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The New Smoke Abatement Bill.

THE new Government bill to prevent the pollution of the atmosphere by smoke again raises the vexed question of the best means of accomplishing this highly desirable result. That the bill, which merely modifies the existing Act of 1875, will leave matters very much as they are, is, however, the considered opinion of those who framed the recommendations of the Departmental Smoke Abatement Committee appointed by the Ministry of Health.

Two years ago an interim report on the prevention of domestic smoke was prepared at the pressing request of the Minister of Health in view of the large housing schemes in contemplation, only to lie dormant in the department.

It is perhaps not sufficiently realised how much of the dirt and damage in our large industrial centres arises from the domestic hearth. In spite of pious opinions to the contrary, it has been established, from carefully ascertained facts, by two independent observers, that of the 2½ million tons of soot turned into the atmosphere something like four-fifths is emitted from domestic chimneys. But that is not all. This incompletely burnt material, formed to some extent by a process of destructive distillation, such as takes place in gas retorts, is charged with tar, whereby it clings to every object with which it comes into contact. Moreover, the tarry soot is strongly acid with sulphuric acid, and its presence on the mortar and masonry of buildings soon shows itself by their gradual disintegration. The evidence of Sir Frank Baines, the head of H.M. Board of Works, was convincing in this respect, and his specimens and photographs exhibited during the inquiry illustrated in a striking manner the conversion of the calcium carbonate (which cement the siliceous particles of the original stone) into the soluble calcium sulphate and the subsequent crumbling of the surface.

Furnace smoke, on the other hand, owing to its higher temperature of combustion, contains a negligible amount of tar; but consists of fine cinder and grit discharged mechanically by the draught. It is true that it darkens the atmosphere, but it does not adhere to any extent, and much of it is washed away by rain.

To return then to domestic smoke. In a brochure recently published and entitled "The Smokeless City,"[1] Mr. E. D. Simon, a member of the Government Committee and present Lord Mayor of Manchester, and Miss Marion Fitzgerald, his collaborator, have put together the principal facts relating to domestic heating and domestic smoke. The information is drawn partly from the evidence of witnesses who appeared before the committee, partly from the reports of Mr. A. H.

[1] "The Smokeless City," by E. D. Simon and Marion Fitzgerald. Pp. xi+82. London: Longmans, Green and Co., 1922. 1*s.* 6*d.*

Barker and Dr. Margaret Fishenden on the efficiency of various forms of grates and kitchen-ranges (already reviewed in these columns), and partly on statistics collected by the Manchester Air Pollution Advisory Board (of which Mr. Simon is chairman) on the cost of washing, a sum estimated at 250,000*l.* a year. The subject is introduced in a preface by Lord Newton, who acted as chairman of the Departmental Committee, and has given time and thought and a sustained and disinterested enthusiasm not often associated in the minds of most people with members of the Upper House. He has even travelled abroad with the sole object of learning how smoke was successfully controlled or prevented in foreign cities.

It is hoped that Lord Newton's pungent remarks on governments—parliamentary and municipal—may be read in the right quarter. He says: "The battle . . . against industrial smoke may be said to have been won in principle, but it is scarcely necessary to warn enthusiasts that there are many parliamentary dangers to be overcome, and that governments are not as a rule particularly zealous in forcing through bills of a non-vote-catching nature."

If the object of the authors was to make out a case against domestic smoke by demonstrating in clear and incisive language, backed by carefully ascertained statistics, its wastefulness and uselessness and the damage it entails, which may be reckoned in millions of pounds annually, the little volume before us may be said to have more than accomplished its purpose. It is now for the public to read the case presented by the authors, take it to heart, and put the conclusions to practical use. The authors have not restricted their remarks to destructive criticism of present methods and appliances for heating and cooking. They have shown a better way. Though they condemn, as all witnesses condemned, the old-fashioned open range, they have described and illustrated modern ranges and discussed their efficiency for varied requirements. They explain in simple language the comparative value of coal, coke, and semi-coke (low-temperature coke) and the relative cost of gas and coal. The book does not profess to be a scientific treatise, and a good deal of recent research on the use of gas for cooking and on the subject of ventilation has been overlooked; but this is no drawback. It is intended for householders, builders, and architects, to whom an appeal based on scientific principles would be incomprehensible and almost certainly unread.

As the new bill excludes all domestic fireplaces and largely ignores the recommendations of the Departmental Committee in regard to new housing construction, it is well that the authors of "The Smokeless City" have saved from the eternal silence of Ministerial pigeon-holes the accumulated and valuable evidence of so many expert witnesses.

Leaving then the subject of domestic smoke, we may consider for a moment the improvements and defects in the new bill. The amendments are few; the qualification of the indefinite term "black" is omitted, and the expression "smoke" includes soot, ash, and grit; the maximum penalty is raised from 5*l.* to 50*l.*, and the person summoned under the Act must show in his defence that he has used "the best practicable means." On the other hand, there is no reference to the supervision of heating arrangements in new private dwellings but only in public buildings; there is no attempt to standardise the system of inspection of factory chimneys, strongly advocated by the representative of the Sanitary Inspectors' Association; no clear definition of the powers of the central authority; no combination of large areas under the County or Borough Councils; no inclusion of new processes emitting noxious vapours; no provision for competent scientific advisors and supervisors appointed by the Ministry of Health to control and report—in short, the position remains very much *in statu quo*, and the prevention of smoke in industrial areas still remains in the incompetent hands of the local authority, without pressure from the central authority.

The only hope for salvation lies in the energetic action of a disinterested sanitary committee and its medical officer. As the two are linked together, and the smoke inspector harnessed to them, and as members of the sanitary committee are usually interested in manufacture and factory chimneys, the prospect of amelioration is not bright. But if such a disinterested sanitary committee, intent on the purification of its atmosphere, existed, it would reduce boiler smoke to a negligible amount (and the greater part of the factory smoke comes from boilers); it would have a building to exhibit the best appliances for domestic heating and cooking; afford details of the cost of installation and efficiency; it would promote classes for stokers, and appoint an expert, scientifically trained, and well-paid inspector. Such an ideal committee would within a short period render the atmosphere comparable with that of the clean industrial centres of France or Germany.

J. B. COHEN.

The Earth's Structure and its Evolution.

Earth Evolution and its Facial Expression. By Prof. W. H. Hobbs. Pp. xviii+178. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1922.) 15*s.* net.

THIS volume is intended to present to the non-technical reader the author's conclusions on the form and structure of the earth's crust. The

contents may be summarised as follows. The first chapter deals with some theories of world formation, Laplace's nebular hypothesis being a special object of attack. The second chapter discusses the nature of the earth's interior, after which four chapters relate to the facts and problems connected with volcanic lava. A broader viewpoint is returned to in chapter 7, which treats of the changes of figure through which the earth has passed; this subject is further developed in the following five chapters, the titles of which refer to the present regions of rapid change, the contrasted aspects of the earth's face, the migrational movements of the earth's surface, the patterns of the "facial wrinkles," and the design of the fracture marquetry. The bearing of the composition of lavas on the question of earth physiognomy is then dealt with, and the final (fourteenth) chapter again reviews the theories of the earth. The author gives a list of references at the end of each chapter to works and papers on the subject of the chapter, but no general index of names or subjects is provided, an omission which should be supplied if a second edition is called for.

Despite the somewhat terrifying vocabulary of the geologist, the book contrives to be interesting, and one of its most commendable features is its wealth of illustration, by diagrams, maps, and photographs. The discussion is of a less broad and comprehensive character than the title would lead one to expect, the balance of the book being rather upset by the prominence given to the vulcanological topics in which the author is specially interested. In themselves, however, these chapters contain some of the most novel and interesting parts of the book.

A more serious criticism than that of the title is that the author makes no mention of much important recent work bearing on his subject, as, for example, when dealing with general theories of earth formation, where one is surprised to find nothing about Jeans's cosmogonic researches. The author is particularly concerned to overthrow the notion, based on observations of volcanic lava, that the earth's interior is molten, only the crust being solid. This view has been generally abandoned by geophysicists, on the ground of seismological and other evidence which the author describes. It has, however, long been historically connected with Laplace's nebular hypothesis, though the latter is of much later date, and the two theories are not necessarily bound up together.

The author gives much prominence to Chamberlin's arguments against Laplace's theory, and regards them as destroying the last support of the hypothesis of a molten interior, and as necessitating a fundamental revision of geological theories. Nevertheless, strong as are Chamberlin's arguments—based on considerations of angular momentum—they have not convinced so great an authority on cosmogony as Jeans that Laplace's nebular theory must be finally condemned, though Jeans has propounded a modified form of the theory to explain the origin of the solar system, which is of a very special type among celestial objects; in this theory the planets are supposed to have been separated from the sun, when the latter was much more diffused than now, by the passage of another star at a distance comparable with the sun's diameter at the time. This theory thus preserves the feature of Laplace's hypothesis which seems specially in disfavour with the author, viz. that the earth has cooled down from a diffuse gaseous state. The author himself advocates the planetesimal hypothesis, *i.e.* that the earth originated as a solid body by the aggregation of meteoritic material. However great the claims of this view may be regarded, our present knowledge, or rather ignorance, of the effect of pressure upon hot bodies certainly does not permit us to preclude the other view, that the interior of a large gaseous body might become solid under the influence of the pressure of the upper layers, before or at the same time as the formation of a solid crust.

Another outstanding omission to refer to recent work bearing on the subject relates to Wegener's theory of moving continental masses, now so much discussed by continental geologists. By many interesting diagrams the author shows the situation of the regions of present rapid change and great folding, and discusses Suess's theory that this folding is in general the result of overthrust of one land mass over another. Professor Hobbs's view is that mountains are raised as a result of underthrusts going out from areas of subsidence, generally the ocean areas. These thrusts are supposed due to shrinkage of the strata under the oceans, though no attempt is made to put the hypothesis on a quantitative basis. This, however, is perhaps scarcely feasible as yet, and Wegener's theory, which attributes the thrusts to the resistance of the heavier substrata to the motion of the land masses as wholes, has likewise many points of difficulty about it.

The author's theory of the origin of pockets of molten lava is one of the most interesting parts of the book. The rigidity of the earth is maintained under conditions of internal temperature which are sufficiently high, even relatively near the surface, for at least the aqueous fusion of rock. This rigidity is due to compression by the overlying load, which greatly raises the fusion point. It would therefore seem as if molten matter could exist only in places where the weight of the upper layers has been wholly or partly removed. This is supposed to occur by the folding of

strong upper layers of rock into domed or arched forms, relieving the pressure beneath, at least for a time. This view differs widely from the one commonly held, viz. that the underground chambers of lava represent intrusions through the strata on which they rest, and that the pressure of the lava has itself elevated the roof of the chamber. The author ably supports his thesis by many different lines of evidence.

Textile Technology.

Textiles. By Prof. A. F. Barker. With chapters on The Mercerized and Artificial Fibres, and the Dyeing of Textile Materials, by W. M. Gardner; Silk Throwing and Spinning, by R. Snow; The Cotton Industry, by W. H. Cook; The Linen Industry, by F. Bradbury. (Westminster Series.) Revised edition. Pp. xii+386. (London: Constable and Co., Ltd., 1922.) 15*s*.

OF the great trinity of human life's essential needs —food, shelter, and clothing—practically all the articles of clothing, as well as a considerable number of articles for improving the shelter, are derived from textiles. The provision of these and other articles has led to the development of the great textile industries. These industries together form the only serious rival to agriculture for chief place among the industries of the United Kingdom, while they rank supreme in their contribution to the country's exports, of which no less than some 40 per cent. are textiles.

It might be expected, therefore, that a large number of people would be interested either as producers or consumers in such a work as the present, which aims at giving in brief compass an outline of the textile industries in their historical, technical, industrial, and commercial aspects. The book opens with an historical introduction; there follow descriptions of the raw materials and their production, and of the principles and processes of spinning, weaving, designing, and finishing. Later chapters deal with the separate industries in turn, namely, the woollen, worsted, cotton, silk, linen, dress goods, etc., and the carpet industries. On the whole the purpose of the book is successfully achieved. The author rightly emphasises the fact that it is the article finally produced which determines the raw material employed and the processes through which this passes. It is for this reason that he deals first with the general principles of spinning and then with the various preparatory processes, which were developed later chronologically for the purpose of presenting the raw material to the spinning machines in a convenient form. The chapter on spinning, in which are described the modern machines and their relation to the old methods, is the best chapter in the book; the account of the preparatory processes is somewhat scanty, rather disjointed, and occasionally inaccurate. Improvements might be made in certain other directions. Thus, the descriptions of machines sometimes suffer from the absence of explanation of some of the technical terms used; while the replacement of a number of the illustrative photographs by line drawings would add considerably to the value of the book.

It is to be regretted that there is no uniformity of plan in dealing with the separate industries; each special contributor writes from his own particular point of view, with the result that a recasting of their work would be necessary to preserve the unity of the whole. None of these special chapters compares favourably with Prof. Barker's own contributions in general treatment and the selection of material; and in too many instances the statistics and other information, having remained unchanged from the 1910 edition, are now so out-of-date as to be misleading.

In spite of its deficiencies, however, this work remains probably the best in English affording a general introduction to the study of textile technology, and as such it is to be commended.

Highway Engineering.

Les Chaussées modernes. Par Prof. P. Le Gavrian. (Encyclopédie du Génie Civil et des Travaux Publics.) Pp. 431. (Paris: J.-B. Baillière et Fils, 1922.) 40 francs.

THE publication of this text-book marks another step forward in the evolution of one of the most recent developments of engineering and is therefore to be welcomed. Road engineering in its modern form may be said to be contemporaneous with the motor car, the advent of which has again brought a large portion of the national transport on to the roads after an eclipse which lasted from the decline of the stage coach, or even the Roman period, until the introduction of the internal-combustion engine for road vehicles.

The problem of constructing roads to suit modern traffic has probably been best met in Great Britain, but the task fell to busy men, the engineers to the local government authorities, who have had many other pressing and difficult problems to deal with during the same time. Consequently, the practice which has been developed, although well described in the periodical literature, has not been codified or reduced to the form of text-books, although two small publications by Mr. H. P. Boulnois and Mr. F. Wood have to a certain extent met the want.

France has, however, already established a Chair of Highway Engineering, the first occupant of which is

the author of this book, while the project is still under discussion in this country. The chair being established, the need of a text-book has been immediately felt and M. Gavrian has met the want by his excellent book.

The first point that strikes one is that the author does not assume previous knowledge of the subject but begins by a discussion of the conditions to be satisfied and the materials which are available, but it is obvious that he expects the student to have a working acquaintance with chemistry, physics and elementary engineering.

The consideration of the action of vehicles on the road surface and *vice versa* is clear and concise; it deserves to be well considered by every one who is interested in the road problem as there is much confusion and uncertainty on this aspect of the problem.

Another section worthy of every commendation is the chapter devoted to definitions and nomenclature. The application of the same or similar names to different substances and compounds in England, France and America has led and can only lead to misapprehensions and failure to take advantage of experience gained in other countries. It is gratifying to note that English nomenclature meets with his approval, and until a standard international nomenclature is established his summary of the differences will be most valuable. The second and third chapters are devoted to a description of the production and testing of tars, pitches and other binding materials, the latter of which is probably worthy of more careful attention than is always given to it, since some failures have undoubtedly been due to materials differing in composition and properties from those employed successfully elsewhere.

A discussion of the relative usefulness and suitability of various rocks and slags in combination with different binders would have been useful as a separate section, while the binder used in Rocmac deserves more space as it has advantages in certain situations probably not possessed in the same degree by other materials.

Considerable attention is given to the manner in which pot holes are formed and the obscure phenomena known as corrugation of road surfaces. No conclusion is put forward with regard to the latter, but the need for careful research is urged. It is probably not a simple problem and will resist resolution for some time as the related problem of the corrugation of steel rails subjected to electric traction has done although the conditions can be much more exactly determined in the latter case.

M. Gavrian has collected a considerable quantity of data on the tractive effort required on different types of road surface and for different types of tyres; this is all to the good as the publication of authoritative figures should do much to reconcile transport owners to the high cost of modern roads by showing that there is reduction in cost in another direction. The destructive effect of certain kinds of tyre is also well brought out and may help towards their elimination if it brings home to the vehicle owner that any slight advantage he may gain individually has to be paid for eventually in greater expenditure on the road itself.

A standard English text-book of this type would be of great assistance to the student not only of highway engineering but of general engineering also, as the subject is too often neglected.

Radio-Communication.

(1) *Die drahtlose Telegraphie und Telephonie.* Bearbeitet von Dr. P. Lertes. (Wissenschaftliche Forschungsberichte. Naturwissenschaftliche Reihe. Herausgegeben von Dr. R. Ed. Liesegang. Band IV.) Pp. xi+152. (Dresden und Leipzig: T. Steinkopff, 1922.) 4*s*.

(2) *Marine Wireless Pocket Book for the Practical Operator and Student.* By W. H. Marchant. Pp. vii+180. (London: Sir I. Pitman and Sons, Ltd., 1922.) 6*s*. net.

(3) *Continuous Wave Wireless Telegraphy: A Non-Mathematical Introduction to the Subject of Wireless Telegraphy from the Engineer's Point of View.* By B. E. G. Mittell. (Pitman's Technical Primer Series.) Pp. xvi+114. (London: Sir Isaac Pitman and Sons, Ltd., 1922.) 2*s*. 6*d*. net.

THE development of the art of radio-communication has been so rapid that much of the apparatus described in technical books on the subject is either obsolete or is very little used. Its inclusion, however, may be justified on the ground that it is wanted by students for examinational purposes. As the number of books on the subject is large and is rapidly increasing, the expert who reads them all will naturally weary of going over the same ground so often.

(1) Dr. Lertes's book will be of value as a work of reference. The descriptions are much too brief to be followed by any one who is not thoroughly familiar with the subject. A wealth of references are given which will be useful to any one who is making a special research on some branch of the subject. It would, however, be a help to the reader if the references were subdivided under various headings such as mathematical, physical, technical, and commercial. The ground covered is very wide and an account of the Johnsen and Rahbek electrostatic relay is included.

(2) This pocket book is intended principally for the

marine radio-telegraphist. Detailed instructions are given as to the methods of adjusting the various standard Marconi sets. Descriptions are also given of the apparatus of the Telefunken and Radio-Communication Co. The diagrams are very clear and the tables, rules, instructions, etc., included have been well selected.

(3) As the bulk of the world's radio-communication is carried on by continuous wave (C.W.) systems, it is natural that there should be a demand for elementary but accurate descriptions of these systems. The number of C.W. arc stations now exceeds a thousand, and more than 10,000 kilowatts have been installed for their operation. There are also many high frequency and valve generator stations. As space is limited in this booklet, some of the descriptions of important methods are too brief to be of much help to the reader, and there are notable omissions. The chapters on the advance of the C.W. system and on the Poulsen arc are instructive and contain novel matter. We can commend the book.

Plant Morphology and Physiology.

Practical Plant Biology: A Course of Elementary Lectures on the General Morphology and Physiology of Plants. By Prof. H. H. Dixon. Pp. xi+291. (London: Longmans, Green and Co., 1922.) 6*s*.

A TEXT-BOOK by such an experienced teacher as Prof. H. H. Dixon is very welcome. To judge from the introduction, this book represents in condensed form the series of lectures which the author has found most suitable for the introduction of his subject to a class in which medical students predominate. At the end of each lecture brief notes are added as to the scope of the practical work to be carried out in conjunction with the course. Each lecture occupies on the average about eight pages, and in the thirty lectures a wide series of types are covered, from unicellular forms to the flowering plant. Considerable physiological work is included, and the subjects of nuclear division, heredity, and evolution occupy the last three lectures. The treatment is therefore of necessity much condensed, and an elementary student would find it difficult to use the book except under guidance.

Three salient features in the book have impressed the present reviewer. The first is the interest and charm with which the author's style and personality invests the subjects of the elementary course. It is clear that each time Prof. Dixon renews his acquaintance with these familiar plants, his class will find him filled with the enthusiasm of a first encounter. The student cannot forget that he is studying living plants, even when examined in the remote region of a "microscopic field." With the aid of a "ghost micrometer," an instrument Prof. Dixon demonstrated to Section K of the British Association for the Advancement of Science at Edinburgh last year, comparative data as to size, rate of movement, etc., are always kept before the student. The brief instructions given on p. 74 for practical work with Spirogyra provide an excellent example of how to make a student realise that Spirogyra is a living object in a three-dimensional world, and not a design transferred from the plane of the microscopic image to the plane of the paper. The second striking point is that the author has found it advisable to build up a knowledge of the plant by progress from the simpler unicellular forms to the more complex vascular plants. The initial difficulty of the unfamiliarity of the plant forms thus first introduced to the student is grappled with most successfully, and very interesting use is made of the opportunity thus provided, at an early stage of the course, of indicating the great practical and human significance of biological studies. On the other hand, this method of approach appears to make the treatment of plant physiology more disconnected and less experimental. Photosynthesis appears fairly early in the course, but the experimental treatment at this stage does not encourage any effort to associate the process with gain in dry weight and in carbon content. Respiration is discussed first as an anaerobic process with yeast, and later is treated more generally under Chlamydomonas. While some general questions as to the water relations of the cell appear in Lecture II., root pressure and translocation, hinted at in Lecture XIX. on the fern, are not fully treated until Lecture XXV.

Coming to the third point of interest, as might be anticipated from the author, a much wider use is made of relatively complex data from physics and chemistry than is usual in an elementary botanical text-book. If botany is to progress this seems to be an essential development, even if it implies ultimately a recognition that elementary botany courses need building upon the physics and chemistry of the final years of the graduate science course! Lecture II. introduces us to diffusion and osmosis, Lecture III. to phenomena of the colloid state, Lecture IV. to enzyme action and surface phenomena in heterogeneous systems. This pace is rather sweeping and makes great demands upon the student. It is probably also inevitable that as botanists venture into these paths, the pioneers will stumble occasionally in their unfamiliar surroundings. The attempt to define the difference between a gel and a sol on p. 22 appears to be a case in point. The explanation here given of the structure of a gel would render the phenomena of diffusion in

such gels entirely unintelligible, and the experiment illustrating the retention of congo red by a gelatin gel must receive quite another explanation than that given to it.

The Development of Vertebrates.

Traité d'embryologie des vertébrés. Par Prof. A. Brachet. Pp. xvi+602. (Paris: Masson et Cie., 1921.) 60 francs net.

FOR a remarkably clear and well-illustrated account of the development of the vertebrates the student could not do better than turn to this text-book from the pen of the distinguished professor of the University of Brussels. The information given is thoroughly up-to-date, the conclusions for the most part convincingly supported by an abundance of facts marshalled with great skill. While the author does not hesitate to discuss controversial questions, yet this treatise is strikingly free from prejudice, and none the less interesting because it deals for the most part with matters of fact. We find none of the fantastic phylogenetic interpretations of developmental stages according to the recapitulation theory which disfigure so many general text-books of embryology.

Naturally, in a single volume of some 600 pages, the whole range of vertebrate embryology cannot be covered in detail, and it is the early stages and germ-layer formation that receive particular attention. We know of no text-book in French or English with such a lucid account of these complex processes in the vertebrates. By skilful selection and the omission of unimportant detail Prof. Brachet also provides good descriptions of the development of the chief organs. The development of the cranial nerves, for instance, is particularly well presented.

There are some points on which the author is not convincing, and on which his conclusions might, we think, be revised and modified. In the account of the mesoblastic somites of the head, like so many other embryologists, he uncritically adopts van Wijke's scheme of enumeration, which inevitably leads to confusion in the region of the hyoid arch, instead of Balfour's system. We are unable to understand his reluctance to admit that in vertebrates above Amphioxus there are still traces of the formation of mesoderm from enterocoelic pouches, and we consider that he attaches too much importance to what he terms acrogenesis, cephalogenesis and notogenesis, a distinction which seems somewhat artificial and founded on certain specialisations of growth in the embryos of higher forms. Nevertheless, Prof. Brachet's volume is an excellent treatise, and will be heartily welcomed by students and teachers of embryology.

Our Bookshelf.

The Principle of Relativity. Original Papers. By A. Einstein and H. Minkowski. Translated into English by M. N. Saha and S. N. Bose. With a Historical Introduction by Prof. P. C. Mahalanobis. Pp. xxiii+186. (Calcutta: University of Calcutta, 1920.)

THE book under review begins with an interesting historical account of the experiments dealing with the elucidation of the æther-idea in physics, and we are led through the work of Michelson and Morley, Lorentz and others to a brief account of Einstein's theory of relativity and some of the results obtained with its aid. The second section reproduces Einstein's original paper "On the Electrodynamics of Moving Bodies" (*Annalen der Physik*, 1905), and this is followed by a short note on Albrecht (!) Einstein and the various phases of his scientific activity. The next section on the "Principle of Relativity" is apparently a translation of Minkowski's paper on "The Fundamental Equations for the Electromagnetic Processes in Moving Bodies" (*Göttinger Nachrichten*, 1908), though no reference is given, and the title is omitted. An appendix to this is given, and it concludes with the well-known lecture of Minkowski on "Space and Time," delivered to the German Naturforscherversammlung at Cologne (1908), and published in the *Physikalische Zeitschrift* (1909) and in "Das Relativitätsprinzip," a collection of papers by Lorentz, Einstein, and Minkowski (Teubner, 1913). The sixth section of the book consists of Einstein's monumental work on the "General Theory of Relativity and Gravitation" (*Annalen der Physik*, 1916), and the concluding section brings a number of explanatory notes, mostly mathematical, on special points.

The translation cannot be called a good one. In a work of this kind we expect a fairly literal translation, but in the present book there are numerous errors in translation, and the choice of English equivalents for German words is frequently unfortunate. In many instances the mathematics is faultily reproduced. The numbering of the pages is not continuous, but recommences at the beginning of section 4, and the omission of the footnotes from the originals is regrettable. Provided it is studied with care, the translation will nevertheless be of service to those who are unfamiliar with German, and wish to grapple with the pioneer works on this subject, some of which are rather inaccessible.

A Little Book on Water Supply. By Dr. William Garnett. Pp. xv+144. (Cambridge: At the University Press, 1922.) 6*s.* 6*d.* net.

"THIS little book when in manuscript was condemned by a very high authority on educational publications, for it did not enable the reader to prepare for any specific examinations." So the preface begins. But was not the very high authority anxious to be kind? We, too, are inclined to condemn the little book as an educational work, not because it is useless for examinations, but because it lacks a coherent plan.

There is no attempt to group the portions of letter-press into chapters. General statements are sand-

wiched between local descriptions, thus "Aqueducts" are treated between "Storm Waters" and "The Water Supply of New York"; "Watersheds and Water-partings," with a long description and full-page illustration of the Rhone Glacier, appears between engineering details of the water-works of Glasgow and of Liverpool. And between "The Birmingham Water Supply" and "Proposals to supply London from Wales" there is an account of the Nile storage at "Assouan" in a paragraph devoted to "Other Famous Dams."

Apart from the absence of arrangement, the book fails in saying next to nothing of the rainfall of the country and its fluctuations, data for which in immense abundance are available; nothing of the system of legislation by which water supplies are allocated, save for scraps in relation to individual schemes. An appendix gives an account of the theory of cyclones put forward by Prof. Bjerknes; but there is nothing as to the distribution of rainfall in the actual cyclones which traverse the British Isles.

As a scrap-book of useful and often entertaining information on the supply of water to modern London and ancient Jerusalem the book will give pleasure to many readers, and the facts as to other cities, ancient and modern, are accurate wherever we have tested them, though not always up to date. Our sole complaint is that a scrap-book should be put forward as an educational work, for we hold that continuity of plan, clearness of arrangement, and simplicity of statement are essential for any such book, and these we do not find. We repeat that large parts of the book are excellent, and every Londoner would do well to read those which refer to the Metropolitan Water Board. H. R. M.

Étude géométrique des transformations birationnelles et des courbes planes. Par Henri Malet. Pp. viii+261. (Paris: Gauthier-Villars et Cie, 1921.) 32 francs net.

ORTHODOX elementary geometry deals principally with the metrical properties of space, based on Euclid's axioms. In the modern developments of geometry the metrical properties are a secondary consideration. The study of ordered aggregates of spatial elements, such as points, lines and planes, became a powerful weapon in the hands of the geometers of the last few generations, and one of the most useful forms of this study is the method of transformations and correspondences. M. Malet sets himself the task of presenting the fundamental ideas of correspondences, leading up to the generalised type which forms the title of his book. As is natural he offers first a careful study of homographic correspondences of points on straight lines, then the *method* of projection, coming finally to birational transformations. His method is purely geometrical.

The theory is applied to the type of plane curves called algebraic, defined by the author in the sense that one and only one algebraic curve can be made to pass through a number of given points in a plane, these points being independent: he examines carefully the meaning of independence.

Attention is directed to the remarkable fact that many of the most important contributions to modern geometry have been made by Frenchmen; M. Malet claims that this is due to "ces qualités de clarté et de précision qui furent toujours l'appanage de notre race."

S. B.

A Manual of Indian Timbers: An Account of the Growth, Distribution, and Uses of the Trees and Shrubs of India and Ceylon, with Descriptions of their Wood-Structure. By J. S. Gamble. Reprint of second edition with some additions and corrections. Pp. xxvi+868+20 plates. (London: Sampson Low, Marston and Co., Ltd., 1922.) 3*l.* 3*s.* net.

THE Empire Timber Exhibition, held in London in July 1920, was remarkable for the number of beautiful woods which were displayed in the India section. It was difficult to understand why most of these valuable timbers were either unknown or not appreciated in the European market. Most people in this country believed that teak was the only timber of importance produced in India, and were surprised to see the variety of species that were made up into furniture, panelling, parquet flooring, and a host of miscellaneous articles, ranging from fishing-rods to scientific instruments. The cause of the neglect of Indian woods may be put down to lack of business methods on the part of the Government, which controlled the great bulk of the forests. This supineness is now a matter of the past, and efficient measures have been taken to make known in England the wealth of timbers available.[1]

The publication of a reprint of Gamble's "Manual of Indian Timbers," which has been for many years out of print, is a step in the right direction. To those who are unacquainted with this splendid book, we may direct attention to the accurate mass of information which it contains on the timbers and forest trees of India, Burma, and Ceylon. About 1500 species are described; and their uses and qualities are pointed out.

A Guide to the Identification of our more Useful Timbers: Being a Manual for the Use of Students of Forestry. By Herbert Stone. Pp. viii+52+3 plates. (Cambridge: At the University Press, 1920.) Price 7*s.* 6*d.* net.

THE distinctive characters of the commoner kinds of timber are well described in this brief manual, which should prove useful in teaching students. Thirty-one broad-leaved trees and ten conifers are included, all of which, except four, teak and three kinds of mahogany, are cultivated in this country. It is assumed that the student has sufficient knowledge of the elementary structure of wood to follow the descriptions. There are three plates. Certain slight errors in nomenclature should be corrected in the next edition. The term "deciduous oaks" is chosen to designate the two British species. This is not a distinctive name, as it does not include in this manual the American white oak and red oak, which are equally deciduous. *Ulmus effusa* (p. 18) is not a "bad" species, as alleged, but is a name applied to a distinct elm, not native to Britain, which is perhaps more correctly called by the prior name of *U. pedunculata*.

[1] See "Indian Trade Enquiry Reports on Timber and Paper Materials," published in 1921 by the Imperial Institute, where possible uses in this country for thirteen different woods, other than teak, are suggested.

Letters to the Editor.

The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*]

The Influence of Science.

THE ingenious letter under the above heading, on page 180 of NATURE of August 5, by that industrious astronomer of Stonyhurst College, Father Cortie, S.J., seems to require some brief notice because of the singular character of the statements made in it. We are asked to believe that Copernicus's "heliocentric doctrine was freely taught, even in ecclesiastical colleges, until Galileo interested himself as a champion of the system"; in spite of the admission that after this "truculent and hot-headed controversialist" had endeavoured to get the Church to realise that the doctrine was not really antagonistic to Scripture when reasonably interpreted, and after the offended Pope had brought the matter before the Holy Office, that authority determined that "the Copernican system was false and absurd philosophically." And we are also asked to believe that the outcome was merely that Galileo had as a penance "to recite certain prayers, and was sent to a beautiful villa at Arcetri"; the implication being that there was really no punishment, and that there was no call for anxiety or distress on the part of either him or his daughter throughout the proceedings.

Yet some of us have learnt from extant documents that Galileo was made to recant, to abjure and curse the theory of the earth's motion, and to promise to denounce to the Inquisitor any one suspected of similar heresy.

Some rather definite pressure must have been brought to bear upon the old man in order to secure this damning retractation—a retractation which the younger and more energetic Bruno a few years previously had contumaciously refused to make. Perhaps, however, it may be contended that in Bruno's case also the Cardinals "proceeded with all the gentleness and moderation which were compatible with judicial forms!" If so, it is a comfort to us scientific heretics of to-day that judicial forms have by this time lost some of their virulence and the Holy Office some of its power. The flail of orthodoxy is still wielded in high places, by searchers out of scientific heresy; but the penalties inflicted are no longer ecclesiastical, and—*pace* Father Cortie—are less severe.

On second thoughts it occurs to me that the letter may be intended humorously, in preparation for the suggestion that the Church and the Aristotelian professors had some inkling or precognition of the theory of relativity. Father Cortie summarises "the only proofs that were brought forward" for the heliocentric doctrine; and doubtless the court concluded, as modern self-elected authorities do in an analogous case, that "there is no evidence" for any modification of conservative tradition.

OLIVER LODGE.

Action of Cutting Tools.

IN NATURE of July 22, p. 118, there is an interesting description by Prof. E. G. Coker of experiments in which the strains and stresses of a transparent material (celluloid) in the neighbourhood of the edge of a cutting tool were made apparent by polarised light.

It ought to be noticed that the word "cutting" as applied to tools used for metal work (and hard substances), though generally in use, is incorrect, the actual action of such tools being to cause shearing.

Cutting and shearing differ in that in the former the part removed by the tool is merely bent, while in the latter it is at the moment of formation exposed to

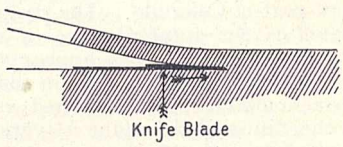

FIG. 1.—Cutting action of knife.

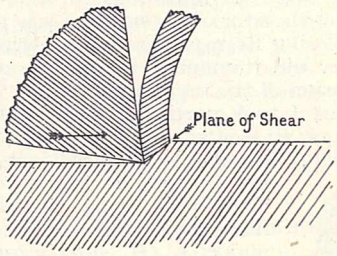

FIG. 2.—Shearing action of tool.

intense local shearing sufficient to cause permanent set or fracture throughout its whole thickness. This is illustrated in Figs. 1 and 2.

In connexion with this subject I may refer to a paper of my own (Proc. Roy. Soc., 1882), which, so far as I know, is the only place where the distinction has been made. There are very few tools and very few materials which lend themselves to true "cutting" (*e.g.* thin-bladed tools and soft substances like animal tissues), and in any attempt to "cut" hard materials the tool is soon brought up by the frictional grip of

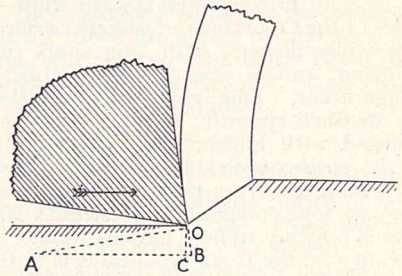

FIG. 3.—OA, normal force on face of tool; BO, frictional force on face of tool; OC, component of OA tending to make the tool "dig"; CO, component of BO tending to make the tool lift.

the material on the blade. In tools for hard materials (*i.e.* shearing tools) the friction of the shearing on the face of the tool is the chief factor in the determination of the angle at which the tool-face should be presented to the work. Any angle will cause the requisite shear, but unless the friction on the face balances the inward component of the force due to its slope, the tool will either tend to "dig" or to retreat from the material being operated on (see Fig. 3).

Thus for soft copper or aluminium, for example, where the coefficient of friction is large, the angle should be more acute than for brass, where the friction is much smaller.

A. MALLOCK.

9 Baring Crescent, Exeter.

Rudbeckia and Aquilegia.

WHEN recently (July) collecting Eocene fossils in the vicinity of Roan creek, Colorado, I saw for the first time the singular composite *Rudbeckia montana* Gray in life. It abounds in the valleys and gulches, occupying similar positions to those in which one finds *R. laciniata* on the eastern side of the range. The latter, so far as I could ascertain, is absent from the region of *R. montana*, though it occurs in the south-western part of Colorado. The striking feature of *R. montana* is the total absence of rays. The large conical or cylindrical discs appear very black, slightly yellow from pollen when in flower. The involucral bracts are coarse and pointed, surrounding the base of the disc and diverging at various angles. The whole effect is most peculiar and unusual. Rayless Compositae are known in various genera, and occasionally occur as mutations in normally rayed genera. The ancestor of *R. montana* was presumably rayed, but losing its rays through a germinal modification, how did it manage to survive and flourish to the exclusion of the rayed form ?

On July 21 I took particular occasion to watch a large group of *R. montana* on Dry creek, a tributary of Roan creek. The plants appeared just as attractive to bees as the rayed species. They were being visited by great numbers of worker Bombus, the majority *B. rufocinctus phaceliæ* Ckll., but there were also many *B. edwardsii bifarius* Cresson. Other bees were fewer, but I collected females of *Megachile pugnata*, say, *M. grindeliarum* Ckll. and *Halictus trizonatus* Cresson. There were also two species of plant-bugs, *Lygæus reclivatus*, say, and *Lygus pratensis* L. Thus it seems certain that the loss of the rays has not interfered at all with cross-pollination by bees.

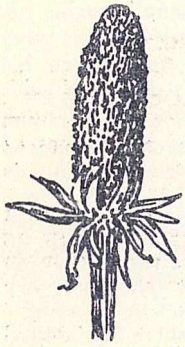

FIG. 1.—*Rudbeckia montana*, Gray. ½ natural size.

On the high mesa, between Roan creek and Salt Wash, in the aspen groves, I first saw the white-flowered sub-species of the Columbine, *Aquilegia cærulea* James. The large white flowers, with long spurs (up to 90 mm.), dotted among the green shrubbery, were truly magnificent. One got the impression of a perfectly distinct species ; but some of the flowers were suffused with bluish, and rarely one found a genuine *A. cærulea* with blue, sepals. The flowers certainly averaged larger than those of *cærulea*, but the spurs were long enough for Tidestrom's *pinetorum*, which seems possibly to be a habitat-form.

The locality on the Roan mountains is in the midst of a Canadian zone flora, with no pines, the only conifer being *Pseudotsuga mucronata*, which is abundant. *Pinus edulis* and *Sabina* occur on the slopes lower down. The underlying geological formation is the Green river Eocene. The white (*albiflora* Gray) sub-species of *A. cærulea* may well have arisen by mutation from the blue-sepalled type, but how did it manage to supplant it ? It cannot be a matter of the direct effects of the environment, since genuine *cærulea* grows rarely in the same localities. Both forms are visited by Lepidoptera, and there is no reason for supposing that *cærulea* is specially favoured by butterflies, *albiflora* by moths. In the locality of *albiflora*, as we found it, long-tongued moths must be very rare, but long-tongued butterflies (especially Papilio) abound.

These cases of Rudbeckia and Aquilegia are difficult to explain. Is it possible that, while there is no direct influence of the environment on the characters, there is something in the soil (the shales being rich in peculiar organic products) which has affected the germ-plasm of the plants, bringing about a selective elimination of certain qualities ?

T. D. A. COCKERELL.

University of Colorado, Boulder,
July 25.

The Rat and its Repression.

THE valuable contributions on rat repression by Lord Aberconway and Lieut. Alfred E. Moore, which have appeared in the columns of NATURE, may, I venture to think, be usefully amplified by some reference to one of Britain's paramount industries : shipping, considered in the light of the rat menace.

Undoubtedly, rats represent a serious problem to the shipping industry, and I only suggest some possibilities that occur to me in the hope that others more competent may be induced to table something more valuable. Among the avenues to be explored are :—

(*a*) The possibility of an international agreement in regard to ship fumigation and disinfection, having special regard to ships arriving at British Empire ports.

(*b*) The possibility of stimulating invention in regard to ship-proofing : *e.g.* anchor chains, mooring ropes, gangways, and all shore connexions are avenues of infinite possibility when one is considering rat invasion.

(*c*) The possibility of stimulating research into the most effective means of destroying rats aboard ship by means of fumigation, electricity traps, raticides, etc.

(*d*) The possibility of creating a national board composed of the representatives of port authorities, ship owners, authorities on rat repression, and ship store superintendents, and of providing in connexion with such national maritime board suitable laboratories for testing and research.

(*e*) The possibilities of asbestos-concrete plus barium carbonate as a light and at the same time poisonous covering in the place of wood where its use would not be inconvenient.

It is doubtful if man has a more cunning foe than the rat, and in view of the fact that the vermin is ever increasing, and the rat's adaptability when it is called upon to vanquish obstacles to its depredations, it seems to me well worth our while to concentrate upon effective measures to counter the activities of our enemy.

DENBIGH.

The Bath Club, 34 Dover Street, W.1,
August 4.

The Spectrum of Helium in the Extreme Ultra-Violet.

MR. FRICKE showed (*Phil. Mag.* 41, May 1921) that in the extreme ultra-violent the arc spectrum of helium probably contained but one line with a wave-length near 585 Å.U.

I have recently attacked the subject again using a vacuum spectroscope so arranged that a good vacuum could be maintained in the body of the apparatus while the discharge tube contained helium at a pressure of about a millimetre. No window was employed, the success of the device depending on the use of a very short and narrow slit and upon the suitable application of a powerful pump.

With a continuous current the line at 584·4 is of very great strength, and is accompanied by three new lines at 537·1, 522·3, and 515·7 whose intensities decrease with their wave-length and in a manner strongly suggesting a series relation. Luckily the

first three members appear in the second order spectrum, a comparison with the hydrogen line 1215·68 and with the three following lines of the same series is therefore possible, with the result that the wave-lengths are probably correct to one or two tenths of a unit.

The spacing of these four helium lines on the frequency scale is of great interest and importance, for it is found to be identical with the spacing of the first four lines in the singlet principal series. It may be stated, therefore, with considerable certainty that the line 584 forms the first member of a principal series, which, according to the notation of Prof. Fowler, is to be represented by $oS–mP$.

Besides this series there is a single line at $600{\cdot}5 \pm 0{\cdot}3$ of a feeble and diffuse character; its origin is not entirely above suspicion. In the extreme ultra-violet the arc spectrum of helium appears to contain no lines in addition to those just mentioned.

The relation between the accepted values of the resonance and ionisation potentials in helium and the wave-lengths of these new lines is rather puzzling. The ionisation potential should certainly correspond to the limit of the $oS–mP$ series; now this limit can be accurately calculated, it corresponds to 24·5 volts, but the experimental value is 25·3 volts. This is the chief difficulty, but it is not the only one, for the agreement between the wave-lengths of the individual spectrum lines and the values of the resonance potentials as determined by Franck and Knipping is not satisfactory. A correction of about $-0{\cdot}8$ volt, if applied to all the potential measurements, will bring the two sets of data into fair agreement, but at the expense of the first resonance potential which is left without any corresponding line in the spectrum.

The matter should be of some interest to those who are struggling with the model of the helium atom.

THEODORE LYMAN.
Jefferson Laboratory, Harvard University,
August 3.

Transcription of Russian Names.

WITH regard to the recent correspondence in NATURE on the transcription of Russian names, may I direct attention to the fact that the Russian Academy of Sciences adopted a system of transliteration many years ago, and a note by Prof. J. W. Gregory giving the new rules appeared in NATURE on May 14, 1908, p. 42. In all the publications of the Academy the Latin transcription of Russian names is given in accordance with this system.

Since, in the event of Russia adopting the Latin alphabet, the Academy of Sciences, as the highest authority of the country, will be called upon to formulate the rules, I think it would be advisable for all countries to conform to the rules already set forth by this Institution.

It is needless to say that at present Russian transcription is in a very confused state, the name of the same author being frequently given in different ways (*e.g.* Cholodkovsky = Kholodkovsky; Ivanov = Iwanow = Iwanoff).

CECIL A. HOARE.
Wellcome Bureau of Scientific Research, N.W.1,
July 25.

Sense of Smell in Birds.

THE observations with regard to the olfactory sense of vultures recounted by Mr. C. B. Williams (NATURE, July 29, p. 149) are at variance with those of hunters and field naturalists and the experiments of Audubon, Bachman, and Darwin (see Darwin's "Journal of Researches, Voyage of H.M.S. *Beagle*"). From *a priori* reasons it could be argued that birds as a whole depend mainly on sight, and no one would be inclined to deny an obvious fact when it is emphasised by morphological modification. Ducks and geese and other birds which feed for long periods on land and marsh certainly have good powers of smell, but in the majority the sense is feebly or not at all exercised. The conclusions of Mr. Abel Chapman, given on pages 241 and 423 of his "Savage Sudan" (1921), that with few exceptions birds and certainly that eagles and vultures possess no sense of smell, deserve attention, for he is a wildfowler with a long experience. He has told me, among many interesting observations which prove the fact, that in the Sudan, when it is necessary to preserve meat from a carcase for mess purposes, all that is necessary is to remove it a short distance and cover it with branches. The vultures discover without delay the carcase and pick it clean, but fail to find the rich supply of meat so near them. The fact appears, therefore, to be that vultures use their telescopic eyes not merely to watch what is taking place over a wide range below them, but to note what their neighbours are doing. If one disappears, the rest in turn fly to the region to find out the cause.

ALEXANDER MEEK.
Armstrong College, Newcastle-on-Tyne, August 3.

A Coincidence in Values.

IT is to be noted that if the simple multiple "seven" of the atomic heat (6·4) be taken a magnitude is obtained double that of the gram-molecular volume for the ideal gas (22·412 litres). On such a basis of reckoning the "ideal atomic heat" would be expressed by deduction from the ideal gas as 6·403.

Dulong and Petit's law would thus be stated: "The product of the atomic weight and the specific heat of an element in the solid state is constant, and for the ideal solid is exactly $\frac{3}{7}$ths of the gram-molecular volume for the ideal gas."

A linkage exists between the liquid and gaseous states through the gas constants. Although the solid state has not in any great measure adapted itself to what Van't Hoff termed mechanical concepts, we can foresee the existence of a simple connecting link between all the three states of matter. The cynic, of course, will observe that much virtue doth abide in the magic number seven!

L. M. STEWART.
The University, Birmingham.

The Evolution of Consciousness.

YOUR reviewer, in a kindly notice of my book in NATURE of July 29, p. 147, sums up its general attitude in these words: "All that is, Mr. Tilby tells us, has emerged in a definite historical sequence, and we have merely to accept the fact and not ask why." May I point out that I did not say this, and I do not think it? Indeed, it conflicts rather glaringly with the thought I tried to express.

Certainly we have to accept the facts of the universe in their historical sequence; but we have to do something more than accept them—we have first to discover them before we can accept them. And of the major portion of those facts we are still unaware, as the fundamental contradictions of contemporary philosophers abundantly testify.

But to suggest that we are "not to ask why" is to commit treason against the intelligence. That lazy heresy was once popular in the circles of pious orthodoxy, and it has occasionally infected the more epicurean or more pessimistic type of agnostic. But this merely negative attitude will never satisfy. It is very largely because man has asked why that he

has progressed, and it is because he is still (and rightly) dissatisfied with the answers given that he continues to advance.

There may conceivably be a limit to the acquisitions and interpretations of a finite mind; but man is as yet so evidently in his infancy mentally, psychically, and even politically, that we are in no immediate danger of knocking our heads against that possibly predestined barrier to profitable inquiry. Nor do I for one believe that any such barrier exists. There is manifestly an Unknown, but I should hesitate to describe it as the Unknowable.

A. WYATT TILBY.

Howstean, Frinton, Essex.

I AM very glad to accept Mr. Tilby's disclaimer. I did indeed associate his evolution of consciousness with a certain theory of "emergence" made famous in an address to the Psychological Section of the British Association last year. I did not mean to suggest that Mr. Tilby's theory was obscurantist or dogmatic. THE REVIEWER.

Transparency of Liquids and Colour of the Sea.

IN an earlier note in NATURE (Nov. 24, 1921, vol. 108, p. 402) I pointed out that the scattering of light in its passage through a liquid resulting from the local fluctuations of density, the magnitude of which is given by the Einstein-Smoluchowski relation, should enable its transparency to be determined for the parts of the spectrum in which it does not exercise selective absorption. It should be mentioned that in making an experimental test of this point, account has also to be taken of the scattering resulting from the anisotropy of the molecules and that there is an important difference between this and the scattering due to density-fluctuations. The orientation-scattering is almost completely unpolarised and is therefore distributed symmetrically in all directions. The density-scattering is polarised and is twice as intense longitudinally as in a transverse direction.

The coefficient of extinction resulting from the joint effect of both types of scattering can be calculated theoretically if the compressibility, refractive index, and the ratio of the components of polarisation in the transversely-scattered light are known. Taking the case of benzene as an example, the coefficients of extinction calculated for the 5461 and 4358 lines of the mercury spectrum, which fall in regions in which there is no selective absorption, are respectively 0·00022 and 0·00060. These values agree very closely with the recent experimental determinations of Martin, and form a striking confirmation of the theory. There is little doubt that the observed transparency of many other liquids will similarly be found to be in agreement with theory when accurate data are available.

The case of water is of special interest. Of all ordinary liquids it is the one for which the coefficient of scattering is smallest, and is therefore most affected by traces of selective absorption. There is an absorption band which is clearly marked up to 0·5 μ, and it is possible that traces of it extend into the blue region of the spectrum. For the 4358 line, the coefficient of extinction calculated theoretically is 0·00006 and Martin's observed value is 0·00012. It seems probable that a little farther out in the violet, the transparency may agree more closely with that derived from the theory of scattering.

The newer data now available enables a quantitative test to be made of the theory put forward by me in a recent paper (Proc. Roy. Soc., April 1922) that the blue colour of the deep sea arises from the molecular scattering of sunlight in water, the thickness of the effective layer being determined by the attenuation of the sun's rays as they penetrate into the liquid. The tentative calculations made in that paper have now been revised. The table shows the theoretical albedo of ocean water expressed in terms of the equivalent scattering by dust-free air at normal temperature and pressure.

ALBEDO OF OCEAN WATER.

Wave-length in μ.	0·658	0·602	0·590	0·578	0·546	0·499	0·436
Equivalent kilometres of air	0·5	0·7	1·8	2·8	5·2	7·0	15

It is evident from these figures that the blue of the sea would be much more saturated than the blue of the sky, which is the standard of comparison. The height of the homogeneous atmosphere being 8 kilometres, the sea would be about half as bright as the zenith sky on a clear day. This agrees well with the photometric determinations made by Luckiesh during aeroplane flights over deep ocean water in the Atlantic (*Astrophysical Journal*, vol. 49, 1919, p. 129). Luckiesh makes it clear that the greater part of the observed luminosity of water viewed perpendicularly really arises from light diffused upwards from within the water. His determinations thus appear to furnish a quantitative proof of the theory which attributes the colour of the deep sea to molecular scattering of light.

C. V. RAMAN.

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Telescopic Observation of Atmospheric Turbulence.

IN his recent contribution to meteorology, "Physics of the Air" (U.S. Weather Bureau, Washington), Prof. Humphreys refers, in chapters 11, 12, and 14, under the general headings of "Wind Layers" (p. 219), "Wind Billows" (p. 221), "Barometric Ripples" (p. 228), and "Special Cloud Forms" (p. 296), to the demonstration by Helmholtz (translated by Cleveland Abbe, "Mechanics of the Earth's Atmosphere," Smithsonian Institution, 1891) that "adjacent layers of air differ abruptly from each other in temperature, humidity, and density, and therefore may and often do glide over each other with . . . a wave-producing effect." Prof. Humphreys proceeds, of course, to associate these demonstrations with the problems of atmospheric turbulence.

May I be allowed to point out, however, that it is *not* the case, as stated by Prof. Humphreys (p. 219), that "these air waves are *seen* only when the conditions of humidity at the interface are . . . just right" for the condensation of visible clouds—I speak from the experience of personal observations covering, intermittently, a period of upwards of twenty years. These "Wind Billows" or "Air Waves" of Helmholtz's demonstrations are always readily visible in the absence of clouds. The various directions of their flowings, and the order of their temporary stratification, are accurately legible by the method I employ of a projected telescopic image of the sun for the purpose of their observation. The "cautious aviator," instead of succumbing to the idea that he needs must fly in the face of "unknown danger," should know that the early stages of turbulence are—if only the sun is unclouded—at all times conspicuously and spontaneously recognisable by this very simple method of observation.

CATHARINE O. STEVENS.

The Plain, Boar's Hill, Oxford, August 9.

Hesperopithecus, the Anthropoid Primate of Western Nebraska.

By Prof. HENRY FAIRFIELD OSBORN, American Museum of Natural History, New York.

EVERY discovery directly or indirectly relating to the pre-history of man attracts world-wide attention and is apt to be received either with too great optimism or with too great incredulity. One of my friends, Prof. G. Elliot Smith, has perhaps shown too great optimism in his most interesting newspaper and magazine articles on Hesperopithecus, while another of my friends, Dr. A. Smith Woodward, has shown too great incredulity in his article in NATURE of June 10. It is in reply to both these extremes that I have especially prepared for NATURE additional information regarding the fauna and habitat of this new Primate, and additional figures to show the comparison between the small, water-worn, type tooth of the genus (Fig. 2, 1-4) and the teeth which most nearly resemble it.

First, a word regarding the time and circumstances of the discovery of this Primate which happen to have a humorous side. Fresh and very violent attacks on the Darwinian theory have been made during the last two or three years all over the United States, especially under the leadership of William Jennings Bryan, a man of ingenious and fertile mind and persuasive powers of oratory, gifted as a politician and as a religious advocate. As an opponent to Darwinism, Mr. Bryan's attack culminated in his very carefully prepared article in the *New York Times* of Sunday, February 26, 1922, in which he ably fortified his position by long quotations from Prof. W. Bateson's Toronto address recently published in NATURE (April 29, p. 553), and by other critics of Darwinism. The following Sunday, March 5, I replied to Mr. Bryan, and realising that quotations from the highest scientific authorities in the world would not have the slightest influence upon him or his followers, I referred him to the writings of St. Augustine, also to the Holy Scriptures, and especially to a passage in the Book of Job (xii. 8), "Speak to the earth and it shall teach thee." In brief, I advised Mr. Bryan to drop all his books, as well as his attempts to grasp the meaning of the diversity of opinion among scientific writers, and to inquire of the earth only what it had to teach him. I added that he would not necessarily lose his religion, but that he would certainly become an evolutionist.

I presume it is widely known that Mr. Bryan is a native and prominent citizen of the State of Nebraska, and it is certainly a humorous coincidence that on March 14, only nine days after my advice was given, I received from the western part of the State of Nebraska the tooth from which has been named the Ape of the Western World (Hesperopithecus). This is the very first evidence, after seventy-five years of continuous search in all parts of our great western territory, of a Primate of any kind above the ranks of the numerous Lemur-like and Tarsius-like lower Primates which have long been known in our Eocene beds.

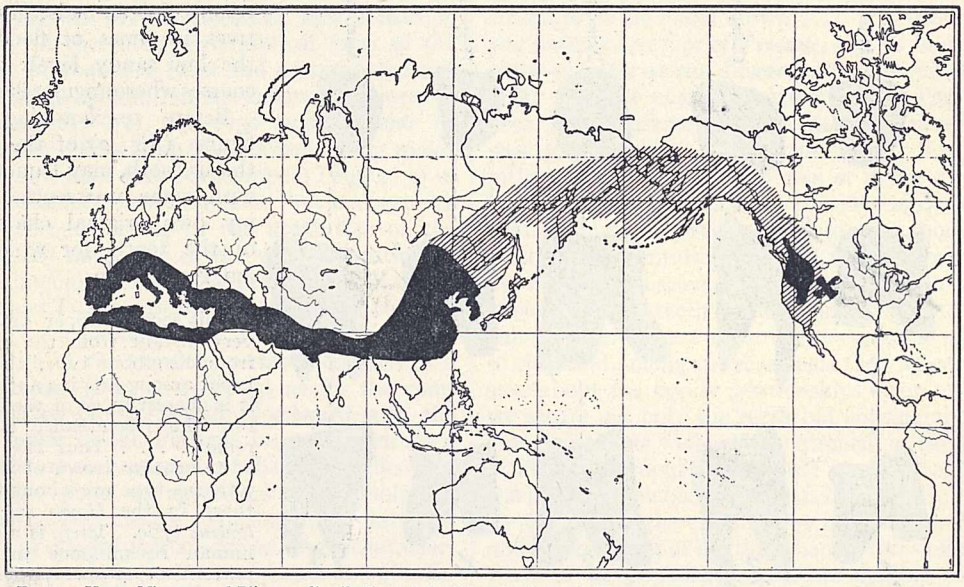

FIG. 1.—Upper Miocene and Pliocene distribution of the Strepsicerine and Hippotragine Antelopes. Known distribution in black, hypothetical migration area in oblique lines.
X, Region of western Nebraska, Snake Creek beds, site of the discovery of the Hesperopithecus tooth.

While we have all eagerly looked forward to such a discovery, and I have always regarded it as possible, I have never regarded it as probable, for the reason that the higher Primates, seeking the protection of forests, never venture out for long distances on the plains; moreover, accustomed to a forest fruit supply, they would have been exposed to great dangers in migrating from Asia to western North America except by the aid of a continuous forest belt or of a rather dense forest and savanna belt bordering a plains belt. In 1910 I published in my "Age of Mammals" (page 336, Fig. 156) a map, which I now send to NATURE for reproduction (Fig. 1), with indications of such a life belt for animals of the plains—antelopes and horses; adding an X to show where Hesperopithecus was found.

Since 1910 additional discoveries have been made which tend to indicate the existence also of a continuous forest and savanna belt between eastern Asia and western North America (black area and oblique lines), for we have found animals related to the strepsicerine and hippotragine antelopes, to the plains ungulates remotely related to the kudu, to the sable antelope, and to the eland (Taurotragus). We have also traced the migration of two kinds of forest- and savanna-living mastodons over this entire region, namely: (1) of proboscideans closely related to the *M. arvernensis* of southern Europe, to the *M. sivalensis* of India, and to the *M. mirificus* of western Nebraska, specimens of which have now been found in the very Snake Creek beds in which Hesperopithecus was discovered; also (2) of the true forest-living proboscideans of the genus Mastodon recently recognised in the Snake Creek beds. A true elephant (*E. hayi*), which resembles the *Elephas planifrons* of the Upper Siwaliks of India, has been found in more recent deposits.

From these relatively new and most significant discoveries we may characterise the Snake Creek region of western Nebraska, in Middle Pliocene time, as in the belt of the south Asiatic forest, savanna, and plains fauna, which extends two-thirds of the way around the entire globe, from the region of Britain to the central-west region of the United States, and probably right across to the Atlantic coast. The plains element in this fauna is extremely abundant, especially the Hipparion; somewhat more rare are the true horses (Pliohippus), and still more rare are the remains of the three kinds of antelopes and of the two kinds of mastodons above mentioned. Finally, of the utmost rarity are the remains of the Primates, because during the eight seasons of continuous and expert search we have only discovered two teeth, namely, the tooth now regarded as a third superior molar of an old individual of Hesperopithecus found by Dr. W. D. Matthew in 1908, and the type tooth of *Hesperopithecus haroldcookii* found by the geologist Harold J. Cook in 1921. We are this season renewing the search with great vigour and expect to run every shovelful of loose river sand which composes this deposit through a sieve of mesh fine enough to arrest such small objects as these teeth. Even by this most laborious and painstaking method the probability of finding more material is not very great, for the reason that the anthropoid Primates have always been very clever and resourceful animals, climbing into trees in times of flood, avoiding the low sandy levels and water-courses where ungulates are trapped.

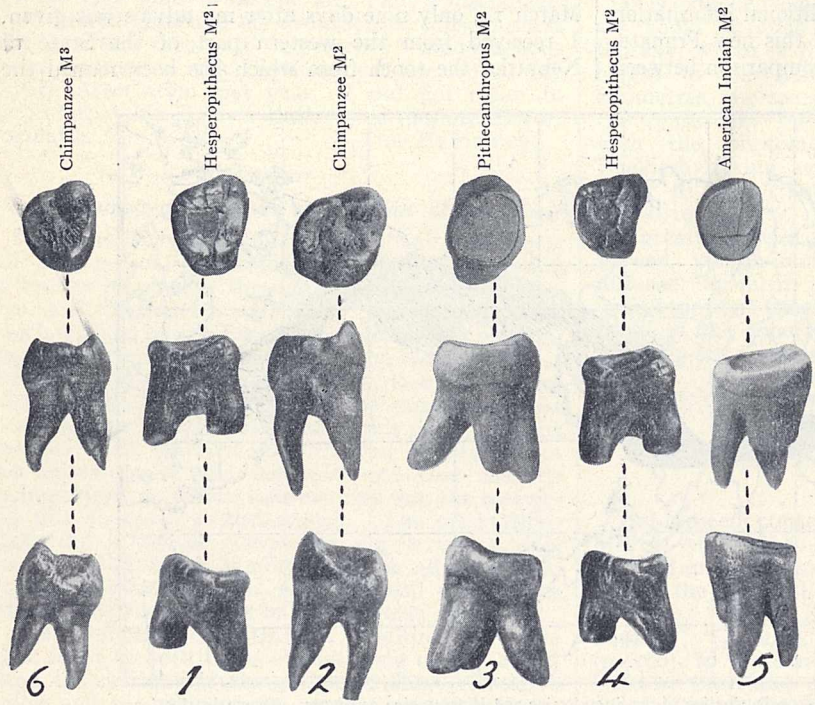

FIG. 2.—Comparison of the Second Superior Molars of the Right Side of the Upper Jaw in the Primates.
Upper row: crown views of the superior molars.
Middle row: anterior views of the same teeth.
Lower row: posterior views of the same teeth.
(1) Hesperopithecus, the new Nebraska Primate, middle-aged.
(2) Anthropopithecus, a young chimpanzee.
(3) Pithecanthropus, adult Trinil Ape-man.
(4) Hesperopithecus (photographed in a different light).
(5) *Homo sapiens mongoloideus*, aged North American Indian.
(6) Third superior molar of Anthropopithecus, a young chimpanzee
All photographed to the same scale and natural size.

Before re-examining the new figures (Fig. 2) of the Hesperopithecus tooth, may I quote verbally, with some unessential omissions, my own original characterisation of the tooth, for which I alone am responsible.

> This second upper molar tooth is very distant from the gorilla type, from the gibbon type, from the orang type; among existing anthropoid apes it is nearest to m^2 of the chimpanzee, but the resemblance is still very remote. . . . Thus the proportions of the molar crown of the Hesperopithecus type are about the same as those in the *Homo sapiens mongoloideus* type. There is also a distant human resemblance in the molar pattern of Hesperopithecus . . . to the low, basin-shaped, channelled crown in certain examples of *Homo sapiens*. But the Hesperopithecus molar cannot be said to resemble any known type of human molar very closely. The author agrees with Mr. Cook, with Dr. Hellman, and with Dr. Gregory, that it resembles the human type more closely than it does any known anthropoid ape type; consequently, it would be misleading to speak of this Hesperopithecus at present as an anthropoid ape; it is a new and independent type of Primate and we must seek more material before we can determine its relationships. It is certainly not closely related to *Pithecanthropus erectus* in the structure of the crown, for Pithecanthropus has a single, contracted crown in which the superior grinding surface has a limited crenulated basin, whereas Hesperopithecus has a widely open crown with broadly channelled or furrowed margins, and a postero-internal crest suggesting the hypocone of a higher Primate form. . . .

The type description, as published in the American Museum *Novitates*, April 25, 1922, requires little or no modification as a result of two months of intensive research which has been devoted to this tooth, detailed results of which will shortly be published by my colleague, Prof. Gregory. The accompanying new illustrations (Fig. 2), prepared especially

for NATURE, are photographs of a most convincing character, in which the Hesperopithecus molar (Fig. 2, 1-4), in three aspects, is placed directly between corresponding molars of a chimpanzee (right and left) which most nearly resemble it. It will be seen at once (1) that the Hesperopithecus molar, although greatly water-worn, has entirely different proportions from the chimpanzee molar: it is much broader transversely; it is much narrower in the fore-and-aft dimensions. This affords positive evidence that Hesperopithecus had a shorter facial region than the chimpanzee. In this respect it approaches the mongoloid human type (Fig. 2, 5) more closely than it does any of the anthropoid ape types; (2) the roots of the Hesperopithecus molar are much more robust and more human in proportion than those of any of the frugivorous apes; (3) the upper molar of Hesperopithecus, while resembling the upper molars of certain American Indians of mongoloid type in several absolute measurements, differs widely in the more asymmetrical form of the crown, which is broader in front and narrower behind, whereas in the mongoloid human molars the crown is more symmetrical; (4) the type upper molar of Hesperopithecus differs from the corresponding molar in the Trinil Ape-man (Pithecanthropus) (Fig. 2, 3) in nearly all its absolute measurements; but it resembles the Pithecanthropus molar in the great size of the internal (lingual) fang, also in the wide separation of the internal (lingual) and external (anterobuccal) fangs. It also resembles Pithecanthropus in the evenly concave depression of the grinding surface, which is quite unlike the ridged form of the grinding surface observed in a chimpanzee molar (Fig. 2, 2-6); (5) as for the comparison suggested by Dr. Smith Woodward with the third lower molar of the Pliocene bear (Hyænarctos), the differences are so fundamental that it is difficult to find any single point of agreement; the molar of Hesperopithecus very clearly conforms to the flattened tritubercular to quadritubercular type which characterises all the upper molars of anthropoid apes and of man.

Thus, after making due allowance for the characters resulting from the prolonged natural usage of the Hesperopithecus molar, also for characters due to long exposure to erosion and stream action, and to percussion by the sharp sand of the river bed, there nevertheless remain five outstanding characters, as well as many highly significant details of character, which tend to show that this tooth belongs to one of the higher Primates, and that this genus ultimately may be included either within the Simiidæ (anthropoid apes), or near certain ancestors of the Hominidæ (human stock).

I desire to summarise with emphasis my original statements about this tooth, namely, that among existing anthropoid apes it is nearest to m^2 of the chimpanzee, but the resemblance is still very remote . . . that the proportions of the molar crown of Hesperopithecus are about the same as in *Homo sapiens mongoloideus* (American Indian) type . . . that there is also a distant human resemblance in the molar pattern of Hesperopithecus to the low, basin-shaped, channelled crown in certain examples of *Homo sapiens* . . . that the Hesperopithecus molar cannot be said to resemble any known type of human molar very closely. It is certainly not closely related to *Pithecanthropus erectus* in the structure of the molar crown . . . it is therefore *a new and independent type of Primate, and we must seek more material before we can determine its relationships.*

My original characterisation and description have been fully confirmed by the intensive research of the past two months. I have not stated that Hesperopithecus was either an Ape-man or in the direct line of human ancestry, because I consider it quite possible that we may discover anthropoid apes (Simiidæ) with teeth closely imitating those of man (Hominidæ), just as we have discovered in the true Piltdown man (Eoanthropus) teeth closely imitating those of the chimpanzee. There are so many crisscross adaptations of this kind among the mammals that we can never be sure about the family relationships of an animal until we secure not only the teeth but considerable parts of the skeleton as well. No anatomist in the possession of Pithecanthropus molars only would have discovered the human resemblance which is indubitably established by the roof of the cranium, by the shape of the brain, and by the shape of the thigh bone. For similar skeletal parts of Hesperopithecus we are making most determined and prolonged search in the type locality; it is not at all probable that the desired evidence will be easy to secure. Until we secure more of the dentition, or parts of the skull or of the skeleton, we cannot be certain whether Hesperopithecus is a member of the Simiidæ or of the Hominidæ.

Science in Egypt.

By Col. H. G. LYONS, F.R.S.

THE important part which modern science can play in the economical development of natural resources is generally recognised to-day, but nowhere may this be seen more clearly than in Egypt, with its subtropical climate, its controlled water-supply, and its immunity from the vagaries of the weather which affect more northern latitudes. Here a population which in 1882 was under seven millions has now grown to more than twelve millions, and inhabits a cultivable area which does not exceed seven million acres all intensively cultivated; for much of the area, which was formerly flooded annually and then furnished a single crop after the river had fallen, is now under perennial cultivation with a supply of water at all seasons, and consequently up to five crops in two years are taken from it. Under these conditions the most economical use of the material resources that science can devise, and all the improvements that it can suggest, are of the utmost importance to the country.

During Egypt's period of financial difficulty the provision for scientific work was very meagre, but with the reorganisation of the irrigation and the introduction of reforms, an improving revenue enabled gradually increasing grants to be made to state departments, and many of them have, during the past thirty years, established services in which scientific work of value and importance has been carried on.

Some scientific work had been initiated at a much

earlier date, for the medical school at Qasr el Aini was established early in the last century, and about 1860 a 20-centimetre astronomical refracting telescope by Brünner of Paris, with an equatorial mounting, was set up at Abbassia; a four-metre base-bar together with two 40-centimetre theodolites and a portable transit instrument by the same firm were purchased for the survey of Egypt which was then projected, but which did not become an accomplished fact until about fifty years later.

To-day there are at least a dozen services occupied primarily with work of a scientific character.

The Survey of Egypt is the successor of the earlier surveys of 1823, 1853 and 1878, but none of these were ever completed nor had they any scientifically organised control. It now comprises the cadastral survey, the topographical survey, the desert survey, and the geological survey.

The cadastral survey is of special importance in Egypt on account of the high value of agricultural land, and the exceptional degree of subdivision of the holdings. The network of triangulation on which it is based now covers the Nile Valley and Delta, and is controlled by the first-order triangulation now in progress, which is of the standard demanded in international geodetic work. The topographical survey utilises the material provided by the cadastral survey and adds to it all topographical information besides extending the maps beyond the limits of the cultivated land, to meet the needs of different branches of the public service. There are now published series of map sheets on scales of 1 : 2500, 1 : 10,000, and 1 : 50,000, covering all the inhabited area of the country, while other maps on scales of 1 : 250,000 and 1 : 1,000,000 include the large areas of desert as well.

Survey work as it is extended into the desert assumes a special character, for on account of the large areas to be covered, the difficulties of transport, and the absence of all artificial topographical features, special methods of surveying have been adopted. This work is now in the hands of the Desert Survey, which also undertake the precise location and demarcation of prospecting and mining areas leased by the Government.

On the highly cultivated alluvial plains of the Nile Valley and the Delta accurate levelling is of special importance, so a network of levelling of high precision has been carried over them and extended into the Sudan along the Nile. Besides this the cultivated area throughout Egypt has been contoured at 50 centimetre intervals. At the headquarters of the Survey of Egypt are drawing, photographic, and printing offices in which are produced the maps of the various surveys and also those which are required by the geological survey and by other State departments.

In 1896 a geological reconnaissance of Egyptian territory was authorised which, at the end of five years, developed into a geological survey. The staff has always been small, but a very large amount of valuable work has been done under the difficulties and limitations imposed by desert travel.

Not only have the mineral resources of the country been located and described, thereby becoming available for commercial purposes, such as the phosphate deposits in Egypt and manganese deposits in Sinai, but our knowledge of the structure and stratigraphy of north-eastern Africa has also been greatly advanced, and the interesting fauna of Lower Eocene age which was brought to light in the desert to the west of the Fayum has greatly extended our knowledge of the past history of the African continent. Geological work has been carried out for several years in connexion with petroleum research in the Red Sea area, and the results have been published in various reports. The records of the geological survey and the collections which fill its museum provide a store of information relating to the structure and stratigraphy of the Nile Basin and north-eastern Africa.

The Physical Department, which until a few years ago was part of the Survey Department, and is now a part of the Ministry of Public Works, includes the Helwan Observatory with its time service, the meteorological service, the service of weights and measures, and the hydrological investigations in connexion with the Nile. The observatory, which was formerly at Abbassia, was removed in 1904 to Helwan, 20 km. south of Cairo, because the building at Abbassia was wholly unsuitable and the extension of the electric tramways to its neighbourhood prevented all magnetic work. In it the 30-inch reflecting telescope at Helwan is employed in the photography of southern nebulæ, of comets when they appear, and of Jupiter's eighth satellite, which has been observed almost exclusively by Greenwich and Helwan since its discovery.

The time service is also directed from the observatory, and the observatory clock transmits the noon time signals which are utilised at Cairo, Alexandria, Port Said, and at Khartoum. Magnetic observations are carried out both by means of magnetographs and by weekly absolute determinations. The meteorological service of Egypt and the Sudan includes, besides the central observatory at Helwan, 57 climatological stations, of which 23 are in Egypt, 27 in the Sudan, and 7 in Palestine, and about 230 rainfall stations in Egypt, the Sudan, and Abyssinia. First established to study the conditions determining the Abyssinian rainfall, and consequently the Nile Flood, it has now a much wider importance and is one of the recognised national meteorological services.

The increasing demands of agriculture and its dependence on the supply of water provided by the Nile have necessitated a high precision in river-gauging, and the hydrological work which this involves is now centred in the Physical Department, where the records of 70 river-gauge stations are discussed, and hydrological investigations are undertaken. The storage of water in the valley of the Nile at various points, the need for accurate measurements of the discharge throughout the low stage of the river, the study of the effect of turbulence in the water at flood stage, etc., present a series of physical problems which are of direct importance to Egypt, as well as being of great interest to many other countries.

The department is also charged with the inspection of weights and measures throughout the country, and the prototype standard metre and the secondary standards of length, which were acquired for the purpose of the Survey of Egypt, are now kept at the Helwan Observatory, where any comparisons desired are carried out in a well-equipped comparator house.

Weights are compared with standard copies at the observatory, and sets of certified weights are supplied to all who require them.

The Government analytical laboratory and assay office undertake a large amount of important work which falls under the headings of (*a*) chemical and physical inspection of materials; (*b*) technical chemical consultations; and (*c*) experimental research. Stores and materials of inferior quality frequently find their way on to the Egyptian market, and only by the systematic analysis of material tendered can these be eliminated and economies effected. To the same end the technical clauses in specifications governing supply by contractors are drafted by the staff of the laboratory.

The chemical work carried on in connexion with criminal investigation and other legal matters forms a branch of work which demands much time and great care. Recently published reports indicate that the consultative and research work is at present mainly related to questions affecting petroleum, and the development of petroleum resources in Egypt has given rise to an inquiry into the actual conditions under which petroleum products are used in Egypt, which was undertaken by the laboratory. The small refinery which the Egyptian Government has recently installed at Suez to deal, in the first instance, with royalty petroleum only, but with a view to its ultimate extension if that is found to be desirable, is also under the supervision of the director of the laboratory.

The first medical school in Egypt was formed in 1827 at Abu Zabel by Clot Bey, a French doctor in the service of Mohammed Ali, and ten years later it was transferred to Qasr el Aini on the south side of Cairo, where it still remains. For many years the number of students was small, but of late the school has been much enlarged and the number now amounts to 387. Attached to the school is the Qasr el Aini hospital, and these two form an important centre of scientific work in the country. There are now in the medical school well-staffed departments of biology, physics, chemistry, anatomy, physiology, pathology, and pharmacology, and in all of these not only is instruction given to students but research is carried on by the staff.

Although the number of scientific men in the institution has until recently been too restricted to admit of much research being undertaken in addition to teaching, several important investigations have been carried out; among these may be mentioned the study of the anatomy and racial characteristics of the ancient Egyptians, and of those neighbouring races whose remains occur in the cemeteries of the Nile Valley, and the comparison of them with the present inhabitants has added greatly to our knowledge of the Mediterranean peoples; the investigations which have been carried out of the life history of Ankylostoma and Schistosomum (Bilharzia) have done much to place our knowledge of these on a sound basis, the Bilharzia organism having been discovered in these laboratories, while work of no less importance has been done on the treatment of the diseases which are caused by these parasites. Valuable work on pellagra has also been done recently. Not only is there much more to be investigated in the interest of Egypt itself, but the special conditions, climatic, racial, etc., which occur there provide opportunity for many promising lines of research.

The Department of Public Health, which dates from 1886, is also actively working in the same scientific field and, in addition to the administrative work which it carries on throughout the country, maintains several branches specialising in scientific work. Under the director of the laboratories of the department the water service carries out a regular inspection of all public water supplies, whether in the hands of the Government, municipalities, companies, or private individuals. The examination of substances having a direct bearing on questions of hygiene, such as foodstuffs, drugs, etc., is also undertaken in these laboratories, as well as the chemical and bacteriological examination of water.

Here too research on the main diseases of the country, ankylostoma, bilharzia, and typhus, is in progress with the co-operation of eminent specialists, and in this connexion the recent work of the late Mr. Bacot and of Dr. Arkwright will be recalled. An antirabic institute provides for the treatment of persons bitten by rabid animals. The annual reports of the Department indicate the wide scope of the scientific investigations which have to be undertaken in the course of its work, and highly expert assistance must without doubt be employed if they are to be brought to a successful conclusion under the peculiar conditions which an arid subtropical climate provides.

The special conditions which obtain in Egypt, a highly fertile soil, a controlled water supply rendering agriculture independent of rainfall, and a moderately hot climate, form the foundation of its agricultural wealth; the prosperity of the country depends on the efficiency with which these favourable conditions are utilised, and to this end the irrigation engineer, the entomologist, the economic botanist, and the agricultural chemist are working in co-operation. Perennial irrigation has now been extended until about half the cultivable area is supplied with water at all seasons of the year, with the result that in normal years about 32 per cent. of that area is occupied by cotton. It will be evident therefore that the scientific institutions of the Ministry of Agriculture are of the highest national importance, and on their efficiency Egypt's prosperity must mainly depend.

In 1919 a Cotton Research Board was appointed with the object of bringing together the heads of all the technical departments which were interested in the cotton crop, and to ensure that all problems relating to it were dealt with as adequately as possible. It was also to provide laboratory accommodation for investigators engaged in research on cotton. In its first annual report published last year the experimental work upon cotton which had been undertaken was reviewed, and a programme for further work at the scientific institutes of the Ministry was outlined. These institutes include laboratories, experimental farms, gardens, etc.

The chemical laboratory of the Ministry, which undertakes examination and study of soils, water, manures, feeding stuffs, and agricultural products, is situated close to the botanical laboratory and the experimental farm. The work carried on at these has for its object the improvement of cotton, wheat, and

other crops which are grown in the country, on the basis of field selection combined with self-fertilisation and hybridisation. One important and promising research which is in hand is the effect of the gradually diminishing "sharaki" (waterless) period on the soil flora. Propagation in bulk of improved strains of wheat and cotton is arranged with the State experimental farm and with selected private cultivators. The fungoid and bacterial diseases of Egyptian crops in general and of cotton in particular are investigated, and means for their control are devised and tested.

The supply of trustworthy cotton seed of the best growths is so important in order to produce a high quality of staple, and the opportunities of mixing good seed with inferior qualities before it reaches the cultivator are so many, that the Ministry actively interests itself in the matter, through the botanical laboratory.

To this may be added the important work which is being done on the flowering-curve method as an index to the effect of environmental conditions; or investigations of the causes of bud-shedding; and on the root systems of cotton plants. Similar attention is being paid to millet, rice, opium poppy, beans, and sesame; and sugar cane will be added shortly.

The Entomological Section undertakes the study and investigation of insect pests and advises on methods for their control. The fumigation of all cotton seed produced in the ginneries of Egypt is also controlled by this section, and samples of the seed obtained from ginning are sent to it for germination and examination for worms.

The work of the horticultural section should also be mentioned, for in it much work is being done in introducing and acclimatising new species or varieties of trees, and farm and garden plants.

Thus a beginning has been made to provide the scientific organisation necessary for the development of agriculture on sound lines, but something on a larger scale will be needed before it can be adequate to the country's requirements. In these institutions a number of questions of first-rate importance to the Egyptian cultivator are under study, such as the effect on the cotton crop of a high subsoil water-table, of rotation in irrigation, of reduced watering, and many others, and for their satisfactory solution the provision and efficient maintenance of a highly trained and experienced scientific staff is essential.

The scientific diagnosis and investigation of animal diseases are carried out at the veterinary pathological laboratory which was opened in 1904, and the Serum Institute, which dates from 1903, provides the anti-cattle-plague serum required for the immunisation of cattle against cattle plague both in outbreaks and as a preventive measure.

Outside the State departments science is not widely represented in Egypt. There are a few scientific societies, of which the oldest is the Institut d'Égypte, which was founded in 1859; its object is the study of all that concerns Egypt and the surrounding countries from the literary, artistic, and scientific points of view. The Geographical Society was founded in 1875 and publishes bulletins and memoirs at intervals. In 1925 the fiftieth anniversary of its foundation is to be the occasion of an international geographical conference.

The Cairo Scientific Society, founded in 1898, is an active institution which meets fortnightly throughout the winter half of the year and publishes its proceedings monthly in the *Cairo Scientific Journal*. At Alexandria a hydrobiological institute has been recently established, and much important work awaits the scientific research which should be undertaken there. But these are all too few for the needs of the country, and their paucity suggests a lack of appreciation of the importance of scientific knowledge.

In spite of difficulties due to the war, which Egypt has experienced in common with most other countries, science has of recent years been playing a more and more important part in the development of the country and its resources. The conditions there prevailing often differ widely from those which have been studied in other countries, and much research by scientific men of high training and wide experience will be necessary before the many problems which present themselves are solved. Such work is not in the interest of Egypt alone, for much that is done there will, if it is of a high scientific standard, be a permanent addition to the general stock of knowledge. Egypt in the past has benefited largely by the science and technical skill which has been gradually built up by generations of students in many lands, and she may now furnish her own quota in return by scientific research in the many fields of inquiry which the Valley of the Nile affords.

Gelatin.

By Dr. T. SLATER PRICE.

GELATIN, in the form of glue, has been so long known that, according to Dr. Bogue (*J. Franklin Inst.*, 1922, vol. 193, p. 795), "we are unable to penetrate the archives of the human race to a date where we may say with assurance that glue was not yet discovered. Certain it is that this material was in use as an adhesive in the days of the great Pharaohs of Egypt." As glue, or κόλλα, it has given us the term "colloid," and at the time when this term was first used by Graham it was supposed that all colloids were substances of very complex constitution, such as is glue. This, however, is by no means the case, since what are known as the suspensoid colloids may consist of the elements themselves, *e.g.* colloidal gold and silver. The emulsoid colloids, however, consist to a large extent of very complex chemical substances, as, for example, the proteins, and it is to this class that gelatin belongs. Because of its complex constitution the chemical investigation of gelatin and of the processes which occur in its extraction from bones and hides is still in its infancy, and essentially progress has only been made in the direction of the examination of the degradation products. It is therefore not to be wondered at that the enormous literature on gelatin consists, to a very great extent, of accounts of results obtained in the investigation of its colloidal properties.

Naturally, the earliest physical properties to be investigated were the viscosity of the sol and the swelling of the gel, and it was soon found that the relations were very complicated, depending on previous history, even in systems made up from gelatin and pure water alone. For example, shaking, or repeated passage through a viscometer, will decrease the viscosity of a gelatin sol; at ordinary temperatures the viscosity of a freshly made sol gradually increases, whilst that of a freshly diluted sol gradually decreases; in a freshly made gel the intensity of the Tyndall effect gradually increases; and so on, all indicative of the formation of a structure and of the attainment of an equilibrium of some kind.

If the results obtained with gelatin in pure water are so complicated it is no wonder that they are still more so in the presence of acids, bases, and salts. Von Schroeder showed that in the presence of either hydrochloric acid or sodium hydroxide a maximum viscosity of the sol is attained at a low concentration of either of these substances. Again, according to other investigators, the effect of equivalent (tenth normal) solutions of various acids on the swelling is indicated by the following series, which is known as a Hofmeister series, after the investigator who was the first to examine the effects of different salts on the physical properties of the proteins:

$$HCl > HNO_3 > \text{acetic acid} > H_2SO_4 > \text{boric acid.}$$

With the sodium salts of various acids the swelling decreases in the order:

Thiocyanates > iodides > bromides > nitrates > chlorates > chlorides > acetates > tartrates > citrates > sulphates.

Moreover, the order in the series may be affected by the concentrations of the substances used.

Such series are very difficult to understand, since the order of the compounds does not bear much relation to their ordinary chemical properties; for example, it is difficult to understand why acetic acid comes between nitric and sulphuric acids.

A way out of such difficulties has been found in recent years by the realisation that gelatin, like other proteins, behaves as an amphoteric substance and that its properties in solution depend on the hydrion concentration. For progress in this direction we are chiefly indebted to the work of Procter in England, Pauli in Austria, and Loeb in America, the basic ideas being due to Michaelis and Sörensen.

Gelatin is a stronger acid than base, so that hydrion, in the form of an external acid, has to be added to the solution in order to bring the gelatin to the isoelectric condition. At the isoelectric point the hydrion concentration, C_H, is approximately $2{\cdot}5 \times 10^{-5}$, that is, the pH ($= -\log C_H$) is 4·7, which is on the acid side of the neutral point of water (pH = 7·0). The theory of amphoteric electrolytes shows that at the isoelectric point their solutions should contain a maximum number of neutral particles and should therefore possess peculiar properties; in accordance with this it is found that the properties of swelling, viscosity, osmotic pressure, etc., show a minimum at that point.

On the acid side of the isoelectric point, *i.e.* at pH < 4·7, gelatin should behave as a base and form gelatin-acid salts, whilst on the alkaline side, pH > 4·7, it should act as an acid and form metal gelatinates. Loeb has endeavoured to show that this is true in several ways, of which the following may be quoted, where use is made of silver nitrate and gelatin which is brought to different pH's, all *less* than pH = 7·0, by treatment with varying concentrations of nitric acid. It can be predicted that on the alkaline side of the isoelectric point the gelatin, when treated with silver nitrate, will combine with the silver forming a silver gelatinate, and that the amount formed will be greater the higher the pH. If such a silver gelatinate is formed the silver should not be readily washed out by water and should remain in the gelatin after washing. On the acid side of the isoelectric point the gelatin should form gelatin nitrate, and it should be easy to remove the silver by washing. The following analytical figures show the agreement between theory and experiment.

c.c. 0·01N-Ag in combination with 0·25 gm. Gelatin at different pH's.

pH	3·6	3·7	3·9	4·1	4·3	4·6	4·7	5·0	5·3	5·7	6·1	6·4
c.c.	0·5	0·3	0·3	0·2	0·2	0·2	0·55	1·25	3·2	4·0	4·85	4·9

The retention of the silver by gelatin at a pH > 4·7 is well shown by the fact that if test tubes containing samples of the various gelatins are exposed to light, those which are on the alkaline side of the isoelectric point blacken, whereas those on the acid side do not, but remain transparent even when exposed to light for months.

Results similar to those with silver nitrate are obtained when a nickel or copper salt is used. With potassium ferrocyanide the gelatin should retain the ferrocyanide, as gelatin ferrocyanide, on the acid side of the isoelectric point, and this is found to be the case.

Results such as the above indicate the necessity of knowing the pH when any investigations are carried out, and also of making comparisons of any particular property at the same pH. When such comparisons are made, Loeb has shown that the Hofmeister series, with their anomalies, disappear; for example, the various monobasic acids, and acids such as phosphoric, oxalic, and citric acids, which dissociate into two ions at ordinary dilutions, have the same effect on swelling, viscosity, etc., at the same pH. Dibasic acids, such as sulphuric acid, which dissociate into three ions at ordinary dilutions, should, and do, give different effects from the monobasic acids. Similar results were found with alkalis, and abnormal effects produced by such salts as sodium acetate were shown to be due to the alteration of the pH of the gelatin solutions when the salt was added.

The increased swelling, viscosity, etc., which take place on either side of the isoelectric point and reach a maximum at pH's of about 3·5 and 8·5 respectively, are attributed by Pauli to the greater hydration of the gelatin ions formed, as compared with that of the neutral molecule, but Loeb is not in agreement with this. The latter postulates the existence in any protein solution of molecularly dispersed particles, floating side by side with submicroscopic particles occluding water, the amount of which is regulated by the Donnan equilibrium (Procter was the first to apply the Donnan equilibrium to the study of gelatin solutions). The osmotic effects are determined by the molecular particles, the viscosity effects by the submicroscopic particles. Any influence in the solution (change in H-ion concentration) by which the molecular dispersion

is increased at the expense of the solid particles will result in an increase in the osmotic pressure and a decrease in viscosity, and the opposite conditions would result in the reverse of these effects.

The quantitative investigation of the physical properties of gelatin seems to have passed through three phases: in the first phase it was treated mainly as a colloid, in the second mainly as an amphoteric electrolyte, and now, in the third phase, as illustrated by Loeb's latest ideas, it is being realised that both its amphoteric and colloidal properties must be taken into account, since both play a part in its industrial applications. For example, its action as a protective colloid is of great importance in the preparation of photographic emulsions, but in the operations of developing and fixing its behaviour as an amphoteric substance must be considered, as may readily be realised when one remembers that the usual developers are alkaline, and that acid fixing baths are often used; the swelling of the gelatin film will vary in the baths, and in the change from the developer to the fixing bath the gelatin must, at some time, pass through the isoelectric point.

The structure of gels has been a bone of contention for a long time. Nägeli assumed that gels were two-phased and that the solid phase was crystalline, but Scherrer has not found any indication of crystalline structure in gelatin when examined by the X-ray method. Bütschli and van Bemmelen have advocated a cell-like structure, forming a net-work, and Hardy concluded that the solid phase consists of a solid solution of water in gelatin and the liquid phase a solution of gelatin in water; Wo. Ostwald has put forward the idea of a two-phase liquid-liquid system. Procter postulates the existence of a solid solution of the exterior liquid in the colloid in which both constituents are within the range of the molecular attractions of the mass, and Loeb has extended this idea. At the present time the conception of a fibrillar structure, as advocated by McBain and his co-workers for soaps, is gaining ground and is especially supported by Bogue in America and Moeller in Germany.

Current Topics and Events.

PROF. F. G. COKER was recently presented in London with the Howard N. Potts gold medal of the Franklin Institute of Philadelphia, awarded to him in recognition of his recent work on photo polarimetry. His method of determining stress in models of pieces and shapes made of homogeneous nitrocellulose material was brought to the attention of the Institute's committee on science and the arts in February 1921, and it was found that the General Electric Company of Schenectady, New York, had in use Prof. Coker's apparatus. A committee was appointed to investigate the apparatus and method, and it reported that Prof. Coker's work was in the highest degree worthy of recognition by the Institute on account of the ingenuity and experimental skill shown "in applying the principles of photo elastimetry to the study of the magnitude and distribution of strains in models of pieces and shapes under stress." The medal, with the accompanying certificate and report upon which the award was made, was presented to Prof. Coker at a dinner at the Savoy Hotel by Dr. R. B. Owens, secretary of the Franklin Institute.

SOME very remarkable achievements in gliding, or soaring flight, are described by the Berlin correspondent of the *Times* in the issue of August 21. The flights were made by two of the competitors in a test competition on the Wasserkuppe, near Fulda, for the grand prize for motorless sail-planes offered by the German Aeronautical Industrialists Union. On August 18 one of the competitors, Herr Martens, remained in the air forty-three minutes, cruised over the starting-place, and then flew due west, at an altitude of about 320 feet, a distance of ten kilometres, landing comfortably in a meadow near Weyhers. On the following day Herr Hentzen remained in the air about one hour forty-five minutes at an altitude varying between three hundred and six hundred feet, then cruised to the starting-line and across country, landing also in Weyhers, near the spot where Herr Martens had landed the day before. His total time in the air was two hours and ten seconds. The wind was west-north-west, a moderate breeze with occasional gusts. It died away as he set off for the cross-country flight. The machine flown by Herr Martens was a monoplane, designed by the Science Section of the Hanover Technical High School, in conjunction with the Hanover Flying School. The *Times* correspondent gives the following details of its structure: span, 39·4 ft.; wind surface, 172·2 sq. ft.; surface pressure, 2·4 lb. to the sq. ft. The pilot sits directly under the plane. The controls are worked by both the hands and feet. Lilienthal's glider, the correspondent recalls, had a span of 23 ft. and a wind surface of 151 sq. ft.

WE learn from *Science* that from the list of applicants for the Bishop Museum fellowships Yale University has selected the following fellows for the year 1922–1923: Dr. H. W. Fowler, ichthyologist, Philadelphia Academy of Science; Dr. N. E. A. Hinds, instructor in geology, Harvard University; and Dr. Carl Skottsberg, director of the Botanical Garden, Göteborg, Sweden. Dr. Fowler will devote his attention to a study of the fish of Hawaiian waters; Dr. Hinds will continue his investigations of the geology of the island of Kauai; and Dr. Skottsberg proposes to make a study of the flora of Hawaii with particular reference to comparison with the plant life of Juan Fernandez and other islands of the south-east Pacific. The four Bishop Museum fellowships yielding one thousand dollars each were established in 1920 by a co-operative agreement between Yale University and the Bernice P. Bishop Museum of Honolulu. They are designed primarily for aid in research on problems in ethnology and natural history which involve field studies in the Pacific region.

ON September 18 to 24 will be held at Leipzig the Centennial Festival of the Gesellschaft Deutscher Naturforscher und Ärzte (Association of German Men of Science and Physicians). The meetings will be preceded by a series of lectures and demonstrations in scientific microscopy to be given at Leipzig University. At the festival an exhibition will be held and a number of papers read by leading German men of science. Among the latter are the following: "The Theory of Relativity in Physics," Dr. Einstein; "The Theory of Relativity in Philosophy," Dr. Schlick; "Restorative Surgery," Drs. Bier and Lexer; "A Century of Atavistic Research," Dr. Johannsen (Copenhagen); "External Phenomena and Atavism," Dr. Meisenheimer (Leipzig); and "The Theory of Human Atavism"; "Progress and Retrogression in the Course of the World's History"; "Germany's Climate"; "The Highlands of Tibet and their Inhabitants," by Dr. Sven Hedin. Following the festival will be a series of continuation courses in medicine to be given at Leipzig, while during the period of the meetings special theatrical performances and concerts are to be arranged. Any one interested in medicine or natural science may take part in the meetings for a fee of 100 marks (or a correspondingly higher fee in the case of foreign countries). Those who wish for further particulars should apply to the Association at Leipzig.

THE autumn meeting of the Institute of Metals will be held at Swansea on September 19-22. On the evening of the opening day the first annual lecture on subjects of practical interest to those engaged in the non-ferrous metals industry will be given by Dr. R. S. Hutton, on "The Science of Human Effort (Motion Study and Vocational Training)." There will be a number of social functions and visits to works, and the following are among the communications to be submitted: Sixth report to the Corrosion Research Committee on the Nature of Corrosive Action and the Function of Colloids in Corrosion, Dr. Guy D. Bengough and J. M. Stuart; report to the Aluminium Corrosion Research Sub-committee on Experiments on the Oxide Method of Determining Aluminium, J. E. Clennell; "Grain-size and Diffusion," Prof. J. H. Andrew and R. Higgins; "The Structure of Eutectics," F. L. Brady; "The Antimony-bismuth System," M. Cook; "The Effect of Superheated Steam on Non-ferrous Metals used in Locomotives," Sir Henry Fowler; "The Constitution and Age-hardening of Alloys of Aluminium with Copper, Magnesium, and Silicon in the Solid State," Marie L. V. Gayler; "Intermetallic Actions: the System Thallium-arsenic," Q. A. Mansuri; "The Effects of Overheating and Melting on Aluminium," Dr. W. Rosenhain and J. D. Grogan; and "The Copper-rich, Aluminium-copper Alloys," D. Stockdale.

THE programme arranged for the Engineering Section of the British Association at the Hull meeting is somewhat of a departure from those of recent years. Two mornings are to be devoted entirely to papers and discussions on single definite subjects, and every effort has been made to arrange the programme in such a way that ample time will be available for discussion. The subject for Thursday, September 7, is "The Strength of Railway Bridges"—a vital topic at the present moment, when bridges are being subjected to loads very much in excess of those for which they were originally designed. Papers on the subject will be read by the engineers of some of the leading railway companies. On Friday, September 8, a descriptive paper will be read on "The Equipment of a Modern Portland Cement Works." The manufacture of cement is one of the leading local industries, and a visit will be paid to the new works of the Humber Portland Cement Co., which have been recently equipped on the most up-to-date lines. A paper of interest to the cement industry will be that on the effect of fire on reinforced concrete buildings. On Friday morning also the president, Prof. Hudson Beare, will give his presidential address on "Some Australian Railway Problems." Monday morning, September 11, will be devoted entirely to a discussion on "Economic Steam Production, with special reference to Marine Practice," and papers on the subject will be read by representatives of the Fuel Research Board, the Admiralty, and Messrs. Babcock and Wilcox. On Tuesday morning a paper on a closely allied and highly controversial subject, viz. "The Propelling Machinery of the Cargo Carrier of the Future," will be read by one of the leading engineers of Messrs. Beardmore and Co., who have done a great amount of work in developing the oil engine for this purpose. On Wednesday morning a paper on the resolution of compound stresses will be read and also one on electrical ignition apparatus for internal combustion engines, and a demonstration of the Collins micro-indicator for high-speed engines will be given. A number of afternoon visits to works and objects of engineering interest has also been arranged.

THE meetings of Section M (Agriculture) of the British Association at Hull are to be held under the presidency of The Rt. Hon. Lord Bledisloe, whose presidential address is to be on the subject of "The Proper Position of the Landowner in Relation to the Agricultural Industry." Following the practice introduced by Mr. Orwin last year, Lord Bledisloe will circulate his address and invite a discussion on his views. This will take place on September 11. In the programme of the section are three joint meetings and discussions with other sections. The first of these on the opening day—Thursday, September 7—is to be held at 11.30 A.M., and will be opened by Sir William Beveridge on the subject of "Weather Cycles in Relation to Agriculture and Industrial Fluctuations." This meeting is in association with Sections A and F (Mathematics and Physics, and Economics). Contributions have also been promised by Mr. Udny Yule and Mr. R. A. Fisher. On the following day a meeting will be held at 11.30 A.M. jointly with the Physiology Section to discuss the subject of Vitamins. This discussion will be opened by Prof. Drummond, and Messrs.

Golding, Orr, and Prof. T. B. Wood have promised to take part. The other joint discussion is also with the Economics Section, and should prove of wide interest, as the subject is "The Possibility of Increasing the Food Supply of the Nation." Sir John Russell, Sir T. H. Middleton, Mr. C. S. Orwin, and Prof. Somerville have promised to speak from the agricultural side. Sir A. Daniel Hall is reading a paper on "Land Reclamation on the East Coast," and an excursion to see natural and artificial warpland should be interesting in this connexion. Prof. T. B. Wood is contributing a paper embodying some of the results which have been obtained in the work at the Animal Nutrition Institute at Cambridge. Among other interesting papers are several dealing directly or indirectly with the use of lime in the improvement of soil conditions, and with the evaporation of water from soil. Horticulture and the nutrition of fruit trees will be dealt with by Mr. H. V. Taylor and Prof. B. T. P. Barker, and farm costs in Yorkshire by Dr. A. G. Ruston. In addition to the excursions already mentioned another has been arranged to enable members to see something of the farming of the Yorkshire Wolds, and it is also hoped to visit some of the oil-cake factories in Hull.

THE Toronto correspondent of the *Times* announces that the Quebec Government has decided to set aside about 22,000*l.* for the purpose of establishing a Radium Institute, under the control of the University of Montreal, for the experimental treatment of cancer.

ACCORDING to the Spanish journal *Iberica*, two underground railways are now in course of construction in Barcelona, viz. the Ramblas–Gracia, of a total length of 3400 metres, and the Puerto branch, 1800 metres in length. The two lines, which will be double-track systems, are of 1·435 metres gauge. The construction of the system will be a matter of some difficulty, as most of it will be underground tunnel-driving, although a certain part, serving traffic in the busiest part of the city, will be in the open. Little difficulty is experienced as regards water, because most of the ground through which the tunnels will be driven consists of a thick stratum of quaternary clay, superimposed in places by strata of hard limestone marl. The method of construction adopted is the Belgian system. The diameter of the tunnels on the straight will be 7 metres, and in curves, etc., 9·95 metres.

A CORRESPONDENT informs us that the admirable drawings referred to in a review of Messrs. Heron-Allen and Earland's report on Antarctic Foraminifera in NATURE of August 19, p. 241, were by *Miss* M. H. Brooks and not *Mr.* M. H. Brooks as therein stated.

THE Cambridge University Press promises for the autumn "The Air and its Ways," by Sir Napier Shaw. The volume will contain the Rede Lecture for 1921, and other contributions to meteorology, for schools and colleges.

Our Astronomical Column.

COMETS.—A photograph of Skjellerup's Comet, 1922*b*, was obtained on July 31 at Greenwich: it confirms the short period, which appears to be very close to 5 years, thus making it definitely the second shortest cometary period. That of Encke's Comet is $3\frac{1}{3}$ years, that of Tempel's Second Comet is $5\frac{1}{6}$ years. The identity with Grigg's Comet, 1902 II, is rendered almost certain, since both the period and the other elements accord closely. The perihelion distance has increased considerably, but only by an amount comparable with that which has occurred in the case of the Comet Pons-Winnecke.

The *Journal des Observateurs* of August 15 contains a series of observations of Reid's Comet, 1922*a*, made at Santiago da Chili by Rosauro Castro. There are twenty-two days of observation, from February 6 to March 31. The places of the comparison stars are taken from the Perth Astrographic Catalogue. The comet was observed for $2\frac{1}{3}$ months, so that there is ample material for deducing the orbit. As the later observations deviate considerably from Mr. Wood's ephemeris, there is some reason to suspect appreciable departure from a parabola.

M. Kamensky has made in *Astr. Nachr.* 5168 a very elaborate investigation of the perturbations of Wolf's Periodic Comet from 1884 to 1919, due to Venus, Earth, Mars, Jupiter, and Saturn. The comet was observed at five apparitions (1884, 1891, 1898, 1911, 1918), and the normal places are all closely satisfied by the final elements, the largest residual being 8″·6. The perturbations during the above period have been small, the range of the mean daily motion being from 518″·4 in 1898 to 523″·8 in 1884, or 1 per cent. There is, however, a near approach to Jupiter in 1922, which is likely to produce notable changes in the orbit, making it quite doubtful whether it will ever be seen again. M. Kamensky promises to investigate them. It is to be hoped that others will emulate him in similar researches on other periodic comets. Those of d'Arrest, Pons-Winnecke, and Tuttle are all in need of such work.

THE PROBLEM OF THREE BODIES.—It has long been recognised that the analytical solution of the general problem of three finite masses, moving under their mutual attraction, cannot be obtained in a form that is of practical utility. Something can, however, be learnt of the circumstances of motion, by studying particular cases by the method of mechanical quadratures. Researches of this kind are being pursued at Copenhagen Observatory under the direction of Prof. E. Strömgren. Some of the results were published in the Jubilee Number of *Astronomische Nachrichten*, and are now reprinted as a brochure. There are two cases of special interest where the masses are as 1, 2, 1, the largest being in the centre. The first is an approximation to an "orbit of ejection," and involves periodic near approaches. The outer masses describe curves resembling *limaçons* (without loops or cusps), while the central one describes a curve resembling the inverse of an ellipse with respect to the centre. The other case is an approximation to the case of the arrangement of the three masses at constant distances along a rotating straight line. When the conditions for the straight line are slightly departed from, each body describes a small loop; that of the central body is practically an ellipse with its major axis perpendicular to the rotating line. In each case the motion is periodic, and the curves repeat themselves indefinitely.

Research Items.

THE AGE OF STONEHENGE.—In the August issue of *Man* Mr. E. Herbert Stone describes some astronomical enquiries into the midsummer sunrise at Stonehenge. The date, 1840 B.C., given here for midsummer sunrise in line with the axis of Stonehenge must, the writer says, be regarded merely as a rough approximation. Owing to want of precision in the data Sir Norman Lockyer considered that the error—plus or minus—might amount to as much as 200 years; that is to say, the actual date is probably not earlier than 2040 B.C., and not later than 1640 B.C.

THE HULL MUNICIPAL MUSEUM.—Mr. T. Sheppard, Curator of the Hull Municipal Museum, has published a pamphlet giving an account of the collections under his charge. The museum originated in the collections of the museums of the Literary and Philosophical Society, which dates back to 1823. Eventually these collections were made over to the Hull Municipality, and the new museum, which has been improved by numerous gifts and purchases, was opened in 1902. It now contains numerous examples of the Prehistoric, Bronze, and Roman periods, and of the Anglo-Saxon, pre-Viking, and Viking ages, besides more modern productions. The Geological Gallery is an important feature of the institution, which seems to be efficiently conducted. The publication in a cheap form of monographs for the use of visitors is an important part of the work of the museum.

THE FLORA OF THE DAKOTA SERIES.—The Upper Cretaceous flora, so widely known as that of the Dakota Beds, is receiving detailed attention from C. Wilber Berry, who marks out successive stages in the southern states of N. America. His review of these in a paper on "The Flora of the Cheyenne Sandstone of Kansas" (U.S. Geol. Survey, Prof. Paper 129—I, 1922) shows that the term "Dakota flora" has been too vaguely used. The author has proved the Patapsco flora of Virginia and Maryland to be Albian. A comparison of genera gives the Cheyenne Sandstone a distinctly higher position, presumably Cenomanian, since the flora of the Woodbine Sand of Texas (*ibid.*, 129—G) is held to succeed it and to be Turonian rather than Cenomanian. The Woodbine flora is synchronous with that of the true Dakota Sandstone of the western interior, and floras older than this should not now be described as of Dakota age.

DEVONIAN FOSSILS FROM CHITRAL AND THE PAMIRS.—Dr. H. H. Hayden in the course of his journey through Chitral and the Pamirs in 1914 studied the geology and collected the fossils he came across. Of these the Devonian Invertebrata, chiefly Brachiopoda, have now been described and figured by F. R. Cowper Reed (Mem. Geol. Surv. India, New Series, vol. vi., mem. 2). His investigations go to show that in Chitral the Upper Devonian is developed with a fauna of a west European type indicating a Frasnian age; the presence of the Middle Devonian is not proved, but the Lower Devonian is believed to be present. In the Pamirs the Upper Devonian fauna presents a different facies and does not possess a single species in common with the Chitral beds, it is unlike that of any beds of western Europe, but on the other hand, especially as regards the Brachiopoda, is characterised by a certain American element. Beds of Middle Devonian age are also probably present in the Pamirs. As might be expected, a fair number of the species proved to be new and are accordingly named and illustrated on the sixteen accompanying plates, which are of unusual excellence.

THE CRETACEOUS MARINE TRANSGRESSION IN THE AFRICAN REGION.—The investigation by Dr. L. F. Spath (Annals of the Durban Museum, vol. 3, part 2, August 1921) of Cretaceous ammonoidea from Pondoland assigns the strata from which they have been collected to upper stages, Turonian to Campanian. Prof. J. W. Gregory, however, has gathered from the other side of the continent, in Angola, evidence of Albian strata, and it may be concluded that a submergence of some extent took place before the widely recognised Cenomanian transgression. Dr. Spath, following on Mr. R. B. Newton's account of the brachiopods and molluscs, describes the ammonoids from Angola in a memoir in the Transactions of the Royal Society of Edinburgh, vol. 53, part 1, 1922, with handsome plates provided by the funds of the Carnegie Trust. Most of the 117 specimens were collected near Labito Bay, and not a single Cenomanian ammonite occurs among them. The fauna is compared with that of Albian horizons in Madagascar and India; but the author holds that its closest affinities are with that of the Mediterranean region. Similar relations have been indicated for the Cenomanian fauna of West Africa. The paper includes considerations affecting the classification of ammonoidea from the British Gault.

MOUNT ETNA AND UPPER AIR CURRENTS.—In a paper published by the Reale Accademia Nazionale dei Lincei (vol. xxxi. ser. 5*a*, fasc. 7, 1922), Prof. Filippo Eredia shows that numerous pilot balloon observations conducted at Catania confirm what had been revealed by cirrus clouds and smoke from the volcano, namely, that the upper wind is very persistently from the N.W., and that Mount Etna does not effect any local modification in the general course of the Temperate latitude westerlies, which have been shown by Hildebrandsson to acquire a northerly deviation at the higher levels. The balloon observations in question disclose a definite N.W. direction at all seasons at the height of about 2400 metres (7000 feet *circa*), this direction becoming very persistent at 3300 metres (10,000 feet). It is found that the increase in the speed of the wind with altitude is in the Etna region more pronounced in summer than in winter, and the fact is connected with the greater rotation of the direction of the wind with height in summer, the surface winds in winter being also W. or N.W. The N.W. upper current is styled "il contro-aliseo boreale," that is, the northern counter (anti) trade feeding the tropical high pressure, in accordance with the terminology of Hildebrandsson.

BRAZILIAN CLIMATOLOGY.—An official publication ("Boletim de Normaes, Ministerio da Agricultura, etc., Directoria de Meteorologia"), under the direction of Sampaio Ferraz, has recently appeared, comprising meteorological statistics for a large network of stations scattered over the republic of Brazil, so that, although the records cover but a few years, it is evident that a commencement has been made towards a very thorough climatological survey of this remarkably progressive tropical state. For the capital, however, Rio de Janeiro, situated in lat. 23° S., near the southern tropic, a thirty years' record or more exists for most of the meteorological elements, and it may be of interest to quote a few figures. The annual range of mean temperature is what one would expect in a maritime city at the margin of the tropics, namely, about 10° F. between 77°·3 F. in January and 68°·1 F. in July, the figure for the year being 73°·6. The absolute maximum is 102°·2 recorded in December, and the absolute minimum for the period 50°·3 in September. Thus frost, which is often quite severe in the extreme south of the republic, has not been recorded in the capital by a wide margin. The mean annual rainfall is 46 inches, with a summer maximum, and the greatest 24-hour fall of 8·9 inches is in no way remark-

able for a hot country, this amount having actually been exceeded in England. The mean annual evaporation exceeds the rainfall by 1 inch—a balance fairly typical of this type of climate. Rain falls on 136 days, and thunderstorms occur on as many as 68 days. The mean annual humidity is 78·3 per cent., with little monthly variation, whilst the vapour tension follows closely the monthly mean temperature. The general subject of the geographical and seasonal variation of absolute humidity is deserving of more study, but it seems almost inevitable that, except perhaps in arid continental interiors away from sources of vapour supply, the dominating factor controlling the variations must be temperature.

CURRENT METERS.—A pamphlet by Dr. M. A. Hogan on "Current Meters for use in River Gauging" has been issued by the Department of Scientific and Industrial Research for the committee on gauging rivers and tidal currents (London: H.M. Stationery Office, 1*s.* 6*d.* net). The pamphlet gives in vi + 33 pp. a useful summary of information relating to the conditions affecting the design and use of current meters. Several meters in common use are described, and sections are devoted to a discussion of the effects of oblique and varying velocities, and also of turbulence. Theoretically, the best type of meter is the screw type fixed on a rod, with blades or guard rings specially designed for the good measurement of oblique velocities. But the main disadvantages attached to this type of meter concern the practical details, such as the supporting of the rod during measurement, and in this respect it is concluded that the cup-type meter, being supported by a cable, is more easily manipulated. The results of tests of meters in turbulent water and also for low velocities are collated. The author concludes that in favourable circumstances most meters will give results of sufficient accuracy for river gauging, but that when the conditions are unfavourable, as when turbulence is present, the crude results given by a single meter of any existing type are likely to be considerably in error. The most important effects of turbulence arise through the variations in direction of velocity rather than in magnitude. With the cup type of meter turbulence causes over-registration, while with the screw-type meter it causes under-registration, so that a combination of the two types can be used to measure turbulent flow.

TELESCOPES *VERSUS* FIELD GLASSES.—Although almost every text-book which deals with optical instruments describes the astronomical or Kepler and the Galilean telescopes, and explains how the former may be converted into an erecting telescope like the latter, few of them direct attention to the decrease of luminosity of the field due to the erecting devices, and still fewer give any information as to the relative extents of the fields of view of the two instruments. It is, however, on account of the small field of the Galilean instrument that it is no longer used in astronomical observatories, and some explanation of this restriction of the field should be given in any modern text-book on optics. To fill the gap in present-day text-books Dr. A. Sonnefeld, of Jena, contributes an article on the subject to the issue of *Die Naturwissenschaften* for July 28. From the point of view of the instrument-maker wishing to widen the field, the subject has been treated recently by Messrs. Hughes and Everitt, Transactions of the Optical Society, 22, p. 15, and by Mr. T. Smith in the same volume, p. 84.

SPECTRA ON THE QUANTUM-ORBIT THEORY.—This theory has been so successful in describing the known facts as to the spectra of elements constituted of a single nucleus and a single electron, that there is considerable justification in the hope that it may help to explain the spectra of more complicated elements. An approximate solution of the larger problem has been given by Sommerfeld in his "Atombau und Spektrallinien," but there are assumptions made by him as to actual spectral observations which Prof. Hicks points out in a paper on the subject in the August issue of the *Philosophical Magazine* are not justified. In the first instance the expression for the frequencies of the lines of a series which results from taking the atom to consist of a central nucleus, a ring of equally spaced electrons and outside it a single electron obeying the quantum laws, is not general enough to cover all known series. In the second instance observation lends no support to Sommerfeld's deduction that the different types of spectra are obtained by giving one of his constants successive integral values. Lastly, many small and often irrelevant points are referred to as striking confirmations of the theory, which, when examined more carefully, are found to afford no support to it.

HEXOSAMINES AND MUCINS.—Dr. P. A. Levene, in Monograph No. 18 of the Rockefeller Institute, gives the interesting results of his work on constitution of these substances. He shows that the nitrogen in the amino-sugars is present as a primary amino group, in analogy with the other glucosides. A large number of derivatives are described and many of the hexosamines were synthesised. As regards the mucins, it is shown that there are two groups, from one of which chondroitin-sulphuric acid is obtained, from the other mucoitin-sulphuric acid. They differ in the fact that the former, obtained from cartilage, aorta, and sclerotic, contains the amino-hexose, chondrosamine; the latter, obtained from umbilical cord, vitreous humour, and cornea, contains in its place chitosamine. This latter amino-sugar is sometimes called glucosamine. The chitosaminic acid derived from it turns out to be 2-amino-mannonic acid, whereas chondrosaminic acid is 2-amino-talonic acid. Apart from this difference, the two conjugated sulphuric acids are similar and consist of the amino-hexose, glucuronic, acetic, and sulphuric acids in equi-molecular proportions. The amino-sugar and glucuronic acid are combined as a disaccharide. The acetyl group is linked to the amino group. Finally two molecules of the whole are joined as glucoside by their glucuronic acids. There appears to be a slight difference in the place of attachment of the sulphuric acid to the amino-sugar.

THE COMPOSITION OF PHOSPHORITE.—Mr. A. F. Rogers (*Amer. Journ. Sci.*, vol. 203, p. 269, April 1922) writes of "Collophane, a much neglected mineral," and shows that this name deserves a more general recognition. It was given by Fridolin Sandberger in 1870 to an amorphous calcium phosphate and carbonate, with some water, from Sombrero. Sandberger eliminated the carbonate; but the material has been shown by Lacroix to consist almost exactly of $3Ca_3(PO_4)_2.CaCO_3$. Dahllite is clearly its crystallised representative. The author regards the variations in composition as due to solid solution, calcium fluoride and sulphate being sometimes concerned. Collophane becomes important if we recognise that a large part of the ordinary phosphorite of commerce, rock-phosphate and the rest, consists of this material. When the author states that, "like most other amorphous minerals, it is of colloidal origin," he probably means that it once was in a colloidal state. Dahllite has, of course, been previously recognised as forming the concretions of phosphorite in Podolia, which show internal radial crystallisation. Carbon dioxide varying from 2·40 to 11·72 per cent. is recorded by J. Samojlov (*Compte rendu* Congr. internat. géol., 12me session, Canada, 1913, p. 850) as a constituent of the widely spread Jurassic and Cretaceous phosphorites of Russia.

The Glasgow Meeting of the British Medical Association.

THE ninetieth annual meeting of the British Medical Association was held in Glasgow on July 25-28, under the presidency of Sir William Macewen, and its proceedings included much of interest to men of science outside the circles of medical specialism. In his address delivered on the evening of July 25 in the Bute Hall of the University, after welcoming the Association to Glasgow and referring to some of the great names associated with the University of Glasgow during the 471 years of its existence, the president put in a strong plea for a broader scientific outlook with less concentration on purely human phenomena. He referred to the want of scientific training and scientific habits of thought in the general community, and pointed out how this had led to the neglect of discoveries of the greatest practical importance. It had now been discovered that such a disease as syphilis was a preventable germ disease, which could be stamped out by means made known to them: "If this generation did not stop the disease it committed a crime against posterity." The main part of the address dealt with the enthralling subject of brain-surgery, of which the speaker is one of the most distinguished pioneers, and of which he is still an acknowledged master.

On the following three days the Association met in separate sections, housed in the medical and scientific departments of the University, and in various of these papers were read and discussions held which were of wide scientific importance. In the section of pathology an interesting discussion took place on "Animal and Vegetable Pathology in Relation to Human Disease," the openers being Prof. Hobday and Prof. Lang. The former dealt mainly with the importance of diseases communicable to man, such as glanders, rabies, anthrax, and tubercle. Prof. Lang discussed in a more general way the relations of vegetable pathology to animal, tending on the whole to sound a note of caution against the assumption that the principles underlying the processes of disease and healing are identical in the two kingdoms. He discussed the case of crown gall, on which important recent work had been done by Smith and Townsend, and by Robinson and Walkden. In this case tumours developed in relation to wounds such as those made in grafting, and it had been shown that the new growth was due to infection by a specific microbe *Bacterium tumefaciens*. The fundamental differences in organisation between the higher animal and the higher plant should, in Prof. Lang's opinion, be carefully borne in mind before instituting close comparisons between such tumours caused by *B. tumefacium* and the malignant new growths of man. The probability was that the pathogenic processes of plants and animals had begun to diverge from one another at a very remote period of evolutionary time, and the value of the study of plant pathology to the human pathologist (and incidentally to the student of medicine) lay rather in its broadening the outlook than in its providing the bases for direct inferences from one subject to the other. In the course of his paper Prof. Lang referred to the fact that the study of ancient plants obtained from the Old Red Sandstone of Scotland had disclosed injuries, due apparently to irritating gases, and healing processes, bearing the closest similarity to what may be observed in modern plants after exposing them to irritating vapour. This fact is obviously of extraordinary biological interest as being the most ancient case of pathological reaction which has been subjected to histological investigation.

The discussion just mentioned had its supplement on the following day in the new but highly successful section of micro-biology, sitting under the presidency of Dr. R. M. Buchanan, when Prof. V. H. Blackman opened a discussion on "Some Similarities and Dissimilarities in the Micro-biology of Plant and Animal Diseases." Prof. Blackman also was inclined to emphasise the differences rather than the resemblances between the diseases of plants and animals. He gave an interesting general review of the relations of parasite and host in the parasitic diseases of plants. The immunity of plants towards hostile micro-organisms was a natural immunity: the acquired immunity so characteristic of many human diseases and forming the basis of modern serum-therapy was quite unknown in relation to specific diseases in plants. Immunity was often of a passive kind, such as is provided by a resistent enticle or cell-wall, successful invaders in such cases making their way in through natural openings such as the stomata, or through special perforations made by their own activity. In other cases the immunity was of an active kind, involving a distinct physiological reaction on the part of the plant. Thus in cereals immune to "rust" the cells have developed a hyper-sensitiveness to the proximity of the fungus, dying upon its approach, before they can be penetrated by the parasite. In other cases the host imprisons the invading parasite in an envelope of impermeable cork cells. Prof. Blackman also directed attention to the existence amongst plants of diseases due to so-called ultra-microscopic organisms. Two diseases of this type occurring in the potato had recently been found to show a further analogy with diseases of a similar type occurring in animals in that they were insect-borne, being transmitted by aphides or green-fly.

The "ultra-microscopic" or "filter-passing" organisms were also to the fore at other meetings of the section of micro-biology. On Wednesday, July 26, Dr. F. d'Herelle, of the Pasteur Institute, opened a discussion on his theory of "Bacteriophage"—a theory formulated to explain the fact that among the contents of the alimentary canal there always exists a "something" which possesses the power of dissolving bacteria of certain definite types, *e.g.* in the case of man bacteria of the coli-typhoid-dysentery group. This "something," sometimes called an enzyme, sometimes given the more definite name bacteriolysin, is of uncertain origin. The balance of probability would probably appear to most biologists to be in favour of its being formed by the activity of the host, its formation being part of the general defensive mechanism of the body. Dr. d'Herelle, however, believes it to be formed by an ultra-microscopic enemy of the bacteria, which he names *Bacteriophagum intestinale*, and he supports his theory by a mass of striking arguments. Dr. Twort, of the Brown Institute, gave an account of his earlier work, in which he determined the existence of a similar bacteriolytic substance in cultures of *micrococcus*. A point of much interest emphasised by Dr. Twort, but usually ignored by biologists, is the probability that ultra-microscopic organisms exist in abundance free in nature, and are not confined to a parasitic existence.

In the discussion on Thursday, July 27, upon the "Bacteriology of Influenza," an important rôle was again assigned to the ultra-microscopic type of organism. Dr. Mervyn Gordon recalled that a large number of diseases, such as measles, mumps, small-pox, were now attributed to these organisms, measuring under 0.5μ in diameter, to which Prowazek had given the name Chlamydozoa. Strong evidence had recently been adduced that the real causative agent

of common cold was an organism of this type, measuring 0.2-0.3μ in diameter. Dr. Gordon gave an account of his recent researches, which are entirely confirmatory of the view that influenza is similarly due to organisms of this type, which can be obtained from the nasal and pharyngeal secretion during the first three days of the disease, though not later.

The section of physiology met on two days only, each being taken up mainly with an interesting discussion. The first, on the "Etiology of Rickets," opened by Dr. Leonard Findlay and Prof. Mellanby, was mainly of medical interest, but it left two distinct impressions on the lay mind: (1) That there is still much difference of opinion in regard to the cause of this blot on the health of our great cities, and perhaps too great a tendency to the belief that one single factor is responsible rather than a complex of factors; and (2) A strong impression of the valuable return which is bound to accrue to the community through the activities of the Medical Research Council under the guidance of its present secretary.

The other discussion in this section had for its subject "Basal Metabolism," *i.e.* the metabolism during complete rest. In his interesting opening address Prof. Cathcart incidentally emphasised the extreme complexity and elusiveness of the phenomena grouped under that blessed word metabolism—facts which are liable to be accorded insufficient weight by biological writers and teachers.

One of the most important features of the Glasgow meeting was the discussion which took place on Friday morning, July 28, in the section of medical sociology upon "Alcohol as a Beverage in its relation to certain Social Problems"—a discussion which stood out in strong relief from most discussions on this much discussed subject from its including moderate and calmly reasoned statements from scientific investigations of recognised status. The discussion was opened with an admirable introductory statement by Prof. Mellanby, of Sheffield, in which he laid down the basic facts regarding the physiological action of alcohol. As a drug it was to be regarded as a narcotic, acting on the cells of the cerebral cortex and slackening its control and discipline over the lower nerve centres. It was as a narcotic drug that alcohol in small doses found its usefulness in human life, dispersing temporarily worries and troubles, and so facilitating bodily functions that were known to be interfered with by anxiety. As a food the value of alcohol in moderate amounts rested on the fact that it is rapidly absorbed and to the extent of about 98 per cent. oxidised so as to set free heat. Experiment showed that as much as 40 per cent. of the heat lost from the body during a given period could be supplied by alcohol, but the practical utility of this was to a great extent neutralised by the poisonous drug action. Under abnormal conditions, however, such as those of Diabetes mellitus, the food value of alcohol in small doses could be utilised to take the place of sugar. Dr. J. T. MacCurdy, of Cornell, speaking as a psychiatrist, emphasised the fact that "the Alcoholic is, before he ever touches a drop, an abnormal person," and also emphasised the great difficulty in carrying out a just comparison between the two evils of such abnormality finding expression in alcoholism or in some other form of vice or crime. From the purely scientific point of view one of the most interesting contributions to the debate was that from Prof. C. R. Stockard, of Cornell Medical College, which told of his experiments, extending over a long series of years, on the influence of alcohol in causing abnormalities of developing eggs and embryos. His experiments on mammals (Guinea-pig) were of particular interest in demonstrating how heavily dosing the parents with alcohol produces marked effects in diminishing fertility, in increasing pre-natal and early post-natal mortality, and in causing defectiveness of the offspring. If we are justified, as no doubt we are, in extending Stockard's results to man, we are afforded incidentally a fine illustration of natural selection at work in the civilised community—for these individuals that are afflicted with the particular form of "unfitness" that finds its superficial expression in drunkenness are seen to be subjected to a severe process of weeding-out during fœtal and infantile life which works in the direction of keeping up the standard of the surviving stock.

It must not be thought that the proceedings of the sections exhausted the activities of the meeting. An admirable "Museum" was got together by Prof. Teacher, while Dr. Dunkerly arranged a microbiological exhibition, which included beautiful series of Leishmania and of Spirochaetes exhibited by Sir Wm. Leishman, and Dr. Connal's series of developmental stages of Loa loa in the body of the transmitting fly. Numerous interesting demonstrations were given at the afternoon meetings of the various sections, and the meetings concluded on Friday evening, July 28, with the "popular" lecture—entitled "The Physician—Naturalist, Teacher, Benefactor"—delivered to a large audience by Prof. Graham Kerr.

The gold medal of the Association was presented to the Right Hon. Sir. T. Clifford Allbutt and to Lieut.-Col. A. Martin-Leake at the general meeting on the evening of July 25. The presentations were made by the president on behalf of the association. The medal for distinguished merit was instituted by the association at its annual meeting in Manchester in 1877. The medal is awarded on the recommendation of the Council to some person who shall have conspicuously raised the character of the medical profession by scientific work, by extraordinary professional services, or by special services rendered to the association. On this occasion the medal was in each case accompanied by a testimonial or address stating the grounds of the award.

The Stewart Prize of the Association was presented to Dr. J. C. McVail at the same meeting on July 25. The prize was founded by the late Dr. Alexander Patrick Stewart, who was among the earliest to give attention to sanitary questions and also to distinguish between typhus and typhoid fever. The primary object of the Stewart Prize is to afford recognition of important work already done or of researches instituted and promising good results regarding the origin, spread, and prevention of epidemic diseases.

Broadcasting in America.

MR. A. P. M. FLEMING, manager of the research and education departments of the Metropolitan-Vickers Electrical Co., Ltd., who has been closely identified with the development of radio broadcasting in Great Britain, recently attended a conference of the American Institute of Electrical Engineers at Niagara Falls as a representative of the British Institution of Electrical Engineers and the British National Committee of the International Electrotechnical Commission. He took advantage of the opportunity while in America to make a close investigation of the position of radio telephony extending over a period of two months, and, in addition, studied the trend of public taste and opinion

with regard to broadcasting and the steps which are being taken by the Government to control radio transmission. He tested a wide variety of makes of receiving apparatus and discussed the methods of working, cost and organisation of broadcasting stations, and obtained a considerable amount of valuable experience which will assist in enabling British manufacturers to avoid the pitfalls into which many American firms have fallen. Mr. Fleming also visited the largest broadcasting stations and discussed the situation with the leading makers, radio engineers and officials.

Since the end of 1920 the broadcasting position in America has been chaotic. Practically anybody—private companies, municipalities, departmental stores, universities, Government offices, newspapers—have been able to set up transmitting stations, the only restrictions being the wave-length, 360 metres, and the power, about 1½ kw. At the present time there are nearly five hundred broadcasting stations in the United States working without reference to each other, except in a few cases of friendly co-operation, with regard to time of operation, type of programme and object of the station. The stations are concentrated chiefly along the eastern states and on the Pacific slope, and no less than twenty stations are in close proximity to New York City. Broadcasting programmes are announced in advance through the press, and much use is made of gramophone records for transmission. The U.S. Government called a conference of interested parties at Washington a few months ago under the chairmanship of Mr. Herbert Hoover, and appropriate working conditions were decided. The passage of a Bill now before Congress will afford the Secretary of the Department of Commerce considerable powers to control and co-ordinate the radio traffic, including broadcasting. The process, however, at this stage is slow, and some time must elapse before the American system is giving the public as efficient service as it is hoped the British system will give from its inception.

The action of the Postmaster-General in restricting broadcasting is viewed with much approval in the States, as affording the most convenient means whereby confusion may be avoided.

During his visit Mr. Fleming saw the principal broadcasting stations in operation, including East Pittsburgh (call sign KDKA), Newark (WJZ), Chicago (KYW), Springfield (WPZ), all operated by the Westinghouse Co., the Detroit Free Press, Detroit News, Federal Telegraph and Telephone Co., Rochester School of Music, etc. From the two Detroit stations, as well as those at Pittsburgh and Chicago, Mr. Fleming broadcasted for the benefit of American listeners the position of radio telephony in Great Britain.

The broadcasting station comprises studios in which the artistes play and sing, transmission rooms, control rooms, green room and offices. Every station differs from others, all being in an experimental stage of development, and each one has points of interest which can be incorporated into English practice. It is estimated that two million radio receiving sets are in use, and during the last two years about 12,500 companies have been incorporated for carrying on radio business. Many of these, however, are mushroom affairs, against which the public has been warned.

The pioneer work in the development of broadcasting was conducted by the Westinghouse Co., of Pittsburgh, which opened station KDKA in December 1920. The Company also immediately placed upon the market a number of receiving sets and a remarkable demand arose. The whole country responded to this new form of entertainment, and the demand created has no parallel in recent years.

The patent situation with regard to radio apparatus, circuits and valves was so obscure and complicated that many of the leading makers might unwittingly have infringed each other's patents, and the pooling of the patents by the principal manufacturers has eased what might have been an extremely difficult situation. The Radio Corporation, a group of radio manufacturers already in existence and interested in communication by radio telephony, was utilised to act as a selling agent. There are, of course, many manufacturers outside this group, but small makers are not permitted to utilise patents for which they are not licensed, their sets consequently being less effective and up-to-date than those of the leading makers. Clearly the "mushroom" companies are unable to indemnify their clients against actions which may take place if basic patents are infringed by the apparatus they make.

One of the most interesting organisations in the States is the American Relay League, a national non-commercial association of radio amateurs who combine to relay friendly messages between amateur stations across the Continent and to protect the interests of amateurs. In this way messages from amateur transmitting stations can be sent over very much longer distances. Under British conditions such work is not possible, as those who hold 10-watt transmitting licenses can only send out messages connected with the experimental work for which their license is primarily intended, but attempts are being made to modify these restrictions. Amateur transmission could not, of course, take place while broadcasting is in progress.

During the hot summer months in America the public is not particularly keen on indoor entertainment, and noises in the receiving set due to atmospheric electrical disturbances are troublesome. The public taste is also changing, and those who have experienced reception last winter are developing a taste for more serious and solid matter than has hitherto been the case. Educational matter and health talks are becoming increasingly popular in programmes. More and more church services are broadcasted, and the improvement in the quality of sermons is helping to fill churches which have hitherto been very thinly attended. Market and stock reports are also sent out, and these are of great importance to farmers, *e.g.* the ruling price of pork in Chicago, obtained by radio, may help a farmer to decide whether to send his hogs to market or not immediately. University extensions and extra-mural lectures are being broadcasted to an increasing extent, and invalids and others ("shut-ins") who are unable to seek entertainment out of doors find radio a great boon.

There is no doubt that radio has come to stay. Its character will change, both through technical improvements and through changes in the public taste, but it is rapidly becoming a permanent part of the national life. It is being used to an increasing extent to send out what is known as "perishable news," to relieve the load on the ordinary telephone and telegraph lines. In this respect the attitude of the press has undergone a notable change. From opposition it has changed to whole-hearted support. Newspapers publish programmes at length, and have radio columns in which expert advice is given to amateurs.

Mr. Fleming is most optimistic as to the future of radio in Great Britain. While British audiences are likely to be more critical than American, with the aid of all that American experience has to offer British broadcasting will establish itself as the best in the world, and the public will find in it a unique and continuous source of entertainment and instruction, full of possibilities of expansion. The develop-

ments which are taking place even now in America are likely to produce far-reaching changes, such as the so-called wired wireless, by which radio transmission is conducted for part of its path by an ordinary wired line. What these developments do, however, must be left for the future to determine.

Third International Congress of the History of Medicine.

THE papers read at this Congress, which was held in London on July 17-22 under the presidency of Dr. Charles Singer, may be classified in four main groups according to their subjects, viz., epidemiology, anatomy, pharmacy, and veterinary medicine. Among the papers on epidemiology special mention may be made of those by Prof. Jeanselme, on bubonic plague in the Middle Ages, in which a relationship between famine and plague was shown; by Dr. Ernest Wickersheimer on the black plague at Strasbourg in 1349, with extracts from a contemporary document; by Miss M. Buer on the decrease of epidemic diseases in the 18th and early 19th centuries, a decrease attributed by her to improvements in agriculture, improvements in house and town planning and the advance in medicine; and an interesting account by Sir William Collins of Sir Edwin Chadwick, the father of English sanitary science. Other papers of epidemiological interest were those of Dr. Torkomian of Constantinople on inoculation against small-pox by the ancient Armenians, of Dr. Belohlavek of Prague on epidemics in Bohemia in the Middle Ages, and of Dr. Neveu of Paris on plague in Tuscany in the fifteenth century.

Perhaps the most interesting contribution to the history of anatomy was the paper of Prof. Wright on Leonardo da Vinci's work on the structure of the heart, in which it was stated that Leonardo was the first to show the exact attachment of the chordæ tendineæ to the cusps of the auriculo-ventricular valves, the first to direct attention to the dilatations of the origins of the aorta and pulmonary valves, the first to note the occasional presence of an inter-auricular foramen or foramen ovale, and the first to describe the moderator band in the right ventricle of the heart. Dr. Donald Campbell made a communication on the significance of the Arabic MSS. of Galen's work on anatomical administration, in which he suggested that the preservation of this work when portions of it were totally lost otherwise indicated that the Muslems did not completely destroy the second library of Alexandria, as is generally supposed. In a paper on the anatomical studies of Descartes in Holland, M. Fosseyeux showed by extracts from contemporary literature that Descartes, who was the grandson and great grandson of medical men, studied anatomy both in the human subject and in animals at Amsterdam, Utrecht, Leyden, and Harlem between the years 1630 and 1638. Other anatomical papers were those by Dr. T. Wilson Parry on the collective evidence of trephination of the human skull in Great Britain during prehistoric times, by Dr. Kathleen Lander on women as anatomists, by Dr. Krumbhaar of Philadelphia on the beginnings of anatomical instruction in the United States, and by Dr. J. D. Comrie on early anatomical instruction in Edinburgh.

In an historical sketch of pharmacy in Great Britain and Ireland, Mr. J. B. Gilmour showed that it was not until the 16th century that any beginning was made with the regulation of the practice of medicine or the sale of drugs, and even down to the 18th century the sale and dispensing of drugs was chiefly in the hands of the physicians and apothecaries. The paper deals successively with the evolution of the pharmacist, the history of pharmacy law, the origin of the Pharmaceutical Society of Great Britain, pharmaceutical education and science, the protection of professional interests, pharmacy in Ireland, and the history of pharmacopœias and pharmaceutical literature. In his paper on art in the Italian pharmacy of the 15th century Prof. Castiglioni of Trieste stated that at the beginning of the 15th century the practice of medicine was closely associated with that of the apothecary, so that the druggist's shop was often an intellectual centre which served not only as a consulting-room for the doctor but also as a place where books and curiosities were exhibited. Prof. Castiglioni showed a large number of photographs of pharmacy jars from his private collection, illustrating the development of medicine in the 15th century. Mr. C. J. S. Thompson traced the history of "Hiera Picra," a remedy composed mainly of aloes and colocynth, which was first used, according to tradition, in the temples of Æsculapius in Greece and is still sold in the pharmacies of Great Britain and the Continent. M. Buchet contributed a paper on the history of legislation concerning poisons, and M. Fialon described the ancient statutes of the apothecaries of Lyons.

Major-General Sir Frederick Smith gave an interesting description, illustrated by lantern slides, of the position of veterinary anatomy in England during the 16th, 17th, and 18th centuries, in which he emphasised the following points: (1) The comparative absence of information on the subject, in spite of the fact that up to the 15th century practically only the anatomy of animals was studied by students of human medicine. (2) The interest shown by lay writers on a subject in which they were ignorant, but the importance of which in the advancement of veterinary knowledge they fully recognised. These men wrote on the subject and drew on their imagination. (3) The absence of any veterinary school in this country until the end of the 18th century, when one was founded in 1791 with Vial de Sambel as professor. Prof. F. J. Cole of Reading read a paper on Ruini on the anatomy of the horse, a work which, published in 1598, was the first monograph on the anatomy of an animal. Other papers on veterinary medicine were read by Mr. F. E. Bullock on "Mulomedicina Chironis," a compilation of ancient veterinary treatises; by M. H. J. Sevilla on the syndrome of colic in the Greek Hippiatric writings, and by M. Moulé on the history of glanders in Greek and Roman writers.

In addition to the papers on the history of epidemiology, anatomy, pharmacy, and veterinary medicine, communications on various topics of medico-historical interest were read. In a paper entitled "Magistri Salernitani nondum cogniti," Dr. Capparoni of Rome gave an account of a manuscript which he had found in the cathedral of St. Matthew at Salerno, containing the names of thirty-one hitherto unknown medical men from the second half of the tenth to the sixteenth century, most of whom were monks or ecclesiastics of some kind. This discovery confirmed Dr. Capparoni's view that scientific medicine at this period was mainly practised by monks until the papal prohibition in the 12th century to practise medicine outside the cloisters, with the result that the school of Salerno was founded by laymen. In a paper on Dante and Averrhoism in Italy, Prof. Castiglioni discussed the relations of

Dante with medicine. Though opposed to the view that Dante himself was a medical man, the professor stated that the poet studied medicine at Bologna, was closely connected with Alderotti and Pietro d'Albano, two of the most distinguished physicians of that time, was prior of the corporation of physicians and apothecaries, and was given the title of magister in a contemporary document.

Other papers on miscellaneous topics were those by Dr. F. J. Poynton on doctors and the dawn of aerostatia, by Dr. J. D. van Gils of the Hague on the doctors of Molière and Shaw, and by Mme. Panayotatou of Alexandria on hygiene and dancing in ancient Greece. It is proposed to hold the next Congress of the history of medicine at Geneva in 1925.

The Research Association of British Rubber and Tyre Manufacturers.

PROBABLY in no industry is the old ground of knowledge less thoroughly explored and the new unbroken field for useful research so extensive and attractive as in the rubber industry taken as a whole. A hundred years or a little more have passed since the discovery that rubber could be converted into a workable form by solution in suitable solvents or by mechanical kneading, and the process of vulcanisation was discovered eighty years ago. These operations, which are yet applied unaltered in principle and very little different in practical detail, still represent the foundation of rubber manufacture of the present day; compared with them, all the other innovations have been of minor importance. The disadvantages, however, inherent to these fundamental operations are so marked as to cause surprise that so little further advance has been made during the last half-century. It is almost astounding that so large a portion of the effective history of the industry should be found recorded in the remarkable "Personal Narrative" of Thomas Hancock, published in 1857, after his retirement.

If anything further had been needed to emphasise the importance of the rubber industry, particularly that section of it dealing with the production of rubber tyres for various types of vehicles, and the call for its further scientific development, the period between 1914 and 1918 supplied the necessary stress in an unmistakable manner. It was natural, therefore, that members of certain companies interested in the manufacture of rubber goods should decide to take advantage of the assistance offered by Government to found a Research Association of British Rubber and Tyre Manufacturers. An energetic Committee under the chairmanship of Mr. Alexander Johnson saw the Association pass from the embryo stage to a state of healthy and vigorous existence with Mr. B. D. Porritt as director of Research.

On account of the early part of the year 1920 being inopportune for the purchase of premises and equipment, the Research Association first found a temporary home in University College, London, thus enabling a commencement with a preliminary, albeit necessarily restricted, programme of work, more particularly of a purely physical and chemical nature. Later, after careful search and inspection of suitable premises, purchase was completed of two detached houses at 105 and 107 Lansdowne Road, Croydon. These possessed several advantages, and after necessary alterations have been converted into a prepossessing unit. The space between the two houses is now occupied by a substantial connecting building which provides increased accommodation in addition to inter-communication. The frontage of the site is 120 feet and the depth 206 feet, the latter leaving ample room for future extensions.

The building, which was formally opened by Lord Colwyn on July 26, comprises administrative offices, library, experimental laboratory for the preparation of rubber, incorporation of compounding ingredients and vulcanisation, workshop, mechanical testing laboratory, physical laboratory, chemical laboratories, storage accommodation and caretakers' quarters. All the necessary heavy experimental plant is contained in the basement of the inter-communicating building, and one of the two original houses has been kept entirely free from running machinery in order to permit the use of delicate instruments without risk of disturbance from vibration.

Those responsible for the founding of this Association have realised that the importance of research to industry lies not so much in the possibility of very occasional discoveries of a revolutionary nature as in the sure benefits which are the abundant fruit yielded by the application of science to the improvement of existing methods. The functions of the Association, while not excluding the study of fundamental problems, include more prosaic considerations such as improvement in the control of manufacturing operations and the testing of raw materials and final products. In such directions there is indeed urgent need for work, such vital matters as the reasons for the use and selection of various necessary "compounding ingredients" and the methods adopted for the production of vulcanised rubber possessing special physical properties, *e.g.* resistance to cutting or abrasion, resilience, toughness or even hardness, being based on almost entirely empirical grounds, often of the least desirable type.

Whatever requirement may have to be left unsatisfied in such an Association as this, it should be able to anticipate with the utmost confidence an abundant and unceasing supply of problems for investigation. D. F. T.

University and Educational Intelligence.

PROSPECTUSES of Universities and Colleges for 1922–23 are beginning to appear. Leeds University publishes an extensive programme of evening courses (advanced) in engineering, dyeing, textile and leather industries, and geology, and afternoon courses in coal-mining. During each of five evenings of the week from five to nine classes will be held. The faculty of engineering of the University of Bristol announces additional vacation courses to be held in 1923. University College, Exeter, is establishing new courses, intermediate and final, in horticulture and in agriculture, the final course in agriculture being at the Seale-Hayne Agricultural College, Newton Abbot.

SECONDARY education in the United States is, as every one knows, conducted chiefly in public (that is to say, in State) schools. But the part of the field occupied by the private high schools and academies is not inconsiderable. Advance sheets from the biennial survey of education in the United States, 1918–20 (Bulletin, 1922, No. 9 of the Bureau of Education), show that in 1919–20 there were 2093 of these institutions, attended by 184,153 secondary students and, in addition, 250,000 elementary pupils. A remarkable growth occurred between 1905 and 1920. During this period the number of their secondary students increased by 72 per cent. Nearly 75 per cent. of the institutions are under denominational control; of these 60 per cent. are Roman Catholic, and the following analysis shows that to the Roman Catholic schools is chiefly attributable the above-

mentioned increase in the number of secondary students in private schools. The increase was—in Roman Catholic schools from 20,150 to 76,054; in other denominational schools from 39,106 to 53,965; in non-sectarian schools from 47,951 to 54,134; in all from 107,207 to 184,153. The increase in the number of secondary students of negro race in private schools is also noteworthy—from 2774 in 1905 to 9526 in 1920. Less than half of the total number of these schools are co-educational, 385 being for boys only and 728 for girls only.

"WE should have a dynamic education to fit a dynamic world" is the burden of the address delivered by Dr. James Harvey Robinson, on "The Humanising of Knowledge," before the American Association for the Advancement of Science, at a meeting with the Pacific division in Salt Lake City on June 23-24. Once it was well to dehumanise science; now it must be rehumanised. Dr. Harvey thinks there is a real danger threatening the progress of science itself in neglecting the protest of philosophy, that the ideal of dehumanising scientific investigation loses sight of the fact that the onlooker is one of the essential elements in the observing and recording. The danger is not that the scientific ideal is faulty, but that mankind will not accept an idea unless it is attractive as well as true. "The politicians in the Kentucky legislature think themselves competent to decide whether the State should grant funds to any institution in which man's animal extraction is taught; the politicians in the New York legislature have provided that no one shall teach in the schools of the State who is known at any time to have expressed any distrust of our institutions." We on this side may smile at these fears; but after all it is well to be reminded that the scientific investigator is prone to take himself for granted and not to realise "what an altogether astonishing and even grotesque mystery he and his doings constitute" for the general mass of social human beings.

"CO-OPERATION and the Problem of Unemployment" is the title of a pamphlet issued last month by the Calcutta newspaper *Capital*, being a reprint of a series of articles contributed by Captain J. W. Petavel, Principal of Maharajah Kasimbazar's Polytechnic Institute, together with correspondence between Captain Petavel and the Vice-Chancellor of the Calcutta University. The recent establishment by this university of a Poverty Problem Study Fund, to meet the cost of lectures and publications devoted particularly to the exploitation of a definite scheme of social reform, constitutes a new departure in university policy in regard to research in applied sociology. This scheme "to organise the children and the adolescents in schools *and continuation schools*, so as to make them form the trunk of a great tree of co-operative production and exchange, whose branches will extend in all directions and carry health into every part of our social system," is not new. Among its earliest supporters were the late Lord Roberts and Sir Horace Plunkett. Of late "economists and educationists in almost every part of the world," says the Vice-Chancellor of Calcutta University, have been canvassed, with the result that there has been a steadily increasing volume of opinion in favour of the scheme, and steps are being taken towards operating a large-scale trial application of it in schools in Bengal by means of self-supporting school market-gardens and school workshops. The experiment cannot fail to arouse keen interest, not only in India but wherever attempts are being made to extend and improve education without increasing its cost.

Calendar of Industrial Pioneers.

August 27, 1898. John Hopkinson died.—Distinguished as an engineer and a mathematical physicist, Hopkinson was a graduate of Trinity College, Cambridge, and in 1871 was senior wrangler and Smith's prizeman. For some years he was scientific adviser to Messrs. Chance, of Birmingham, and made improvements in lighthouse apparatus. As a consulting engineer in London he took up the study of electrical problems; in 1882 patented the three-wire system, and four years later, with his brother Edward, published an important memoir on the principles of the design of dynamos. In 1890 he became professor of electrical engineering at King's College, London, and on two occasions served as president of the Institution of Electrical Engineers. His death was the result of an Alpine accident.

August 27, 1914. William Thomas Lewis, Lord Merthyr of Senghenydd, died.—Coal owner, iron master, steel maker, engineer, and a captain of industry, Lewis began life as an apprentice in a South Wales engineering works. In 1860 he became mining engineer to the estates of the Marquis of Bute, and twenty years later was made sole manager. He was a pioneer in the construction of steel works.

August 31, 1751. Christopher Polhem died.—A famous mining engineer of Sweden, Polhem was born in 1661, in 1693 became engineer of the mines at Fahlem, and in 1716 was raised to the nobility and was made a member of the council of mines. He travelled extensively, carried out important engineering works, and was one of the original members of the Academy of Sciences of Stockholm.

August 31, 1865. John George Appold died.—After amassing a considerable fortune as a fur skin dyer, Appold turned his attention to mechanical pursuits and at the Great Exhibition of 1851 attracted attention by his centrifugal pump. Among his other inventions was the brake used in connexion with the laying of the first Atlantic cable.

September 2, 1834. Thomas Telford died.—The son of a shepherd of Eskdale, Dumfries, Telford was born on August 9, 1757. Apprenticed to a mason, he afterwards worked in Edinburgh, London, and Portsmouth, became surveyor of public works in Shropshire, engineer of the Ellesmere Canal, and in Scotland built the Caledonian Canal and opened up the country by the construction of 920 miles of roads and of 120 new bridges. Many other bridges, canals, and harbour schemes were due to him, and among these were the Gotha Canal between the Baltic and North Sea and the famous suspension bridge over the Menai Straits. An acknowledged leader in the world of civil engineering, in 1818 he became the first president of the Institution of Civil Engineers and held that position till his death. He died at 24 Abingdon Street, Westminster, and was buried in the nave of Westminster Abbey. His statue stands in the Chapel of St. Andrew.

September 2, 1883. Cromwell Fleetwood Varley died.—One of the pioneers of the Atlantic Telegraph Cable, Varley as a boy entered the service of the Electric and International Telegraph Company and of this firm became engineer-in-chief. After the failure of the first Atlantic cable he constructed an experimental line for studying the phenomena of signalling, and during 1864–5 tested the whole of the new cable for the Atlantic Telegraph Company. Retiring from active work in 1868, he continued his investigations and in 1870 transmitted musical sounds over an ordinary telegraph wire. E. C. S.

Societies and Academies.

PARIS.

Academy of Sciences, July 24.—M. Haller in the chair.—Charles **Moureu**: The third international conference of pure and applied chemistry. This conference was held at Lyons from June 27 to July 1, and was attended by representatives from 24 nations. The next meeting will be held at Cambridge in June 1923.—Maurice **Leblanc**: The electrification of railways by means of high frequency alternating currents.—V. **Grignard** and A. C. **Purdy**: α-β'-dichlorethyl ether. Three of the four possible dichlorethers are known. The fourth, $CH_3 . CHCl . O . CH_2 . CH_2Cl$, has now been prepared by the action of dry hydrochloric acid upon a mixture of paraldehyde and ethylene monochlorhydrin.—M. **Abramesco**: The series of polynomials with two complex variables.—Farid Boulad **Bey**: The geometrical examination of the internal forces and displacements round a point in an elastic body.—Paul **Dienes**: The displacement of tensors.—Paul **Sacerdote** and Pierre **Lambert**: A new method for detecting the presence of a submarine. The plan proposed is suitable for a narrow entrance to a port and is based on the difference between the electric conductivity of the submarine and of sea water.—G. **Athanasiu**: An actinometer with electrodes of mercury covered with a thin layer of mercurous chloride, bromide, fluoride, or sulphide. A cell is constructed of H form, with mercury electrodes covered with a thin film of haloid salt. Exposure of one electrode to light causes an immediate increase in the E.M.F. of the cell.—St. **Procopiu**: The variations in the arc spectrum of mercury with the conditions of emission. In a vacuum, working at 14 to 15 volts, with low vapour pressure, there are more lines visible in the ultra-violet (up to 2191) than when working with 65 volts and 3·5 amperes. Other modifications are noted if the arc is working in air or in coal gas, the lines forming the triplets in the two secondary series being specially affected.—Mlle. Irène **Curie**: The determination of the velocity of α rays of polonium. The method of deviation in a magnetic field was employed; and this gave $1{\cdot}593 \times 10^9$ cm. per second for the velocity of the α rays of polonium, with a precision of about 0·3 per cent. Geiger, by a different method, obtained a result within 0·4 per cent. of the above.—P. **Lebeau** and M. **Picon**: The reactions furnished by sodammonium with hydrocarbons. Paraffins and ethylene derivatives are unacted upon by sodammonium: allylene gives 66 per cent. of the sodium derivative and 33 per cent. of propylene, and other hydrocarbons of the acetylene series behave similarly. Benzene and its derivatives are unacted upon, as are also the terpenes. Naphthalene, acenaphthene, and phenathrene give tetrahydrides.—Octave **Mengel**: The fall of dust called a "rain of blood." Remarks on the coloured snow which fell in Briançon on March 12, 1922. The meteorological data suggest that this dust came from the Sahara.—Emile F. **Terroine** and René **Wurmser**: The utilisation of ternary substances in the growth of *Aspergillus niger*. This mould would appear to utilise indifferently any sugar in its growth, and shows no qualitative preference. The sugars used were glucose, levulose, saccharose, maltose, arabinose, and xylose. The concentration of the nitrogenous food (ammonium sulphate) was also without effect on the growth, but the nature of the source of nitrogen had a marked influence.—L. **Blaringhem**: The heredity of the physiological characters in the hybrids of barley (second generation).—Paul **Becquerel**: The theory of the meriphyte in the phenomena of vascular ontogeny.—A. **Pézard**: The idea of the "seuil différentiel" and progressive masculinisation of certain female birds. The experimental results relating to the action of the ovary on the plumage of birds can explain, on the hormone theory alone, some anomalies apparently in disagreement with recent theories of endocrinology.—Paul **Wintrebert**: The mode of building of the vomer in the course of metamorphosis in the Salamandridæ.—Paul **Carnot** and Marc **Tiffeneau**: A new hypnotic in the barbituric series: butyl-ethyl-malonylurea. The hypnotic properties of the dialkyl-malonylureas were studied by E. Fischer from dimethyl to the di-isoamyl derivative; but the unsymmetrically substituted malonylureas were not examined. This has been taken up by the authors, who find in ethyl-butyl-malonylurea a useful new hypnotic. It has three times the hypnotic power of veronal and has given satisfactory results in clinical practice.

July 31.—M. Guignard in the chair.—The president announced the death of M. Louis Favé.—Emile **Picard**: The meeting of the International Research Council held at Brussels in July 1922. The address given by M. Picard at the opening of the meeting.—L. **Maquenne** and E. **Demoussy**: The influence of calcium on the utilisation of the reserves during the germination of seeds. It has been shown that the influence of calcium on the germination of seeds is specific, and other electrolytes do not produce the same effect. Calcium salts are almost without influence on the diastatic conversion of the insoluble reserves into soluble products; it is possible, but not yet proved, that the ferments responsible for the reconversion of the soluble products into plant tissue may be stimulated by the presence of lime.—R. **Chodat** and E. **Rouge**: The intracellular localisation of an oxydase and localisation in general.—Jules **Baillaud**: Some data on the constitution of the galactic cluster deduced from the study of the zone of the Paris photographic catalogue.—Jean G. **Popesco**: The relation between photo-electric phenomena and the surface tension of mercury. The surface tension of an electrically charged drop of mercury was measured by a photographic method before and after exposure to ultra-violet light. The results of the experiments show that there is a relation between the photo-electric phenomenon and the surface tension.—E. M. **Lémeray**: The structure of the universe and general relativity.—R. de **Mallemann**: Molecular double refraction and optical activity.—M. **Yovanovitch** and Mlle. **Chamié**: The preparation of a standard radium salt. A solution of barium chloride containing radium is precipitated by ammonium carbonate in a special apparatus due to M. Jolibois. The radiferous barium carbonate produced was fairly satisfactory as a standard, different preparations agreeing in their radioactive properties within 0·5 per cent.—Er. **Toporescu**: The preparation of sodium bicarbonate.—Mlle. G. **Marchal**: The dissociation of beryllium sulphate. The dissociation pressures are given for seventeen temperatures ranging from 590° C. to 830° C.—Maurice **François** and Louis Gaston **Blanc**: A method of preparing the iodobismuthates of the alkaloids in the crystalline state.—H. **Gault** and T. **Salomon**: The alkyl-methyl-pyridazinone carboxylic esters.—G. **Vavon** and A. **Husson**: Catalysis by platinum black. Platinum black may have its hydrogenating power reduced by the gradual addition of catalyst "poison," such as carbon bisulphide. Thus the activity of a certain specimen of platinum black, after treatment with 0·4 mgr. of carbon bisulphide, lost the power of reducing acetophenone, but retained its catalytic power as regards the reduction of cyclohexene.—Kenneth C. **Bailey**: The direct synthesis of

urea starting with carbon dioxide and ammonia. Applying the device of the hot and cold tube, carbon dioxide in presence of ammonia in excess and with thoria as catalyst, gave a 19 per cent. conversion into urea.—M. **Gignoux** and P. **Fallot**: The marine Pliocene on the Mediterranean coasts of Spain.—A. **Guilliermond**: Remarks on the formation of chloroplasts in the bud of *Elodea canadensis*.—G. **André**: The filtration of plant juices. Comparative analyses of juice expressed from the potato, after clarification by the centrifuge, filtration through porous porcelain filter, and filtration through collodion. In the last case, the proportions of nitrogen and phosphorus present are reduced.—Gabriel **Bertrand** and B. **Benzon**: The importance of zinc in the food of animals. Experiments on mice.—H. **Vallée** and H. **Carré**: The degree of infection of aphthous fever.—Georges **Bourguignon**: Double chronaxy and a double motor point in certain human muscles.

SYDNEY.

Linnean Society of New South Wales, June 28.—Mr. G. A. Waterhouse, president, in the chair.—W. F. **Blakely**: The Loranthaceæ of Australia, Part ii. A revised classification of the Loranthaceæ, based on that of Engler, is put forward. The most notable changes in the nomenclature affect the genus Atkinsonia which is displaced by Gaiadendron, while the species under Loranthus, with versatile anthers, are transferred to Phrygilanthus.—Dr. R. J. **Tillyard**: Some New Permian Insects from Belmont, N.S.W., in the collection of Mr. John Mitchell. Nearly half the insect wings discovered at Belmont belong to the family Permochoristidæ. In association with these are two other Mecopteroid types, viz., Belmontia and a new type, described in this paper, which stands in the same relation to the Order Diptera that Belmontia does to the Trichoptera and Lepidoptera. In addition the first discovery of a true Lacewing (Neuroptera, Planipennia) of Palæozoic times is recorded. The remainder of the fauna consists of Homoptera, both Auchenorrhyncha and Sternorrhyncha, a new genus of the latter being described.—J. **Mitchell**: A new Gasteropod (fam. Euomphalidæ) from the Lower Marine Series of New South Wales. Description of a new species of Platyschisma from Allandale, where it occurs associated with *P. oculus*, *Eurydesma cordatum*, and *Aviculopecten mitchelli*.—**Vera Irwin-Smith**: Notes on Nematodes of the genus Physaloptera. Part iii. The Physaloptera of Australian Lizards. This paper deals with specimens of Physaloptera contained in three collections. They were found to consist of two forms, one of which has been identified as *P. antarctica* Linstow var. *typica*. The other has been treated as a new variety of the same species. Linstow's brief and inadequate diagnosis of the species has been supplemented by a detailed description. The rest of the paper is devoted to a special study of the female reproductive organs, in which it is pointed out that the practice of helminthologists of basing specific distinctions, in this group, upon the dimensions and arrangement of these parts is not reliable, since very considerable variations have been found within the one species.—J. **McLuckie**: Studies in Symbiosis. i. The Mycorhiza of *Dipodium punctatum* R.Br.

Royal Society of New South Wales, July 5.—Mr. C. A. Sussmilch, president, in the chair.—A. R. **Penfold**: Observations respecting some essential oils from *Leptospermum Liversidgei*. The variation in the essential oils obtained from a well-known Tea Tree (*Leptospermum Liversidgei*) is tabulated as follows:—

	Yield.	Specific Gravity 15° C.	Optical Rotation.	Refractive Index.	Solubility in 70 per cent. Alcohol.	Citral.	Citronellal.	
	Per cent.					Per cent.	Per cent.	
No. 1	0·8	0·8960	+ 6·2°	1·4854	1 in 1·5 vols.	75	..	type "*b*"
No. 2	0·5	..	..	..	..	..	70	type "*c*"
No. 3	0·25	0·8885	+12·10°	1·4822	insol. 10 vols.	46	..	type "*a*"
No. 4	0·33	0·8905	+12·75°	1·4820	ditto.	46	..	type "*a*"
No. 5	0·55	0·8826	+11·2°	1·4603	1 in 1·5 vols.	..	82	type "*c*"
No. 6	0·6	0·8910	+ 7·25°	1·4832	ditto.	70	..	type "*b*"

The author is inclined to the opinion that there are probably three forms of this shrub, and points out that the types "*b*" and "*c*" are of great economic importance. The type "*a*" (the original one) is of very little commercial value, hence the importance of the other types, particularly as botanical diagnosis has so far failed to distinguish them.—A. R. **Penfold** and F. R. **Morrison**: Preliminary note on a new Stearoptene (probably a phenol ether) occurring in some essential oils of the Myrtaceæ. The authors announced the isolation of a beautifully crystalline solid of a yellow colour from the essential oils of *Bækea crenulata* and *Darwinia grandiflora*. It has a melting-point of 103-104° C., molecular formula $C_{13}H_{18}O_4$, and contains two methoxy groups. It is apparently a phenol ether. It has, so far, only been obtained in small quantity, amounting to 6 per cent. in the former, and 2 per cent. in the latter oils, but it is anticipated that other essential oils at present being investigated will yield it in greater amount.—J. K. **Taylor**: A chemical and bacteriological study of a typical wheat soil of New South Wales. Monthly determinations of soil moisture, bacterial numbers, nitrates, and nitrifying power were made in soil from various plots at Wagga Experiment Farm. The bacterial numbers, nitrates and nitrifying power were greater in summer than in winter in spite of the partial drying out of the soil. The general order of merit of the plots for bacterial activity and accumulation of nitrates was cultivated fallow, cropped land, uncultivated fallow, and grass land. The bacterial numbers are comparable with those from soils from similar climatic regions but the nitrifying power is not particularly good and fluctuated curiously from month to month.

Official Publications Received.

Annals of the Astrophysical Observatory of the Smithsonian Institution. Vol. 4. (Publication No. 2661.) Pp. xii+390. (Washington: Smithsonian Institution.)

The British Mycological Society. Transactions, 1920. Vol. 7, Part 4. Edited by Carleton Rea and J. Ramsbottom. Pp. 221-324. (London: Cambridge University Press.) 12*s*. 6*d*.

Memoirs of the Asiatic Society of Bengal. Vol. 6: Zoological Results of a Tour in the Far East. Edited by Dr. N. Annandale. Part 7. Pp. 397-433+plates 15-17. 2 rupees; 3*s*. Part 8. Pp. 435-459+plates 18-21. 2 rupees; 3*s*. Vol. 7, No. 4: Introduction to the Study of the Fauna of an Island in the Chilka Lake. By Dr. N. Annandale. Pp. 257-319+plates 7-11. 3 rupees; 4*s*. 6*d*. (Calcutta: Asiatic Society of Bengal.)

The Newcomen Society for the Study of the History of Engineering and Technology. Transactions, Vol. 1, 1920–1921. Pp. 88+18 plates. (London: Newcomen Society.) 20*s*.

University of Colorado Bulletin. Vol. 22, No. 3; General series, No. 180: Catalogue, 1921–1922. Pp. 426. (Boulder, Colo.: University of Colorado.)

Experimental Researches and Reports published by the Department of Glass Technology, The University, Sheffield. Vol. 4, 1921. Pp. ii+118. (Sheffield: The University.)