few years.

The volume opens with a short account of the general principles involved in the measurement of electrical currents. The second chapter deals with mechanical design, and the various types of ammeter, voltmeter, and wattmeter are classified in accordance with their methods of control. Much useful information is given on such subjects as the properties of cylindrical springs and the arrangement of damping vanes. There is an interesting note on pivots and on the methods of manufacturing them to ensure good wear. In this and the following chapters such matters as the mounting of the series resistances of voltmeters, the design of reactances for minimum power factor, the construction of condensers with zero temperature coefficient, the methods of constructing pointers and scales, and of leading in the conducting wires to instruments, are discussed with great care and thoroughness. It is the study of points like these that makes the difference between a good instrument and a bad one. Chap. iii. deals with the quickness of action of instruments, and the considerations in the design that are important from this point of view; fundamental electrostatic and magnetic theory is discussed, and among other matters the legal definitions of the units of current voltage and resistance are included, and also some elaborate tables of the working constant of instruments made by different manufacturers.

One of the most useful parts of the book is Chap. v., which deals with the properties of electrical materials. After a general account of the ordinary materials used as conductors, and those employed for insulating wires, some figures are given for the most suitable current densities to use in ammeter coils, and for the resistance per volt in voltmeters. The thermo-electric properties of alloys are discussed in detail, and the properties of the material known as "Therlo," which has been produced in the United States as a substitute for manganin, are included. Some interesting data are given of the dielectric strength and insulation resistance of dielectrics. Evershed's well-known work on the effect of moisture on insulation is dealt with, as well as the less-known work of Thornton on dielectric constants. No account of insulating materials nowadays is complete which does not give some data relating to bakelite and its derivatives, and a good deal of information is to be found about it, as well as about bitumen and impregnating materials. In dealing with magnetic substances, some useful data are given of the Heusler alloy, including its hysteresis loss for a good range of flux density. Yensen's vacuum iron is mentioned, and figures relating to it are given. The remaining chapters of the book deal with the properties of the principal types of instrument, namely, moving coils instruments, soft iron instruments, dynamometer types of voltmeters, ammeters, and wattmeters, hot-wire instruments, and electrostatic instruments.

The figures and tables that are included in these chapters must have involved careful and elaborate research, both in obtaining the necessary data and in classifying them. They provide a very valuable

compendium of information about present-day instruments.

This book should be on the shelves of all electrical engineers and instrument makers.

(2) Dr. Kennelly's work on telephone receivers and other vibrational instruments is well known, and his method of considering the characteristics of telephone receivers as reciprocating electric motors has been widely recognised. He says in the preface, "The basic idea in the subject-matter is that every electrical vibration instrument possesses a motional impedance diagram, which is its fundamental form and is capable of disclosing many electro-mechanical characteristics of the instrument."

The book starts with an account of the Bell telephone receiver, and describes the various types which are now being manufactured. A considerable part of the subject-matter in the following chapters describes the researches Dr. Kennelly and his assistants have made on the vibration of the telephone diaphragm, and the collection of these papers into a book will be of great value to those who are interested in this subject. Nowadays, when the clear reproduction of speech and music is occupying the attention of so many people interested in broadcasting, the book should be of especial interest. Not only does Dr. Kennelly deal very thoroughly and completely with the telephone receiver, but his book also contains a very good account of the various forms of vibration galvanometer which are now in use in light-current laboratories, as well as many of the different forms of oscillograph. In this connexion the oscillographmeter which Dr. Kennelly has devised is described. All those who are interested in light-current electrical measurements and the development of the telephone will find that this book is a necessary addition to their libraries.

Mendelian Studies.

Studia Mendeliana: ad centesimum diem natalem Gregorii Mendelii a grata patria celebrandum. Adiuvante ministerio Pragensi edita. Pp. 415. (Apud "Typos," Brunae, 1923.) 50 Kč.; 1½ dollars.

THE centenary of the birth of Gregor Mendel was celebrated at Brunn in 1923 by an international meeting of biologists. In "Studia Mendeliana" are collected twenty-four papers written in honour of the occasion. The inclusion in this volume of several papers on general evolution, of others on cytology, anthropology, the evolution and inheritance of sex, and lastly on the transplantation of tissue in relation to specific difference, illustrates the variety of the modern developments which have grown out of Mendel's fundamental discovery.

Among the papers on evolution is one by Prof. Lotsy on the importance of hybridisation in the production of new forms both in Nature and among domesticated races. Prof. V. Haecker writes on the origin and classification of racial characters, and advocates a close analysis of their occurrence in related forms from an evolutionary point of view. Prof. Witschi discusses the theory of orthogenesis, specially in relation to the evolution of sex. He regards sex differentiation as forming an orthogenetic series, culminating in forms with complete sex differentiation and determination at the reduction division. But the coincidence between sex determination and the reduction division is unessential, as shown by haploid and diploid hermaphrodites in animals and plants. From Witschi's own experimental work on rudimentary hermaphroditism and sex inheritance in local races of Rana, he concludes that they represent stages in the passage from the hermaphroditism of the Chordata to the highest forms of sex differentiation and determination at the reduction division. Differences between the local races of Rana he attributes to quantitative changes in the sex genes, brought about by indirect action of external conditions—an interpretation closely akin to that of Goldschmidt in his work on inter-sexes in Lymantria.

Working on Drosophila, Prof. Mohr has found a new case of the interesting phenomenon named by Bridges "deficiency," this term indicating the loss or inactivation of a section of a chromosome involving several genes. Hitherto such cases have been found only in sex-linked characters, but here the second chromosome is affected. Mohr makes the suggestion that all the dominant mutations in Drosophila which are known to be lethal when homozygous may turn out to be due to "deficiency." A report on the progress in the cytological and genetical investigation of the genus Crepis is made by Babcock, Collins and Mann. It is remarkable that the cross between *C. setosa* with four pairs, and *C. biennis* with twenty pairs of chromosomes, has given a hybrid with twenty-four pairs of chromosomes, and this hybrid has proved to have some degree of fertility. The authors regard this as an indication that more than one pair of homologues exist in the *C. biennis* group.

Dr. W. E. de Mol writes on heteroploidy and cross-fertility in *Hyacinthus orientalis*. He found both diploid and heteroploid forms to be self-sterile, but cross-fertilisations in general gave good seed. Heteroploid forms frequently arise as bud sports on diploids, and it is of special interest that these will not cross with the forms from which they derive.

In her essay on the transplantation of living tissue, Frl. Erdmann discusses the work of Leo Loeb on the

"individual differential" in newly-born rats and guinea-pigs of known breeding. Loeb found that the closer the relationship the more successful were the transplantations. The slightest difference in relationship affected the results, even brother to brother transplantations being more successful than those from parents to children. From the work of Spemann it is known that such individual distinctions arise during the development of the embryo, and Erdmann and others have suggested a parallelism with interspecific fertility. Nevertheless, Loeb has shown that in *Rana temporaria* these distinctions are independent of, or subsidiary to, the specific differential. Of great interest is Erdmann's observation that interspecific transplantations in Rana are facilitated by an intermediate period of growth of the graft in various media. C. P.

Oceanography.

An Introduction to Oceanography: with Special Reference to Geography and Geophysics. By Prof. James Johnstone. Pp. xii+351. (Liverpool: University Press of Liverpool, Ltd.; London: Hodder and Stoughton, Ltd., 1923.) 15*s.* net.

OCEANOGRAPHY is an extraordinarily composite subject; it touches on almost every branch of science, from the astronomical theory of the tides to the biological significance of the plankton. For this reason it is difficult for the student to weld the very varied facts at his disposal into a single consistent body of knowledge. Herein lies the value of a book such as this, which brings out the general theory in a clear and very readable manner without unnecessary detail.

After a brief description of its morphology, the probable origin of the world-ocean is discussed. This leads naturally to the consideration of its depth and the character of the bottom and the nature of the ocean margins. Great stress is rightly laid on the very small vertical scale of the surface features of the earth. Two chapters then follow on the chemistry and physics of sea-water. In the chapter on the tides, the author has attempted with very fair success the difficult feat of a non-mathematical exposition of the theory of their production. The oceanic circulation is described and explained very clearly, so that the significance of the underlying causes can be fully appreciated. The final chapter on secular changes in the ocean is perhaps the most interesting and suggestive, and fixes in the mind the ideas put forward in the rest of the book.

When so wide a field is covered it is almost impossible for the standard to be maintained throughout. The chapters on the chemistry and physics of sea-water are not quite so good as the rest of the book. In the section on the hydrogen ion concentration of sea-water, the notation has been confused, the symbol pH being used at first (p. 149), where it is obvious that the hydrogen ion concentration, C_H, is referred to, although later "pH" is correctly defined and expressed (p. 153). In the description of the effect of cooling a solution of sodium chloride (p. 185) it is incorrect to say that "The quantity of ice formed increases, the quantity of sodium chloride crystals formed also increases and the concentration of the solution remaining unfrozen increases." As the eutectic is approached, *either* pure ice or pure sodium chloride crystals separate according to the initial concentration of the salt. Not until the eutectic is reached do salt crystals and ice separate out together (*vide* "A System of Physical Chemistry," vol. ii., W. C. McC. Lewis, pp. 247 and 248).

The explanation on page 186 of why ice formed from sea-water floats is strange. The expansion of water on solidification has been overlooked. The ice formed from sea-water is not only lighter than sea-water but is lighter than fresh water, since its specific gravity is about 0·92 (*vide* "Handbuch der Ozeanographie," Band I., Dr. O. Krümmel, p. 507).

Apart from these sections the book is excellent, and it is hoped that they will be revised in the next edition. The illustrations are well done, and there is a good appendix which can be referred to for literature. There are few misprints; the formula at the top of p. 147 should read "$Q = P.K/T$," and on p. 191, line 18, "more" should read "less," while on p. 187 "$NaSO_4$" should read "Na_2SO_4."

Our Bookshelf.

(1) *Outlines of Fungi and Plant Diseases: for Students and Practitioners of Agriculture and Horticulture.* By F. T. Bennett. Pp. xi+254. (London: Macmillan and Co., Ltd., 1924.) 7*s.* 6*d.* net.

(2) *Practical Botany.* By Rai Bahadur K. Rangachari. Pp. iii+114. (Madras: Government Press, 1923.) 18 rupees.

(3) *British Mosses and How to Identify Them.* By J. H. Crabtree. (How to Identify Series, No. 19.) Pp. 63. (London: The Epworth Press, 1924.) 1*s.* 6*d.* net.

(4) *Plant Studies.* By Prof. James A. Todd. (Foundations of Nature Study Series.) Pp. 151. (Edinburgh: A. Baxendine and Sons, 1924.) 2*s.* 6*d.* net.

(5) *The Nature-World of London.* By Walter Johnson. 1: Trees and Plants. Pp. viii + 118 + 8 plates. (London: The Sheldon Press; New York and Toronto: The Macmillan Co., 1924.) 3*s.* net.

(1) MR. BENNETT'S book on fungi and plant diseases has been written more particularly for students of agriculture and horticulture. It should serve its purpose very well. The first part gives a general account of the fungi, with a short classification and the life histories of a number of members of the various groups. The second part deals with plant diseases as

such. The modern study of this subject only began about 1866, but has developed in many aspects in recent years. The chapter dealing with the general aspects of parasitism, such as infection, resistance, and immunity, might very well have been considerably extended. In later pages all the better known fungus diseases of crops, from mycetozoa to rusts and bacteria, are clearly described, together with their effects on the host plant and methods of treatment. In connexion with wheat rust, the important developments since the "bridging" theory was generally held are only referred to in a footnote. The volume will be useful to all those who wish to acquire a general knowledge of plant diseases. Its conciseness and arrangement will appeal to the student.

(2) The second work on our list is a small book of laboratory exercises to accompany the author's "Manual of Elementary Botany for India." The plants studied and illustrated are chiefly tropical forms such as *Dolichos lablab*, *Arachis hypogæa*, and *Andropogon sorghum*, which are not generally examined in European laboratories. The figures, many of which are photomicrographs, would have been clearer in some cases if they had been taken with a higher magnification. The book is in three sections, the first dealing with the morphology of root, stem, leaf, flower, and fruit; the second with physiology, in which various simple experiments are outlined; and the third with Cryptogams.

(3) The author gives in small space popular descriptions of about sixty of the commoner British mosses. On each page two species are described, with photographs of the species on the accompanying page. Technical terms are avoided, but habitats, and in some cases localities, are given. This popular treatment should enable moss-lovers to recognise genera, and in many cases species, without much difficulty. The photographs usually show the habit without attempting to portray any further detail.

(4) Mr. Todd's book is one of a series on the foundations of nature study. It is intended for teachers who are conducting school classes in this subject. Beginning with a short chapter on the cellular structure of plants, there follow others equally brief on the various plant organs, vegetative reproduction, plant identification, trees and cryptogams, with a final chapter of notes on ecology. The definition of a flower (p. 53) is not very happy, and some of the figures suffer from their small size. Those who have had no previous acquaintance with botany would find it of greatest use.

(5) The charmingly written little book of Mr. Walter Johnson is full of lore concerning the trees and other plants of the London area, as they are known to the author. Botanist and layman alike can find entertainment in its pages. The historical trees referred to include Nelson's mulberry and Captain Cook's "cotton tree," which is a balsam poplar. Chapters on the wild flowers and weeds of London are equally entertaining accounts of plants found in the commons, gardens, and open spaces of London. In the final chapter on London's mushrooms and toadstools, many of the common forms are mentioned, including some of those found in wine cellars. It is to be hoped that the author's promise of a further volume on other phases of Nature in London will be carried into effect.

Kitāb al-'ilm al-muktasab fī ziraʿat aḏh-ḏhahab: Book of Knowledge acquired concerning the Cultivation of Gold. By Abu'l-Qāsim Muḥammad ibn Aḥmad al-'Irāqī. The Arabic text edited with a translation and introduction by E. J. Holmyard. Pp. iv+62+53. (Paris: Paul Geuthner, 1923.) n.p.

MR. HOLMYARD in the introduction to his book remarks justly that "the investigation of the original sources of Arabic chemistry has scarcely yet been attempted." The most important work was that of Berthelot, yet owing to the limited range of works studied, particularly in the case of Jabir ibn Hayyān, it is likely that some of the conclusions of the great French historian of chemistry may require modification. A reaction against the rather premature generalisations of Berthelot, which are most warmly supported by those who have no knowledge of the original sources, has undoubtedly set in, and the further investigation of Arabic sources by those competent to undertake the work will no doubt provide information of great interest to students of the history of chemistry.

The text published by Mr. Holmyard is a small treatise by a thirteenth-century Arabic alchemist. The intrinsic interest of the work is not very great: the theory that all metals are really the same and differ only in unessential properties, which may be removed, is Aristotelian, but the assumption that "the metallic substance freed of such accidental properties is gold" seems unusual, and, as Mr. Holmyard says in his introduction, was opposed by other Arab chemists, including Ibn Sina ("Avicenna"), who held that each metal is distinct. The author speaks of the "two leads," the "two coppers," and so on; some materials will "turn copper yellow with the yellowness of gold," but "do not make it complete." As the Latin Geber says, *tutia* will "citrinise copper of a good yellowness," but he adds that it is to be taken only for "the lesser work," *i.e.* for deception only. The comparison of the elixir, which is to transmute metals, with the remedy, which is to cure disease, is instituted. Many names of Greek-Egyptian alchemists, such as Zosimus, Agathodemon, Maria, etc., are mentioned: the first as "the Jew"; Khalid ibn Yazid and Marianus also appear. The "Art of the Egyptians" is chemistry. All this points clearly to the sources: Arabic chemistry came from Hellenistic Egypt in the first instance, and one of the important questions to which further research will disclose an answer is how much original work the formerly much vaunted Arabic alchemists really did.

Mr. Holmyard must be congratulated on his book, and readers will look forward to the conclusions he will perhaps draw from the study which has enabled him to produce it. Of the Arabic text the reviewer is unable to offer an opinion, but it has been looked through by Prof. Browne and Mr. Steele, who are experts.

J. R. P.

L'Hérédité. Par Prof. Émile Guyénot. (Encyclopédie scientifique: Bibliothèque de Biologie générale.) Pp. 463. (Paris: Gaston Doin, 1924.) 19·80 frs.

THE scientific experimental study of heredity may be said to have begun with the present century. The views of the early hybridisers were too vague, and were based upon results too varied and indefinite to lead anywhere. Moreover, the work of the nineteenth

century was required to build up an edifice of knowledge concerning organic structure and development, the nature of sexual reproduction, and the structural basis of heredity, before definite views of the laws of inheritance could be propounded and accepted. But in the last twenty-four years advance has been rapid, because all these and other lines have converged upon the solution of the central problem of heredity. Where all was formerly hazy and nebulous, results are now seen to be clean-cut and precise, continually opening up further vistas of understanding concerning the relations between the details of organic structure as we find them, and the laws and exceptions to the laws of inheritance as they are developed by experimental work.

While the advances in Mendelian heredity, sex chromosomes, etc., have been rapidly incorporated into biology on account of their fundamental character, yet to the lay mind heredity remains for the most part an unintelligible and almost mystical "force." Even the medical profession remains in an uninstructed condition regarding a subject which vitally concerns their daily activities.

Any book which spreads the modern knowledge of heredity is therefore to be welcomed, and the volume before us, by Prof. Guyénot, should be very useful in this respect for French-speaking peoples. The author's definition of heredity is worth quoting: "L'hérédité consiste dans la totalité des réalisations morphologiques ou physiologiques que le descendant tient de ses parents."

The volume is divided into three sections. The introduction begins with a chapter on the continuity of living matter as the basis of heredity. The sections deal with the laws of hybridisation, the chromosome theory of heredity, and Mendelian anomalies. In the last, such topics as hyperdactyly in fowls, lethal factors, cytoplasmic inheritance, and xenia are discussed. The final chapter is devoted to inheritance in man. While containing little or nothing that is new to the geneticist, the book presents a useful summary of recent advances in this field. The number of Drosophila mutations has now reached more than 300, not 100 as the author states. R. R. G.

Human Protozoology. By Prof. Robert W. Hegner and Prof. William H. Taliaferro. Pp. xix+597. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1924.) 4.50 dollars.

THIS work has been prepared primarily for the use of students in the authors' course of protozoology in the School of Hygiene of the Johns Hopkins University, but it will be of great use to students pursuing similar courses in other institutions, and to medical officers who desire a concise statement of the facts of protozoology. Emphasis is rightly laid on the value of a study of parasites from lower animals, which are often more easily obtained than the allied species occurring in man, and serve as excellent material for practice in technique and in the study of life-cycles.

In the general introduction to the organisation of the protozoa, structure and modes of division are considered. The following chapters deal in turn with the main groups of protozoa, the structure and life-history of representative genera and species being described and careful reference made to the methods of spread of those which occur in man. A chapter is devoted to the genetics and the physiology of reproduction in the protozoa, and a final chapter gives useful information on the diagnosis of intestinal protozoa. A well-chosen list of books and memoirs on protozoa occupies some fifty pages, there is an adequate index of authors and of subjects, and the volume is excellently illustrated by clearly drawn figures.

In reviewing a work which is so well done it is almost ungracious to ask for more, but here and there the authors might consider whether in their next edition they could add a few further details; *e.g.* in the chapter on Hæmosporidia (exclusive of malaria) it would be useful to have some account of the life-history of Piroplasma, incompletely known though it be, and of *Theileria parva*, a short account of Proteosoma, and a reference to Mrs. Adie's work on Hæmoproteus.

The authors are to be congratulated on the production of this excellent manual.

A Check-List of British Birds: With a Short Account of the Status of Each. Compiled from "A Practical Handbook of British Birds." By H. F. Witherby. Pp. 78. (London: H. F. and G. Witherby, 1924.) 3*s*. 6*d*. net.

ORNITHOLOGISTS will welcome this little book, which is printed on one side only of the paper for convenience in labelling or for the making of notes. The fact that it is taken from the "Practical Handbook of British Birds" is a sufficient guarantee that it is up-to-date and correct in all matters ornithological and nomenclatorial.

From the biological point of view, it is very instructive to look down the pages of the book and note which of the species remain binomial, which have run into trinomials. The latter, of course, are in the great majority—a sign of the enormous amount of geographical variation which patient research reveals. The problem is to understand why some species show this tendency to break up into geographical races or subspecies, while others remain invariant. The lack of variability in some of these may be apparent only, due to our ignorance; but this cannot be true of the Chough, the Snow-Bunting, the Brambling (the specific name of which, by the way, contains a misprint), the Meadow-Pipit, the Waxwing, the Lapwing, the Redwing, and many others. Sometimes whole groups, such as the Tits or the Wheatears, seem to show excessive variability, while the Anseres contain an unusually large proportion of "unsplit" species.

The evolutionary biologist should pay more attention to the rich mine which the labours of the systematist, most notably in the group of birds, have opened up for him. J. S. H.

Exercises on Ordnance Maps. Selected and arranged by C. H. Cox. Pp. 60+12 maps. (London: G. Bell and Sons, Ltd., 1924.) 1*s*. 9*d*.

ELEMENTARY and advanced exercises are based on twelve sections of different scale ordnance maps of various styles. Concentration on map work of this nature is the best introduction to the study of geography. Even if some of the questions are a little far-fetched as exercises on the maps, the book is excellent and deserves to be widely used in schools. R. N. R. B.

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.*]

On the Vibrations of Air in Organ-Pipes of Unusual Shapes.

IN 1867–68, when I was Principal of La Martinière College, Calcutta, I made some experiments on organ-pipes in conjunction with the Cathedral organist, Mr. Frye, who was trying to rebuild a small organ on which to practise in his own room. His problem was how to get pedal-tones from pipes smaller than the regulation minimum, namely, 8 ft. stopped diapason, a very inconvenient size in an ordinary house. I studied his "Hopkins and Rimbault," and became quite fascinated with the subject, chiefly on its scientific and mathematical side.

Mr. Frye supplied the first hint for a solution of the problem. He noticed how low were the tones given by a large bottle with a small neck, when blown across the mouth like a flute. For example, a bottle which stands easily in a space 1 ft. high on a base $4\frac{3}{4}$ in. in diameter gives the note Bass E♭, the pitch of an open diapason pipe about 6 ft. 8 in. from mouth to top. But the practical difficulties in the way of making a pedal "bottle-stop" proved too much for him.

I found my available text-books useless, and had to invent the mathematical investigation for myself. A "bottle-pipe" is really two pipes of unequal diameters, joined together by a flange from the outer edge of the smaller pipe with the mouth-piece, to the inner edge of the larger stopped pipe. The text-books give the formulæ of vibration in a uniform cylinder, either open or stopped. I took these formulæ for the two separate parts, and made them fit at the junction by the two conditions, that the air-pressures must be the same for both, and that with each swing the volume of air thrown from the small part into the large must be equal to the volume returned by the large into the small. Hence I deduced the formula

$$\tan mh \,.\, \tan mk = \frac{\text{area of mouth-part}}{\text{area of stopped part}} = \frac{r^2}{R^2},$$

where h and k are the lengths of the two parts, r and R their radii, and m is proportional to the vibration-rate of this composite pipe, so that $ml = \pi$, if l be the length of the open diapason of the same pitch.

This formula shows that h and k are interchangeable, so that the mouth-part may be short and the stopped part long, or the reverse, without altering the pitch. It is also easy to see that the lowest note will be obtained by making the two parts of the same length. This form gives us a new kind of organ-pipe which I call a *Bicylindron*. If r be the radius of the mouth-part, and R that of the stopped part, and h the length of either half, then

$$\tan^2 mh = \frac{r^2}{R^2} \text{ or } \tan mh = \pm\frac{r}{R},$$

where as before $ml = \pi$ gives the length l of the "tone," as estimated by organists; *i.e.* Bass C = 8 ft. tone; Tenor C = 4 ft. tone, etc.

That the above formulæ are accurate enough for practice I have proved by making zinc models with suitable measurements.

It can easily be seen from this formula that a *Bicylindron* "stop" can be made of two varieties. If $r < R$ the pitch will be lower than that of a stopped diapason of the same total length, $2h$. If $r > R$ the pitch will be higher; but it will be lower than that of an open diapason of length $2h$. For a pedal-stop, of course, r must be less than R.

But "Hopkins and Rimbault" gave another solution. There is an organ in Oxford, with a *Pyramidon* stop, invented by Ouseley. Each pipe is an inverted pyramid, closed at the base, with a mouthpiece at the narrow end, near the apex. The writer is astonished at the low note such pipes give in comparison with their height; but he attempts no explanation of the mystery. To the mathematician such a pipe is merely a conical pipe, closed at the broad end. My copy of Besant's "Hydrodynamics," said not a word about conical pipes, though almost all reed-pipes in an organ have open conical resonators. So I had to invent the theory for myself, and found out the formula, which gives the fundamental note and the overtones, namely,

$$\tan mh = mk,$$

where h is the distance from mouth to base, and k from vertex to base, m having the same meaning as before. I verified this formula by a few small zinc models. It is not given in Basset's "Elementary Hydrodynamics" (1890), nor in Lord Rayleigh's "Theory of Sound" (1894). The latter works out the theory of open conical pipes, and shows that they are, in pitch and in harmonics, equivalent to cylinders, as organ-builders know by experience. Basset perversely limits himself to conical pipes *without any mouthpiece*; so that his investigation is useless for the *Pyramidon*. But I have worked out the problem from the data given by both authors, and deduced from either the formula given above. Both authors give the formula for the mouthless pipe, namely,

$$\tan mk = mk,$$

which is merely a particular case of my formula, when $h = k$; *i.e.* when the mouthpiece is run down to a mere point at the vertex.

From the formulæ given above, mathematical readers can prove that, space for space, a *Bicylindron* always beats a *Pyramidon* for depth of pitch. For example, if the breadth at the stopped end be 9 inches for both, and the breadth at the mouth 3 in., and the height from mouth to stopper be 2 ft., the *Pyramidon* gives nearly a $6\frac{1}{2}$ ft. tone, while the *Bicylindron* gives a tone rather lower than $9\frac{2}{3}$ ft.

But the all-important consideration has not yet been noticed. In an organ everything depends upon "quality of tone"; and it is now an established axiom that quality of tone depends upon the proportionate admixture of harmonic overtones. The standard musical instruments — violin, piano, and organ—all give the complete series of natural musical harmonics, the vibration-rates of which are proportional to the series

1, 2, 3, 4, 5, etc., *ad infinitum*.

There is one exception in the organ. The stopped diapason can give only the odd harmonics, 1, 3, 5, 7, etc. The octave harmonics, which make the tone bright and clear, are all cut out. Thus a stopped diapason can give a soft sweet tone, but can never give the full rounded ring of the open diapason. Its chief advantage is that it takes up only half the space and saves half the cost in materials.

Now the formulæ given above prove that the overtones of a *Pyramidon* are all incommensurable and therefore unmusical. The best voicer in the world can make nothing out of it beyond a dull humming note. But with the *Bicylindron* all we have

to do is to make the ratio $r:R$ exactly equal to $\tan \pi/n$, where n is any integer, and we shall get the harmonic sequence

$$1,\ n-1,\ n+1,\ 2n-1,\ 2n+1,\ 3n-1,\ 3n+1,\ \text{etc.}$$

For pedal notes the best values of n are 5, 7, or 9; these will give octave harmonics. If we take $n=5$ we shall get a pipe shorter than the stopped diapason of the same pitch in the ratio of 4 : 5; but its harmonic overtones will be the series

$$1,\ 4,\ 6,\ 9,\ 11,\ 14,\ 16,\ \text{etc.},$$

which should give a far better quality than the ordinary stopped diapason.

But the best of all for quality is the $\pi/3$ *Bicylindron*, the length of which is two-thirds that of the open diapason of the same pitch. This pipe has the harmonic sequence

$$1,\ 2,\ 4,\ 5,\ 7,\ 8,\ 10,\ 11,\ 13,\ 14,\ 16,\ \text{etc.}$$

This pipe, if properly voiced, should make a solo stop with a unique loveliness of tone. Experimentally I have proved the sequence 1, 2, 4, and 5.

I worked out my formulæ in the case of a double conical pipe, made of two cones joined together at the broader equal ends, each tapering to a smaller mouth in opposite directions. The result can be found by a very pretty calculation from the formulæ given by Basset or Lord Rayleigh; it is

$$m \sin m\mathrm{H} = \left(\frac{1}{k}+\frac{1}{k'}\right) \sin mh \sin mh',$$

where $\mathrm{H}=h+h'$; h and k have the meaning given above for the *Pyramidon*; h' and k' the corresponding quantities for the second cone; and m gives as before the vibration-rate of the whole pipe, which is of lower pitch than an open cone of the same length. This double pipe is intended for reed-stops, which need a cone tapering to the narrow reed-tube. By taking $h'=h$ or $h/2$ we can get all the harmonics of the open cone h'; and by giving suitable values to k and k' we can ensure that the fundamental tone shall be an exact double octave below the open cone h', thus gaining the conditions for good quality. Hence we find in either case

$$\frac{1}{k}+\frac{1}{k'}=\frac{\pi}{2h}.$$

In 1868 I made four pipes on this plan, using some harmonium reeds I had by me, of pitch Tenor C, D, E, and F. Mr. Frye tried them in the Cathedral organ. We both agreed that the tone was very beautiful, when it came on. But there was a distinct burr at the beginning and end of the tone, and the pipes were so "slow of speech" that in a quick run they never spoke at all. Such "free reeds" are probably inappropriate: they are never used by English organ-builders. But the experiment shows that in expert hands a reed-pipe of this kind might be made with a tone of unique beauty, free from all defects of "speech."

JAMES A. ALDIS.

The Quantum Theory of Dispersion.

IN a recent letter to NATURE (May 10, p. 673) Dr. Kramers advanced a quantum theory of dispersion which is a generalisation of the theory of Ladenburg. The formula proposed by Kramers for the polarisation of an atom when put in a wave is his formula (5). This formula is stated by Kramers to satisfy the condition demanded by the Correspondence Principle, namely, that the dispersion due to an atom in a state of high quantum number is the same on the classical and on the quantum theories.[1] The presence of the second term has been introduced by Kramers for this purpose. From the point of view of the virtual oscillators of Bohr, Kramers, and Slater, the second negative term of Kramers is somewhat dissatisfying, because an oscillator would give rise only to a term of the first positive type.

The present writer has been also considering the question of interaction between radiation and quantised atoms in connexion with the question of the Brownian movement of atoms in black body radiation. A picture similar to the virtual oscillator finds application also in that field. However, the exact form of the interaction has been conjectured by the writer to be somewhat different from that proposed by Kramers.

The difference can be illustrated in the case of the linear oscillator. In this case the expression of Kramers becomes at long wave-lengths

$$P=[n-(n-1)]\frac{e^2}{m}\frac{1}{4\pi^2(\nu_i^2-\nu^2)}=\frac{e^2}{m}\frac{1}{4\pi^2(\nu_i^2-\nu^2)}.$$

The same result may be also derived as

$$P=[\tfrac{1}{2}+\tfrac{1}{2}]\frac{e^2}{m}\frac{1}{4\pi^2(\nu_i^2-\nu^2)}.$$

In this manner the negative term may be avoided. In order to satisfy the Principle of Correspondence, the dependence of P on ν must be in general slightly more complicated than that for the oscillator. This dependence can be derived from a consideration of a "virtual orbit" rather than a virtual oscillator. (I am indebted to Prof. Van Vleck for this term.) The "virtual orbit" has the same frequency as the "virtual oscillator." However, its reaction to the external field is comparable with that of an electron, the orbit of which is the mean of all the orbits between the two stationary states. (The meaning of "mean" is of necessity somewhat indefinite.) It is clear that in the general case a properly taken sum of the contributions of the various ν_i^a, ν_i^e will give the required result. Thus it is sufficient to attribute to a transition between a quantum state of quantum number $(n_1+\tau_1, \ldots n_u+\tau_u)$ to $(n_1, \ldots n_u)$ one half of the contribution to the polarisation on the classical theory due to the terms in frequencies $\tau_1 w_1+ \ldots +\tau_u w_u$ (in Bohr's notation) in order to satisfy the Principle of Correspondence.

It appears that the form of the theory here outlined is better capable of explaining dispersion at long wave-lengths (say for an atom in the normal state) than the form of Kramers because the characteristics of the motion are of greater influence on the "virtual orbit" than on the "virtual oscillator" point of view. By introducing a properly taken mean, one may hope to obtain the influence of a static field as a limiting case of a field considered in the theory of dispersion.

G. BREIT.
Physics Department,
The University of Minnesota,
Minneapolis, Minn.

THROUGH the courtesy of the Editor of NATURE, I have been permitted to see Mr. Breit's letter, and I welcome the opportunity thus afforded me to add some further remarks on the theory of dispersion, in order to elucidate some points which were only briefly touched upon in my former letter.

In addition to the empirical applicability of a dispersion formula of the type (4), the arguments which

[1] Prof. J. H. Van Vleck, of this University, has shown, in a publication which is to appear soon, that this formula satisfies the Correspondence Principle for the case of the general non-degenerate multiple periodic orbit.

led to the proposal of formula (5) rested on the classical expression for the amplitude of the secondary wavelets which an incident plane wave sets up in a system of electrified particles. Consider a system, the motion of which is of multiple periodic type, and let the electrical moment M in a given direction of the undisturbed system, which is supposed to possess u independent fundamental frequencies $\omega_1, \ldots \omega_u$, be represented by

$$M = \Sigma C \cos(2\pi\omega t + \gamma), \quad . \quad . \quad . \quad (1^*)$$

where the frequencies $\omega = \tau_1\omega_1 + \ldots \tau_u\omega_u$ and the amplitudes C depend on the quantities $I_1, \ldots I_u$, which in the theory of stationary states are equal to integer multiples of Planck's constant h, as well as on the set of integer τ-values characteristic for the considered harmonical component of the motion. Let next the incident wave be linearly polarised with its electrical vector parallel to the given direction, and let the value of this vector at the point where the system is situated be given by $E \cos 2\pi\nu t$. The electrical moment of the forced vibrations of frequency ν set up in the system will then be equal to

$$P = \frac{E}{2}\Sigma\frac{\partial}{\partial I}\left(\frac{C^2\omega}{\omega^2 - \nu^2}\right)\cos 2\pi\nu t, \quad . \quad . \quad . \quad (2^*)$$

where $\frac{\partial}{\partial I}$ stands as an abbreviation for $\tau_1\frac{\partial}{\partial I_1} + \ldots \tau_u\frac{\partial}{\partial I_u}$.

Now in the limit of high quantum numbers the frequencies of the spectral lines connected with the different possible transitions will coincide asymptotically with the frequencies of the harmonic components of the motion, and, according to the Correspondence Principle, the energy of the spontaneous radiation per unit time combined with each of these frequencies will be asymptotically represented by the expression $\frac{(2\pi\omega)^4C^2}{3c^3}$. We will now make the assumption that, in this limit, formula (2*) gives an asymptotical expression for the dispersion. In order to obtain a general expression holding for all quantum numbers we note that, while the frequencies ω of the harmonic components of the motion are given by the general formula

$$\omega = \frac{\partial H}{\partial I},$$

the exact expression for the frequencies of the spectral lines is given by the general quantum relation

$$\nu_a = \frac{\Delta H}{h},$$

where ΔH signifies the difference of the energy H in two stationary states for which the values of $I_1, \ldots I_u$ differ by $\tau_1 h, \ldots \tau_u h$ respectively. The assumption presents itself that, in a generalisation of formula (2*), the symbol $\frac{\partial}{\partial I}$ has to be replaced by a similar difference symbol divided by h. This is just what has been done in establishing formula (5). In fact, this formula is obtained from (2*) by replacing the differential coefficient multiplied by h, by the difference between the quantities $\frac{3c^3A^ah}{(2\pi)^4\nu^{a2}(\nu^{a2} - \nu^2)}$ and $\frac{3c^3A^eh}{(2\pi)^4\nu^{e2}(\nu^{e2} - \nu^2)}$ referring to the two transitions coupled respectively with the absorption and emission of the spectral line which corresponds with the harmonic component under consideration.

Apart from the problem of the validity of the underlying theoretical assumptions and of any eventual restriction in the physical applicability of formula (5), the dispersion formula thus obtained possesses the advantage over a formula such as is proposed by Mr. Breit in that it contains only such quantities as allow of a direct physical interpretation on the basis of the fundamental postulates of the quantum theory of spectra and atomic constitution, and exhibits no further reminiscence of the mathematical theory of multiple periodic systems.

In this connexion it may be emphasised that the notation "virtual oscillators" used in my former letter does not mean the introduction of any additional hypothetical mechanism, but is meant only as a terminology suitable to characterise certain main features of the connexion between the description of optical phenomena and the theoretical interpretation of spectra. This point is especially illustrated by the appearance of negative as well as positive oscillators, which helps to bring out the new feature, characteristic of the quantum theory of spectra, that the emission and absorption of a spectral line is coupled with two separated types of physical processes. The fundamental importance of this general feature for the interpretation of optical phenomena is, as mentioned in my former letter, indicated by the necessity, pointed out by Einstein, of introducing the idea of negative absorption in order to account for the law of temperature radiation.

H. A. KRAMERS.
Institute for Theoretical Physics,
Copenhagen, July 22.

Lake Victoria and the Flow of the Yala River.

DURING a recent investigation into the epidemiology of sleeping sickness along the east coast of Lake Victoria, north of the opening of the Kavirondo gulf, I observed the following phenomena which I trust some readers of NATURE may be able to explain, for I cannot.

The river Yala, which enters the lake at this part of the coast, passes through swamps which are kept back from the lake by sand-banks. Having landed here I noted many channels cut through the sand, running inland from the lake. The local natives said, "These were made by our forefathers, six generations ago, to drain the swamps." I pointed out that at that moment (about 9.30 A.M.) the water was not running out *from* the swamp but *into* it from the lake at quite a considerable rate, which I thought might be two miles per hour.

The natives replied that the current ran thus from daybreak until two in the afternoon, when it was reversed and flowed back into the lake. This is the daily routine so long as the lake is at the higher levels of its seasonal variations; when it is low, in the dry season, the flow through these channels is always from the swamp.

I am much puzzled as to the explanation of this diurnal variation, which cannot be accounted for by changes in direction of wind. I was working along that coast for several weeks and soon noted that the breeze from lake to shore (westerly, here) does not commence before 9.30 A.M., often not till ten; until that time, from the small hours, there is a strong cool breeze from off shore.

I omitted to ask the natives in which direction the current flowed during the night: they had said "from daybreak," but that probably means merely the earliest time when they noticed it.

Since it occurred to me that the great loss which must take place from the open lake by evaporation during the heat of the day might conceivably lower

the level of the lake in the afternoon, I obtained readings of the level at Entebbe by the official recorder at 8 A.M., noon, and 4 P.M. On three successive days the records were as follows :

Date.	8 A.M.	Noon.	4 P.M.
July 2 . . .	10·42	10·42	10·42
,, 3 . . .	10·42	10·42	10·42
,, 4 . . .	10·41	10·42	10·41
,, 5 . . .	10·40	..	..

This explanation, therefore, is not possible, and indeed seems improbable in consideration of the vast size of the lake and the relatively small amount of water poured into it by the Kagera and smaller rivers, of which the Yala is one. The inflow would need to be very much larger in order to raise the level of the whole lake during a single night.

G. D. HALE CARPENTER,
Uganda Medical Service.

Entebbe, Uganda, July 5.

English Enemies of the American Slipper-limpet, *Crepidula fornicata*.

IN 1923 the present writer found a shell of a dead slipper-limpet (*Crepidula fornicata*) at West Mersea, Essex, bored extensively by the boring sponge *Cliona celata*. This year a good number of living slipper-limpets have been examined, and one, the fourth individual of a chain of 8 living ones, was found with the living sponge boring into the shell. In the shell of the dead animal the sponge could be seen to have bored through all parts including the shelf, but had been inhibited from perforating over almost the whole of the area on the dorsal side, where another slipper-limpet had been attached to it. In the living specimen the sponge can be seen to be forming a honeycomb mesh-work in the dorsal portion of the shell, but it has only perforated to the surface in the postero-dorsal region ; the shelf of the shell is also attacked and is almost perforated in places. On the part of the shell where the next individual in the chain was sitting there is a nodular deposition of calcareous matter over strands of the sponge tissue. This deposit has been laid down, not by the owner of the shell, but by the individual sitting on the shell, and undoubtedly as a reaction to the irritation caused by the sponge. Crepidula has, therefore, found an enemy in Cliona in its new environment, and it will be interesting to know to what extent the slipper-limpet will be attacked in future in view of its economic importance.

Crepidula has other enemies. I have observed the whelk-tingle, *Ocinebra* (*Murex*) *erinacea*, attack the shell of Crepidula and bore through to the body, and shells can be found on the oyster-beds also bored either by Murex or Purpura, but it is difficult to estimate whether the boring whelks are of much value in killing off numbers of Crepidula. Whitstable fishermen know that dabs, *Pleuronectes limanda*, eat Crepidula, and I have seen fresh slipper-limpets in recently opened stomachs of this fish, but it seems likely that many of these limpets are obtained from chains broken in the dredging operations. Mr. Luckhurst, of Whitstable, informs me that star-fishes, *Asterias rubens* chiefly, attack Crepidula, especially in winter time, when the slipper-limpets have apparently been weak. Since Crepidula was introduced into England from America round about the year 1880, it will be interesting to know from time to time in the future what English marine animals become inimical to it. At present Crepidula appears to be maintaining its dominance in the rich waters of the Thames Estuary ; this year there is a great fall of spat in many places in the north-western portion of the Estuary, although for the last few years the spatfall has been below the average in most places.

J. H. ORTON.

Marine Biological Laboratory,
Plymouth, July 29.

Former Fertility of the Kalahari Desert.

PROF. J. W. GREGORY, in his article on my recent Kalahari pamphlet in NATURE of April 12, p. 539, objected to my citing the Sylphium of Cyrenaica as evidence of the former fertility of the desert. I also gave the wine palm, *Raphia monbuttorum*, as evidence ; for, whereas it formerly lived in the Egyptian oases, it is now confined to the more humid regions further south. Hassanein Bey has recently given evidence to the same effect in the oases of Kufra and Ouenat. In the latter place he describes rock drawings of ostriches, giraffes, and other animals that require grassland, and could not possibly live in the desert as it is to-day. The fact that there are no camels shown indicates that the pictures were made before A.D. 640, when the Arabs arrived in Africa with their camels. Nowadays, life in Ouenat would be impossible without these animals.

In South Africa we have the same evidence—Bushman drawings of hippopotamus, rhinoceros, and other animals, where these could not live to-day, although we know they lived all about here 100–150 years ago. The last lion, hippopotamus, and rhinoceros were shot in the neighbourhood by the fathers of people still living in Grahamstown. I have already given the evidence of the Yellow-wood (Podocarpus), the typical Knysna forest tree, still lingering on hills in Namaqualand in what is now practically desert, and a few specimens are found on isolated hills between there and Cape Town. Recently, however, I have been shown by my neighbour, Mr. M. G. Godlonton, a specimen of the Winterberg bamboo (*Arundinaria tessellata*, Monroe), growing in his garden, which is a striking proof of more humid conditions not very long ago. It was only one hundred and fifty years ago since Barrow, Lichtenstein, and le Vaillant saw our Karroo plains swarming with big game, as now in Uganda, and we have every reason to believe that at that time the slopes of the mountains were covered with bamboo forest as now on the Nandi plateau in Central Africa, and of which these few stray stragglers still survive.

The Winterberg is about 7000 ft. and some 50 miles north of Grahamstown. E. H. L. SCHWARZ.

Rhodes University College,
Grahamstown, July 16.

Chalky Boulder Marl at Hastings.

As relief workers in the Hastings district are continuously laying bare geological sections of first-class importance, and as the demands upon my time have precluded the possibility of my bringing the full details before scientific societies, I feel that geologists in general would be interested in a short account of them in the pages of NATURE. They relate not only to Wealden but also to Pliocene and Pleistocene times.

WEALDEN.—Excavations in the Wadhurst clay have brought to light a remarkable richness of both vegetable and animal life, particularly among the mollusca, in which Nature has shown herself most energetic, not only in the cases of well-known genera and species of ordinary character—necessitating a revision of the Wealden mollusca—but in others she has shown great prodigality, some of the gastropods—dextral and sinistral—attaining a length, or height, of sixty feet

and upwards. These sections have also given the life-history of important rocks and rock-structures, and furnished serial examples of the metamorphoses by which the dense hard "blue-stone" is gradually altered into a soft, brilliantly coloured agate-like sandrock. (I have presented a somewhat extensive series of these to the British Museum (Natural History).)

PLIOCENE.—Beds of this age have been cut through, showing deposits of beautiful red-yellow loam, fifty feet thick, now lying at various altitudes, from a little above O.D. up to more than five hundred feet. These overlie a series correllatable with those of Piltdown. The underlying flint gravel is very much panned and of an orange-red colour, so familiar in East Anglia. The basement original sand is now indurated into a sandstone, requiring heavy steel tools to work it, in which were found worked flints. This, I think, is the first time worked flints have been found in a dense tertiary sandstone; naturally, the flints have undergone a great deal of alteration since they were chipped.

PLEISTOCENE.—The latest revelation has been made in the forming of battered-down lawn-tennis courts, upon the adjoining hillsides, and overlying the loam. The most southern court is cut out of chalky boulder marl, very white in colour. The associated boulders were often between two and three feet long, and consist of various gneisses, schists, granites, and numerous volcanic and metamorphic rocks; and sedimentary rocks foreign to the locality; and palæozoic and mesozoic fossils and rocks. The upper part of this big boulder drift was associated with immense worked flints, especially Wealden "flints," bulbed facets sometimes reaching one hundred square inches. The smaller implements are of well-known Mousterian types. In the overlying material came the orange-red-brown implements which I regard as of Aurignacian age. The latter occur by thousands on certain hill-tops and valley shoulders in a quartzite drift full of glacially striated and faceted foreign rocks, originating in the destruction of just such glacial drift as is now revealed. Above these came quantities of the productions of the Hastings Kitchen Midden men. My esteemed colleague, Mr. Lamplugh, informs me that a similar drift has been reported to him from another locality. It now appears certain—if there be such a thing as a certainty—that glacial conditions reached even beyond our present shore line, and probably extended over the Great South river, as is shown by similar deposits near the French coast.

W. J. LEWIS ABBOTT.

Zoological Nomenclature: Thirty-five Generic Names of Mammals.

THE following generic names of mammals (with genotype in parentheses) have been submitted to the International Commission on Zoological Nomenclature for inclusion in the Official List of Generic Names.

The Secretary will delay final announcement of the votes on these names until January 1, 1925, in order to give to any zoologists who may desire the opportunity to express their opinions.

Alces Gray, 1821, 307 (*alces*); *Arvicola* Lac., 1799, 10 (*amphibius*); *Ateles* Geoffr., 1806, 262 (*paniscus*); *Bison* H. Smith, 1827, 373 (*bison*); *Bradypus* Linn., 1758a, 34 (*tridactylus*); *Canis* Linn., 1758a, 38 (*familiaris*); *Capra* Linn., 1758a, 68 (*hircus*); *Cebus* Erxl., 1777, 44 (*capucina*); *Cervus* Linn., 1758a, 66 (*elaphus*); *Cholœpus* Ill., 1811, 108 (*didactylus*); *Condylura* Ill., 1811, 125 (*cristatus*); *Cricetus* Leske, 1779, 168 (*cricetus*); *Crocidura* Wagl., 1832, 275 (*leucodon*); *Cystophora* Nills., 1820, 382 (*cristata*); *Dasyprocta* Ill., 1811, 93 (*aguti*); *Didelphis* Linn., 1758a, 54 (*marsupialis*); *Erethizon* F. Cuv., 1822, 432 (*dorsata*); *Felis* Linn., 1758a, 41 (*catus*); *Gulo* Pallas, 1780, 25 (*gulo*); *Halichœrus* Nills., 1820, 376 (*grypus*); *Lepus* Linn., 1758a, 57 (*timidus*); *Lynx* Kerr, 1792, 32 (*lynx*); *Mus* Linn., 1758a, 59 (*musculus*); *Myrmecophaga* Linn., 1758a, 35 (*tridactyla*); *Nasua* Storr, 1780, 35 (*nasua*); *Ovibos* Blainv., 1816, 76 (*moschatus*); *Phyllostomus* Lac., 1799, 16 (*hastatus*); *Procyon* Storr, 1780, 35 (*lotor*); *Putorius* Cuv., 1817, 147 (*putorius*); *Rangifer* H. Smith, 1827, 304 (*tarandus*); *Rhinolophus* Lac., 1799, 15 (*ferrum-equinum*); *Rupicapra* Blainv., 1816, 75 (*rupicapra*); *Sciurus* Linn., 1758a, 63 (*vulgaris*); *Sorex* Linn., 1758a, 53 (*araneus*); *Vespertilio* Linn., 1758a, 31 (*murinus*).

C. W. STILES.

U.S. Public Health Service,
Washington, D.C.

von Zeipel's Red Star near M 37.

THE very red star in the outlying regions of Messier 37 referred to in the Astronomical Column of NATURE of June 14, p. 870, was brought to our attention some years ago by Prof. v. Zeipel as an object of unusual interest.

Three polar comparison photographs in March and September 1921 gave a mean photovisual magnitude of 12·86, in exact agreement with v. Zeipel's result in *Astr. Nach.* 5288. Two polar comparisons made with ordinary plates on September 6 and 8, 1921, gave for the photographic brightness 17·75 and 17·95 respectively. The latter values are not very trustworthy, because the images were near the limiting magnitude of the plates; but the mean, 17·85, should be within 0·2 of the true photographic magnitude on the international scale.

The provisional colour index is, therefore, 5·0 mag. The ratio of the integrated intensity of the photovisual region of the star's spectrum (approximately λ5000 to λ6000) to that of the region to the violet of λ5200 is accordingly about 100 times the corresponding ratio for an Ao star.

FREDERICK H. SEARES.

Mount Wilson Observatory,
Pasadena, California, July 25.

A Biological Study of Radiation.

THE review of the second edition of our book, "Radium, X-rays, and the Living Cell," under the above title in NATURE of July 26 cannot pass without comment from us. One out of the two columns devoted to this review is a dissertation by the reviewer on the avoidance, by suitably directed regime and feeding, of the ills that fall to the lot of civilised man, including complaints such as cancer, dyspepsia, gastric and duodenal ulcer, gallstones, appendicitis, etc. We think that the natural inference of your readers will be that we have been writing on these matters; but we have neither written on this subject, nor do we subscribe to the opinions of the reviewer. Our efforts in producing the second edition of this book have, as in the first edition, been devoted to bringing together the chief experimental facts which have been ascertained of the effects which the rays from radium and X-rays have upon living organisms, and discussing very briefly any generalisations which may be possible on these facts.

HECTOR A. COLWELL.
SIDNEY RUSS.

Cancer Research Laboratories,
The Middlesex Hospital, W.1,
July 29.

Tropical Colonisation and the Future of Australia.[1]

By Prof. J. W. GREGORY, F.R.S.

IN North America the presence of the Negro has introduced problems of inscrutable perplexity; in South America a mixed race is in firm possession; in Africa as a whole the white man has no chance as a colonist; and in South Africa his future depends on some complex measure of segregation. In Asia, only in the north and north-west has the white man any prospect of permanent dominion. In contrast to these restrictions, in Australia the fundamental problem is the possibility of the occupation of the whole continent by the European race.

When the chief inrush of immigrants into Australia occurred after 1850, the belief was almost universal that the natural home of the white man was in the temperate zones and that the torrid zone must be left to the coloured races. That policy was accordingly adopted by Australia and pursued for fifty years. The tropical districts were left open, with varying limitations, to Asiatic immigration. Few Asiatics, however, took advantage of this opportunity, though large numbers were eager to enter the cities and settlements in the south, where the European had done the pioneer work. In the north the Asiatics were a hindrance, as they were too few to help materially, and they were sufficient to discourage the entrance of white artisans.

In 1901 Australia, on federation, found itself faced by two problems—the empty north which the open-to-Asia policy had not filled, and the disturbing effect of indentured coolies on white labour. The policy of excluding coloured people and working the northern plantations with white labour was declared to be a physical and physiological impossibility. In 1907, in opposition to this traditional view, I remarked ("Australasia," i. p. 15) that "medical authorities on tropical climates seem now, however, to be coming to the opinion that this view is a popular prejudice which does not rest on an adequate foundation." The evidence to that effect had been stated in a remarkable paper by Dr. L. W. Sambon, and endorsed by the late Sir Patrick Manson, and has been supported by the general trend of medical opinion during the past seventeen years.

The general distribution of mankind is in such close agreement with the rule that the white race has settled in the temperate regions and left the tropics to the coloured races, that any policy inconsistent with that arrangement must be prepared to encounter a strong prepossession to the contrary. Nevertheless, that rule is inconsistent with so many facts that it is not a safe basis for a national policy. In America, for example, the whole continent, except for the Eskimo in the north, was occupied by dark-coloured Mongolian tribes, in which, according to Flower and Lydekker ("Mammals," 1891, p. 752), "the colour of the skin, notwithstanding the enormous difference of the climate under which many members of the group exist, varies but little." The most northerly part of Europe is occupied by a coloured race, the Lapps. In Africa the darkness of the skin does not always vary in accordance with distance from the Equator.

[1] From the presidential address, "Inter-Racial Problems and White Colonisation in the Tropics," delivered to Section E (Geography) of the British Association at Toronto on August 7.

SUPPOSED UNFAVOURABLE FACTORS IN TROPICAL CLIMATE.

(*a*) *Heat.*—The belief in the unsuitability of the tropics for the white man rests on several considerations. Most importance is naturally attributed to the heat, as that is the essential difference between the tropical and other zones. Intense heat is regarded as injurious to people not protected by a dark skin. That view overlooks the automatic process by which the living body adjusts itself to temperatures even higher than occur in any climate on earth, and that would quickly cook it, if dead. During some experiments by Sir Charles Blagden in 1774, Sir Joseph Banks remained in a room for seven minutes at a temperature of 211°; and Blagden subsequently stayed at the temperature of 260°, while eggs were roasted hard and beefsteaks cooked in a few minutes. White men work in furnaces and bakeries at 600° F., and if they can survive such temperatures even for short spells, they should be able to withstand the hottest climate on earth.

That heat is not the dangerous factor in the tropics is obvious from the well-known fact that the hottest areas are often the healthiest. Agra is hotter and healthier than Bombay, and the summer heat of Colorado is fiercer than that in the less healthy Mississippi Valley.

(*b*) *Moist Heat.*—As dry heat affords no explanation of the high mortality of some tropical localities, appeal was made to moist heat, and to the combination of heat and moisture marked by a high wet bulb temperature. At any temperature above blood heat the body is cooled only by the evaporation of perspiration, which does not take place in air saturated with moisture. Hence in the Townsville experiments a man placed in a room in which the wet bulb temperature rose from 98° to 102°, fainted in forty minutes. In a hot locality a dose of atropin, which suppresses perspiration, may be quickly fatal.

A wet bulb temperature higher than blood heat would be fatal to men, white or black; but no earthly climate has such temperatures. It was at first suggested that the limit of human activity was the wet bulb temperature of 73°, but there are well authenticated records of miners working for four-hour spells for months at the wet bulb temperature of 80° to 90° in Hongkong, the Straits Settlements, Beaufort in Borneo, and Ocean Island in the Pacific. At all these places people, both white and coloured, survive these conditions. Hence the limit has been gradually raised and it is recognised that men can withstand wet bulb temperatures of 85°, though the power of work under such conditions is necessarily greatly reduced. The highest wet bulb temperature mentioned in Dr. Griffith Taylor's record at Port Darwin is 81°. The wet bulb data for North Australia are scanty; but there seems no reason to expect that any considerable areas have a more uncomfortable climate than Calcutta, to which Dr. Taylor compares the worst localities of tropical Australia. Calcutta is one of the healthiest cities in India, and has a large and vigorous European population, many of whom spend there the whole year.

Moist heat is trying and must be considered in judging

climates from the standard of comfort and personal efficiency. The investigation of wet bulb temperatures, the significance of which was shown by Sir John Haldane, has been developed in reference to the textile industries by Dr. Leonard Hill and Dr. Boycott, to mining by Sir John Cadman, to the conditions of tropical Australia by the work of Prof. Osborne and has been illustrated by the ingenious climographs of Dr. G. Taylor; it has yielded results of high practical value. But the wet bulb isotherm does not delimit the areas where the white man may live and work, and does not really affect the question of white *versus* black colonisation, as there does not seem to be any reason to believe that black men could withstand a higher wet bulb temperature than white men. In answer to an inquiry on this question, Sir John Haldane replied that his impression on the contrary was that "white men can usually stand more heat than black men," and he reported the information given him that in places like the Red Sea the Clyde stokers stand the heat better than the Lascars, "and, in fact, have constantly to carry the latter out and lay them on deck to cool."

(*c*) *Monotony in Temperature.*—Another temperature factor that has been appealed to is that depressing equability of temperature which occurs on some tropical coasts. Excessive monotony in the weather is no doubt depressing, and temperature changes have a stimulating beneficial effect. Extremes of cold and heat are still more inconvenient and trying, and a moderate equability is often advertised as an attractive feature in a climate. The equability of the oceanic climate is recognised as most favourable for many conditions of health. The areas over which extreme uniformity of temperature prevails throughout the year are, however, so restricted that this factor does not affect the problem of tropical settlement as a whole. With the exception of low tropical islands, places with monotonously equable climates are in positions whence a change may be secured by a visit to some neighbouring hill country.

(*d*) *Actinic Rays.*—A fourth factor to which much importance has been attached in connexion with the tropical climate is the effect of the chemical rays of the sun. Great importance was once attached to the pernicious influence of the ultra-violet chemical rays of the sun on persons not protected by a dark skin. Residents in the tropics were therefore advised to line their clothes with orange-coloured fabrics to shield themselves from the chemically active rays. These views reached their extreme in the writings of Surgeon-Major C. E. Woodruff in 1905, who held that the actinic rays of the sun are so inimical to the white man that they inhibit his permanent settlement within 45° of the Equator. He therefore regarded the tip of Patagonia as the only area in the Southern Hemisphere fit for white occupation. The temporary stagnancy of the population of Australia after the droughts of 1900–1902 he regarded as evidence that the native-born white Australian and delicate New Zealander were wasting away through physical decay due to the enfeebling sunshine, just as the health of American and European children was being ruined by the "daft" practice, as he called it, of flooding schoolrooms and nurseries with streams of light. Woodruff's conclusions have naturally been disregarded.

Any deleterious effects of the chemical rays of the sun may be avoided by the use of appropriate clothes, and physical considerations suggest that a black skin should afford less protection than a white skin. Any injury that may be wrought by powerful sunshine, according to Aron's work in the Philippines, is due to the heat rays at the red end of the spectrum and not to the chemical rays. The modern lauded system of heliotherapy is based on the belief that strong sunshine is a powerful curative agency.

(*e*) *Miscellaneous Factors.*—The four previously considered factors have the advantage that they can be readily understood and tested; but as they have failed to provide any basis for the unsuitability of the tropics for the white man, the appeal has been shifted to a complex of tropical influences, including a rise of body temperature, the lessened activity of lung and kidney, and nervous disturbances. Dirt and disease and carelessly prepared food are also mentioned, though they are due to human agencies. The physiological effects of the tropical climate in this indictment are contradicted by high authorities. The rise in body temperature is emphatically denied amongst others by Breinl and Young from observations in Queensland, and by Chamberlain on the basis of extensive observations on American soldiers in the Philippines. A slight rise may occur in passing from the temperate regions to the tropics, but it is soon recovered; and Shaklee reports from his experiments on monkeys at Manila that "the healthy white men may be readily acclimatised to the conditions named—that is, to the tropical climate at its worst." Shaklee adds that the most important factor in acclimatisation is diet.

The asserted ill-effects of the tropics on respiration appear to have no more solid basis. Prof. Osborne found at Melbourne that the rate of respiration was increased on the hottest days, and his observations agree with those of Chamberlain in Manila. So far from the tropical conditions being injurious to the kidneys, it is asserted, as by Dr. A. B. Balfour, that there is less trouble with that organ in tropical than in temperate climates. The apparently inconsistent observations on the action of the kidneys between various tropical localities and people may be explained by differences in diet.

The remaining charges against the tropical climate are insignificant, or not based on climatic elements, or are indefinite. Some of the alleged factors are trivial, such as the liability to various skin diseases owing to change in the skin reaction; for if the white man allows himself to be kept out of any country by such a cause he does not deserve to get in. The hygienic troubles due to association with an insanitary people are sometimes adduced; but they are not an element in climate and would not operate in a land reserved for white people. The remaining factors rest on ill-defined nervous ailments which are more likely to be due to domestic difficulties than to climate. These nervous troubles fall mainly on the women who have the strain of disciplining native servants into conformity with British ways. Nervous disorders are said to be worst in hot, dry, dusty regions which in the tropics are generally regarded as the most healthy, except to those whose constitutions require a moist atmosphere.

Medical opinion has gone far towards the general adoption of the conclusion that there is nothing in

climate to prohibit the white man from settling in the tropics.

As an example of a recent authoritative verdict may be quoted the report of a sub-committee appointed in 1914 by the Australian Medical Congress to investigate the medical aspects of tropical settlement. After extensive inquiries, the comparison of the blood of children born and bred in the tropics with those of the temperate regions, and other evidence, the sub-committee reported in 1920 as follows: "After mature consideration of these and other sources of information embodying the results of long and varied professional experience and observation in the Australian Tropics, the sub-committee is unable to find anything pointing to the existence of inherent or insuperable obstacles in the way of the permanent occupation of Tropical Australia by a healthy indigenous white race. They consider that the whole question of successful development and settlement of Tropical Australia by white races is fundamentally a question of applied public health in the modern sense. . . . They consider that the absence of semi-civilised coloured peoples in Northern Australia simplifies the problem very greatly."

Improvements by Public Sanitation.

The trend of medical opinion to the view that there is no physiological reason why the white race should not inhabit the tropics may lead to a change similar to that regarding some localities in the temperate zones, which were formerly regarded as death-traps and are now popular health resorts. The island of Walcheren, on the coast of one of the most densely peopled countries in Europe and only thirty miles from so fashionable a watering-place as Ostend, had, a century and a quarter ago, one of the most deadly climates in Europe. The largest army which had ever left the British islands landed there in 1809. Napoleon did not think it worth powder and shot. "Only keep them in check," was his order, "and the bad air and fevers peculiar to the country will soon destroy the army." Napoleon's judgment was justified. The force of 70,000 men disembarked on July 31 and August 1. By October 10, according to Sir Ranald Martin, 142 per thousand were dead of disease, and 587 per thousand were ill.

Algeria is now a trusted sanatorium. Yet disease annually swept away 7 per cent. of the French army that conquered it. Sir A. M. Tulloch remarked that if the French Government had realised the significance of that mortality "it would never have entered on the wild speculation of cultivating the soil of Africa by Europeans, nor have wasted a hundred millions sterling with no other result than the loss of 100,000 men, who have fallen victims to the climate of that country." The same change of view has taken place in reference to some tropical localities. The deadliness of the Spanish Main to our armies was described by Samuel Johnson. "The attack on Cartagena," he said, "is yet remembered, where the Spaniards from the ramparts saw their invaders destroyed by the hostility of the elements; poisoned by the air, and crippled by the dews; where every hour swept away battalions; and in the three days that passed between the descent and re-embarkation half an army perished. In the last war the Havanna was taken, at what expense is too well remembered. May my country be never cursed with such another conquest." Yet Havana, under American administration, has become one of the healthiest cities in the world.

Sir John Moore, when Governor of St. Lucia (1796), wrote home that it is not the climate that kills, but mismanagement. His insight has been demonstrated in the same region. The French attempt to build the Panama Canal was defeated by disease. Discovery of its nature enabled the late Surgeon-General Gorgas to secure for the 10,000 men, women, and children in the canal construction camps, in spite of the high humid heat, as good health as they would have had in the United States. Gorgas claimed that the results at Panama "will be generally received as a demonstration that the white man can live and thrive in the tropics." Gorgas realised that the results for the future are even more momentous. He predicted that as "the amount of wealth which can be produced in the tropics for a given amount of labour is so much larger than that which can be produced in the temperate zone by the same amount of labour, that the attraction for the white man to emigrate to the tropics will be very great when it is appreciated that he can be made safe as to his health conditions at small expense. When the great valleys of the Amazon and of the Congo are occupied by a white population, more food will be produced in these regions than is now produced in all the rest of the inhabited world."

The Development of Tropical Australia.

The experience of colonisation in tropical Australia is limited to about seventy years; but it affords no ground for the expectation that the ultimate effects on the white race will be detrimental.

(*a*) *Vital Statistics in Queensland.*—In Queensland, most of which is tropical, the death-rate is lower than in any European country and is lower than in most of extra-tropical Australia. In the six years 1915–21, according to the statistics in the Australian Year-book (No. 15, 1922, p. 99), the crude death-rate in Queensland was the lowest in the six Australian States for one year, and fourth of the six States in three years, and the fifth in three; it was not once the highest. In the same six years the infantile death-rate was lowest in Queensland in three years, and the second lowest in two others. According to the same authority, by Index of Mortality (*i.e.* the death-rate in proportion to the ages of the community), Queensland was in 1921 the second State in order of merit, being inferior only by 0·03 to New South Wales, the State most favoured in this respect.

The physical vigour of the Queenslander is shown by his athletic prowess, and by the low rejection-rate of recruits from that State for the Citizen Army. The longevity in Queensland may be judged by the experience of the life assurance offices. It has often been asserted that assurance rates show that tropical climates are unhealthy. Yet the chief actuary for the greatest Australian assurance company, the Australian Mutual Provident Society, reported to the Committee of the Australian Medical Congress, "I have no hesitation in saying that as far as we know at present there is no need for life assurance offices to treat proponents who live in North Queensland differently from proponents who live in other parts of Australia."

Physical and mental degeneration in a people living

under unfavourable conditions would probably be most readily observed in the children. To use this clue I asked the Queensland Education Department whether its inspectors had noticed any unfavourable symptoms among the children in the most tropical of its northern schools. The Department replied that on the contrary its schools at Cairns and Cooktown, two of the most northern towns, are exceptionally efficient, and one of them is sometimes the leading school in the State.

(*b*) *Northern Territory.*—The great success of Queensland, although more than half the State is within the tropics, renders the more striking the failure of the adjacent Northern Territory of Australia, of which the records are disappointing. Agriculture has declined; the Government demonstration farms have been reduced to native reserves; the meat works have been closed; the population has fallen in numbers; and mining production has become insignificant. The present state of the Territory has been adduced as evidence of the futility of trying to develop a tropical land by white labour. Its failure was not, however, due to the White Australia policy, which was introduced after the failure was complete, but to geographical disadvantages not yet surmounted. The Territory, before 1901, was open to Asiatic immigration, but the hope that it would be adequately peopled from Asia was not fulfilled. Poorness of soil, unsuitable distribution of rainfall, and inaccessibility of position explain its backwardness. Great hopes are based on cotton, but its profitable cultivation appears dependent upon the establishment of a protected cotton manufacture in Australia, which would secure a market for the crop at a price that would pay for the high cost of picking. The remedy for the failure lies not in another attempt with Asiatics, but in the removal of the isolation of the Territory.

(*c*) *Queensland and the Sugar Industry.*—Queensland in contrast to the Northern Territory has made firm progress; the population has continued to increase; and though at first coloured labour was introduced, the proportion of the Asiatic population in 1911 was only 1·47 per cent., and of the Polynesian only 0·29 per cent.

The numbers of coloured labourers in Queensland were too small seriously to affect the population, but they were sufficient to be a constant irritant and source of uncertainty in the local labour market. This trouble led, in 1900, to the prohibition of indentured coolie labour throughout Australia. This decision was supported by the great majority of the Queensland people in spite of the most emphatic warnings of disaster.

The Australian adoption of white labour for its sugar plantations has been the greatest contribution yet made to the practical solution of the problem whether the white man can do agricultural work in the tropics. The experiment shows that white labour can be employed successfully in such an ultra-tropical industry as sugar cultivation in even the ultra-tropical climate of the Queensland coastlands, provided the settlers are protected from infectious disease and from the competition of people with lower standards of life.

Drawbacks of the Tropical Climate.

The conclusion that white settlement of the tropics is possible should not lead to the drawbacks of a tropical climate being overlooked. The conditions where the wet bulb temperatures are high are uncomfortable and unfavourable to mental and physical activity. People who are not keenly interested in their work should avoid the tropics. Ellsworth Huntington in a valuable series of works has directed attention to many facts which show the dependence of Western civilisation on the stimulating nature of the temperate climate, for the frequent changes in temperature and wind are conducive to alertness and general efficiency.

The enervating effect of the tropical climate is no doubt counterbalanced by various compensations. Man needs less in food, fuel, clothing, and housing, while the same amount of exertion will produce a more luxuriant and valuable crop. The supremely fertile tropical regions have, however, usually a hot muggy climate, which is not attractive to Europeans while areas with less trying conditions are available. Northern Australia, even if it were not hampered by a high proportion of poor land, would naturally develop slowly, just as in Canada the Northern Territory and the rocky backwoods have lagged behind the St. Lawrence basin and the rich-soiled western plains.

Conclusion.

The conclusion that the white man is not physiologically disqualified from manual labour in the tropics and may colonise any part of Australia simplifies inter-racial problems, as it provides an additional outlet and spacious home for the European race.

The preceding survey of the position where the three main races meet in intimate association indicates that the world will have a happier and brighter future if it can avoid the co-residence in mass of members of the different primary divisions of mankind. Individual association and contact should secure for each race the benefit of the intellectual, artistic, and moral talents of the others; while industrial co-operation should aid each nation to make the best use of the land in its care.

The world has reached its present position by the help of each of its three great races, and it still needs the special qualities of each of them. The contemplative Asiatic founded all the chief religions, the ethical basis of civilisation. The artistic Negro probably gave the world the gift of iron, the material basis of civilisation. The administrative genius of the European race has organised the brain power of the world to its most original and constructive efforts. The affectionate, emotional Negro, the docile, diligent Asiatic, and the inventive, enterprising European do not, however, work at their best when associated in mass. That association is attended with serious difficulties; for race amalgamation, which is the natural sequel, is abhorrent to many nations, and the intermarriage of widely different breeds, according to many authorities, produces inferior offspring. The policy of co-residence with racial integrity has failed to secure harmonious progress in North America and South Africa. The development of the best qualities of the three races requires their separate existence as a whole, with opportunities for individual association and co-operation.

In view of the inter-racial difficulties that have developed wherever the races are intermingled, Australia will throw away a unique opportunity if it fails to make a patient effort to secure the whole continent as the home of the white race.

A Philosopher on Relativity.

By Sir OLIVER LODGE, F.R.S.

AT the twenty-third annual meeting of the Eastern Division of the American Philosophical Association, held at Brown University, Providence, R.I., in December 1923, a presidential address on "The Einstein Theory and a Possible Alternative" was delivered by Prof. William Pepperell Montague, professor of philosophy in the Columbia University of New York. In this address Prof. Montague shows himself to be a philosopher rather especially interested in physics; and he claims the advantage of having discussed certain aspects of the subject with Prof. Bergen Davis and other members of the physics department at Columbia. He reviews and criticises parts of the Einstein theory in a lively manner, thereby arousing interest among philosophers; and his contentions are deserving of notice.

Apparently Prof. Montague raises no objection to Einstein's General Theory, so far as it deals with matter and gravitation, and so far as it replaces the idea of force by the idea of space-curvature. He seems to consider these apparently diverse ideas as only different methods of expressing the same thing; much as you might say that it does not matter whether you represent an ellipse by drawing it, or by writing $x^2/a^2+y^2/b^2=1$. Both modes of expression represent the same thing. Some might hold that a picture is a nearer approach to reality than a formula, but both call up relevant ideas in the mind. Moreover, a picture,—which regarded from a strict point of view is millions of molecules of one substance superposed upon billions of another,—must depend helplessly on the human mind for recognising in it any of the properties of an ellipse!—must, in fact, depend just as much on mind for its interpretation as does the algebraic convention. After all, as regards precision of measurement, the mathematical rather than the pictorial presentation is the more explicit and accurate of the two.

I must make it clear that Prof. Montague expresses appreciation of pure mathematics and feels no philosophical objection to those more striking and revolutionary ideas of Einstein which were borrowed from the pure mathematicians. In the geometrical way of regarding matter and force, the infinite finiteness of the universe, the representation of impenetrable specks of matter as impassable distortions of space,—in all this Prof. Montague rather rejoices; as the following extracts will show:

". . . bodies moving with accelerated velocities are subject to forces, hence the later Einstein theory consists, first, of a new though Cliffordian conception of the nature of *force*; and, second (growing out of that), of a new though Riemannian conception of the *universe itself*, as a domain at once boundless and finite. . . .

"Some will undoubtedly feel stifled and penned in at the thought that if they were to travel in a 'straight' line for only a few septillions of miles they would find themselves on the way home without ever having turned around. Others will find the new Riemannian hyper-sphere large enough for all practical purposes; and they will delight in the possibility of relating in some curious way the curvature or size of the universe as a whole to the dimensions of its minimum elements."

Prof. Montague does not think that the hyper-geometrical conceptions of reality need be upset by what he urges as failure in the simpler basis on which the original doctrines of relativity were founded—doctrines admittedly not so well established by actual *ad hoc* observation of predicted results as those of the more general theory have been.

"It is not, I think, too inaccurate to say that while the Special Theory reduces geometry to physics and is offensively destructive and phenomenalistic in its conception of the world, the General Theory reduces physics to geometry and its tone and temper are rationalistic and constructive. The muddy prose of Hume and Mach gives place to the clear poetry of Riemann and Clifford."

Prof. Montague goes on to pay a tribute to the late Prof. Clifford, with which, as an old student and junior friend of that remarkable genius, I cannot but sympathise:

"It was Clifford, working under the inspiration of the new geometry of Riemann, who, I think, first suggested that matter could be conceived as a non-Euclidian wrinkle in space. . . . It is pleasant to think that Clifford, whose mind was of such rare beauty and who in his appreciation of spiritual values possessed what the musicians call a sense for absolute pitch, should have been the first to hold a conception which now seems destined to have most far-reaching consequences."

So it turns out that Prof. Montague's criticisms are directed, not at the more recondite parts of the subject so finely developed and expounded by Eddington, but at its foundations as ordinarily expressed. His main objection seems to be to the Larmor-Lorentzian law for the composition of velocities, and to the absolute constancy of the velocity of light as supposed to be measured by different observers. He objects also to this velocity being regarded as a maximum velocity which cannot be exceeded. His view is that light is not really emitted and abandoned to a stationary ether, as a water splash is abandoned by a ship, but that light is continually associated with the lines or field of force belonging to and moving with the source,—somewhat after Faraday's idea of ray vibrations; an idea which, in modified form, has obtained weighty support of late, and about which it is best not to be dogmatic.

There has been a conspicuous tendency, of late, to revolt against the simplicity of the undulatory theory. Something more than that is evidently wanted. And incidentally I may mention that Prof. Benedicks, of the Metallographic Institute of Stockholm, has written an immediately forthcoming small book called "Space and Time," in which he supports some modification of the emission theory. With a corpuscular theory in empty space, the Michelson-Morley experiment would raise no difficulty at all, and probably would never have been performed; for the velocity of light would depend on the motion of the source, and everything would be simple. A similar simplicity is aimed at by Prof. Montague. He does not indeed propose a corpuscular theory—he sees difficulties in that,—but

he is well aware that what he does suggest is quite alien, and indeed contrary, to the early parts of the Einstein theory. He adduces therefore simple imaginary experiments, akin to those so often appealed to by philosophic relativists, by which he thinks the Einstein view might be disproved. He realises the difficulty of doing anything effective with only two signalling observers, who must be dependent on inconclusive to-and-fro journeys, so he arranges a triangular duel, with a third observer, or rather signaller, equidistant from the other two.

Let there be two observers on the same parallel of latitude, with perfect signalling appliances and stop-watches, which, however they are affected by the rotation of the earth, must at least go at the same rate; and let there be a third signaller at the north pole, who by symmetry is able to establish simultaneity between the other two. At the word "Go!" from the pole, the two on the equator signal to each other, and time the interval between sending and receiving. Prof. Montague claims that, on the ordinary wave theory, and as he mistakenly seems to think on the Einstein theory, the one travelling to meet the signal should get it sooner than the one whom it has to overtake. For, as he says, even waves take less time to travel less distance,—. . . "even Einsteinian light travels a shorter distance in less time than it does a longer distance."

On the other hand, on a corpuscular theory there would be no observable difference, because the increased speed of the corpuscles from an ordinary source would compensate for the recession of their recipient. So both Prof. Montague and Prof. Eddington would, I presume, expect a negative result; and the experiment would not discriminate between them. Unless, indeed, it gave a positive result, to the chagrin of both, and the triumph of a common-sense view based on the behaviour of ordinary waves.[1]

It will be observed, however, that Prof. Montague has abandoned translation, as hopeless for his purpose, and has utilised rotation; and about rotation there has always been something with a tinge of the absolute about it, even in relativity doctrine. But whether it is necessary to make this admission, in order to safeguard a positive result from Prof. Montague's imaginary experiment, is very doubtful. His own attitude is hostile to waves in a stationary ether, as well as to the less intelligible doctrine that every observer, at all times, must measure the same velocity for light; he does not actually sustain or mention a corpuscular theory, as Prof. Benedicks does,—and as apparently the Swiss genius Ritz did,—but his postulated entanglement of the waves with the field of the source comes to somewhat the same thing.

Prof. Montague goes on to attack the composition of velocities in a more direct manner, and likewise ridicules several curiosities of time measurement, including queer tales by rapid travellers with return tickets, cited from Eddington and Weyl; but concerning the hypothetical slowing down of physiological processes by motion, and other humorous interpretations of certain equations, I am not myself seriously sympathetic enough to justify my trying to sustain them against criticism.

Incidentally I note that he has a long footnote in which, by means of to-and-fro north and south signalling compared with the result of similar east and west signalling, he claims that we might distinguish between Einstein and Lorentz,—whatever that may mean. It looks as if he thought that Einstein discarded the β factor representing the FitzGerald-Lorentz Contraction (introduced by Larmor in 1900, "Æther and Matter," p. 173 *et seq.*, and vigorously used by Einstein), while Lorentz admitted it. Either I misunderstand him here, or he makes a mistake.

The alternative which Prof. Montague seriously proposes to the relativity treatment of light is not the corpuscular theory,—for, as he says, "light is in almost all respects wave-like rather than corpuscular"—but it is this,

". . . that the medium or carrier of light waves is not a doubtfully existent ether-substance, but the certainly existent field of force which each electron and proton carries with it."

He thus desires to abolish a stationary ether, as Einstein does not, and claims that because an electric field is centred on its charged particle, it follows that when a charged particle moves, its field must move with it.

"The velocity *in* the field will be constant and absolute, but the velocity *of* the field has to be added to it."

Thus he tries to combine the advantages of the wave and emission theories in this respect. But the full treatment is not so simple; a great deal is known about the way in which a field moves, and he would find himself immersed in plenty of complexities, unless he discarded electromagnetic theory altogether.

Finally Prof. Montague proposes an experiment to test his crucial assumption, namely, that the velocity of light is affected by the motion of the source, and is not independent of it as it would be in a stationary ether and as it is in Einstein's theory. His proposed experiment depends on rotation, again; and, to summarise it briefly, it employs the idea that light from the sun's advancing limb ought to come to us quicker than from the receding limb. His proposed rotator is not the sun, however, but a mechanical cylinder, sphere, or disk, projecting light from opposite points of its circumference, through a couple of narrow slits or tunnels, on to a moving sheet of sensitive paper. The slits or narrow tunnels are carried by a pair of drums, which are separated by a considerable distance and are revolving about an axis at right angles to the main axis and parallel to the path of the two beams of light. (He makes these drums revolve in opposite senses, but that is surely a mistake or a needless complication.) It follows that if they are revolving quickly enough, the light may be unable to get through both slits, because of the time taken in the journey between them, and he claims that with increasing speed the fading of the spot from one beam should precede the fading of the other. His experiment therefore is really a Fizeau-like experiment to measure the velocity of light, or rather to compare the velocities from two oppositely moving sources without the use of a mirror or any return journey: the fading and disappearance of the traces on the photographic film at a certain

[1] May I direct attention to a clear pre-relativity description of all this class of problem, in an old volume of NATURE for 1892 (vol. 46, pp. 497-502, and also on pp. 164 and 165; the latter with a misprint of θ for ϵ in two places).

speed of rotation being looked for, and the times of fading compared. But presumably any mode of determining the velocity of light would serve: the essence of the experiment is not the mechanical details, which are crude, but the suggestion that it is possible to find a difference in the velocity of light according as it comes from the approaching part of a rotating wheel or from the receding part.

Well, that is a definite suggestion for experiment, if any one really thinks it likely (as I do not) that the velocity of light depends on the motion of the source: though it would seem as if measuring the velocity of light from an approaching and receding star would be more likely to decide the question. At any rate, the difficulties encountered by employing a non-terrestrial source would be of another order. Prof. Montague fears, however, that a final entanglement of the light in the fields of atmospheric matter might interfere with a correct determination of velocity from an astronomical source. It might also be argued that the known Doppler effect, depending on stellar advance and recession, gives a relative frequency accurately calculable on the basis of a constant velocity for light, and that to supplement this by the peculiarities of a projectile kind of light would be merely perturbing. To this he would doubtless reply that a fair and square initial consideration of light as projected from its source will give the Doppler effect and explain the M.M. result with perfect ease. He might also claim, perhaps, that his variety of ray-wave would evade the usual Foucault objection to emission theories, and might give the Fizeau result in dense substances as well. These things are not elaborated in his paper.

But now—seeking what can be politely said in support of any of his contentions—it must be admitted, I think, that the relativity explanation of the Doppler effect can be made to look as if it had a weak point. Algebraically it comes out right, of course, but it has too much the air of the ordinary explanation, which attributes an obvious meaning to $c \pm v$. The ordinary explanation, for an observer approaching a source, is simply that the observed frequency increases in the ratio

$$\frac{n}{n_0} = \frac{c+v}{c}$$

by simple composition of velocities: which is still Professor Montague's, and used to be everybody's, argument. But, with the relativity law for compounding velocities, deduced from Larmor's transformation, this so described ratio would be unity, and there would be no Doppler effect at all if it had to depend on an apparently changed speed of arrival of the waves. Relativity, however, does not attempt to proceed by compounding velocities for the purpose of explaining the Doppler effect: it knows that c cannot be added to or subtracted from, by anything a source or an observer can do; so it simply applies the Larmor-Lorentz transformation to the space and time periodicities of wave motion, and deduces algebraically

$$\frac{n}{n_0} = \sqrt{\left(\frac{c+v}{c-v}\right)}.$$

Neglecting v^2/c^2 this has the same value as the ordinary expression above, and no experiment yet made can discriminate between them. But am I wrong in imagining that a relativist would dislike writing it in that form and would prefer the expression

$$\sqrt{\left(\frac{1+v/c}{1-v/c}\right)}?$$

For this, though identical, conveys no inappropriate suggestion of compounded velocities.

In conclusion, it is always satisfactory when controversialists can get up against a question of fact. Stripping it to bare bones, we may put these two questions:

(1) Does the velocity of light really depend on the speed of its source?

Wave theory, Einstein theory, ether theory, all say "no." Corpuscular theory answers "yes": and Prof. Montague's adopted conception of a ray vibration also, in his opinion (but as I think doubtfully), answers "yes."

(2) Does the measured or apparent velocity of light depend on the motion of an observer?

Corpuscular theory, and Prof. Montague's theory, reply, "Yes if the source is stationary," "No if the source is moving with the observer." Ordinary wave theory would say "Yes in any case," for what the source is doing does not matter; that can only affect wave-length, not speed. Einstein's theory would loudly say "No in any case": for if one could discriminate between motion of observer and motion of source, relativity as commonly stated would be upset, and attention to a stationary ether would be made inevitable. Experiment so far has declined to answer: for a to-and-fro journey involves squares and can be dodged. So then at present we have no discriminating reply, unless an answer in favour of Einstein is to be taken as implied by the general consistency and sufficiency of his theoretical results both old and new.

One who is impressed with the mysterious way in which the Larmor-Lorentz transformation thoroughly formulates all known results without any trouble or hesitation, and yet who is not helped thereby to form a clear physical conception of the process, might urge that to clinch matters an experiment is desirable which should aim at determining $c \pm v$; when v is the speed, not of source, but of observer. That is, an experiment is wanted which would measure the speed of an observer relatively to light, and therefore relatively to a stationary luminiferous medium. Direct determination of the velocity of light at different seasons of the year, by any method, would at first sight seem able to settle this question, provided an accuracy greater than one in ten thousand could be attained.

But consider this further. A fixed space-interval and a time-keeper constitute the real observer: the FitzGerald contraction does not depend on whether motion is positive or negative, nor does direction of motion affect the rate of a clock. Hence if the experiment is made now and six months hence, x/t will equal x'/t', and no difference in the speed c will be perceived.[2] That seems right from one point of view; and yet, physically, waves *ought* to travel down an ether stream quicker than up, unless group velocity has something objectionable to say.

To sum up the position, still in an interrogative

[2] Because $\frac{x'}{t'} = \frac{x/t - u}{1 - ux/c^2t}$, which equals c if $x/t = c$, and not otherwise.

manner without dogmatism:—change of frequency depends solely on relative motion of source and observer: combined motion of both through a medium does not affect frequency on any theory, so long as the motion is steady. Ordinary aberration is wholly and solely caused by motion of observer relative to path of ray. Is observed velocity of light dependent on motion of observer, too? The strength of the relativity position is that no way of performing the experiment is likely to give a positive result, unless truly relative motion is introduced, as by mounting the whole receiver on the end of a revolving arm; and questionably even then. The strength of the ether position is that a relative ether stream past fixed "stations," though undemonstrated, is at least not negatived by this or any other experiment, and may therefore nevertheless be a reality. A philosopher may be able to explain what "reality" means.

Obituary.

DR. ROBERT KIDSTON, F.R.S.

BY the unexpected death of Robert Kidston on July 13, palæobotany suffers an irreparable loss. Dr. Kidston was still at the height of his activity, and had probably never been busier in his life than when the end came. He was then in South Wales, engaged on his fossil investigations. Equally distinguished in systematic and structural palæobotany, Kidston was the veteran leader in his science, worthy to rank with the great continental masters, such as Zeiller, Grand'-Eury, and Nathorst, who had already passed away.

Robert Kidston was born at Bishopston House, Renfrewshire, on June 29, 1852. The family removed shortly afterwards to Stirling, where Kidston's life was spent. As a young man Kidston went into business in a bank, but his strong bent for natural history soon turned him towards scientific pursuits. About 1878 he attended botanical classes in the University of Edinburgh. He was then, and remained throughout life, a keen field botanist.

Kidston soon became interested in fossil plants, and his work met with early recognition, for, from 1880 onwards, the plant-remains collected by the Geological Survey of Scotland were referred to him. This gave him his first great opportunity.

In Kidston's work as a fossil-botanist two periods may be distinguished. From the beginning up to 1904 he was predominantly a floristic and stratigraphical palæobotanist, and so indeed he continued to be, but from 1904 onwards he further took a leading part in morphological and structural investigation, and expressed himself with a wise authority on the great questions of affinity and descent. His work in every field was remarkable for that sound judgment which has so generally characterised the best systematists.

From about 1880 a constant succession of papers on fossil plants was maintained; only a very few can be mentioned here. In 1886 Kidston was entrusted with the duty of preparing a catalogue of the Palæozoic plants preserved in the British Museum, a valuable work of reference in its time. Thus he was already recognised as our leading systematist in Palæozoic botany.

Kidston always took a special interest in the fructification of ferns and fern-like plants. A paper published in 1887, "On the Fructification of some Ferns from the Carboniferous Formation," proved to be of exceptional importance, for various reproductive organs described belonged, as Kidston afterwards showed, to the group of the Pteridosperms. Thus, in the case of *Neuropteris heterophylla*, of which he afterwards discovered the seed, the fructification described in 1887 turned out to be the male form.

The memoir on Lepidophloios (1892) is the leading monograph on that genus of fossil Lycopods. A paper on the various divisions of the Carboniferous rocks as determined by their fossil flora (1893) is a valuable contribution to the geology of that period. Two important memoirs on the fossil flora of the Yorkshire coal-field, on which he had already published a number of reports, appeared in 1896 and 1897. The second is of remarkable interest, as containing the first complete description of the cones of Sigillaria, and thus finally establishing the true nature of that long-disputed genus.

A general summary of the flora of the Carboniferous Period appeared in 1901–1902. This was written at a transitional time, when botanists had recognised the Cycadofilices as a class, but were still ignorant of their reproduction. Kidston's remarks do justice to the position at that date.

The second and more brilliant period of Kidston's work opens with his important paper on the fructification of *Neuropteris heterophylla* (1904). He was the first to demonstrate, by direct proof of continuity, that a fern-like plant of the Coal Age bore seeds. Previous evidence (only slightly antedating Kidston's discovery), however convincing, had been indirect. Kidston, in fact, was a pioneer in this field. A year later (1905) he published a preliminary note on Microsporangia in connexion with the foliage of Lyginodendron and was thus the first to identify the male organs of a "seed-fern." This was followed up in 1905 by his great memoir on the microsporangia of the Pteridospermeæ, a truly admirable work, showing a rare soundness of judgment in discussing the affinities of the newly discovered group.

A purely anatomical memoir on the internal structure of *Sigillaria elegans* (1908) was the first full and illustrated account of the structure of a ribbed Sigillaria. The work was extended to other species a year later.

Other papers on structural subjects dealt with new species of Dineuron and Botryopteris (early ferns) and with a new Lepidodendron from Pettycur, all of Lower Carboniferous age. Kidston had a special predilection for Lower Carboniferous plants, and was among the first to grasp the full importance of this fine flora.

One of Kidston's later memoirs on the fossil flora of the Staffordshire Coal-Fields (1914) includes a number of important discoveries, the most striking being perhaps the pollen-bearing organ of a new Neuropteris, very different from that of *N. heterophylla*.

The mere glance we have taken at a few outstanding papers may serve to show how Kidston's work illuminated every side of Palæozoic botany. His work was fully appreciated on the Continent and was by no

means confined to his own country. In 1911 appeared a fine volume on "Les Végétaux houillers recueillis dans le Hainaut Belge" containing various new genera and species. Another foreign work was his joint book with Dr. Jongmans on the Calamites of Western Europe, published by the Dutch Government. This is a huge monograph; the Atlas published in 1915 contains 158 fine plates. So far as the writer is aware, only a portion of the text has appeared.

It remains to notice briefly some of Kidston's work in conjunction with other botanists. One of his most valued colleagues was the late Prof. D. T. Gwynne-Vaughan, whose early death was so severe a loss to botany. Their work on the fossil Osmundaceæ, in five parts, ranging from 1907 to 1914, is a palæobotanical classic, tracing back the history of the Royal ferns from the Tertiary to the Permian. An admirable photograph is extant, showing the two collaborators at work together on this investigation. Other papers with Gwynne-Vaughan were on a Tempskya from Russia, by far the best account up to that time of this peculiar type of fern-stem, and on a Lower Carboniferous fossil, *Stenomyelon tuedianum*, discovered by Kidston. This is a model of anatomical work, concise, clear, and exhaustive.

Kidston's work in conjunction with Prof. W. H. Lang, on the Old Red Sandstone plants of the Rhynie Chert-bed (five memoirs, 1917–1921), was the most important of all, for it demonstrated, in full detail, the structure of the oldest land-plants of which we have any certain knowledge. Never was a great discovery more completely and wisely expounded. The simple plants of Rhynie, thanks to Kidston and Lang's researches, now form the basis of evolutionary work on the plant kingdom.

Other joint memoirs by the same authors were on Hicklingia, a new genus of Early Devonian Plants (1923), and on *Palæopitys Milleri* (1923), the famous but long neglected "cone-bearing tree" of Hugh Miller. The authors worked out the structure fully, but reserved judgment on the affinities of the plant, which is certainly of astonishingly high organisation for an Early Devonian horizon.

Kidston, at the time of his death, was engaged on what, from a floristic point of view, was to have been the greatest work of his career. This was nothing less than the full description and illustration of all the Carboniferous plants of Great Britain. The series, published by the Geological Survey, was planned to consist of ten memoirs but would, no doubt, have run to more. Four memoirs have been actually published, illustrated by 91 fine plates. They only embrace a portion of the ferns and fern-like plants. The systematic descriptions are illuminated by admirable observations on broader questions of affinity. It is understood that two more parts are sufficiently advanced for publication, and it is earnestly to be hoped that this magnificent work, a credit alike to the author and to the Department which undertook it, may eventually be brought to completion.

Kidston, among his other accomplishments, was a highly skilled photographer and was thus enabled to illustrate his own works, both systematic and anatomical, in a manner which adds immensely to their value and beauty. In all his writings Kidston showed himself a most fair and generous critic. His splendid collections both of impressions and sections were always available for the use of his scientific colleagues. The present writer, in particular, can testify how much he owes to the constant and generous help of his old friend.

D. H. S.

Prof. Alois Mrázek.

On November 26, 1923, died Dr. Mrázek, professor of zoology in the Charles' (Bohemian) University of Prague. He was born in 1868 in Příbram, and originally worked under A. Frič in the patriotic study of the fauna, the aim of which was to increase the knowledge of Bohemian fauna and the extension of the single genera. Later on, under the influence of his second teacher, Prof. Vejdovský, he devoted his study to typical problems of the period of classical morphology and cytology. He did not limit himself only to the discovery and description of new genera, but he was also interested in the problems, which are typical for the area, of the classical morphology and cytology.

Mrázek directed his study chiefly to the Crustacea and Copepoda, especially to the hermaphroditism of the first and the numerous anatomical details of the antennæ of the second, and the exactness of his work became known in foreign countries, from which valuable material was entrusted to him for research. He found cystercoids in copepods, and their study brought him to that of the complicated cycles of the evolution of helminthes, and so he became a co-editor of the *Journal of Parasitology* and a member of the Helminthological Society of Washington. He investigated also the Sporozoa, Planariæ, Oligochæta, and studied very deeply the life of ants, all work of great exactitude, and discovered fresh-water Nemertines in Bohemia, as well as the only representative of subtropical Temnocephalids in the Lake of Scutari. His beautiful drawings appear frequently in the larger works on cytology. Mrázek was a modern zoologist who was a master of the problems of his time, not a one-sided systematist or a mere morphologist. His work touched also problems of variability, heredity of acquired characters, regeneration, and he devoted a good deal of his time to the study of the relations between the organism and the medium in which it lives, to ecology.

Mrázek was a splendid teacher, full of sacrifice, especially in laboratory work. He published a series of popular lectures on the theory of evolution, and translated Romanes' work, "Darwin and after Darwin." He founded a small but pretty aquarium in his institute, which is visited by thousands of students and other people. While still living, he presented to his institute his rich private library and all his instruments, etc. He was a member of the Bohemian Academy of Science and of the Royal Society of Bohemia. His death is a great loss to our University.

Bohuslav Brauner.

We much regret to announce the death of Prof. P. Natorp, emeritus professor of philosophy in the University of Marburg, author of "The Logical Foundations of the Exact Sciences," and leader of the neo-Kantian school, aged seventy.

Current Topics and Events.

THE East African Parliamentary Commission has started on its long journey, a journey fraught with great and manifold possibilities. If any assurance was needed that scientific matters would receive their fair share of attention, it is to be found in the fact that Major A. G. Church, a member of the Medical Research Council, is one of the Commissioners. No such assurance is, however, required, for Mr. W. Ormsby-Gore, the chairman, is fully alive to the important part which scientific knowledge plays, and must continue to play, in the development of our tropical possessions. He has not forgotten the lessons learned in the West Indies, and realises that many of the same problems will be found in East Africa, together with others peculiar to what was once called the Dark Continent. Indeed, he and those with him are well aware that it is in the main owing to the triumphs of science that the old opprobrious title is no longer wholly applicable, but they are also persuaded that much more light requires to be shed on many difficult questions before the darkness which at present enshrouds them can be fully dispelled. Human, animal, and plant diseases will engage their attention. All three are closely linked, perhaps more closely linked in Africa than anywhere else in the world. Examples come readily to mind: there is human sleeping sickness and animal trypanosomiasis, which the Commissioners will find in every territory they visit, and one thinks also of the calamity of a heavy aphis infection of millet and the famine which may follow it, and of the desolation which locusts leave in their track and the dire effects of their inroad upon both man and beast.

WHILE certain human diseases—as, for example, sleeping sickness, malaria, tuberculosis, leprosy, dysentery, yaws, the venereal complaints, and so forth—will be found common to all the countries in which the East African Parliamentary Commission will prosecute its inquiries, there are others to which the Commissioners' attention will be particularly directed in certain localities. In Northern Rhodesia there have been many cases of splenic abscess amongst natives, an obscure condition requiring research; plague merits special attention in Nyasaland and Kenya Colony; while in Uganda cerebro-spinal fever causes many deaths amongst natives. Again, some of the general diseases are more serious in certain territories than in others. Yaws is a crippling force in Kenya, syphilis a devastating disaster in Uganda. All these questions will require consideration, as will those of native hygiene generally, a subject intimately bound up with housing conditions and therefore with technical education. Veterinary problems abound, and in connexion with them and with many plant diseases the necessity for entomological research will be apparent, as indeed is also the case with respect to human pathology. It will be seen that on the scientific side alone there will be plenty to engage the Commission's attention. It cannot deal with details, but if it grasps some of the great underlying principles and speaks eventually with authority as to the necessity of increased facilities for education and research and for coping with disease and death, it will not have travelled and laboured in vain.

THE Government has decided to proceed at once with certain preliminary investigations in order to ascertain the feasibility of the scheme for using the tidal power of the River Severn for the production of electrical power by the erection of a barrage across the river. Lord Parmoor, to whose scientific department (the Department of Scientific and Industrial Research) the work has been entrusted, has already made arrangements to put it in hand. The Lord President of the Council has appointed the following Committee to supervise and direct the work:—Mr. G. S. Albright (chairman), Prof. A. H. Gibson, Mr. G. W. Lamplugh, Mr. Maurice Wilson, and Dr. J. S. Flett. The feasibility of the Severn scheme turns upon the possibility of finding satisfactory foundations for a barrage. Accordingly the first stage of the investigation will involve:—(*a*) The study by the Geological Survey of the stratigraphical formations in the neighbourhood of the sites suggested for the erection of the barrage; (*b*) taking preliminary soundings with the view of determining the contour of the river-bed at the sites; and (*c*) preliminary measurements of the flow of water at different states of the tide. Meanwhile, two eminent consulting engineers, Sir Maurice Fitzmaurice and Sir John Purser Griffith, have been invited by the Lord President to submit a joint report before the end of this year as to the possibility of constructing a barrage on one or more of the sites suggested on the assumption that safe foundations exist. The data which will be provided as a result of the geological and hydrographical investigations will be placed at their disposal. The staff of the Geological Survey has already begun the inquiry, and a report will probably be ready for submission to the Committee before the end of September.

BETWEEN 11 and 12 P.M. on August 22, a slight earthquake (intensity 4, Rossi-Forel scale), which lasted about six seconds, and was followed by another after an interval of about a minute, was felt in Inverness-shire, at Gairlochy, Spean Bridge and Roy Bridge, all within a few miles of the Great Glen fault. This fault, which runs from Tarbat Ness and crosses Scotland along the line of the Great Glen, has given rise to earthquakes in several parts of its course. Shocks are strongest and most frequent in the section between Inverness and the north-east end of Loch Ness, the last series being those of 1901. From 1870 to 1906, at least seven shocks occurred in the neighbourhood of Fort William, and it is possible that the strong Oban earthquakes of 1880 and 1907, as well as other slighter movements farther to the south-west, were connected with this fault. But, so far as known, this is the first time that an earthquake has originated near the south-west end of Loch Lochy

WE are interested to learn that Mr. Joseph F. Rock, head of the National Geographic Society's expedition into Yunnan, S.W. Szechuan and S.E. Tibet, has recently returned to the United States after eighteen months in the field. He reports the finding of aboriginal tribes in China practising religious ceremonies which existed before Buddhism was introduced into either China or Tibet. He also brought back important plant and bird collections, the herbarium specimens numbering some 12,000 specimens. The plants were collected in the extreme north-west of Yunnan, Tsarong, south-eastern Tibet, the independent Lama Kingdom of Mili and also in eastern Yunnan. The birds collected number about 1600, and are from regions where few collections had previously been made. The collection contains land and water birds, and in addition a few hundred mammals. The birds and mammals will be presented to the Smithsonian Institution. Chestnuts of apparently immune species were found which may prove of value in the United States where the chestnut disease has wrought such havoc. Mr. Rock's chestnut introduction should prove of great interest to the tanning industry in the United States, which has depended upon chestnut to a great extent and has recently faced the possibility of this supply being destroyed through the ravages of blight. A fine set of firs, spruces, hemlocks, pines and junipers were also brought back. A large collection of rhododendron seeds was made, amounting, it is stated, to 493 kinds, and specimens of many of the rhododendrons as well as seeds of these and of Alpine plants have been sent to Kew and to Edinburgh.

IN his presidential address to the Society for Psychical Research, just published, Mr. J. G. Piddington emphasised the difference between the certainty of astronomical predictions and the certainty of the psychical phenomena studied by the Society by saying that the Astronomer Royal, if he wished, could safely wager 5000*l.* to 1*l.* that an eclipse would take place at a certain time, whereas no such wager would be safe in, say, a case of alleged telepathy or clairvoyance. The comparative immunity from such uncertainty enjoyed by most men of science, he said, might actually disqualify them from being the best judges of the Society's work. The best policy would be to aim at convincing the average educated person. One of the difficulties lay in the fact that every science tended to become more and more complex, and those members of the Society who did not keep pace with the development of their methods were inclined to lose interest in their proceedings. Thus the latest automatic writings of some of their members were a sort of elaborate and extensive mosaic, a galaxy of cross-correspondences. In Mr. Piddington's opinion, this greater complexity arose from *someone's* intelligent design, though he would not venture to trace the intelligence which was deliberately complicating some of the phenomena investigated by the Society. The greater danger was a wave of credulity and superstition. The cause of psychical research stood to lose more through the credulity of the crowd than through its indifference or its scepticism.

THE Council of the Zoological Society of London has instituted an Aquarium Research Fellowship of the annual value of 350*l.*, tenable for one year, but with the expectation of reappointment for two further years if satisfactory progress is being made. The Research Fellow will be expected to give his whole time to his investigations, which will be carried out chiefly at the Aquarium in the Zoological Gardens. The object of the research is study of the conditions which affect the life of the organisms living in an aquarium, and not the anatomy, physiology, or life-histories of individual organisms. Candidates should be recent graduates in honours in some branch of science, and should be recommended as likely to carry on research on independent lines. Experience of marine or fresh-water zoology is not required. Inquiries should be addressed to the Secretary, Zoological Society of London, Regent's Park, London, N.W.8. It is not expected that an appointment will be made before October 15.

DR. FRASER HARRIS, acting on medical advice, has resigned the professorship of physiology in Dalhousie University, Halifax, Nova Scotia, which he has held since 1911.

DURING last week, an unusual contest was in progress at the Crystal Palace, where Mr. C. W. Hart pitted himself against a horse, Saucy Lassie, in an endurance test. The test, which was to see which could cover the greater distance in six days, came to an end on Saturday, August 23, when the total distances covered were: The man, 345 miles 880 yards; the horse, 337 miles 1618 yards. Mr. Hart was thus the winner by 7 miles 1022 yards.

A PHYSICIST is required under the directorate of radiological research of the Research Department, Woolwich. Candidates must possess an honours degree in physics and at least three years' experience in research. Applications in writing, with testimonials and references to published work, should be made to the Chief Superintendent, Research Department, Woolwich, S.E.18.

DR. W. J. HUMPHREYS, of the U.S. Weather Bureau, Washington, would be glad if any observers of "ball lightning" would send him a complete description of the phenomenon with the following details: date, witnesses, geographical position, time during the storm, size, shape, sharp or blurry outline, whether with or independent of wind, direction of motion (vertical, inclined or horizontal), kind of motion (smooth or jumpy), effects produced, indoors or outdoors, and if the former how it entered.

A PRELIMINARY programme has now been issued of the centenary celebration of the Franklin Institute and the inauguration celebration of the Bartol Research Foundation, to be held in Philadelphia on September 17-19. The Franklin Institute has helped in no small measure in the prosecution of research into physical science and its applications during the past hundred years, and a noteworthy gathering of physicists and engineers from both sides of the Atlantic is being brought together to celebrate the

anniversary. Among the British men of science who are to deliver addresses are Sir Ernest Rutherford, Sir William Bragg, Prof. W. L. Bragg, Prof. E. G. Coker, Prof. F. G. Donnan, Sir Charles Parsons, and Prof. J. S. E. Townsend. Other distinguished men of science, exclusive of the large body of Americans, who will be present, include Prof. Charles Fabry, Prof. F. Haber, Prof. W. Lash Miller, and Prof. P. Zeeman.

THE southern slope of the Grasberg, in the valley of the Dürren Ager, parish of Oberaschau, Austria, has been in motion. Portions of the forest have migrated to the valley, and landowners can no longer identify their own areas. One man has a piece of forest tipped on him, but the timber is not his; another has lost the meadows he intended to mow; they have slidden away. The area of the landslide is about 100 acres and is a quarter mile broad. The depth of the mass moved is not more than 50 feet, but it is not limited to the weathered surface. The whole slope has been soaked. Coloured or black clays and shales, dark grey "ruschel"-shales, interstratified between sandstones of the upper chalk, seem specially suitable for landslides. Two rows of stakes have been driven in so that measurements can be made to follow the movement.

WE learn that arrangements have been made by which Automatic and Electric Furnaces, Ltd., 17 Victoria Street, London, S.W.1, and Electric Furnace Company, Ltd., Elecfurn Works, 173-175 Farringdon Road, London, E.C.1, will jointly design Wild-Barfield internally heated electric furnaces having an input greater than 25 kw., which in future will be supplied by the latter firm. Automatic and Electric Furnaces, Ltd., will continue the manufacture and sale of the Wild-Barfield automatic hardening furnaces with magnetic detector, and internally heated type of furnaces up to 25 kw. Arrangements have also been made with George J. Hagan Co., of Pittsburg, U.S.A., who have constructed a large number of electric resistance furnaces up to 350 kw. capacity, for the use of their drawings and information, so that the best British and American practice will be incorporated in the designs.

Our Astronomical Column.

SOLAR SPECTROGRAPH FOR THE POULKOVO OBSERVATORY.—*Engineering* for July 18 contains a detailed description and several photographs of the 7-metre solar spectrograph by Grubb, which has just been erected at the Poulkovo Observatory. The instrument, in which a grating is employed, is of the Littrow type, and is modelled on the 30 ft. tower spectrograph at Mount Wilson. The sun's rays are received on a cœlostat, for which a special erection is made at the top of the south wall of the Observatory, and are reflected into an object-glass, after passing through which they are reflected to the slit of the spectrograph on the ground floor, where they form an image of the sun about 10 cm. in diameter. The main object of the instrument is the study of the sun's rotation by means of the Doppler effect shown by light from the eastern and western limbs. By using a system of four prisms, light from the centre and limbs of the sun is made to fall simultaneously on different parts of the slit, and the spectra are obtained in juxtaposition on a plate 24 cm. long by 4 cm. wide. The spectrograph lens has an aperture of 10 cm. and a focal length of 706 cm. No description of the grating is given, but it is stated that the instrument will give from one spectrogram a velocity measurement of greater accuracy than 1/10th of a kilometre per second in the line of sight. Arrangements are provided for rotating the instrument, the solar image remaining fixed. The cœlostat, which has an aperture of 25 cm., has been made adjustable for any latitude between 60° and 37°, in order that it may be used at the Simeis Observatory, in the Crimea, if desired.

THE LIVERPOOL ASTRONOMICAL SOCIETY, ANNUAL REPORT, 1923–24.—This body has undergone remarkable vicissitudes. It was founded in 1881 by Espin, Isaac Roberts, and R. C. Johnson, and proved so useful in helping beginners, and amateurs generally, that in a few years its membership rose to nearly 1000. Then a period of stagnation set in, and the publication of its journal became very irregular. It was the realisation of its earlier usefulness that led to the formation of the British Astronomical Association in 1890. The competition thus afforded led to a distinct revival of the Liverpool body, though it has since been a local rather than a national body. War difficulties once more led to a suspension, but all will be glad to hear that meetings have now been resumed and that the outlook is hopeful. Papers were read during the session by the president (Dr. Whichello); by Mr. W. Porthouse on the moon; Mr. J. Rice on relativity; Rev. A. L. Cortie, S.J., on sun-spots and magnetism; and others.

While not at all endorsing the president's statement that the B.A.A. is too much under the influence of the professional astronomer to be of use to the ordinary amateur worker, we may freely admit that it is a great benefit to astronomers at a distance from London to have their own meetings both for discussion and observation; and doubtless all will join in wishing this society, the name of which recalls happy memories to many of us, a new lease of useful life.

ANNUAIRE DE L'OBSERVATOIRE ROYAL DE BELGIQUE, 1925.—This useful annual contains the usual almanac information about sun, moon, planets, stars, tides, etc. It gives very full information about wireless time-signals, and time determination. Incidentally it notes that while most of the national ephemerides adopt the new system of commencing the astronomical day at midnight at the beginning of 1925, the Berliner Jahrbuch adheres to the old system. It will therefore be necessary to state the system employed fully and clearly in all astronomical time determinations: it will be unwise to use the phrase Greenwich Mean Time for the new system without some distinguishing mark: Greenwich Civil Time is probably the best to use, but a warning is necessary that it does not mean Summer Time.

An error may be noted in the table of Periodic Comets on p. 168. The period given for Tuttle's Comet, 12·15 years, is far too short. The next return should be given as May 1926, not February 1937. Also the Comet Grigg-Skjellerup should be included as due to return in 1927.

Research Items.

SHORT CIST BURIAL IN KINCARDINESHIRE.—A short stone cist unearthed at Catterline, Kincardineshire, in March 1923, contained a fairly perfect male human skeleton which has been carefully examined by Prof. R. W. Reid and recorded by him and Rev. J. R. Fraser (Proc. Soc. Antiq. Scot., ser. 5, vol. x., 1923-24, pp. 27-40). The discovery revealed several unusual features. The covering of the cist, instead of being formed of a single series of large stones as is usual, was made up of several layers definitely arranged and graded, and embedded in sand three feet deep from top of bottom. One of the larger of the cover stones bore rude incisions in spiral and concentric circle form, but the weathering of the stone showed these were clearly handiwork of a much older date, and were not used as the artist had intended. Another of the cover stones was artificially perforated. The skeleton showed the ordinary characteristics of the round-headed bronze age race of north-eastern Scotland, with strongly platymeric limbs, but the skull capacity was unusually large, 1600 c.c., as against an average of 1458 c.c. for a considerable series of short cist skulls from the same region. The height of the individual was also out of the ordinary for his race, his stature, calculated from the leg bones, being 5 feet 10 inches, and calculated from the arm bones, 5 feet 8 or 9 inches. It would appear, however, that his arms were shorter in proportion to his legs than is the case in modern races. The average height of the short cist men of Aberdeenshire is only 5 feet 4 inches. The skeleton was accompanied by a low-rimmed clay beaker of the "drinking-cup" type, and by a fragmentary and rudely chipped quartzite pebble.

BIOCHEMISTRY IN INDIAN AGRICULTURE.—The Journal of the Indian Institute of Science, vol. vii. parts ii. and iii., contains two papers dealing with problems of considerable interest in connexion with Indian agriculture. In the first, G. J. Fowler and Y. N. Kotwal show, by a series of laboratory experiments, that dilute aqueous solutions of ammonium nitrite are not decomposed by other substances such as acids, amino-compounds, or hydrogen sulphide, which are likely to occur with them in ordinary agricultural or sewage disposal practice. Such loss of nitrogen as occurs in these operations cannot, therefore, be due, to any noticeable extent, to purely chemical reactions, but must be mainly the result of biochemical changes, as has indeed been generally assumed. The second paper deals with the retting of coconut husk for the production of coir. Coir is the fibre used in the production of coconut matting, and is therefore the basis of a large industry. So far as scientific investigation is concerned, it has been even more neglected than most of the coarse textile fibres, and Messrs. G. J. Fowler and F. Marsden are breaking new ground in tackling the problem. The fibre is obtained by soaking in water, which is changed from time to time for about ten months, the crude mass of fibrous tissue (mesocarp) which forms the husk of the fruit of the coconut palm. The natives who carry on this part of the industry have a good deal of rather indefinite and sometimes contradictory information as to the influence of various factors, such as the degree of ripeness of the fruit, the use of much or little water, the character of the water, and especially its salinity, on the quality of the fibre produced. Messrs. Fowler and Marsden find that the essential feature of the soaking process is the breaking down by bacterial agency of the material, described as insoluble gum or possibly a hemicellulose, which binds the fibre together in the husk. The necessary bacteria occur in the husk itself, and they remain active so long as the water is changed frequently enough to prevent them being poisoned by the products of the reactions they cause. The discoloration of the coir which sometimes occurs is due to changes in the tannin originally present in the husk, and the tannin, under unsatisfactory conditions of soaking, may oxidise to red insoluble products, which are deposited on the fibre, or if ferruginous water gains admittance to the soaking areas, may form iron tannate, producing "blue" fibre.

A NEW CERCARIA FROM NORTHERN INDIA.—Dr. B. Soparkar describes (*Indian Journ. Med. Res.*, vol. xi., 1924) a new cercaria from northern India which presents several unusual features. The tail is forked distally, and bears proximally two arm-like lateral processes each terminating in an oval structure which appears to be glandular and to serve as an organ of adhesion. The reproductive organs are much more developed than is usual—the ovary and two lobulated testes being clearly marked, and numerous motile spermatozoa could be seen in the vesicula seminalis. The entire length of the main excretory canal is ciliated. This cercaria develops in rediæ in *Melanoides tuberculatus*, but its further history after issuing from the snail is unknown. The cercaria has not been observed to encyst and it does not possess cystogenous glands; as it is not adapted for active penetration, the author suggests it is swallowed by the next host.

INTERACTIONS OF PROTOPLASMIC MASSES IN *ARCELLA POLYPORA*.—Bruce D. Reynolds (*Biol. Bull.*, vol. 46, Feb. 1924) finds that, like Difflugia, Arcella will, in favourable circumstances, reappropriate by fusion fragments of protoplasm which have been detached from it. Arcella is not attracted by a pseudopodial fragment of Difflugia, and if accidental contact is made the fragment is treated as a mechanical obstruction. Fusion will take place between one individual of Arcella and a protoplasmic fragment of a closely related specimen. Two distantly related individuals which have not been kept in the same receptacle will be attracted by each other's severed pseudopodia, but upon making contact the protoplasm involved will be shattered into bead-like masses. When two lines of a clone (a pure line) are kept under similar environments, cross-fusions between them cease after about 22 days, but if the two diverging lines are kept under different environments, cross-fusions cease after a shorter time—6 to 16·5 days. When small quantities of culture media are frequently interchanged between the hollowed slides in which the members of two diverging lines are kept, cross-fusions apparently continue indefinitely. When two related specimens have become negative to each other's protoplasm, cross-fusions between their progeny may be induced by exchanging small quantities of culture media or by placing them in the same culture medium (time required, 6 days). Physiological changes occur among the descendants of a single Arcella reproducing vegetatively, but such differences are probably due to environmental influences rather than to hereditary variations.

EXPLOSIONS AND ZONES OF SILENCE.—According to M. L. Gazaud's observations of the explosions at La Courtine on May 15, 23, and 25 made near Marseilles, the zone of direct audition is very limited in extent (*Comptes rendus*, Paris Acad. of Sci., July 28).

The explosions were in each case inaudible at the times calculated from the distance, and the same was true at Montpellier. The explosion of May 15, however, was distinctly registered at both stations, but with retardations corresponding to extra paths of 90 and 135 km. respectively, the distance in a straight line from La Courtine being 360 km. At the same time a thick mass of cumulus cloud was observed, rising above the mountain masses of Ventoux and the Basses Alpes, forming an obstacle which was evidently quite capable of reflecting sound waves coming from La Courtine. Such a wall of cloud, if it were concave in front, could concentrate the sound waves so as to make them audible at certain points. A simple calculation of the probable trajectories for the two stations confirmed the above hypothesis, and fixed the probable points at the edge of the cloud mass where the sound was reflected. Reflection from above is shown to have been impossible in these cases, as at the height required to give such large differences of path, the pressure of the air would be very small, and very little sound would be transmitted.

NATURAL GAS INDUSTRY.—Three advance chapters of the Mineral Resources of the United States, volume for 1922, dealing with Natural Gas, Natural Gas Gasoline and Carbon Black produced from Natural Gas, contain significant data proving the rapid development of this industry in America. Consumption of natural gas in 1922 amounted in the United States to 762,546,000,000 cubic feet, being 15 per cent. more than the quantity used in the previous year. West Virginia, Oklahoma, and Pennsylvania ranked chief among the twenty-three producing States, each giving over 100,000,000,000 cubic feet, showing that the palæozoic compared with the tertiary fields are still the most important from the point of view of gas production. The unit value of the gas has also gradually increased, the average at points of consumption being 29·1 cents per 1000 cubic feet compared with 21·6 cents in 1919; the value in domestic consumption shows proportionate increase, being 49·9 cents per 1000 cubic feet in 1922. Unblended gasoline extracted from natural gas in the year under review amounted to 505,832,000 gallons, representing a 12 per cent. increase over the previous year and 8 per cent. of the total gasoline produced in America from all sources. The average yield of gasoline per 1000 cubic feet of gas thus works out at 0·9 gallon. Of the 917 plants in operation for the extraction of this product throughout the United States, those of the compression type produced by far the largest amount of gasoline, though statistics show that the combination process is steadily increasing in favour. The average value per gallon of natural gas gasoline was 14·4 cents in 1922. Carbon black manufacture likewise showed an increase of 13 per cent. over the previous year, amounting in 1922 to 67,795,000 pounds; the advance was largely due to the greater demand for this commodity in the rubber tyre industry. Louisiana and West Virginia together were responsible for more than 90 per cent. of the entire output of the country, the Monroe field of the former State contributing in no small measure to this result. The average price per pound of carbon black was maintained at 8·6 cents, a slight decrease compared with 1921.

ACOUSTICS OF HALLS.—Owing to the pioneer investigations of the late Prof. Sabine, the factors which determine the acoustical properties of rooms are becoming known, and the provisional theory is being tested by the observations made in halls of various sizes and shapes by auditors whose opinions are of value. As the result of a considerable amount of work of this kind, Prof. F. R. Watson, of the University of Illinois, suggests in the July issue of the Journal of the Franklin Institute an improvement in the law expressing the best time of reverberation in a hall in terms of its volume. His expression for a hall without audience is, time in seconds $= 0{\cdot}75 + 0{\cdot}375\sqrt[3]{\text{volume}}$, the volume being in cubic feet. He concludes also that in increasing the absorbing material as the hall gets larger, it is best to keep the average absorption per unit area constant. This involves the energy of the sound source being proportional to the area of the surface of the hall.

THE QUANTUM THEORY OF RADIOACTIVE DISINTEGRATION.—In an article in the *Zeitschrift für Physik* of August 4, Dr. A. Smekal shows that the quantum mechanism proposed by him in 1922 gives a complete explanation, on the lines of the Bohr theory, of all the β-ray spectra which have so far been determined with certainty. Rosseland's criticism of this mechanism is ungrounded, and it is shown that he has simply applied the views of the author to explain the continuous β-ray spectrum of a very special class of β-ray disintegrations. The close analogy between X-ray and β-ray spectra supplies an explanation of the relationships found by Ellis and Skinner between the sequence of the nuclear levels in radium B and radium C. Wentzel has shown that "spark" lines are found in the X-ray spectrum, due to multiple ionisation, the terms of which bear a definite relationship to those of the normal lines. In a β-radioactive atom, instead of a recombination of an electron, as for X-rays, an electron is given off from the nucleus, or moved to an outer orbit. If two β-radiators follow one another in the periodic system, there is a close analogy with the case of a non-radioactive atom which has lost both its K electrons, and in regaining them will give spark lines, as well as the normal X-ray spectrum.

X-RAY ABSORPTION SPECTRA.—New measurements have been made of the fine structure of the K absorption band head of Ti, V, Cr, and Mn, and of the L_{III} band head of Sn, Sb, Te, and I, by Dr. D. Coster, *Zeitschrift für Physik*, July 2, and it is shown that the character of the structure depends on the chemical state of the element concerned. When the valency of the element in the compound used is high, an absorption line, Ka, $L_{III}a$, is found on the long wave-length (soft) side of the band head, but not for compounds in which the element has a low valency. It is thought that the principal band head corresponds to the sudden rise, from zero to a maximum value, of the probability for the removal of an electron from the layer concerned to infinity, when the wave-length diminishes to a particular value; the lines Ka and $L_{III}a$ are probably due to the removal of the electron to an inner electronic layer. The principal band head approaches the position of the Ka or $L_{III}a$ line as the chemical state of the element approaches that of the uncombined gaseous element. It may very well be that the lines Ka and $L_{III}a$ really exist in all cases, but can only be observed when the separation from the principal band head is sufficient. The author deals with the theory of this shifting of the band head and with that of the maxima and minima of absorption observed on the "hard" side of the band head. It is suggested that, in this region of the spectrum, besides the "photo" effect, there is another possibility, so that the atom may take up a larger energy quantum than that corresponding to the removal of an inner electron to infinity; the extra energy might be used in removing an electron simultaneously from

the outer layer; or the atom or atomic complex may be in some special state of tension after the absorption.

FIRST LAW OF PHOTOCHEMISTRY.—The Journal of the Chemical Society for July contains an important paper by Mrs. M. C. C. Chapman on the first law of photochemistry. This law, which was enunciated by Draper in 1843, states that the amount of chemical change in a given system effected by light of a specified wave-length is proportional to the light absorbed. Although this is a fundamental principle of great importance, its validity has not been conclusively established. Its accuracy has, in fact, recently been challenged by Baly and Barker, who found that in the case of the combination of hydrogen and chlorine, when the light intensity was increased in the ratio of 1 : 6, the rate of combination increased in the ratio of 1 : 10. Mrs. Chapman has carried out careful experiments with the same reaction, and the results show that the rate of combination appears, if anything, to increase with the light intensity rather less rapidly than is required by Draper's law. For the ratio of intensities 1 : 6, the ratio of rates of combination was 5·49 in one group of experiments and 5·67 in another. With six slits, the ratio of rates of combination occasioned by opening six slits compared with that with two slits was 1 : 2·97, 1 : 2·95, and 1 : 2·97. The deviation from Draper's law is ascribed to the temporary reduction in pressure of the water vapour occasioned by the formation of hydrogen chloride rather than to an inhibitive action of hydrogen chloride. The experiments were made in the presence of water. The conclusion reached is that the abnormal result obtained by Baly and Barker could not be substantiated, and that Draper's law is valid even in the case of the photochemical change which exhibits the greatest departure from Einstein's law of photochemical equivalence.

BAKERY RESEARCH.—A report on research work carried out at the National Bakery School, London, has recently been issued by Dr. C. Dorée and Mr. John Kirkland. It is divided into four sections, namely, (1) variation in weight of loaves due to loss in baking, (2) weight conserving effects of wrapping loaves in waxed paper, (3) variableness of oven temperatures, (4) quicker ripening of hard flour doughs. With respect to the first part of the report, the opening paragraph quotes the Report of the Interdepartmental Committee on the Sale of Bread by Weight which stated that, in spite of the difficulties encountered, it is possible to estimate with reasonable accuracy the loss which takes place in baking and after. The sale of bread by weight places the baker in a very difficult position, as it has been suggested that it is by no means easy to tell how much dough should be scaled off so that the resultant cooled loaf should just be the desired weight. No conclusions are directly drawn contradictory to the committee's considered opinion, but the mass of carefully collected data in this report throws very grave doubts on its correctness. Loss of weight is found to be affected by the tightness of the dough, by the position in the oven, by the kind and shape of the loaf in question, by the degree of ripeness of the dough, by the length of time the bread is in the oven, and by the presence or absence of certain moisture pastes chiefly of a starchy character. It is further shown that attention to these points is a matter of considerable financial importance to the practical baker. The second part of the report dealing with the effect of wrapping on the weight of the loaf is very limited in scope, although the results are of interest. It is shown that the expense of wrapping is partly met by the decreased loss in weight of the loaf on keeping. There was unfortunately no work done on the important question of the increased cleanliness of the loaf. As to the variableness of oven temperature, it appears that there is often a range of temperature in different parts of the oven of 50° F., and in some cases of more than 100° F. It may be that some of the rather inconsistent results reported in the first part of this report are due to this varying factor. The final part deals with the quicker ripening of certain hard and strong doughs. In view of modern labour conditions it is necessary that something should be done to the stronger and slower ripening flours if they are to be ready for the oven quickly, and the practical suggestion of the addition of lactic acid and the preparation of pastes rich in lactic acids is made.

COAST DEFENCE WORKS.—The destructive effect of the grinding action of shingle or boulders on concrete structures erected on the foreshore is well known. Dr. John S. Owens describes a method which has been used successfully on the south coast of England, and illustrates it with photographs in the *Engineer* for August 8. The method consists in facing the concrete sea wall with wood blocks set in cement, with the end grain exposed. One of the photographs shows an experimental patch of wood blocks inserted in 1921, and the wear of the unprotected surrounding concrete has been from 1½ in. to 2 in. more than the wood. The wood blocks indeed show but little signs of wear, and it has been noticed that where a knot came to the surface of the wood there was a definite hollow worn, the hard knot being worn more rapidly than the surrounding soft wood. The experiments were regarded as so promising that a considerable length of sea wall was faced this spring with wood blocks. The blocks are mostly 6 in. square on the surface and are set with headers 9 in. long at intervals, the other blocks being 6 in. deep. All the blocks were set in neat cement grout and were held in position in the first instance by double-pointed nails, as one of the difficulties encountered was to keep them in correct position while the concrete behind was filled in and rammed.

LATERALLY LOADED STRUTS.—Technologic Paper No. 258 of the U.S. Bureau of Standards contains an account of some tests on steel tubing made by Mr. Tom W. Greene with the view of ascertaining whether experimental results confirmed the theory of laterally loaded struts. The range covered the cases of a column without transverse load to that of a beam with no column load. It was found that the eccentricity due to variation in wall thickness and to deviation from straightness is an important factor. A modified rational formula based upon consideration of the effect of eccentricity was found to fit the experimental results very closely. Failure of a strut will occur when the maximum compressive stress computed by the modified formula is approximately equal to the yield point, and the modified rational formula reduces to the "secant" column formula when the transverse load is equated to zero. A reasonably accurate computation of the stress in a laterally loaded strut can be made by summing the bending stress due to the transverse load and the column stress obtained by the "secant" formula, provided that in the latter formula the effective eccentricity is taken as the sum of the original eccentricity (due to tube irregularities) and the deflexion of the strut at the centre resulting from the transverse load. The methods of measuring the eccentricities in the test struts are clearly described in the paper, and, judging from the exactness of agreement shown by the checks applied, appear to be very accurate.

The International Commission on Illumination.

THE second technical session of the International Commission on Illumination was held in Geneva on July 21-25, under the presidency of Dr. E. P. Hyde (U.S.A.). About forty delegates from France, Great Britain, Italy, Switzerland, and the United States of America were present, while observers from Japan and Poland attended the meetings. The delegates were welcomed to Geneva by M. Stoessel, president of the city, while Dr. Carrozzi, representing the health section of the International Labour Office, welcomed the collaboration of the Commission in problems which were of particular interest to his section. The president announced that national committees were in the process of formation in Belgium and also in the Union of South Africa.

At the first technical meeting two papers dealing with primary standards of light were presented by Dr. Crittenden (U.S.A.), on behalf of Dr. Ives, and by M. Fleury (France). Dr. Ives, by using a cylindrical platinum black body at the instant of melting, has obtained results which are considered sufficiently reproducible to make this type of black body a suitable primary standard. His results indicate that at the melting-point of platinum the black body has a brightness of 55·4 candles per square centimetre, and its radiation very closely colour-matches that of the carbon filament lamps operated at 4 watts per mean horizontal candle, in which the international candle is maintained. M. Fleury is using a carbon tube furnace held at such a temperature that the intensity of the radiation between two given wavelengths is N times that between the same wavelengths emitted by a black body held at the melting-point of gold. The power consumed in the furnace, and hence its temperature, is maintained constant by the use of a thermionic valve controlling a generator, and it is anticipated that the constancy of temperature will be sufficiently exact to enable the furnace to be used as a primary standard of light. As a result of discussion the Commission passed a resolution recommending that the brightness of the black body operated under definite specified conditions be adopted as the primary standard of light, and that the various National Laboratories be asked to specify conditions and to determine its value in terms of the international candle at present in use. An exceedingly comprehensive paper dealing with the properties of tungsten and the characteristics of tungsten lamps was presented by Dr. Crittenden (U.S.A.) on behalf of Dr. Forsythe and Dr. Worthing. Other papers were concerned with the description of an acetylene standard lamp for use in sensitometry, and of special holders for electric lamps used as photometric substandards.

The second technical meeting was taken up with the study of problems in connexion with photometric definitions and symbols arising out of the report of the international committee on definitions and symbols, presented by M. Fabry (France) on behalf of M. Blondel, and the reports of the various national committees. A technical sub-committee was appointed to deal with the recommendations, and agreement was reached on about fourteen definitions, in addition to those on which agreement was reached at the Paris meeting in 1921. Definitions were finally adopted of transmission, absorption and reflection factors, brightness, visibility, total flux, mean spherical intensity, reduction factor, efficiency of a source, and several other quantities. Symbols for luminous flux, luminous intensity, illumination, and for transmission, absorption, and reflection were also agreed upon.

The Italian National Committee presented a vocabulary of illumination in Italian, and it was agreed that it would be advantageous if there were corresponding vocabularies in English, French, and German. As the Swiss National Committee had already placed on its programme the collation of the Italian and French vocabularies, it was decided that this work should be extended by including English and German, and it was decided that a sub-committee with a Swiss chairman should be appointed to deal with the matter.

The third technical meeting opened with a paper by Prof. Fabry (France), chairman of the sub-committee on heterochromatic photometry, appointed at the Paris meeting. Prof. Fabry gave an excellent account of the work done since the Paris meeting on the subject of heterochromatic photometry, and of a programme of work which, if carried out by the sub-committee, would be of the greatest value. A paper was presented by Mr. H. Buckley (Great Britain) on behalf of Messrs. Buckley, Collier, and Brookes on the colour temperature scale for tungsten. Very satisfactory agreement with existing data was obtained in this preliminary work, which it is intended to repeat to greater accuracy. M. Jouaust (France) read an interesting paper on the use of absorbing screens in heterochromatic photometry. Dr. Crittenden (U.S.A.) presented a report on behalf of Mr. K. S. Gibson on the relative visibility function. This report reviewed the more recent work on this problem, including that by Messrs. Gibson and Tyndall, in which the step by step method of direct comparison of different portions of the spectrum was used. It appears from this work that, contrary to what had been suspected, the direct comparison method gives the same results as those obtained by methods involving flicker photometry. The Commission passed a resolution that the values recommended by Mr. Gibson should be adopted as provisional standard values of the visibility factor, except in certain specified cases such as arise in considering the ends of the spectrum or in particular conditions of field intensity and size. These new values differ only slightly from those recommended at the Paris meeting in 1921. The Commission decided at this meeting that the sub-committee on heterochromatic photometry should extend its activities to include the investigation of the transmission characteristics and the specification of coloured glasses, particularly of those glasses used in photometric measurements. It was also decided that a new committee consisting of three members should be set up to deal with colorimetry.

The fourth technical meeting dealt with street lighting and with certain aspects of illumination engineering practice. Mr. H. T. Harrison (Great Britain) presented a paper in which he developed the idea that street lighting should be more of the projection type, such as is associated with automobile headlights. Papers were also presented on street lighting in Paris by gas and electricity, and on some interesting traffic regulating signs recently installed in Paris. A proposal was made that the Commission should recommend the fixing of a legal minimum of illumination for street lighting. It was decided, however, that though it might be desirable for the Commission to give the weight of its opinion on street lighting, this was such a debatable subject that action had better be deferred pending further consideration, and it was agreed that at the next meeting the question of street lighting should be given greater prominence.

The papers on illumination engineering practice were the first of their kind which had been given before the Commission. In these, the authors, Messrs. Lieb, Merrill, and Powell (U.S.A.), gave an account of some of the features of the organised campaign which is being carried on in America to promote the widespread practical application of the principles of good lighting. Dr. Lieb urged that the work of the Commission should not be restricted merely to the theoretical aspects of illumination, but should be extended to include the practical aspects of illumination engineering so that it would be of benefit both to manufacturers and the general public. Mr. Merrill described the method of conducting good lighting demonstrations, while Mr. Powell described various types of propaganda work, and surveyed a large field of investigatory work in practical illumination engineering.

The fifth technical meeting dealt with factory and school lighting and with automobile headlights. Mr. L. B. Marks (U.S.A.) presented the report of the international sub-committee on lighting in factories and schools as a basis of international agreement. Recommendations of the minimum illumination in various circumstances, of the maximum brightness of light sources, of exit and emergency lighting, and of the colour and finish of school interiors, were made. There was general agreement that at present standard minimum values of illumination for working conditions should not have any legal force, and that whatever regulations are made should be based solely on considerations of the health and safety of employees. Mr. Gaster (Great Britain) presented a paper on some further developments in industrial lighting in England, and M. Bordoni (Italy) on some phenomena of glare. Dr. Sharp (U.S.A.), chairman of the international sub-committee on automobile headlights, presented a report in which the proposals made by each of the various countries were reviewed, while papers dealing with the photometry of automobile headlights were presented by Messrs. Bossu and Cellerier (France).

After the technical meetings were over a plenary meeting of the Commission re-elected Dr. E. P. Hyde to the office of president for the next three years. Mr. C. C. Paterson was also re-elected to the office of honorary secretary and treasurer, and Messrs. Edgcumbe (Great Britain), Rouland (France), and Semenza (Italy) as vice-presidents, while Mr. Walsh of the National Physical Laboratory, to whose ability and efforts the technical success of the meeting was so largely due, will continue his work as general secretary for the next three years. It was provisionally decided that the next meeting should take place in the United States of America in 1927.

The meetings were held in the Palais Eynard, which was kindly placed at the disposal of the Commission by the City of Geneva. The delegates were entertained at a motor excursion and a dinner at Bellerive on the evening of Tuesday, July 22, by the president and members of the Geneva City Council; and at a dinner at the Hotel des Bergues by the Swiss National Committee on Wednesday, July 23. On July 24 the Swiss National Committee were the guests of the foreign delegates at a dinner held at the Parc des Eaux Vives.

The Swiss National Committee, particularly the president, M. Filliol, and the secretary, M. Largiardèr, were responsible for the excellent arrangements made for the meeting, while M. Thomas, the director of the International Labour Office, very kindly placed a secretarial staff and interpreters at the disposal of the Commission. H. B.

The Automatic Measurement of Atmospheric Pollution.[1]

By Dr. J. S. OWENS.

THE suspended impurity in the air can be measured by two methods, the automatic recorder or filter, and the jet dust counter method. The former was designed primarily for measurement of smoke pollution, and depends upon filtration of the air through white filter paper, the resulting discoloured spot being compared with a calibrated scale of shades. In the dust counter method the results are independent of the colour of the particles, a count of their number as well as an examination of their size, shape, and nature being made microscopically. Curves showing the numerical value of the suspended impurity for different cities and its variation from hour to hour can be plotted from the average figures for a large number of days. The cities selected for this purpose were London, Rochdale, Blackburn, Glasgow, and Stoke-on-Trent.

The London curves of impurity for Westminster, Savoy Hill, and Kew Observatory indicate that the impurity is lowest between midnight and 6 A.M., after which it rises rapidly to a maximum between 9 and 10 A.M., falling again steadily until about 4 in the afternoon, when there is a tendency to rise slightly to a second but lower maximum. At about 10 P.M. the impurity falls away until about midnight. The Sunday curves are similar, but the maximum in the forenoon is not reached until about an hour later. The rise of impurity between 6 and 7 A.M. is attributed to the lighting of fires, the smoke from which is emitted in greatest quantity soon after lighting.

In plotting the curves referred to, it was found advisable to divide the days into two groups:

(*a*) Days in which there was much smoke haze at some time, as indicated by the automatic recorder showing a shade number equal to or above 4—equivalent to 1·28 mg. per cubic metre. These were referred to as "Z" days.

(*b*) Days of little smoke haze when the maximum did not reach Shade 4.

As the existence of thick smoke haze over a city on certain days is due rather to failure of the natural processes by which normal smoke is removed as produced, than to abnormal smoke production on those days, this division is an attempt to separate ordinary days from those in which the ventilation fails, usually during anti-cyclones with light or indefinite winds and inversion of the lapse rate.

The distribution of impurity for Rochdale and Glasgow is very similar to that in London. The records from Blackburn exhibit certain peculiarities. These were prepared from an average of 269 days for the year 1923–24, 136 being winter—72 of which ranked as "Z" days, that is, days of much smoke haze.

The hourly distribution in Blackburn has certain important peculiarities; for example, a rapid rise of impurity commences in the morning in the summer about 4 A.M., and reaches its maximum on week-days and Saturdays at 7 A.M., while on Sundays the maximum is not reached until 10 A.M. Again, in the week-day and Saturday curves there is a second maximum between 10 and 12 in the forenoon, higher than the first, and separated from it by a 4-hour interval.

It is inferred from this that there are two main sources of smoke, making their maxima at different

[1] Substance of a paper read before Section A (Mathematics and Physics) at the Toronto meeting of the British Association.

times. The Sunday curves show no evidence of a double maximum in the forenoon. It is therefore inferred that the first maximum is due to industrial and the second to domestic smoke. In support of this is the fact that in winter the second maximum is higher than the first for week-days, while in summer the first is higher than the second. The relation

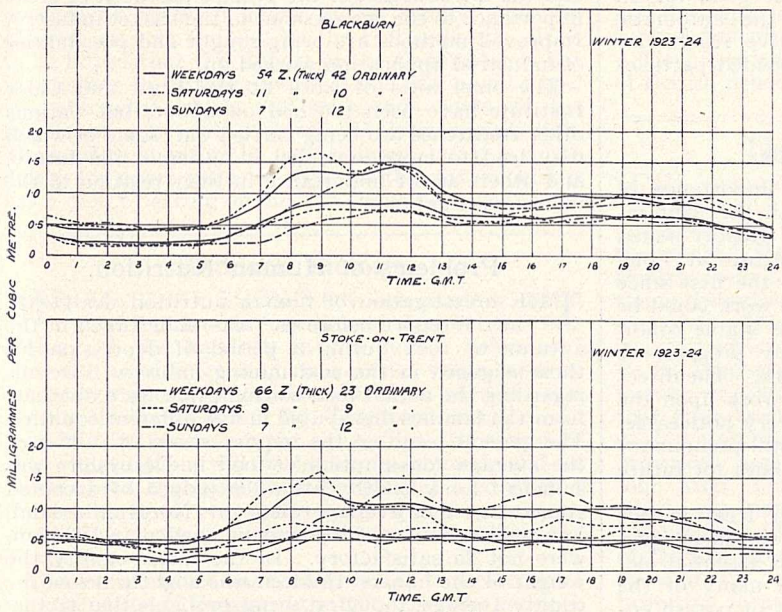

FIG. 1.—Suspended impurity in the air.

between the total smoke emitted on Sundays and on week-days is as 2000 to 3077, based on the curves for ordinary winter days—not ranking as "Z" days. If the Sunday smoke be assumed to be domestic, and the week-day smoke domestic plus factory, the ratio of factory to domestic smoke becomes 1 : 1·85.

Stoke-on-Trent exhibits even more peculiarities than Blackburn. Stoke is a pottery city containing about 2500 ovens. Records are available for a total of 222 days, including 126 winter days —82 of which ranked as "Z." Thus of the winter days recorded 65 per cent. had thick smoke haze, that is, on two out of every three days.

Fig. 1 shows that a definite rise began about 4 A.M. on week-days and 5 A.M. on Sundays. On summer week-days and Saturdays the maximum is reached between 7 and 8 A.M., while in the winter on week-days and Saturdays the maximum is between 8 and 9 A.M., and on Sundays about mid-day. In both summer and winter the impurity is maintained at a high level during the whole afternoon, but with remarkable oscillations, not shown in the records of the other cities mentioned. The minimum impurity is found at about 3 A.M.

The amount of suspended impurity in Stoke on ordinary winter Sundays is not much less than on week-days, the ratio being as 2022 to 2398. Here there are evidently conditions which make it impossible to apply the method already used for ascertaining the relation of factory to domestic smoke. In all the Stoke records for summer and winter, the Saturday maximum in the forenoon is the highest. This can be traced to the custom of lighting pottery ovens on Friday night or Saturday morning.

The incidence of atmospheric impurities on different days of the week has also been examined for six different cities, from which it appears that there is a general tendency to a minimum of smoke haze towards the end of the week, and a maximum about the beginning.

Since the records of the automatic instrument upon which the above conclusions were based depend upon the discoloration of a filter paper by the trapped impurity, experiments were made in which the results obtained with the dust counter method referred to were compared with those by the automatic recorder. In the latter, which was intended for recording city smoke, the impurity is assumed to be black, whereas the dust counter is independent of colour.

In the latter, fully described elsewhere,[2] the action depends upon the projection of a narrow ribbon-shaped jet of air against a microscope cover glass at such a velocity that a marked fall of pressure occurs with adiabatic expansion and cooling of the jet and consequent condensation of water, supplied from a damping chamber, upon the dust particles and the cover glass where the jet impinges. This results in the dust particles being projected against the cover glass by virtue of their greater density, and their increase of mass due to the condensed water. They adhere to the glass as the water evaporates, leaving a linear trace of dust, which can be examined microscopically and counted.

Simultaneous observations were taken with both instruments, and the results plotted in Fig. 2. From this curve it is evident that there is a reasonably constant relation between the number of particles per cubic centimetre, and the weight of impurity in milligrammes per cubic metre as given by the automatic recorder.

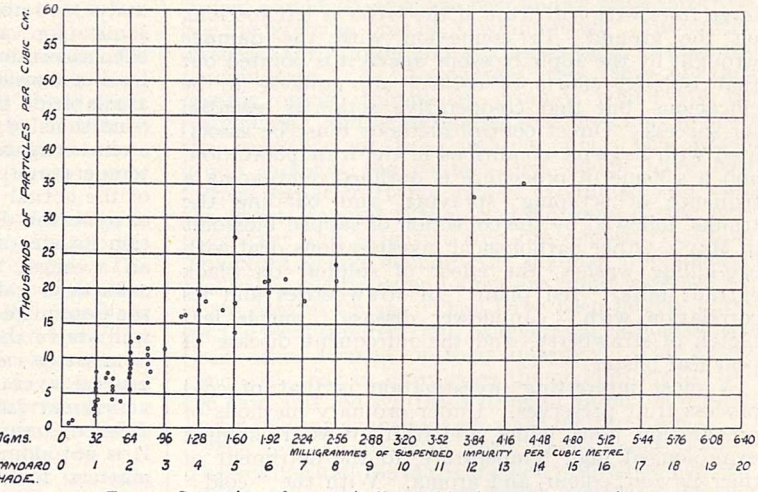

FIG. 2.—Comparison of automatic filter and jet dust counter records.

This indicates a tendency towards uniformity in size of the particles at different times, but there is also a definite departure from such uniformity during thick smoke haze when the average size increases, doubtless due to insufficient time for separation by

[2] Proc. Roy. Soc. A, vol. 101, 1922.

settlement. The maximum diameter of smoke particles in the absence of thick smoke haze is about 1½ microns, while during thick smoke haze the maximum reaches about 3 microns. Fig. 2 shows that the relation in London between number and weight of particles is usually such that 10,000 particles per c.c. corresponds to 1 mg. per cubic metre. It is not suggested that this relation holds good for all types of dust, but it shows that the automatic recorder gives trustworthy comparative results for city air, where the colour of the suspended particles is usually black.

Horticultural Research.

THE growing recognition of the importance of research work in connexion with the fruit industry is emphasised by the Annual Report issued by the National Fruit and Cider Institute at Long Ashton, Bristol. The year 1923 was the first since the outbreak of the War in which the work could be conducted under relatively settled and stable conditions, and it was marked by steady progress as regards both advisory and research work. The direct and practical bearing of the research work upon the current problems of fruit growers is very noticeable, and though many of the results are still preliminary or tentative, they open up suggestive lines for future progress.

The manurial experiments on fruit trees in pot cultures have been continued to study the effect upon growth of the omission of the various essential elements in turn. Leaf scorch affected many of the plants, but an increase in the amount of potash entirely prevented the development of scorch, while a reduction of nitrogen retarded it and reduced its amount. An examination of the root systems of various fruit trees shows that under many systems of planting there must be considerable overlapping of roots, introducing a serious element of competition which probably acts as a severe check to growth in many cases. This research is being continued in connexion with the danger of planting up orchards of large trees with soft fruit, if the latter is left too long on the ground. In connexion with the damage wrought by the apple blossom weevil it is pointed out that isolated efforts of control are unlikely to be efficacious, but that co-operative action is essential for success. Direct control methods must be associated with hygienic conditions in the fruit plantation, and a scheme of procedure is outlined, embracing a sequence of scraping, spraying, and banding the trunks, followed by the collection of capped blossoms in May. Other pathological investigations deal with egg-killing washes, the effect of sulphur on black currant mite, "red plant" in strawberries and its correlation with "cauliflower disease," purple leaf blotch of strawberry, and the infrequent disease of pear leaf blister.

A most interesting investigation is that of cold process fruit preserves. Under ordinary methods of preparation, jams, jellies, and fruit juices are subject to prolonged high temperature, to the detriment of their flavour, colour, and aroma. With the "cold" method the consistency of the product must be such that micro-organisms do not develop, a condition that can be secured by increasing the sugar content to 62-65 per cent., or less if the acidity of the fruit is high. Jellies and fruit juices give very satisfactory results, but more difficulty is experienced with the jams. Large-scale trials are being made to determine whether these methods are suitable for development under commercial conditions.

Another aspect of the work is shown by experiments on the "buffing" of willows, a process whereby, after prolonged boiling in water, a mineral-brown colour is imparted to the wood of willow rods. Freshly cut willow rods can only be peeled for a short time in the spring, owing to the rapid production of new wood which interferes with satisfactory peeling. "Buffed" rods can be peeled throughout the year, and the introduction of the process has been of great importance to the growers and to the basket industry. Improved methods are being sought and possibilities of industrial application worked out.

The chief lines of work at the Fruit and Cider Institute have been touched on above, but various other researches are being carried out, some of which may lead to more extended inquiries in the future, and others are of importance in their relation to the main investigations.

Problems of Human Nutrition.

THE investigation of human nutrition dealt with in the report before us [1] was undertaken in the autumn of 1922 during a period of depression for those engaged in the coal mining industry. Details regarding the actual food consumption were obtained from 140 families distributed in five different counties. The general result of the inquiry shows that though the average consumption of food in Derbyshire was sufficient for a healthy life when judged by accepted standards, the average diets in Northumberland, Lancashire, Stirlingshire, and in particular Durham, were not so satisfactory. In the latter county the weight of the miners' children was slightly below the county average, though it seems probable that factors other than a deficient diet may have been partly responsible for this. The Committee is cautious in drawing conclusions, since the number of families investigated was not large, and it was recognised that the method adopted of reducing each family to the equivalent of "average men" for the purpose of assessing the nutritional value of the family diet is not free from objection.

The Committee has assumed that the average daily food requirement of a miner is equivalent to some 3400 calories. This figure has, however, not been ascertained by direct observation, but is inferred from a consideration of the numerous data already available on the energy output of man under different conditions of rest and work. Prof. K. N. Moss, in an investigation of the effects of high underground temperatures on the miner, has recently given details of the actual food consumption of a selected number of miners in different districts who had a high reputation for steadiness and industry. These figures show an average daily energy intake of well over 4000 calories, a value much in excess of that assumed by the Committee. Moss's selected subjects were clearly well above the general average, but if we regard the Committee's estimate as approximately true for this general average, it is apparent that there may be very great differences of energy expenditure between different individuals employed in the same industry. It is not alone the actual work done in the mine that matters, for much energy may be expended by the miner in walking to and from his work and in recreation in his spare time: as regards the last two items there is the possibility of great individual and local variations.

It is evident that further investigation is required regarding the actual energy output under everyday conditions not only of miners, but also of workmen in

[1] Medical Research Council. Reports of the Committee upon Quantitative Problems in Human Nutrition: Report on the Nutrition of Miners and their Families. Pp. 59. (London: H.M. Stationery Office, 1924.) 1s. 3d. net.

other industries involving heavy manual labour. So long as uncertainty prevails as to the true energy requirements of the individual, the assessment of the nutritional value of the family diet in the manner adopted by the Committee cannot acquire its full value. In times of financial stress the full diet of the wage-earner may have to be maintained at the expense of other members of his family, and the children may in the end be the real sufferers. It is to be hoped that the Report of the Committee is but the prelude to further investigations which will dispel the obscurity which still surrounds some of the important practical problems of human nutrition. The work is bound to be very arduous, but it is worth doing, for apart from its value to the physiologist it has a direct bearing on modern economic questions.

Haddock Biology.

MR. HAROLD THOMPSON has made a useful contribution to our knowledge of the life-history of the haddock in the report before us.[1] This fish is of increasing commercial value, and its abundance fluctuates considerably from year to year. By the researches which Mr. Thompson describes, he certainly brings nearer the time when the causes of these fluctuations will be better understood, and he foreshadows the possibility of being able to predict for two or three years ahead any special scarcity or abundance of the fish in a particular area such as the North Sea.

Great importance has been attached to the accurate determination of the age of the fish. For the haddock it has long been recognised that the most trustworthy determinations of age can be got by studying the markings on the scales. The author has, however, subjected the whole method of age determination in this fish by means of the scales to a minute and critical examination, and especially has been at great pains to study scales taken from many different parts of the body. This careful but tedious examination has justified the methods employed, and the satisfactory conclusion has been reached, that if a few normally shaped scales be taken from a haddock, it is possible in about 95 per cent. of cases to read the age from the number of annual zones marked on them; and further, that by measuring these zones and comparing their length with the total length of the scale in each instance, one can calculate the sizes attained by the fish at the end of each previous year of its life.

The author considers that North Sea haddock grow on the average 17·5 cm. in the first year, though the range of size is considerable, from 11 to 21 cm. The greatest growth in this, as in other years, takes place in the autumn, and growth practically ceases in November, when the scale has formed about 22 rings (sclerites). The first scales make their appearance when the fry are about 3 cm. long. In 1922 and 1921, yearling haddock were sparsely represented in the North Sea, but the 1920 brood was extremely abundant, as shown by the prolific numbers of one-year-old fish in 1921 and two-year-old fish in 1922, in the later months of which year they formed the mainstay of the Aberdeen market haddock supply. The year 1904 was a similar good brood year for haddock and was followed by an abundant fishery of three-year-old fish in 1907.

The rate of growth of the haddock varies in different regions. In the same latitude the best grown fish are found in shallower and warmer water, whereas there is a diminution in growth rate with increase of the depth from which they are captured. South Iceland and Faroe haddock exhibit faster growth than those captured in the North Sea and off the northern coasts of Scotland, for there favourable temperature conditions occur throughout the year, and the temperatures are so much less variable that it is often difficult to note the annual zones on the scales.

The paper is a valuable contribution to the literature of British fisheries.

[1] "Fishery Board for Scotland: Scientific Investigations, 1922. No. 5: Problems in Haddock Biology, with Special Reference to the Validity and Utilisation of the Scale Theory. I: Preliminary Report." By Harold Thompson. Pp. ii+78+3 plates. (Edinburgh and London: H.M. Stationery Office, 1923.) 7s. net.

The Iron Ores of China.

THE widespread distribution of local iron smelting in China led to the general belief that China possesses some of the greatest reserves of iron ore in the world. More careful investigation has failed to confirm some of the earlier estimates, and has led to the under-rating of the quantity of available Chinese iron ores. The series of Memoirs on the iron ores and iron industries of China, of which the first part by F. R. Tegengren has been issued by the Geological Survey of China,[1] will correct the wild statements that have been made on both sides. The first part deals mainly with the ores of the northern and eastern provinces, and is accompanied by 16 plates and a folio atlas including 39 maps. The first map, in which the names are conveniently given both in English and Chinese, shows the general distribution of the iron ores in eastern China. It does not mark those in far western China, where there are many primitive furnaces which smelt iron for their neighbourhood. Their supplies of ore are ample, but are too remote to be of service except locally at the present time.

The Chinese iron ores are of three main types. The first type comprises the pre-Cambrian bedded ores, including the banded quartzitic ironstones that are widely spread in western Australia, India, and South Africa. Of the pre-Cambrian ores the most interesting geologically are the stromatolitic ironstones, of which one of the best known representatives are the Wabana ores of Newfoundland. The author discusses their origin and attributes them to chemical precipitation; he discourages the view of their organic origin, though on grounds which are not convincing; and he recognises that they may indicate the existence of pre-Cambrian life. The second group includes the contact ores which have been formed beside intrusive masses of granodiorite along the lower Yangtze; they include some of the most important and extensive iron ore deposits in China. The third group includes the nodular ironstones of the Palæozoic rocks and they are found especially in north central China. They have been largely mined for the local smelters, and exaggerated estimates have been often formed of their quantity. The author concludes that in most cases the nodules are in beds too thin and too scattered to be of value for working under present conditions on an extensive scale.

The text is issued in both English and Chinese. The volume and the maps are well printed and edited; misprints, such as are probably inevitable when a work by a Swedish author is issued in English and printed in China, are commendably few, though the reversal of the headings of phosphorus and silica in the table on p. 38 gives at first a startling aspect to the analyses. The subsequent parts of this important memoir will include a summary of the distribution of the iron ores of the circum-Pacific region. J. W. G.

[1] "The Iron Ores and Iron Industry of China, including a summary of the iron situation of the Circum-Pacific Region." By F. R. Tegengren, Mem. Geol. Surv. China, Ser. A, No. 2, Pt. I., 1921–23, 180 pp., 16 pls. Accompanied by Atlas of 39 maps. Also Chinese Text.

University and Educational Intelligence.

APPLICATIONS are invited for two professorships in the Latvian University at Riga, namely, astronomy and theoretical mechanics, and geology and palæontology, the duties of which will date from January 1 next. The appointments will be for five years only, as at the end of that period the lectures will be delivered in the Latvian language. Applications for the posts should be sent to reach the Dean of the Mathematical-Natural Science Faculty of the University not later than November 1.

THE University of London Commerce Degree Bureau and Appointments Board has issued a useful little pamphlet entitled "Information as to Appointments and Careers for Graduates and Students." It has nineteen chapters on as many different classes of occupation — Teaching, Commerce and Industry, Civil Service, The Church, Law, Medicine, etc.—and concludes with a bibliography and "list of useful addresses." Copies are obtainable (price 1*s.*, post free; to members of the University of London, 6*d.*) from the Secretary of the Board, 46 Russell Square, London, W.C.1.

EDUCATION in relation to foundry work forms the subject of a useful report drawn up for the Board of Education by one of H.M. Inspectors, with the advice and assistance of Profs. C. H. Desch and C. A. Edwards. The unsatisfactory conditions affecting recruitment and training in the foundry trades have for some time engaged the attention of the British Cast Iron Research Association, the Non-Ferrous Metals Research Association, and other bodies. Unless these are improved, the general standard of foundries in Great Britain, even now lower than in the United States and several countries in Europe, is bound to deteriorate.

THE Indian Universities Conference held in Simla last May is the subject of an article in the June issue of the *Indian Review* by Mr. P. J. Hartog, Vice-Chancellor of the University of Dacca, formerly Academic Registrar of the University of London. One of the most important of the 44 resolutions passed by the conference was one proposing the establishment of an Advisory Board for Scientific Research, to comprise the heads of the scientific departments of the Government of India and a representative of science nominated by each of the Indian universities and by the Indian Institute of Science, Bangalore, with powers to co-opt representatives of other recognised institutes of science not affiliated to any university. There already exists a committee for medical research in India which has accomplished valuable work, showing that co-operation of this kind is practicable in India. Mr. Hartog infers, from the sympathetic reference made to the project by the Member for Education, that it may be realised at an early date. Commenting on the unanimous decision of the conference to request the Government to exempt scientific apparatus and chemicals for universities and other approved educational institutions from the payment of the 15 per cent. customs duty, Mr. Hartog remarks: "It seems absurd that while the charge on power-driven machinery is only two and a half per cent., that on brain-driven machinery is six times as great. The educational industry in India is a key industry, I might say the master-key industry, which perhaps needs more encouragement than any other."

THE purpose of education in schools is discussed at some length by the president of the Carnegie Foundation for the Advancement of Teaching in his annual report for 1922–23. The educational revolution which has produced a great machine for the many in place of a personal direct agency for the few has brought with it certain dangers. The school began as an agency for the development of the individual, for the discipline of the mind and character, by methods involving intimate touch between teacher and pupil. The machinery of organisation necessary for giving effect to the modern doctrine of universal compulsory education tends to obscure this purpose and the fundamental truth, stressed by the Archbishop of York in his address on April 21 to the National Union of Teachers, that in the development of a human soul it is not the amount of information absorbed that counts, but the ability to think clearly and to bring out the right answers to the problems that present themselves in after life. For this the school is dependent on living contact between the growing mind of the child and the cultivated mind of a teacher whose primary qualifications must be intellectual sincerity and moral simplicity and thoroughness. Paul Klapper, Dean of the College of Education of the College of the City of New York, has contributed to the March-April number of the *American Review* an article on "Educational Aims and Social Progress," in which he similarly urges that education should "make power rather than information its final hope." This conception of the function of the school implies a demand for the critical examination and, when necessary, simplification of existing curricula and limitation of the size of classes.

THE London County Council has issued a Handbook of the lectures and classes for teachers which have been arranged for the season 1924–1925. These lectures play an important part in connexion with the education of the Londoner. The successful teacher must always remain a student, and these lectures are designed to bring him into touch with the latest developments in educational methods and to give him opportunities of hearing leading authorities on their own subjects. Any person engaged in teaching in London is eligible for admission at fees which average less than 1*s.* a lecture, while out-county teachers and others are admitted at fees 50 per cent. higher. The lectures scheme is self-supporting, and last year the attendance was more than 16,000. Among the courses and lectures of interest to scientific workers are the following: Prof. C. K. Tinkler (6), on fuels and ventilation; Prof. A. Morley Davies (6), on the geology and geography of the London basin; Prof. E. J. Garwood (10), on the scenery of Switzerland and its origin; Prof. E. H. Neville (6), on the elements of the theory of curvature and curvilinear co-ordinates; Mr. P. Abbott (10), on the teaching of arithmetic; Prof. T. P. Nunn (9), on the teaching of mathematics, trigonometry, and map-projection, and (5), on the teaching of physical science; Dr. C. W. Kimmins (3), on modern movements in education; Mr. W. H. Winch (3), on the conditions of valid experiment in pedagogical methods; Dr. F. H. Hayward (5), on individual versus mass methods in education; Prof. Cyril Burt (5), on mental and scholastic tests; Dr. Charles Singer (10), on the history of science; Prof. C. A. Carus-Wilson (5), on the teaching of science in secondary schools; Capt. P. P. Eckersley (4), on wireless telephony and broadcasting; Mr. Richard Kearton (5), on wild life round London; Maj. T. F. Chipp (5), on Kew Gardens. Special single lectures are to be given by Sir Ronald Ross on malaria and mosquitoes (October 4), and by Prof. Karl Pearson on the relationship of mind and body (November 15). Copies of the Handbook can be obtained from the County Hall, Westminster Bridge, London, S.E.1.

Early Science at the Royal Society.

August 30, 1663. Mr. Colwall gave in an account which he had received in a letter from the governor of St. Helena, concerning the tides, winds, springs, spouts, and weather there.—Mr. Colwall also mentioned, that Mr. Thorowgood, a master of a ship, who had received instructions from the society for the East-Indies was returned, and had some account to give of what he had done for the society in his voyage; which he was desired to bring in.—Mr. Hooke produced his explications of the new sounding instrument, and of the vessel, that fetched water from the bottom of the sea; and of the engine for determining the force of gunpowder by weight. He was directed to draw the figures in great against the next meeting.

1666. Sir Theodore de Vaux produced some papers, which were read, containing a relation of a furred robe, made of the skin of the Tartarian boramez, supposed to be a plant animal; which robe was said in that paper to be kept in the library at Oxford, to which it was given by Sir Richard Lea, ambassador in Russia in the reign of Queen Elizabeth. Dr. Wren was desired to inform himself concerning this robe, and to view it on his return to Oxford.—Sir Robert Moray mentioned, that the King had been discoursing of ant's eggs, and inquiring how they came to that bigness, which sometimes exceeded that of the insect itself.

September 2, 1663. The experiments of closing up of gunpowder, *Aurum fulminans*, and water, in three balls of steel severally, being again made; and that with gunpowder alone being fired and broken, it was debated, what might be the cause, that the gunpowder should fire, and not the gold powder; the latter being the stronger of the two?—Some conceived, that a sulphureous matter might exude out of the heated steel, and be communicated to the gold powder, whereby its fulminating virtue might be deadned.—Others thought, that this powder might fire within the ball (having left some air in it, because not filled full with the powder) and the noise not be heard at a distance. Others were of opinion, that the penning it in, and giving it but a slow heat, might make it melt. It was ordered hereupon, that the operator should bespeak two balls with cavities no bigger than a pea, to fill them full severally with *Aurum fulminans* and gunpowder.

September 3, 1662. The president gave an account to the society of his and the council's address to the King in the name of the society, to return their humble thanks to his majesty for his favour in establishing them into a corporation by his letter patent; with his majesty's answer of his peculiar esteem of the society, and his readiness to give them all due encouragement: as likewise of their address of thanks to the lord chancellor [Clarendon] for his readiness to further that business; by whom they were very favourably received, and assured, that it was his purpose to come himself to the society to express his acknowledgments to them.

September 4, 1661. A proposition of Mr. Hobbes for finding two mean proportionals between two strait lines given, was delivered into the society by Sir Paul Neile from the king, indorsed with his majesty's own hand, and was ordered to be registered; as was afterwards the answer to the problem, by lord viscount Brouncker.—Mr. Wren was desired likewise to deliver a copy of his observations and hypothesis of Saturn to the amanuensis, to be transmitted by Sir Kenelme Digby to Monsieur Frenich.—It was ordered that a collection of all quicksilver experiments be made, examined, and brought in by Mr. Oldenburg.

Societies and Academies.

PARIS.

Academy of Sciences, July 28.—M. Guillaume Bigourdan in the chair.—Charles **Moureu**, Charles **Dufraisse**, and Marius **Badoche**: Auto-oxidation and antioxygen action. The catalytic properties of sulphur and its compounds: generalisation of the phenomenon. A detailed study of the action of sulphur and its compounds in the catalysis of auto-oxidation. Six oxidisable compounds were selected and a large number of inorganic and organic compounds of sulphur taken as catalysts. A summary of the more important results with benzaldehyde, acrolein, styrolene, turpentine, linseed oil, and sodium sulphite is given.—J. **Bordet**: The current theories of anaphylaxy. A critical review of the various theories which have been put forward to explain anaphylactic shock.—Henri **Jumelle**: Neodypsis and Chrysalidocarpus, palm trees of Madagascar.—F. **Gau**: The equation of the deformation of surfaces.—**Siegle** and **Cretin**: The elastic limit and resistance of annealed mild steels in the case of combined traction and torsion.—Th. **Vautier**: The propagation of explosive waves. An account of experiments on the transmission of sound waves in a tube one metre in diameter and several kilometres in length.—J. **Cayrel**: The influence of the pressure on the working of wireless detectors with solid contact. The pressure should be such that the mean resistance of the detector is of the same order of magnitude as the impedance of the circuit associated with the detector. If the impedance of the circuit is high the pressure should be small.—F. **Wolfers**: Interference by diffusion.—P. **Lebeau** and M. **Picon**: The action of heat and a vacuum on artificial graphite. In an apparatus described in an earlier paper the authors have utilised an electrically heated graphite tube. A preliminary study of the tube was necessary to determine the nature and amounts of the gases given up to a vacuum on heating. The present communication gives the results obtained.—Robert **Stumper**: The kinetic study of the decomposition of calcium bicarbonate in aqueous solution by heat.—Mlle. Jeanne **Liquier**: The anomalous rotatory dispersion of acid solutions of nicotine in relation with the concentration in hydrogen ions.—C. **Matignon** and C. **Faurholt**: A new synthesis of oxalic acid. At a temperature of about 470° C. and under a pressure of about 240 atmospheres, carbon monoxide reacts with potassium carbonate and some potassium oxalate is formed. The highest yield was 27 per cent. of potassium oxalate.—A. **Cornillot**: The constitution of phthalonic acid. Researches on its combinations with aniline. In the reactions studied, phthalonic acid reacts principally as an oxylactone, but a small proportion is clearly shown to react in the ketonic form.—Mme. Pauline **Ramart**: Molecular transpositions. The preparation and dehydration of 1 : 1 : 3-triphenyl-2 : 2-dimethyl-1-propanol. This compound on heating to 325° C. in the presence of infusorial earth gives isobutylbenzene and benzophenone; dehydrated with acetic anhydride and acetyl chloride, two isomeric hydrocarbons, $C_{23}H_{22}$, are produced.—E. **Asselberghs**: The existence of a fault in the French Ardennes.—J. **Savornin**: Geology of the Haut Guir and of the Moyenne Moulouya (Morocco).—L. **Gazaud**: Zones of silence. The zone of direct hearing, concentric with a focus of sound emission, is of very limited range; the zone which succeeds it is alternately one of hearing or of silence according to the presence or absence of high compact clouds.—Ph. **Schereschewsky** and Ph. **Wehrlé**: Perturbation currents and the polar front.—H. **Colin**

and A. **Grandsire**: Green leaves and chlorotic leaves: the ternary materials.—I. A. **Christiansen**, G. **Hevesy** and Sn. **Lomholt**: Researches by a radio-chemical method on the circulation of lead in the organism. There is an essential difference between the results obtained with bismuth and with lead. The quantities of lead accumulated in the liver and eliminated by the fæces are greater, at the expense of the amounts found in the kidneys and urine. With bismuth the latter organs play the principal part in elimination. —A. **Fernbach** and I. **Stoleru**: The influence of the reaction of the medium on the antiseptic properties of the hop. The antiseptic power of hops depends essentially on the hydrogen ion concentration of the culture medium.—E. **Kayser** and H. **Delaval**: Contribution to the study of wine yeasts.—Henri **Stassano** and A. **Rollet**: The carbonic acid removed from milk by the usual method of pasteurisation. The advantage of treatment in a closed circuit.—A. **Demolon** and Mlle. V. **Dupont**: The resistance of soils to acidification.—R. **Argaud** and D. **Clermont**: The glandular behaviour of the chordome.—Robert Ph. **Dollfus**: Polyxenia and progenesis of the metacercaria larva of *Pleurogenes medians*.

CAPE TOWN.

Royal Society of South Africa, July 16.—Dr. A. Ogg, president, in the chair.—D. J. **Malan** and D. E. **Malan**: The spermatogenesis of *Locustana pardalina* (Walker). (The Brown Trek Locust.) The chromosome numbers in more than 40 genera of locusts have been worked out, and in practically all cases it has been found that $2n = 23$ (male) and 24 (female). The few exceptions could all be accounted for by secondary linkage of non-homologous chromosomes.—H. O. **Monnig**: A new trichostrongylus from South African sheep. A description is given of *Trichostrongylus rugatus* n. sp. which occurs in the first 8 to 12 feet of the small intestine in South African sheep.—K. H. **Barnard**: The digestive canal of Isopod Crustaceans. The stomach (fore-gut) in a large number of Isopods of various families has been compared with that of Ligia, which may be taken as a basic type. A general agreement exists between the stomachs of omnivorous or herbivorous forms and those of parasitic forms, but with certain modifications due to the physiological differences in the mode of obtaining nourishment.—John **Hewitt**: Facts and theories on the distribution of scorpions in South Africa. The prevalence of primitive types in South Africa seems definitely against the probability of a South African origin for the families concerned. Assuming that the region of greatest differentiation of a group is its centre of dispersal, then we must look to Eurasia as the immediate source of scorpion fauna. But in most of the genera we find clear evidence of local evolution. These centres are different for different genera. Lines of gradational series of forms are explained as phylogenetic series ranged along former routes of migration, the simplest and oldest forms having migrated farthest from the centre of origin.—A. W. **Veater**: (1) Note on covariants and invariants of binary quantics. (2) Note on differential invariants of the group of homographic transformation of a plane and of certain sub-groups.

SYDNEY.

Royal Society of New South Wales, July 2.—Dr. C. Anderson, president, in the chair.—A. R. **Penfold**: The essential oil of *Backhousia sciadophora* (N.O. Myrtaceæ) F.v.M. The leaves and terminal branchlets yielded about 0·3 per cent. of a dark brown oil, which was found to contain about 80-85 per cent. *d-a*-pinene, the remainder being sesquiterpene, sesquiterpene alcohol, with small quantities of phenol and caprylic acid ester. The constants obtained were as follows: Specific gravity, 15/15° C., 0·8799-8802; optical rotation, +33·7-34·2°; refractive index, 20° C., 1·4704 to 1·4717; solubility in 80 per cent. alcohol, insoluble in 10 volumes.—A. R. **Penfold** and R. **Grant**: The germicidal values of the pure constituents of Australian essential oils, together with those for some essential oil isolates and synthetics. The Rideal-Walker tests were carried out as described in previous communications, the following results being obtained: Linalool (13), linalyl acetate (5·25), coumarin (4), vanillin (3·5), isoemethone (14), methyl eugenol ether (13·5), darwinol (13), darwinol acetate (3), bornyl acetate (6), amyl salicylate (4), benzyl alcohol (5·25), benzyl acetate (2), benzaldehyde (9), anthranilic acid (aqueous solution, 2, ethyl alcohol, 12), methyl anthranilate (6·5), anethole (11), anisaldehyde (7), cinnamic aldehyde (17), menthol (synthetic) (20), menthol (natural) (20), valerianic acid (2), ethyl valerianate (4·5), propyl valerianate (8), butyl valerianate (10), isobutyl valerianate (8·5), amyl valerianate (5), menthyl valerianate (3), benzyl valerianate (6), phenyl ethyl valerianate (4), geranyl valerianate (2), rhodinyl valerianate (1), citronellyl valerianate (2).—A. R. **Penfold** and F. R. **Morrison**: Notes on *Eucalyptus piperita* and its essential oils, with special reference to their piperitone content, part i. The leaves and terminal branchlets yielded from 2 to 2·5 per cent. of pale yellow oil possessing the following constants: Specific gravity, 15/15° C., 0·8924-0·9016; optical rotation, −52° to −64·6°; refractive index, 20° C., 1·4805-1·4821; solubility in 70 per cent. alcohol, 1 in 5·3 to 9 volumes; piperitone contents, 42-48 per cent. These results are considerably different from anything that has previously been published respecting this species, and the authors have come to the conclusion that there are two forms of this tree. It is the first time that the composition of the oil, as obtained by Surgeon-General White in 1788 from trees of this species growing around Sydney (considered to be the type), has been revealed, the results published by Baker and Smith from material obtained outside of the Port Jackson district being from another form of the species, now termed the mountain form or variety "A." This latter has been found to yield only 0·6 to 0·8 per cent. of oil containing less than 10 per cent. piperitone.

Official Publications Received.

Supplement to the Journal of the Indian Mathematical Society, Vol. 15. Report of the Fourth Conference of the Indian Mathematical Society, held at Poona in April 1924. Pp. ii+32. (Madras: Indian Mathematical Society.)

The North of Scotland College of Agriculture. Calendar, Session 1924-1925. Pp. viii+164+xxiii. (Aberdeen.)

Diary of Societies.

THURSDAY, SEPTEMBER 4.

IRON AND STEEL INSTITUTE (at British Empire Exhibition), at 10.30 A.M.—L. Aitchison and G. R. Woodvine: Changes of Volume of Steels during Heat Treatment.—C. Benedicks and V. Christiansen: Investigations on the Herbert Pendulum Hardness Tester.—E. D. Campbell and G. W. Whitney: The Effect of Changes in Total Carbon and in the Condition of Carbides on the Specific Resistance and on some Magnetic Properties of Steel.—Prof. C. A. Edwards: Pickling: The Action of Acid Solutions on Mild Steel, and the Diffusion of Hydrogen through the Metal.—Dr. J. Newton Friend and W. E. Thorneycroft: Examination of Iron from Konarak.—M. A. Grossman and E. C. Bain: The Nature of High-Speed Steel.—A. Hultgren: Improvements in the Brinell Test on Hardened Steel, including a New Method of producing Hard Steel Balls.—Dr. W. Rosenhain: Present Position of the Theories of the Hardening of Steel.—F. C. Thompson and W. E. W. Millington: The Effect of Free Surfaces on the Plastic Deformation of Certain Metals.—Ferrous Alloys Research:—Part I. Introductory, Dr. W. Rosenhain; Part II. Iron and Oxygen, F. S. Tritton and Dr. D. Hanson; Part III. The Estimation of Oxygen in Pure Iron, T. E. Rooney. (Papers 6, 1, 4, 9 will be read and discussed.)

FRIDAY, SEPTEMBER 5.

IRON AND STEEL INSTITUTE (at British Empire Exhibition), at 10.30 A.M.—(Papers 10, 8, 7, 2 from list given above will be read and discussed.)