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Euclid's Modern Rivals.

FORTY-FIVE years have passed since Lewis Carroll described the confusion which would attend any departure from the sequence and treatment standardised by Euclid. That view must be shared to-day by many a public examiner and by any one who studies the variety of treatment in modern text-books or reads the various official reports and circulars published of recent years. Within about twelve months two notable reports have been issued, one by the Mathematical Association[1] (see NATURE, February 16, 1924, p. 230) and the other by the Incorporated Association of Assistant Masters[2] (see NATURE, March 3, 1923, p. 277), on the teaching of elementary geometry. The first of these may fairly be described as difficult reading, and much of it is concerned with considerations that many teachers will regard as either too subtle or too idealistic to be of immediate practical consequence. It contains much valuable matter, and at least one very stimulating but revolutionary proposal. A series of articles would be needed to do justice to this report; mention of it is made here only to commend it to those who have not already seen it as well worth serious study.

The second report is much shorter and (many will consider) more practical. It does not aim at giving any reasoned argument for the suggestions offered or making any inquiries into the assumptions required in any course of geometrical study. Its main purpose is to offer a sequence and to recommend various omissions to examining boards, but it declines to advise the compulsory adoption of any one particular order of theorems.

Controversy to-day centres round the following problems: (i.) proofs by superposition, (ii.) the treatment of parallels, (iii.) the appropriate stage for introducing similarity and its formal treatment, (iv.) incommensurables, (v.) the treatment of areas.

It is now generally recognised that the superposition proof of Euclid I. 4 has no logical value; the same remark should apply to Euclid III. 26. Several University Boards have removed these theorems and the allied theorems from their examination syllabus, and have for other reasons also excluded the fundamental properties of parallel lines; where, however, the latter are required, the balance of opinion seems to favour reverting to Euclid's method and Playfair's axiom.

For young pupils, the most common procedure is that laid down in the Board of Education circular

[1] "The Teaching of Geometry in Schools." A Report prepared for the Mathematical Association. (London: G. Bell and Sons, Ltd., 1923.) 2s. net.
[2] "The Teaching of Elementary Geometry." (Being the Report of a Special Committee appointed by the Incorporated Association of Assistant Masters in Secondary Schools. (London: Oxford University Press, 1923.) 1s. net.

of 1909, with some minor modifications. The general recognition that a school course of geometry must repose on assumptions that the pupil is not sufficiently mature to examine critically makes it reasonable to argue that, while connected chains of reasoning in certain parts of the work (for example, the series of theorems on angle properties of a circle) are a valuable training and should be included on that account, yet it should not be regarded as crucial to adopt a treatment which secures logic at the cost of employing machinery unsuitable for immature minds. An extreme instance of this is the formal treatment of incommensurables; but an analogous example is the insistence on *geometrical* proofs of various algebraic equivalents [thus (i.) if $a/b=c/d$, then $ad=bc$, or (ii.) $a^2-b^2\equiv(a+b)(a-b)$, or (iii.) if $\frac{1}{2}h_1.b=\triangle=\frac{1}{2}h_2.b$, then $h_1=h_2$]. In such cases the pupil is being required to put into geometrical form facts which carry more conviction to his mind when expressed algebraically. Although the rigour of geometrical logic demands formal proofs of this nature, it may fairly be urged that latitude granted elsewhere should be admitted here.

School teaching is, of course, largely influenced by the attitude of examining bodies; it is, therefore, of interest to study from this point of view the regulations for Certificate Courses just issued by the Scottish Education Department.[3] The fundamental theorems on angles at a point, congruence of triangles, parallelism have been excluded from the syllabus, but it is surprising to notice that Euclid III. 26-29 (tests of equal arcs) are still included; for every argument that justifies the omission of I. 4 applies equally to III. 26. In its recommendations to teachers, the Department observes that "demonstrations of properties in Geometry should wherever possible be followed by associated examples in Arithmetic and Algebra." But the regulations state that "the proofs of all area propositions must be geometrical, and that proofs which depend wholly or partly on mensuration formulæ will not be accepted." This restriction is open to severe criticism. After the pupil has done geometrical proofs which lead to the mensuration formulæ for the areas of parallelograms and triangles, it seems unreasonable to refuse to allow him to make use of these facts in his treatment of areas of triangles on the same base, etc., because it is demanding a type of geometrical rigour which is not exacted, and indeed is admitted to be unsuitable, in other parts of the course. We have found no statement about the treatment of incommensurables, and in view of what has been said as to the treatment of areas, we find it difficult to know what proof the examiners under this Board expect for Euclid VI. 1, 2, which are included in the syllabus.

There is always a real danger of university and other examining boards failing to keep in touch with the problems secondary schools have to face, and there is no doubt that grave injury can be inflicted on the school teaching of geometry if examining bodies do not give a wide and wise latitude to the teacher.

[3] Note as to Mathematics for Three-year Advanced Courses and Leaving Certificate Courses and a Syllabus of Study. Scottish Education Department, 1924. (H.M. Stationery Office.)

Chemical Aspects of Plant Physiology.

Chemie der Pflanzenstoffe. Von Dr. Georg Trier. Pp. viii+605. (Berlin: Gebrüder Borntraeger, 1924.) 33*s*.

THE extraordinary versatility of the plant is perhaps one of the outstanding facts of the chemistry of plant metabolism. Provided only that they have an adequate supply of the same three essentials, namely, carbon dioxide, water, and nitrate, adjacent plants can produce an almost endless variety of different flower pigments, volatile oils, glucosides, alkaloids, and other active principles, although the initial equipment of all would appear to be essentially the same. The chemist, on the other hand, working with high temperatures and pressures, strong acids and alkalies, etc., can in many cases produce the same substance as the plant, but his methods are so entirely different from those employed by the plant that they throw but little light on the manner in which the plant proceeds. By a careful search for all the various substances occurring in plants, there is some hope of obtaining information as to how the plant works; for in this way it may be possible to recognise definite intermediate stages in any particular up- or down-grade process of metabolism.

It must, however, be borne in mind that the isolation of a given substance from a dead plant does not necessarily mean that this substance occurred as such in the living plant, since many post-mortem changes are possible, due either to the natural changes taking place in the cell or to the process employed in isolation. It is only by a very careful consideration of all the attendant circumstances and the employment of comparatively simple processes of extraction that trustworthy conclusions can be drawn. In this way, also, it is to be hoped that evidence may ultimately accumulate as to the function of any particular substance occurring in the plant; only too often the question arises as to whether any given compound or group of compounds is a waste product which is stored away in the dead tissues of the plant for lack of any other means of excretion, or whether it serves some really useful

purpose to the plant. At present no definite answer can be furnished to most of these problems of chemical plant physiology.

In spite of the fact that man has from the very earliest times procured from the plant essential materials which he could obtain from no other source, the subject of plant physiology has received comparatively little attention, at any rate as regards its chemical aspects; this state of affairs is reflected in the relatively small literature devoted to the chemistry of plant products from the purely scientific, as opposed to the economic, point of view, though it is true that within the last few years a few text-books dealing with the general aspects of the subject have appeared, both in Great Britain and abroad. The book under review is, however, a book of reference rather than a text-book, in that it aims at providing an exhaustive compilation of all compounds which have so far been found to occur in plants. Such a compilation will be welcomed by those interested in the chemistry of plant physiology, since a comprehensive survey of the substances found in the vegetable world cannot fail to be of use to those already engaged in the study and to stimulate the interest of many chemists not already attracted to this field of investigation.

The first 57 pages of the book are devoted to a historical review of the development of plant chemistry, together with a somewhat lengthy disquisition upon the author's interpretation of what is meant by the chemistry of plant products; it is here also that we are introduced to the method of classification adopted in the book. In the author's opinion the older and conventional method of classification, based upon the chemical constitution of the substances concerned, is not satisfactory for plant products inasmuch as the various members of an homologous series cannot really be genetically related to each other in the plant, since the introduction of alkyl groups is not a natural process; homologous compounds, though chemically related and producible by analogous reactions, are, in the plant, derived from different mother substances and are therefore not related to each other in the biological sense. For these reasons the author refuses to be bound by chemical classification and divides his subject-matter into the three following headings: (1) Simple plant products; (2) compound plant products; and (3) plant products of unknown nature. The simple plant products are distinguished from the compound products by the fact that they cannot, like the latter, be broken up into simpler substances by hydrolysis. Plant products of unknown nature include toxins, vitamins, and enzymes.

As may be gathered from the above outline, the method leads to what, from a chemical point of view, may be regarded as a somewhat curious juxtaposition of compounds. Thus, for example, under the heading of simple plant products all compounds containing from one to three carbon atoms are grouped together in a more or less haphazard way, so that we pass from carbamic acid through urea and guanidine to oxalic acid, mesoxalic acid, formic acid and its amide; thence via hydrocyanic, glyoxylic, malonic, and glycollic acids to glycine, betain, and glyoxal; proceeding in this way alternately from acids of all kinds to aldehydes back to acids and on to ketones, aldehydes, alcohols, amines, etc., this extraordinary medley is suddenly brought to an end by a brief paragraph on methyl mercaptan.

The next section, dealing with simple monovalent aliphatic compounds of higher order, starts with butyric acid, after which the remaining acids of all series, both saturated and unsaturated, are arranged in order of increasing molecular weight without regard to their chemical relationships; then follow ketones, aldehydes, alcohols, and hydrocarbons, all treated in groups on the same principle; cyclic compounds coming next commence with hydroaromatic substances and then pass through terpenes, camphor, and rubber to the true aromatic compounds; from these we pass through the lichen acids to heterocyclic compounds, including flavones, anthocyanidins, alkaloids, purin bases, etc. The first group of so-called simple plant products is then brought to a close by a section devoted to compounds of unknown constitution, amongst which are included resins, bitter principles, cork and cuticle, humic substances, carotinoids and algal pigments, etc.

The second group of substances, described as compound plant products because, unlike the previous group, they can be hydrolysed, include the polysaccharides, glucosides, and the esters. One of the striking anomalies of this method of classification is to be found in this section, inasmuch as the anthocyans are here dealt with under glucosides about 160 pages after the glucose-free anthocyanidins have been described. The group of esters includes the simple esters, depsides, glycerophosphoric acid, lecithin, fats, waxes, and chlorophyll, the latter substance being thus completely isolated from the other plastid pigments. The descriptions devoted to the numerous compounds naturally vary very much in length according to their relative importance, but they are in all cases adequate and include mention of the plants in which the compounds occur.

The volume, although complete in itself, is intended only to form the first part of a more comprehensive work, which is to include two more volumes devoted to the chemistry of plant metabolism and the chemical analysis of the plant respectively. The appearance of the completed work may be anticipated with pleasure if the two remaining volumes maintain the high standard set by the present one.

Astronomy for All.

Hutchinson's Splendour of the Heavens: a popular authoritative Astronomy. In 24 fortnightly parts. Edited by Rev. T. E. R. Phillips, assisted by leading astronomers. (London: Hutchinson and Co., 1923–1924.) 1*s.* 3*d.* net per part.

THE publishers are to be congratulated on their enterprise, and the editors, the Rev. T. E. R. Phillips and Dr. W. H. Steavenson, on their ability, in bringing to a successful completion this very fine serial of astronomical science. It is, too, a gratifying sign of the general interest that is taken in astronomy that such a compendium of the science should have been called for. It extends to no less than 976 pages of letterpress, and includes about 1000 illustrations. These latter are the distinguishing mark of the serial, which makes it unique among all other books on astronomy. The title "The Splendour of the Heavens" is fully justified, for the illustrations are lavish and most beautiful, including reproductions of the finest of modern celestial photographs in all departments of the science. It is a delight merely to turn over the pages and to study the pictures.

The explanatory diagrams too are excellent, and are quite new in the greater number of instances. But the picture on page 58 entitled "How a Pure Spectrum is produced" is not quite correct, because, besides a narrow slit, a collimating lens is required for that purpose. Nor is the diagram on page 62 of the solar spectrum very convincing. It requires lettering to make it even recognisable. Compare it, for example, with the spectrum of the moon on page 386, or with that of the sun given on page 483. But being drawn for Boy Scouts, perhaps it was intended to exercise their ingenuity in finding which was the red and which the violet end of the spectrum.

Of course, Galileo must have a fanciful picture on his appearance before the Papal Tribunal, with a misleading legend that he was condemned by ecclesiastical authority to abjure his scientific creed. This is not the whole truth. But no astronomical book seems to be complete without a pseudo-historical reference to the celebrated case. It is a good example of what modern psychologists term the "herd" instinct. Incidentally, in the same part of the book (page 25), what is the precise meaning to be attached to the phrase "the stream of Time rolls on for ever"? But these are minor blemishes, insignificant spots on the sun.

We must also commend the gallery of portraits of distinguished astronomers, and the beautiful coloured plates. These latter include the aspect of the chief constellations as seen from Westminster Bridge at about 10.30 P.M. G.M.T. in each month of the year. In Chapter xxiv. Part i., Mr. Goodacre, who had already given a copiously illustrated descriptive account of the moon in Chapter vi., presents a reduced copy of his map of the lunar surface in 25 sections, with accompanying notes on the various formations. This should be most helpful in its handy form for lunar observers. Part ii. of the same chapter, which extends over the last four instalments of the serial, contains a reduced copy of the thirty-six large-scale charts of the constellations, drawn by the late Mr. Arthur Cottam, which ought to be extremely useful to the amateur observer who possesses even a small telescope. They are preceded by three key-maps, and they are accompanied by descriptions of the chief star-clusters and nebulæ to be seen in each constellation, by tables of astronomical symbols and constants, and by some well-chosen lists of variable stars, red stars, and double stars. The chapter concludes with practical hints on the use of the various forms of micrometer and the spectroscope, with a section on celestial photography, and with a glossary of astronomical terms. This section of the work is a veritable amateur observer's practical handbook. It is due to the combined labours of Mr. Goodacre, Dr. Crommelin, the Rev. T. E. R. Phillips, Mr. Alfred Parr, and Mr. Longbottom, and deserves unstinted praise. It would be well worth while to purchase extra copies of the Parts xxi.-xxiv., and get them strongly bound for use in the observatory. Part xxi. also contains a chapter of practical astronomy for navigators, by Instructor Captain Ainslie, R.N.

The serial claims to be a popular, authoritative astronomy; and it is so, for it is a work which is couched in clear, easily understood language, neither too abstruse nor too technical, and as such will appeal not only to the amateur astronomer, but also to the educated layman. It is written, too, by experts. Dr. Crommelin is responsible for just about one-quarter of the letterpress in the first volume, which includes eleven parts and ten chapters, and for a chapter (xvii.) in the second part on ancient constellation figures. His expositions of the solar system, the earth-moon system, the asteroids, and comets are masterly. Most particularly would we single out for praise his treatment of the lunar perturbations, of tides, and of precession, and his admirable explanatory diagrams of the elliptic, evection, variation, and annual waves of the moon's motion. His son, Mr. C. D. Crommelin, gives an interesting supplementary account of the history of the earth-moon system according to the tidal friction theory of Sir George Darwin. But his magisterial dictum (page 256) at the end of the article might have been advantageously omitted.

The Rev. T. E. R. Phillips writes an excellent chapter

about the frontiers of the solar system, and another on the calendar, in addition to the topics already noticed. Mr. Reynolds gives us a beautifully illustrated and exhaustive article on star-clusters and nebulæ. All the articles on descriptive astronomy, written as they are by practical observers in the different branches, attain a high level of excellence. Thus we have Mrs. Maunder on the sun's surface and its spots, Mr. C. P. Butler on the sun's atmosphere, the veteran Mr. W. F. Denning on the zodiacal light and the inferior planets, and—who more capable?—on falling stars, and on Jupiter. Mr. R. L. Waterfield treats of Mars, and, summing up a very interesting discussion on the habitability of the planet, very sensibly tells us that "although we have found no satisfactory natural explanation of the *canali*, we have no proof of their artificiality. Until that proof is forthcoming we have not the least right to assume the existence of intelligence." Mr. P. H. Hepburn too writes as a master on the planet Saturn. Dr. Steavenson, in the chapter on the story of light and man's control of it, gives us a good account of the action of lenses, mirrors, and prisms, and their combinations in refracting and reflecting telescopes, spectroscopes, spectroheliographs, and interferometers. Cognate to this subject is that of spectroscopy, very ably treated by Prof. Herbert Dingle in the chapter entitled "The Message of Starlight." To the same writer is entrusted the account of relativity and gravitation. This is the one weak chapter in the whole book. The writer is quite capable of giving an account of the theory from the physical point of view, as witness his excellent little brochure entitled "Relativity for All." But here he has chosen to make an incursion into the realms of philosophy, and very poor philosophy it is too. He seems to imagine that there is no salvation from Kantian idealism but by way of Einstein's relativity.

In "Finding the Scale of Space" Mr. Peter Doig discourses on the various methods of parallax, on aberration of light, and on star-streaming. To him also we are indebted for a luminous account of the modern theories concerning giant and dwarf and twin suns. In this second volume, which includes Chaps. xi.-xxiv., Dr. Steavenson, the co-editor, is responsible for variable and new stars, and for observatories and their work. A companion chapter to this latter one is that on the amateur at work by Instructor Captain Ainslie. If one wishes, too, to learn all about the determination of time, its measurement, and its distribution, the construction of clocks and their accessories, let him read the comprehensive article by Mr. Bartrum. Finally, though not least, there is a splendid article in Chapter xvi. on a subject which the writer, the Rev. Hector Macpherson, has made peculiarly his own, "The Structure of the Universe." We take to ourselves his concluding words: "if the overwhelming vastness of the created universe oppresses us, it likewise compels us to bow our heads in reverence before the Immeasurable Power which finds expression in this magnificent Cosmos with its almost infinite profusion of shining suns."

This splendid work, well written, profusely illustrated, and beautifully printed, is worthy of a good index. But it would appear, from an advertisement on the cover of Part xxiv., that one cannot even obtain a list of contents unless one purchases the authorised covers issued by the publishers. However, we have learned that this index can be obtained separately, post-paid, for eightpence. A. L. CORTIE.

A Synthesis of Science and Religion.

Freedom of the Mind in History. By Henry Osborn Taylor. Pp. xii+297. (London: Macmillan and Co., Ltd., 1923.) 7*s.* 6*d.* net.

DR. H. O. TAYLOR is honourably known as the author of several thoughtful and well-informed books on the history of thought. He has carried on his studies from the ancient, through the medieval, world to the sixteenth century, and now, in this latest work, he attempts a sort of synthesis or summary of his ideas. It is based on a course of West lectures given at Leland Stanford University in 1920, and since elaborated in three years' work. To attempt in less than 300 pages what is practically a review of all human, or at least all Western thought, is on the face of it absurd. Dr. Taylor admits this modestly and gracefully in his preface. Yet the volume has a certain value and interest for readers of NATURE as a symptom of the converging lines along which religion, philosophy, and science have now for some decades been advancing. When did this movement begin? Somewhere between the Encyclopædists of the eighteenth century and the end of the nineteenth. In France, Comte had not completed the revolution, though he faces in the right direction. Bergson is in the full swing of it. In England, Mill began to turn in his later years, and T. H. Green is in the full movement.

The point, of course, is not that unanimity has been reached by philosophers and religious thinkers *vis-à-vis* of science, but that the opposition and divorce which were the recognised attitude at the time of the Encyclopædists, have almost disappeared. We are all now in favour of science, in a certain sense, as we were all socialists, in a certain sense, to Sir William Harcourt. Dr. Taylor's book is a striking example of this

comprehensive spirit on the part of a writer whose own studies have lain almost exclusively in the realm of literature and philosophy, and whose religious faith is explicitly and ardently expressed throughout. He attempts to rise above the old antithesis of Hebraism and Hellenism, of duty and reason, with which we were familiar fifty years ago. He represents the progress of mankind as one, caused by the active expansion of the mind on all sides, the religion of the Jews being a parallel phase to the art of the Greeks, the jurisprudence of the Romans or the science of the modern world. It is a gallant effort to see them all as parts of a whole, and he ends with a fervid address to his contemporaries to pursue knowledge and prevent the spread of a flood of folly which might submerge civilisation. But always he would have us join to knowledge the religious element which he defines as love, to enable the knowledge to be used for social ends.

Undoubtedly the thesis is a sound one and Dr. Taylor is on safe ground also in maintaining that there is more of this love in the world to-day than there has ever been before. The current social restlessness is due in large part to this very fact. We are more fully conscious than ever that we are all members of one whole with claims upon its resources which are not yet fairly satisfied, and this sense of community unsatisfied creates discontent and unrest. The solution therefore is to press forward on the lines of greater communion, bringing the forces of science into the service of the common good.

The gospel is a simple one to state, an infinitely difficult one to carry out in detail. The two streams descending, one from the Jews through Christianity, the other from the Greeks through modern science, have commenced to flow strongly together in our own days. The management of the newly-mingled waters, the irrigation of the land through a thousand channels which the task demands, will be the work of generations. Dr. Taylor does not give us any particular directions, but he sees the main outline of the course—where the streams have come from and what they are capable of doing if properly directed. His concluding section is addressed especially to our own countrymen and to Americans. He bids them keep the double end in view. Open the flood-gates. The noblest exercise of freedom is the pursuit of truth. But at the same time set the moral end still higher. Science is a glorious part of human progress, but in its applications to human abilities it needs guidance in its turn, and this must come from love—love as embodied in the moral traditions of the past and as enlarged by the wider conception of a new human fellowship in the future.

F. S. MARVIN.

Our Bookshelf.

Pharmaceutical and Food Analysis: a Manual of Standard Methods for the Analysis of Oils, Fats, and Waxes, and Substances in which they exist: together with Allied Products. By Azor Thurston. Pp. xiii+416. (London: Chapman and Hall, Ltd., 1923.) 21*s.* net.

THE work under notice cannot claim to be a complete thesis on pharmaceutical and food analysis. The subtitle does more justice to the actual contents, and a subsequent volume is foreshadowed from the preface to make the work a complete analytical guide for drugs and foods.

The general scope of the present volume may be judged by the titles of its nine chapters: (1) polariscope; (2) refractometers; (3) specific gravity; (4) general methods of analysis; (5) oils, fats, and waxes; (6) dairy products; (7) flesh foods; (8) eggs and egg substitutes; and, finally, a long chapter on (9) volatile oils. A special feature is the inclusion, in a bibliography, of the titles of more than eighteen hundred papers with literature references, in addition to the usual footnotes. Considering that one-seventh of the whole text space is thus taken up, a strong case is needed to justify their inclusion. There is no section on the microscope—a very essential apparatus to the analyst, whilst viscosity is dismissed in nine lines. General methods of analysis are confined to 25 pages, the same space as is allowed to specific gravity. Actual food products are mainly restricted as indicated in titles of chapters, and cocoa and chocolate are the only beverages considered. Many standard methods of analysis are not referred to, or considered only briefly. In the absence of the second volume, or of an indication of its contents, it is difficult at this stage to decide how far the complete work will be a balanced one. There are some indications that the final revision of text has not been exhaustive. Although published from a London address, the book, which is well printed and bound, is an American product, and is obviously intended for use in that country.

JOS. REILLY.

The Petrology of the Sedimentary Rocks: a Description of the Sediments and their Metamorphic Derivatives. By Dr. F. H. Hatch and Dr. R. H. Rastall. Revised edition. Pp. xv+368. (London: G. Allen and Unwin, Ltd., 1923.) 12*s.* 6*d.* net.

WHEN the first edition of this sound and very readable work appeared some eleven years ago, an appendix (76 pages, by Mr. T. Crook) dealing with the systematic examination of loose sediments was not the least important of its many attractive features. This appendix is now omitted, apparently on the ground that sedimentary petrology has become a somewhat specialised branch with an adequate literature of its own.

The present edition is a complete revision of the first, and embodies many substantial and welcome additions (in bulk, equivalent to some 23 pages of text), some of which supply omissions such as are inevitable in a first edition. There are 10 new illustrations.

As regards Part I. (pp. 3-151) on sediments: the value of Chap. i., which deals very fully with questions of

deposition, is enhanced by a discussion of the influence of climate on deposition; in Chap. ii., loess and marl receive fuller treatment than before; Chaps. iii. and iv., on chemical and organic deposits, contain noteworthy additions relating to deposits of potash-salts and gypsum, and to oolites, algal limestones, crinoidal limestones, chalk, and certain Lower Palæozoic limestones of England.

Among the more important changes in the five chapters comprising Part II. (pp. 155-383), on the metamorphic derivatives of the sediments, may be mentioned new sections dealing with oolitic iron-ores, hæmatite deposits, strain-slip cleavage, crush-conglomerates, fault-breccias, and "stress" and "anti-stress" minerals.

In minor details (amendments of headings and text, and references to literature) revision has been equally thorough. A. B.

The Statesman's Year-Book: Statistical and Historical Annual of the States of the World for the Year 1924. Edited by Sir John Scott Keltie and Dr. M. Epstein. Sixty-first Annual Publication: Revised after Official Returns. Pp. xxxvi+1523. (London: Macmillan and Co., Ltd., 1924.) 20*s.* net.

THIS admirable work of reference again makes a punctual appearance and shows the same commendable thoroughness of revision as in previous years. It can be no light task to revise the statistics of every country in the world; yet with few exceptions figures are given for last year or the latest year in which returns were made. As the new states of the world settle their affairs and get into working order the task of the editors has no doubt become less difficult. Even from Russia and Turkey a great deal of information is now available. The plan of former years has been maintained in the general arrangement of the book; and in spite of several additions, particularly with regard to changes in the constitution in Greece, Italy, Spain, and Turkey, the length of the book has been reduced by some fifty pages. Space has been saved by a revision of many of the lists of books of reference. By eliminating some of the less important titles in these lists, their value is enhanced. The additions and corrections contain facts and figures published so late as April of this year. The number of states has been reduced by one by the merging of Fiume in Italy. This indicates a reversal of the process of multiplication of states which has held for several years. There are coloured maps to show Turkey according to the Treaty of Lausanne and the Syrio-Palestine boundary according to the Beyrouth agreement.

The Carbon Compounds: a Text-book of Organic Chemistry. By Prof. C. W. Porter. Pp. ix+494. (Boston and London: Ginn and Co., 1924.) 21*s.* net.

DIVIDED into three sections, this is essentially a text-book for the student who has had already a good grounding in the principles of organic chemistry. After a consideration of theories of valency and of atomic structure, the author then proceeds to the study of the aliphatic hydrocarbons and their derivatives. The nitroparaffins, the amines, and the ketones are dealt with before even the simple monobasic acids. The inclusion of a chapter on "the ammonia system," showing the analogies between water and ammonia, is unusual in a book devoted to organic chemistry.

In the second section of the book the carbocyclic and heterocyclic compounds are dealt with briefly, perhaps too briefly, but valuable chapters on steric influence and on free radicals are included.

The last section of the book is devoted to a general review of organic reactions. The fourteen chapters are really admirable summaries of such processes as oxidation and reduction, syntheses and rearrangements, and should be of the greatest interest to a student about to enter for a degree examination who wishes to find much useful knowledge in a small volume.

It is a most readable and instructive book, and one that should find a place in every college library. Its greatest value is not in a wealth of detail concerning innumerable compounds, but in its happy exposition of chemical theories and principles. F. A.

Alignment Charts for Engineers and Students: a Text-Book explaining the Theory and Construction of Alignment Charts. By W. J. Kearton and George Wood. Pp. viii+220. (London: C. Griffin and Co., Ltd., 1924.) 16*s.* net.

ALIGNMENT charts have apparently fascinated the writers of engineering text-books to such an extent that they can write of nothing else. That they are interesting and useful cannot be doubted; but the basic principle is so simple, and the application so direct, that the production of so many text-books on the same subject all covering the same narrow field, with elaborate and tiresome explanatory details of familiar algebraic processes, implies a distinct weakness in the training of our engineers. Once the fundamental idea has been explained, there is little in most of these books that could not be developed by any intelligent second-year engineering student; yet engineers must buy them, else why do publishers produce them? Has this process of educational spoon-feeding become typical of engineering college training? In fairness to the present volume it ought to be added that this is one of the best we have seen. Some of the diagrams are rather sprawly, but generally the subject is well developed without too much needless detail. A very valuable series of 35 alignment charts is provided covering a wide field of engineering design.

In Quest of El Dorado. By Stephen Graham. Pp. xiii+346. (London: Macmillan and Co., Ltd., 1924.) 12*s.* net.

MR. STEPHEN GRAHAM travelled on the trail of the Spanish adventurers of old from Spain to the West Indies, through Porto Rico, Haiti, and Cuba, and then to New Mexico, Panama, and Mexico itself. The book is full of colour and high spirits, with just enough of history to allow the reader to understand present conditions. In its vivid description and sympathetic insight, the book gives a far truer picture of tropical America and its inhabitants than most larger and detailed works. The author's reflections on present tendencies in Latin America add a practical value to a book that is full of charm.

Letters to the Editor.

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

Nickel in Ancient Bronzes.

THE issue of NATURE for January 19, 1924, page 100, contained a synopsis of a paper by Prof. John Sebelien of Aas, Norway, upon certain analyses made by him of Egyptian and Mesopotamian bronzes. A remarkable feature of these bronzes examined seems to be the regular occurrence of nickel as an impurity, whereas ores examined from an old mine in Kurdistan revealed no nickel.

In the synopsis referred to, Prof. Sebelien does not tell us whether nickel was present in the slag from the copper mines of Sinai or not. In any case, it is not to be expected that all the copper utilised in ancient Egypt and Mesopotamia came from the countries immediately surrounding them. The demand for tin and copper to make bronze was so great in olden times that even the remote coasts of Spain and Cornwall were exploited by ancient traffickers from the east.

Too frequently the possibilities of Southern Africa as a more convenient source of these desirable commodities in ancient times are overlooked. It is therefore of some interest in this connexion to cite the analysis of a piece of ancient bronze discovered in the Transvaal which was reported upon by Mr. T. G. Trevor, Inspector of Mines for the Union Government at Pretoria, in the Journal of the Chemical, Metallurgical and Mining Society of South Africa for January 1912, as follows :

" Mr. Schoch, the Manager of the Rooiberg mine, has kindly supplied the following analysis of a piece of bronze obtained from a small slag heap on the farm Blaaubank near the Rooiberg mine : copper about 80%, iron and alumina about 5%, tin about 7%, nickel about 3%. The piece is about ¼ to ½ lb. in weight, and is unformed, appearing to be more like the overflow of a crucible than anything else. . . .

" Concerning the bronze, there is no known ore in the Transvaal that by simple smelting would yield such an alloy as this, nor is there any copper mine known in the immediate Rooiberg district. As the composition is that of an excellent bronze it is impossible to doubt that the alloy was intentionally made of a definite composition and was not an accidental production. It is perhaps unnecessary to remark that there is no evidence of any native race south of Benin and the Gold Coast being acquainted with either tin or bronze."

In a discussion of this analysis Prof. G. H. Stanley, now professor of mining and metallurgy in the University of the Witwatersrand, said : " The bronze is a most peculiar product. . . . The presence of nickel is noteworthy ; I do not remember another case in which it has been found in prehistoric bronzes, though arsenic was used for hardening purposes."

To the writings of Trevor, Woodburn, Baumann, and others in the same Journal we are indebted for the knowledge that, at a time which probably synchronised with the exploitation of the gold-mines of Rhodesia, there existed a widespread industry also in tin, copper, gold, hæmatite, and micaceous iron throughout the whole of the Northern Transvaal so far south as the latitude of Pretoria.

It is not generally recognised that a veritable ring of ancient copper mines has been discovered surrounding the Rhodesian gold-bearing centre. McDowell has pointed out that, in the fringe of the Kalahari desert in the west, old copper workings are encountered intermittently for some miles near the Tebedzi River, and it is on the largest of these that the modern Malakoye mine has developed. " All of these workings are on copper ; this one has a length of some 800 feet and has been found to have a depth in places of 130 feet ; certainly not less than 1000 tons of copper must have been taken out of it by those early miners."

On the south, in the Transvaal, " there are at least five or six large groups of ancient workings " in the Messina district, and Trevor states that " it is quite impossible to estimate the amount of copper the ancient workings at Messina Mine must have produced, but it certainly could not have been less than several thousand tons, and if the other workings in the locality yielded proportionately, then the total output from the ancient workings in the vicinity must have mounted well into the tens of thousands of tons." In addition to these extensive workings at Messina there are in the Transvaal the ancient copper mines of the Palabora area which " cover many acres," and " in the aggregate, as in the individual workings, they are far larger than those at Messina."

To the north it is well known that the sites of the Katanga, the Star of the Congo, and the M'kubwa copper fields were all exploited by an ancient people as was the tin of the Broken Hill area, while to the east, in Portuguese East Africa, the copper areas in Macanga territory and near Pandamacua on the Zambesi were equally filched of their wealth. So famous was the latter site that the modern natives still call it by a name which signifies, according to Maugham, " fill yourself with copper."

It was for this copper that the tin of localities such as Broken Hill and Rooiberg supplied the means of producing bronze. Some 2000 to 3000 tons of tin were abstracted from the Rooiberg–Weynek–Leeuwpoort area to the north-west of Pretoria. Estimating this tonnage in terms of bronze, Baumann (1919) arrived at the modest figure of 30,000 tons of bronze produced and exported from this area alone at a remote epoch. This quantity of bronze of the magnitude of 60,000,000 lb., which is the estimated product of one area only, certainly never found a home market in this country.

The value of the gold taken from Rhodesia's gold mines in early times has been variously estimated as between 75,000,000*l.* and 200,000,000*l.* When it is remembered that, after 400 years of European occupation and with all the advantages of modern transport and mining equipment, it has taken fifty years to extract 900,000,000*l.* worth of minerals and precious stones from the earth in South Africa (Prof. E. H. L. Schwarz, *South African Geographical Journal*, vol. vi., 1923), the scale of the operations necessary to remove so huge an amount of gold and other minerals in ancient times may be the more readily appreciated.

Of the gold as well as of the tin, copper, and associated industries, it is at least true that they were not consumed commercially in Southern Africa. These facts therefore aid the imagination in assessing the amount of traffic which has plied along the East African coast prior to the coming of the European. Meantime, it does not seem impossible that the reasons for the occurrence of nickel in ancient bronzes of Egypt and Mesopotamia are to be sought from further afield than the Western arm of the Asiatic continent.

This metallurgical method in prehistory utilised by Prof. Sebelien provides a new and valuable instrument the further exploitation of which may well reward us with data of precision in regard to the commercial movements of ancient civilisations.

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Earth Tides and Ocean Tides.

IN some respects notable progress has been made in the problem of the earth tides since 1862, when Lord Kelvin directed attention to the difference between the observed amplitudes of the fortnightly oceanic tides and their theoretical amplitudes on a perfectly rigid earth and based on this fact an estimate of the earth's modulus of rigidity. On the instrumental side, the interferometer apparatus of Michelson and Gale [1] represents a notable advance over the horizontal pendulum. On the theoretical side, the investigations of Herglotz, Schweydar, Love and Hoskins [2] have enabled us to deal with an earth which, so far as the physical properties of its interior are concerned, resembles the actual earth much more closely than does the homogeneous, incompressible sphere with uniform rigidity throughout treated by Lord Kelvin.

In one part of the problem, however, almost no advance has been made. The observed tidal oscillations of the earth are considerably affected by oceanic tidal oscillations of identical periods, but not, in the long run, by oscillations of different periods. When observations with horizontal pendulums made some years ago in various places near the Baltic Sea indicated a greater apparent rigidity in the prime vertical than in the meridian, and when various ingenious explanations of this peculiarity were found to be untenable, it came finally to be accepted that the true explanation lay in the effect of the oceanic tides. A little calculation shows that the effect of the varying load of tidal water may extend to distances that, at first thought, might seem surprising.

The difficulty of correcting for the oceanic tide is twofold; first the complicated calculations necessary, and second the lack of observational data on the amplitudes and phases of the tides in the open sea. As to the first, however, the method of Boussinesq, which reduces the calculation of the yielding under a surface pressure to the calculation of a certain gravitational potential, is easily applied and has been used by Japanese investigators [3] in connexion with earth tides with fair success, in spite of the fact that the conditions postulated in Boussinesq's solution are somewhat remote from those of Nature. Doubtless more satisfactory methods of calculation would be devised, if only the essential data of observation, namely the facts about the tides at sea, were available.

For tidal oscillations (or, for short, simply *tides*) of long period, theory may, to a large extent, take the place of observation, since it seems very probable that these long-period tides conform rather closely to the equilibrium theory, a statement which cannot be made of the short-period tides, diurnal or semi-diurnal. The smaller amplitudes of the long-period earth tides in comparison with those of short period, and the consequent loss in relative accuracy with which the former can be observed, may be more than compensated by the greater accuracy with which the long-period tides may be corrected for the effects of the corresponding oceanic tides.

One purpose of this communication is therefore to urge that greater attention be paid to long-period tides both of the solid earth and of the ocean. In spite of their scientific importance long-period tides have been rather neglected in comparison with short-period ones, which are larger and of more immediate concern to the navigator. A publication of the U.S. Coast and Geodetic Survey [4] now in press lists 820 tidal stations in all parts of the world at which harmonic tidal constants have been computed, but at only 139 of these were the constants for the fortnightly and monthly tides derived. For the observation of these tides European scientific workers are geographically better situated than those of the United States. The long-period oceanic tides vanish in latitude 35° and reach maximum amplitudes at the equator and at the poles, the polar amplitude being twice the equatorial. In latitude 55° the amplitude is as great as at the equator. In this latitude, or in even higher latitudes, it would be practicable to make good tidal observations in Europe, but scarcely practicable in North America. For the earth tides, the geographical advantage of Europe over North America is somewhat less, since the long-period earth tides, being measured by the deflexion of the vertical, and not by the height of the disturbed level surface as compared with the undisturbed, attain their maximum amplitudes in latitude 45°.

It is desirable in the study of long-period tides to obtain information not merely about the elastic properties of the earth conceived as a perfectly elastic solid, but also about the departures of the earth from perfect elasticity, a matter of which very little is known. For this latter purpose the longer the period of the tide studied the better. Consequently a study of the tides connected with the eighteen-year revolution of the moon's node would be very desirable.

Another purpose of this communication is to ask for information about recent work on earth tides, whether experimental or theoretical, already accomplished or projected. The writer has been designated *rapporteur* on earth tides to the section of Geodesy, International Geodetic and Geophysical Union; it is therefore his duty to prepare a report on the subject for the coming meeting of the Union at Madrid. He has tried to reach directly persons likely to be interested in earth tides, but in view of the present difficulty in getting scientific articles printed at all, and the apparently opposite but very real difficulty due to the multiplicity of organs of publication, it is very probable that he has failed to reach many who are in a position to give him valuable information. The writer would, therefore, be glad to receive information of this sort, reprints of memoirs, etc., and hopes that readers of this communication will not construe the words "earth tide" too narrowly, but will include in them all related matters pertaining to the yielding of the earth to applied forces.

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Washington, D.C., U.S.A., May 7.

[1] *Astrophysical Journal*, Vol. 50 (1919), p. 330.

[2] G. Herglotz: "Über die Elastizität der Erde bei Berücksichtigung ihrer variablen Dichte," *Zeitschrift für Mathematik*, Vol. 52 (1905), p. 275.
W. Schweydar: "Theorie der Deformation der Erde durch Flutkräfte," Veröffentlichung des Königlich Preuszischen Geodätischen Institutes, neue Folge, No. 66, 1916.
A. E. H. Love: "Some Problems of Geodynamics," chaps. iv.-viii., 1911.
L. M. Hoskins: "The Strain of a Gravitating Sphere of Variable Density and Elasticity," Transactions American Mathematical Society, Vol. 21 (1920), p. 1.

[3] T. Shida: Memoirs of the College of Science and Engineering, Kyoto Imperial University, Vol. 4, No. 1, 1912.
R. Sekiguchi: "Tidal Earth Tilting," Memoirs, Imperial Marine Observatory, Kobe, Japan, Vol. 1 (1922), p. 1.

[4] Paul Schureman: "A Manual of the Harmonic Analysis and Prediction of Tides," Special Publication, No. 98.

Relation between Pressure Shift, Temperature Class, and Spectral Terms of the Iron Lines.

IT has been long recognised that the lines of the iron spectrum are displaced towards the red when the pressure about their source is increased, the magnitude of the displacement being not the same for all the lines. On account of this fact Gale and Adams (*Astrophys. Journ.* 35, 1912, p. 10) have classified the lines in four groups, *a*, *b*, *c*, and *d*. Group *a* includes all the flame lines, which have small displacements.

Group *b* is a large one and includes all the lines of small shifts which are not included in Group *a*. Group *c* consists of lines having much larger displacements than those of Group *b*. Group *d* is made up of lines which present very large displacements. An additional Group *e*, including lines showing displacements to the violet side, was found later by St. John and Ware (*Astrophys. Journ.* 36, 1912, p. 14).

A. S. King (*Astrophys. Journ.* 37, 1913, p. 239, and 56, 1922, p. 318) has studied the variation of intensity of the lines of the furnace spectrum of iron with temperature and has grouped the lines in temperature classes. The lines of Classes I. and II. are the least affected, those of Class III. are much strengthened with temperature, and lines of Classes IV. and V. appear only at high temperatures. He has also recognised that some of these lines are strengthened on passing from the arc to the furnace conditions. He denotes these lines by IA IIA. . . .

F. M. Walters, jr. (Journ. Wash. Acad. Sci., 13, 1923, p. 243, and Journ. Op. Soc. Amer. 8, 1922, p. 245) has found many "multiplets" in the iron spectrum of the kind which were first found by the author of this letter in the spectra of manganese and chromium (Phil. Trans. A. 223, 1922, p. 127). The lines forming each multiplet are equally affected by temperature and by pressure, as Meggers and I (in the second paper of Walters, p. 234) respectively have shown. These multiplets are formed by triplet and quintet terms. The absolute values of these terms are not known, but their relative values have been obtained by Walters by the assumption of an arbitrary value of 60,000 cm.$^{-1}$ for the highest level A.

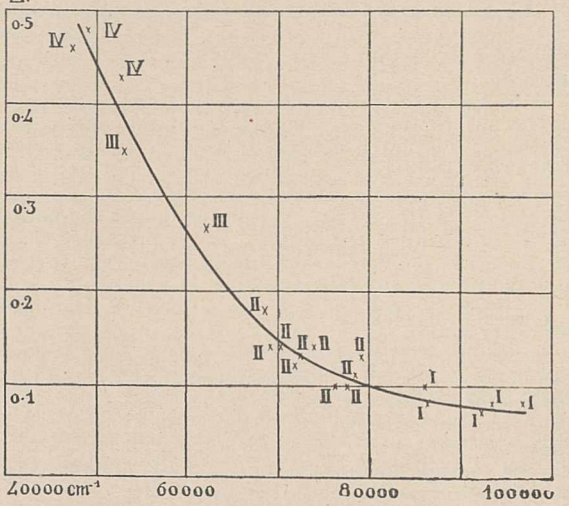

FIG. 1.

Comparing the pressure shifts of multiplets which have a common term, it may be observed that the displacement becomes smaller as the other term becomes larger. It seems that the larger the two terms forming a line, the smaller is the pressure shift and the smaller the effect of temperature on its intensity.

In Fig. 1 the mean values of pressure shifts (taken from Gale and Adams) for each multiplet are plotted against the mean value of the sum of the terms forming each multiplet. It may be observed that the shape of the curve is quite regular, thus showing that the displacement is a continuous function of the sum of the terms. The mean temperature class for each multiplet is also indicated in the figure.

The curve in Fig. 1 has been used to interpret some groups of lines not yet classified. As the matter may be of assistance in the resolution of other complex spectra, the following details may be of interest. In addition to the classified multiplets, Walters gives two more which he has not brought into relation with the others. These multiplets, which will be denoted by α and β, involve a five-fold level Y combined in α with a seven-fold level Z, and in β with a three-fold level X. I have found that the relation of the separations of these levels and the Zeeman effects of their lines indicate that they belong to a *septet* system (the septet system was previously predicted by the writer, An. Soc. Española 21, 1923, p. 480). X is a *p*-term, Y is a *d*-term, and Z is an *f*-term.

The mean value of the pressure displacement for the lines of multiplet α is 0·35 cm^{-1} and for β is 0·43 cm^{-1}. Fig. 1 indicates that the sum of the terms for α will be about Z + Y = 54000 and for β, X + Y = 53000. As the differences of the terms (mean wave-number of each multiplet) are known, Z − Y = 20000 and X − Y = 19000, the terms may be easily obtained, giving Z = 37000 and Y = 170000 in α and X = 36000 and Y = 17000 in β. Strong intercombination multiplets between Z and X with the largest level A = 60000 (a *d*-term of quintets) may be expected at ν23000 (λ4400) and ν24000 (λ4200) respectively. As A + Z = 97000 and A + X = 96000, the expected lines will be, by Fig. 1, those which have the smallest pressure displacements and are among the lines which appear at the lowest temperature. Their intensities may not be very great, because they belong to intercombination multiplets.

The expected multiplets have now been found, one at λ4400 and the other at λ4200. From them and the term A, the following values of X, Y, and Z are obtained (Bohr-Paschen notation) :

X	Y	Z
		$n^7_{4,6}$ = 37349·57
		125·44
	$n^7_{3,5}$ = 17184·19	$n^7_{4,5}$ = 37154·13
	347·48	150·87
$n^7_{2,4}$ = 36288·55	$n^7_{3,4}$ = 16836·71	$n^7_{4,4}$ = 37003·31
469·40	271·30	114·26
$n^7_{2,3}$ = 35819·15	$n^7_{3,3}$ = 16565·41	$n^7_{4,3}$ = 36889·05
326·02	198·90	81·56
$n^7_{2,2}$ = 35493·13	$n^7_{3,2}$ = 15366·51	$n^7_{4,2}$ = 36807·49
	130·50	52·38
	$n^7_{3,1}$ = 15236·01	$n^7_{4,1}$ = 36755·11
		25·55
		$n^7_{4,0}$ = 36729·56

Multiplet AZ is formed of lines of Class I., some of them appearing at the lowest temperature given by King (1400°). The most important line of this multiplet λ4376 is the strongest line of the furnace spectrum at 1400°. Multiplet AX is also formed of low temperature lines.

The pressure displacements of the lines of these intercombination multiplets are very small. Three of the lines of multiplet AZ, λλ4376, 4427, 4462, have (King, *Astrophys. Journ.* 35, 1912, p. 190) their pressure displacements about half as large as those of the remaining lines of Group *a*.

The Zeeman pattern (3*a*/2) of the lines forming the multiplet AZ serves to show that it is an intercombination multiplet formed of a *d*-quintet-term combined with an *f*-septet-term.

The intercombination multiplet BZ (B is an *f*-term of quintets) has also been found at about λ6300, and is composed of lines belonging, as expected, to Class I. Multiplet BX is forbidden by the selection principle.

As the lines forming a multiplet are equally affected by pressure, it follows that this effect does not depend very much, if at all, on the azimuthal and internal quantum numbers of the orbits ; but as the different multiplets are differently affected, it seems probable that the effect depends on the radial quantum numbers. Orbits with very large radius may be more

affected by pressure than those with small ones; and consequently the transitions between the large orbits may be more affected than those between small ones.

The effect of temperature will be parallel to that of pressure. At low temperature the valence electron is moving only between orbits with small radius, but as the temperature becomes higher the collisions between atoms become more energetic and the valence electrons are ejected to orbits with larger radius.

It may be of interest to remark finally that the lines of Group *e*, having displacements to the violet side, remain as yet out of the multiplets.

The work is being extended to other elements.

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Sunshine and Health in Different Lands.

MR. W. H. DINES's letter in NATURE of May 31 is very helpful in bringing this discussion to a head. The inevitable association, in the long run, of sunshine with heat is, of course, the crux of the whole matter considered as a climatological problem, and there is much to support the contention that, on the whole, cool climates are more benign and conducive to general health and vigour than warm. This climatological problem should not be confused with the hygienic problem of securing proper access to, or making the best use of, such allowance of sunshine as each climate affords. This latter is, no doubt, the aspect of the question with which the medical faculty and the "sunlight league" are more immediately concerned, but sooner or later they will be confronted with the wider geographical or climatological relationships of the subject.

The problem of comparing different lands for the purpose of finding and evaluating a sunshine optimum turns upon the possibility of isolating sufficiently the effect of direct sunlight from the effects of the associated conditions of temperature, moisture, and wind—an obviously difficult matter. One might, for example, think that if there were a little more winter sunshine England would come very near, indeed, to the general climatic optimum from the point of view of general salubrity. But the trouble is that any alteration in an average of sunshine would, almost inevitably, be associated with a redistribution in the average conditions of temperature, moisture, and wind, with the risk that more sunshine in England might easily mean a less favourable total combination of climatic elements than the country actually enjoys. It becomes a question of "leaving well alone"! Hence the practical climatological problem is narrowed down to this: What countries approach most closely to a combined optimum integrating the effects of sunlight, temperature, moisture, and wind conditions, including the stimulating influence upon mind and body of frequent, yet not too violent, changes of weather, and storms? There can be no doubt that in respect to this totalisation of effects, in which sunshine is included, Britain stands very high; but no comparison between this and other European, or extra-European, countries would be trustworthy without rigorous investigation. Mortality and longevity statistics may furnish an index of what is required, but they need to be very cautiously interpreted, inasmuch as the onset of disease and senility is largely controlled by various conditions for which climate cannot fairly be held responsible.

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The Modus Operandi of Kidney Secretion.

PROF. SWALE VINCENT, in his recently issued "Introduction to the Study of Secretion," refers, in the chapter on kidney secretion, to my proof (Journ. and Proc. Asiatic Soc., Bengal, N.S., vol. xviii. pp. 85-193, 1922) that the network of renal afferent veins in the substance of the frog's kidney has nothing to do with renal secretion, and states that this discounts most or all of the evidence (Bainbridge and Beddard and others) hitherto advanced in support of the idea that the tubules secrete. I submit that this does not represent the position. I have shown in the paper above quoted that it is almost certain that the secretion obtained by Bainbridge and Beddard in the frog's kidney, when the arteries were ligatured, was due solely to venous blood percolating into the true capillaries surrounding the tubules, and this necessarily implies secretion by the tubules.

May I suggest that the respective rôles of the tubules and glomeruli in the kidney can be established once for all if, in a living mammal, with blood charged with diuretic, the circulation in one kidney be reversed, the other kidney being maintained normal as a control? This can be effected by rapidly joining up the half of the renal artery next the aorta (or a mesenteric artery, if more convenient, the flow through which can be compared with that through the normal control renal artery afterwards) with the renal vein, the renal artery (the half next the kidney) being simultaneously connected with a vein. This operation, in these days of expert surgery, should not prove to be an impossible one (and I speak from experience gained in preliminary attempts to perform the experiment in India), the connexions between the arteries and veins being effected either by means of Hédon tubes or glass tubes internally coated with paraffin-vaseline mixture, as suggested by Bazett and Quinby (*Quart. Journ. Exp. Physiol.*, vol. xii., 1920), and the theoretical importance of it is manifest if, as I anticipate from the results of my own similar saline perfusion experiments, the secretion from the kidney with reversed blood flow will prove to be five to eight times as great as that from the normal control kidney, despite perturbations due to the temporary interruption of its blood flow.

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Emission of Volcanic Gases.

AT Solfatara, south of Naples, in the crater of what is called locally the "little Vesuvius" many of the delegates who visited Naples for the recent University celebrations saw the following puzzling phenomenon. Gas (or vapour) issues from various holes in the floor of the crater and in the walls. The guide ignites a resin torch which he waves over one of the holes. Immediately the volume of gas issuing from the hole becomes denser, and not only that, but the other holes apparently instantaneously become more active, giving out more gas, even though some of these holes are hundreds of yards away. Although the observations were necessarily of a very rough kind, yet every one who saw it agreed as to what was observed. I heard no one who could give any explanation, and my idea that the phenomenon was largely subjective found no supporters.

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May 15, 1924.

Problems of Muscular Receptivity.[1]

By Sir CHARLES SHERRINGTON, O.M., G.B.E., P.R.S.

THE nervous system in its relation to skeletal muscles is commonly and permissibly likened to an electric installation with connected central exchanges whither run wires from receiving stations and whence issue wires to outlying motor machines. Through it a receiving station has touch with any of many of the motor machines outside. The central system is so contrived that a receiving station can put these or those machines into action and simultaneously throw out of action these or those others which would impede them.

The exchanges stand for nerve-centres in spinal cord and brain; the motor machines for muscles, and the receiving stations for the sense-organs, the wires the nerve-fibres connecting all these into a system. The receiving stations are commonly called sense-organs; the reaction which light, sound, or other external stimuli excite through them in the central exchanges is one which partly documents itself to mental experience in a specific way, a way related by the mind to a specific external agent. But that sensual result accrues only when the central reaction involves certain sets of the central exchanges. The central reaction taken as a whole consists of much that does not document itself to the mind. It is preferable, therefore, where the whole central reaction has to be borne in mind, to replace as an appellation for the receiving station the term sense-organ by the simpler term "receptor." This term is suitable in view of either of the two central results, the non-mental "reflex" and the sensual mental; whereas the term sense-organ becomes a misnomer where dealing with the purely reflex.

Of the two-fold central result the reflex moiety can, in experiment, be sundered from the mental, by taking advantage of the partial separateness of the central exchanges for the two; the nerve from the receptor does, however, lead to both. Disease similarly destroys sometimes the mental part without destroying the purely reflex, and indeed sometimes the converse occurs.

The receptors are points of the organism specialised for the surrounding world to act on. They lie at the surface of contact of the organism with its external world. They aim at the muscles with a trajectory through the nervous system. They enable requisite, for the most part speedy, adjustments of the organism reacting to events in its surroundings. They enable this by means of their attachment to the nervous system, which gives to these reactions sufficient speed for their purposive success. These speedy reactions employ machines speedy in their action, the striped muscles. Hence these muscles are, in the constructive plan of the animal, placed at the disposal of the receptors operating through the nervous system. These, the skeletal muscles, are the motor machinery for all that life of the animal which the older physiologists were wont to call the "life of external relation." Of the importance of that life of external relation the moralist has written that even in man the crown of life is an action, not a thought. Should we demur to this distinction, we can still endorse the old adage that to move things is all mankind can do, and that for such the sole executant is muscle, whether in whispering a syllable or in felling a forest.

The receptors played upon by the events of the external world supply their "drive" to the muscles. In reflex action they do so far more simply and for far more simple purposes than when the trains of reaction they set going have to thread the mazes of the higher brain, and, so to say, obtaining mental sanction, issue in acts remoter from the original stimulus. Yet in both cases, the muscles lie at the behest of the receptors, as instruments of their hand.

We should go too far, however, did we infer that the muscles themselves are instruments entirely passive under drive of the receptors acting on them from without. That they are agents not purely passive is shown by their possession of receptors of their own. On their own behalf they send messages into the central exchanges. This must mean they have some voice in their own conditions of service, perhaps ring themselves up and ring themselves off. Let us attempt to penetrate into the significance of this their "receptivity."

It is a receptivity differing obviously from that of other receptors, rightly more commonly chosen to exemplify receptive function, such as retina, ear, tongue, tactile organs, and so on, for in the case of the receptors of muscle, instead of being stimulated directly by agents of the external world, they are stimulated by happenings in the microcosm of the body itself, namely, events in the muscles themselves. In muscular receptivity we see the body itself acting as stimulus to its own receptors. The receptors of muscle have therefore been termed "propioceptors."

Following the functional scheme of all receptors, we may be sure that the central reactions provoked by the receptors of muscle will be divisible into, on one hand, the purely reflex, and on the other hand, those which subserve mental experience.

Let us turn to the simpler of these divisions, the purely reflex. For that purpose, appeal can be had to what may with justification be regarded as a partially surviving animal; an animal which, its cerebral hemispheres having been removed, is a wholly inconscient and purely reflex automaton. From it no sight or sound evokes evidence of perception. There is total inability to evoke from it any sign of mentality, of emotion, let alone intelligence. It remains motionless hour after hour; yet if planted upon its feet in the upright position it stands, and statuelike continues to stand.

Now, standing is a postural act, and one of course of high importance. In maintaining posture the muscles, though they perform no external work, are active with an activity often technically termed "tonus," a postural contraction. In this maintenance of the erect posture by the decerebrate animal, we meet a co-ordinated posture involving many separate muscles harmoniously co-ordinated reflexly. For this reflex postural act of standing some stimulus must be at work

[1] The Linacre Lecture of St. John's College, Cambridge, delivered at Cambridge on May 6.

evoking and maintaining it. We have to ask what that stimulus may be.

If the afferent nerves that pass from a limb to the spinal centres be severed, the standing posture in that limb is no longer executed or maintained. The stimulus exciting the posture in that limb must be something which is applied to the receptors of that limb itself. The skin surface of the limb is rich in receptors, one region especially rich being the sole of the foot. On the receptors of the skin of the sole of the foot the external world may evidently be acting as a stimulus in the form of pressure from the ground upon the skin. To test whether that is the source of the reflex posture, the skin of the foot can be deprived of all its receptors by severing their nerves. This is found to exert no obvious influence upon the posture. Nor does severance of all the receptive nerves from the skin of the whole limb, nor, indeed, of all of the four limbs. The stimulus producing and maintaining the posture is therefore not pressure of the skin against the ground, nor indeed any cutaneous stimulus whatsoever. On the other hand, if, even without interference with the skin nerves, the receptive nerves of the limb muscles—the motor nerves, of course, remaining intact—be severed, the reflex posture disappears at once from the limb. The stimulus which produces and maintains the posture is something which is acting on and exciting the receptive nerves of the muscles of the limb.

What are the muscles which, by their contraction, execute this postural act? The posture keeps the head and neck from sinking, the trunk straightened and the spine supported, the tail from drooping, the limbs from yielding and folding under the superincumbent weight of the body. In a word, the reflex posture counteracts in the various parts of the body the effect of gravity on them in the erect attitude. Experimental analysis shows that throughout the muscular frame of the animal all those muscles, and only those, are in action, the activity of which counteracts gravity in the erect attitude; for example, in the hind-limb the muscles which extend hip, knee, and ankle. The muscles which execute the reflex we may, in short, term "antigravity" muscles. Even the jaw is included; the lower jaw, which, but for its postural tonus would drop, is held lifted against the upper.

If in the limb the receptive nerve of one of these antigravity muscles be cut, that muscle no longer contributes to the reflex posture. On the other hand, severance of the receptive nerves of all the other muscles does not destroy the postural reflex of the muscle the receptive nerve of which remains intact. The stimulus which is the source of this reflex standing is therefore one acting on the receptors of those limb-muscles which are themselves executants of the posture.

The excitability of a receptor is selective. That is, construction fits the receptor to respond to stimuli of one particular kind only, the so-called "adequate" stimulus; thus, the retina to light, a taste papilla to "sweet," and so on. Hence Pavloff's term "analyser" for the receptors, because by them the various complex events which play upon the body and cause reactions of it through the nervous system are to some extent analysed. A wave breaking on the shore excites the retina by its reflected lights, the ear by sound vibrations, and, maybe, the skin by the spray dashed up. The wave as "object" and stimulus from the external world is thus partially analysed by the receptors.

Seeing that the receptors of muscle are an appanage of an organ mechanical in function, a near supposition is that their adequate stimulus is of mechanical kind. What is the adequate stimulus at work in these antigravity muscles in their posture of standing?

A muscle representative of the whole antigravity group is the extensor of the knee. Suppose it isolated from the rest and its freed tendon attached to a stiff spring, and to the spring a light lever so fixed that movement of the lever-point is photographically recorded. If then, by its bony attachments, the muscle be pulled against the spring, we can passively stretch the muscle and record the tensile strain developed in it by the stretch. Let us take the case of the muscle paralysed by severance of all nerves both afferent and efferent which connect it with the nerve-centres (Fig. 1). The tension developed in the muscle as it is stretched yields a curve resembling that given by various fibrous

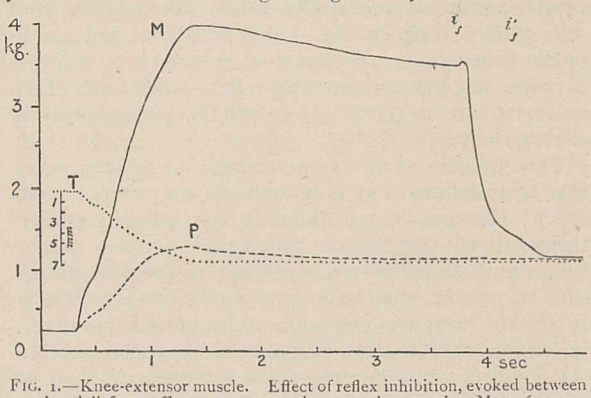

FIG. 1.—Knee-extensor muscle. Effect of reflex inhibition, evoked between i and i' from afferent nerve, on the muscular reaction M to 6·5 mm. stretch T compared with reaction P of the "paralysed" muscle to similar table-stretch. Myograph multiplies tendon-movement 62 times. Time in seconds. (Liddell and Sherrington.)

and elastic tissues of the body, not unlike that given by a strip of indiarubber. Let us repeat the observation, but with the difference that the muscle retains unimpaired its purely efferent motor nerve. The stretching produces the same tensile curve as before, a curve practically indistinguishable from that of the wholly paralytic muscle. Then let us make the observation, with the further difference that the muscle this time retains not only its motor nerve but its receptive nerve as well. We find the muscle yields now a completely different curve of tensile strain. The tension developed by it is much greater, and its curve under equable progressive increase of the stretch runs, tensions being ordinates, convex instead of concave to the abscissa-line. The muscle in response to the stretch now replies not merely by passive strain but also by active contraction of its muscle fibres. In the muscle with its reflex arc intact, the passive pull provokes a reflex contraction of the muscle. Evidently a mechanical stretching of the muscle supplies an adequate stimulus for receptors in the muscle.

The reflex is closely graded by the degree of stretch; and the degree of stretch required to excite reflex contraction is quite small. Mr. Liddell and I have seen a stretch, extending the muscle's resting length by less

than one per cent., produce a reflex contraction registering 2000 grams of tension. The reflex contraction provoked by the stretch tends to produce equilibrium between the extending force and the contractile resistance of the muscle and thus to prevent further elongation of the muscle. This is so whether the passive stretching is applied slowly or quickly. So soon as the stretch ceases to be increased, increase of the reflex contraction promptly ceases.

Reflex contractions produced in this muscle by other means than stretch have not such dead-beat character. Commonly, they long outlast the receptive stimulus which excites them. Stretch-reflexes, though with cessation of further increase of the stretch-stimulus further increase of the reflex contraction ceases, show persistence of the degree of contraction already reached after the progressive stretch has ceased. The question arises whether this persistence of the contraction is due, as in those other cases, to continuance of central reverberation after the exciting stimulus has ceased, or whether the residual passive stretch constitutes a persisting stimulus. Whether, in fact, under appropriate conditions the stretch-reflex can present itself in a purely static form. The question is not unimportant, because, if the residual stretch is a stimulus exciting and maintaining the reflex contraction, then a passive stretch-posture is exciting an active postural contraction.

This question can be examined in several ways. One is as follows. It is possible to subject the reflex arc of the muscle to inhibition; in other words, to throw it out of action temporarily. Such inhibition annuls a stretch-reflex already in progress and, if suitably timed, prevents contraction in response to a stretch however powerful. The muscle passively stretched when the inhibition is in operation exhibits the same curve of merely passive tension as does an entirely paralytic muscle. This being so, we can arrange for the inhibition to begin before and continue while the stretching movement, the "kinetic stretch," is being applied to the muscle and then, when the stretching movement is over and the residual, merely static, stretch remains, remove the inhibition. In this way the reflex arc of the muscle on which the stretch-reflex depends is, so to say, put to sleep during the kinetic stretch and until the stretching movement is finished, and then, when that is over, the reflex arc is, so to say, allowed to wake. On doing so it will find its muscle has assumed a state of stretch, of steady strain, a passively stretched posture. The result observed by

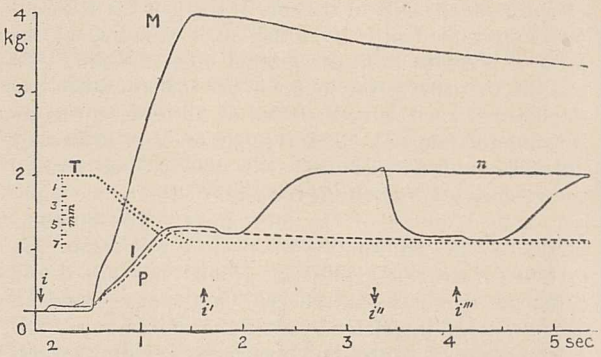

FIG. 2.—Successive reactions M of normal, I of reflexly inhibited, and P of paralysed muscle to stretch T of 7 mm. The inhibition (by afferent nerve) was on first occasion from *i* to *i'*, on second occasion from *i'* to *i''* and again from *i''* to *i'''*, giving therefore on second occasion the fall from and reascent to the plateau line *n* of the first occasion. The inhibitory nerve gave slight concomitant contraction, so that full inhibitory effect is seen only close subsequent to cessation of the inhibitory stimulation. The less steep dotted line T gives the stretch for observation M; the other for observations I and P. Myograph multiplying tendon-movement 62 times. Time in seconds. (Liddell and Sherrington.)

this method is that the muscle on its nervous arc so waking immediately develops a reflex contraction, and then steadily maintains it (Fig. 2). The passive stretched posture acts *per se* as a stimulus. The proprioceptive nervous arc of the muscle reacts to the passive stretched posture imposed upon the muscle, and its reaction results in the production and maintenance in the muscle of an active contraction posture which opposes the passive stretch to which the muscle is subjected.

(*To be continued.*)

The British Empire Exhibition.[1]

EXHIBITION OF PURE SCIENCE ARRANGED BY THE ROYAL SOCIETY.—II.

THE physics section of the Royal Society's exhibition comprises apparatus illustrating the most important modern work on the structure of matter and the nature of electricity and on the various parts of the electromagnetic spectrum, together with metrological and metallurgical exhibits and some apparatus of great historical interest. Demonstrations are given, and these will be changed from time to time. The exhibition has largely been arranged to show the historical development of existing knowledge and its applications, and brings out clearly the way in which important developments arise in the first instance out of researches undertaken from no other motive than curiosity. It is important for physics that the public should recognise this fact, which is the keynote of the exhibition. Knowledge is often valued less for itself than for the industrial developments which it makes possible, and the capitalist who finances inventions gets wealth while the inventor who applies physical discoveries gets fame, but physics generally finds itself in the position of Cyrano de Bergerac when he wooed the fair Roxane in order that another might climb to her balcony:

"Pendant que je restais en bas, dans l'ombre noire,
D'autres montaient cueillir le baiser de la gloire!"

A foremost place must be given to some of the original apparatus by means of which the electron was discovered and its nature investigated. This includes various forms of Crookes's tube, Sir J. J. Thomson's apparatus for measuring e/m and v, and Prof. H. A. Wilson's apparatus for determining e, and though the proverbial sealing-wax and string is not greatly in evidence, the unobtrusive character of the apparatus contrasts with the importance of its results. A series of ten exhibits by Prof. O. W. Richardson comprises originals and models of the means by which he developed the theory of thermionic emission during the years

[1] Continued from p. 864.

from 1900 to 1913. The steps include investigations of the relation between temperature and saturation current, of the effects of gases on thermionic emission, of the effect of potential gradient, of the distribution of velocities amongst the thermions, of their mass, and of their latent heat of condensation and evaporation. Prof. Fleming's exhibit illustrating the history of the thermionic valve naturally follows, showing the pioneer Fleming valve of 1904 with some modern enlarged and improved constructions, the amplifying form with de Forest's third electrode, and the recent dull-emitter valves obtained by thoriating the filament. An application of photo-electricity to astronomical micro-photometry will be shown later by Prof. Lindemann, the current in a soft (neon) cell with sodium electrode being measured with an electrometer; and Prof. Rutherford shows how the velocity of β-particles can be made by quantum dynamics to disclose the energy levels within the atomic nucleus.

The always fascinating Wilson-Shimizu cloud expansion apparatus gives visitors a very graphical picture of the paths of α- and β-particles, and a series of exhibits by Sir Ernest Rutherford indicates the history of his work on the atomic nucleus, the measurement of e, m and v for an α-particle, the counting of scintillations and of the α-particles entering an ionisation chamber, the study of nuclear collisions with their far-reaching theoretical implications, and, finally, that of the ejection of protons from the nucleus. Prof. Joly has some micro-photographs of pleochroic haloes produced by the action of α-particles discharged from radio-active substances embedded in rocks, the age of the haloes being upwards of 50 million years. This work is recent and promises to be particularly interesting, because certain of the haloes disclose a range not attributable to the particles coming from any known element.

Sir J. J. Thomson's exhibit includes some positive-ray photographs, and many will see for the first time with great interest a model of Aston's famous mass-spectrograph, by means of which the method of positive-ray analysis has been applied to find the isotopes of a large number of elements. This leads through Moseley's work, connecting X-ray spectra with atomic numbers, to the study of X-rays, which is illustrated by some historic exhibits due to Sir Oliver Lodge, Mr. A. A. Campbell Swinton, and others, and by a model of the apparatus with which Prof. C. G. Barkla demonstrated the polarisation of X-rays scattered from the lighter elements and the fluorescence of the heavier elements, incident radiation giving the K and L series characteristic of the element irradiated. At the date of these experiments absorption was the only available test for the character of the rays, but the subsequent measurement of their wave-length by crystal analysis brings us to the work of Sir William and Prof. W. L. Bragg. The Bragg spectrometer employing an ionisation chamber, and the Müller spectrograph employing a photographic method, are both shown, together with some atomic models of the now familiar type. A greater variety of the latter will also be found in the chemical section of the Palace of Industry. The National Physical Laboratory exhibits an interesting table which brings out the relation of crystalline structure to the places of elements in the periodic table, together with models for some intermetallic compounds and solid solutions.

Prof. A. Fowler is responsible for some exhibits and a demonstration dealing with the spectra of elements in different stages of ionisation, bringing out the relation between the spectrum of a given atom in the neutral state and those of ionised atoms of succeeding atomic numbers. The connexion between atomic structure and the visible part of the spectrum is also illustrated by Prof. F. Horton and Dr. A. C. Davies, who supply a demonstration on excitation potentials, and by Dr. W. E. Curtis, who gives a study of the band spectrum of helium.

Perhaps the most impressive exhibit in connexion with radiation is a series arranged by Profs. Fowler and Merton and Mr. F. Twyman illustrating the production and measurement of rays extending over no fewer than forty-six octaves, comprising *Reststrahlen* apparatus (about 10^6 Å.U.), an infra-red spectrometer (5000 to 10^5 Å.U.), a quartz spectrograph (to 2000 Å.U.), and a vacuum grating (to a few hundred Å.U.). With these may be compared an X-ray spectrograph (to 0·1 Å.U.) on one hand and a multivibrator wireless wavemeter (N.P.L.) and a cathode-ray oscillographic method of frequency measurement on the other. Kindred exhibits are a Lummer-Gehrcke plate, a Fabry-Perot interferometer, and various spectroscopes and diffraction gratings. An interesting spectrographic series is that by which Mr. Evershed claims to have verified the Einstein shift in the solar spectrum. The Astronomer Royal also shows specimens of the Sobral photographs, and the Royal Observatory, Edinburgh, some spectrograms of various types of stars. Other interesting astronomical photographs are furnished by Prof. Lindemann and Mr. G. M. B. Dobson and by the Dominion Astrophysical Observatory, B.C. The very ingenious Guild's trichromatic colorimeter and a photometric exhibit (N.P.L.) should be mentioned here, and also the method used by Sir Herbert Jackson and Mr. C. Beck for seeing the surface colour of ultra-microscopic particles by means of polarised light.

The problems of fine measurement are well represented. As regards measurement of length, perhaps the most interesting apparatus is Prof. Whiddington's ultra-micrometer, in which a minute change in the distance between the plates of a condenser is measured by its effect on the frequency of an oscillating valve. There are also travelling microscopes (N.P.L.), the generator comparator, end gauges, and an auto-lapping chuck for making these (Pitter Gauge and Precision Tool Co., Ltd.), the Lewbeck projection micrometer (London Electric Wire Co. and Smiths, Ltd.), and means for recording extension due to load (Prof. W. E. Dalby) and temperature (Research Department, Woolwich). Guild's spherometer employs a criterion of great precision for determining the degree of contact between a given surface and a spherical surface of quartz, the interference rings at the point of contact being studied for this purpose. Measurement of weight is represented by a set of stellite weights (N.P.L.) which are constant to 1 part in 10^7 during several years, and measurement of time by a study in clock rates (Royal Observatory, Edinburgh), a new electric clock (Mr. H. A. Thomas) which makes use of

an oscillating valve, and a free pendulum (Mr. F. Hope Jones) which swings *in vacuo* and spends only 2 ft. oz. of energy per week. Measurements of pressure and temperature are respectively exemplified by some Pirani pressure gauges (General Electric Co., Ltd.), depending on the cooling of a hot wire by the gas under measurement, and by a resistance thermometer, thermocouples, and a disappearing-filament pyrometer (N.P.L.). This section of the exhibition is supplemented by the N.P.L. exhibit in the Palace of Engineering.

Considerable space is devoted to metallurgy. Specimens of crystallised gold are shown by Prof. A. Liversidge, and there are interesting studies of the behaviour under stress of very large single crystal specimens of aluminium (Prof. H. C. H. Carpenter, Prof. G. I. Taylor, and Miss C. F. Elam), and of tungsten (Dr. F. S. Goucher, General Electric Co., Ltd.), the deformation produced by stress being of the nature of a shear or slip in a direction parallel to the crystal planes indicated by X-ray analysis. A photomicrographic investigation of fatigue in other metals (N.P.L.) tends to the same conclusion. The study of alloys is exemplified by the crystal models referred to above, by a kind of three-dimensional graph (N.P.L.) showing the constitution of a three-element system at various temperatures, and by diagrams, photographs, and sections illustrating the metallography of copper-tin alloys (Mr. C. T. Heycock and the late Mr. F. H. Neville).

Relics of great historical interest have been contributed by the Science Museum, the Royal Institution, and King's College, and to these must be added a representation of the coat-of-arms of the Royal Society and a volume containing facsimiles of the signatures in the latter's charter book.

For the sciences grouped under the heading of geophysics, which are characterised by their all being dependent on observations made simultaneously by a number of observers distributed over the earth's surface, an exhibition is being held in one of the new galleries of the Science Museum at South Kensington, and portions of this will be moved to the Wembley Exhibition in rotation. This method of compensating for the scantiness of the available space was a happy thought, and no doubt many visitors will make an opportunity of seeing the whole exhibition at South Kensington, for British workers have made great contributions to these studies and their Imperial aspect is obvious: they have, moreover, a very direct bearing on everyday life. Sir Napier Shaw is responsible for a series of exhibits showing the manner in which data as to atmospheric movements and changes are obtained and collated, and (in conjunction with Miss E. E. Austin) for maps indicating rainfall and evaporation throughout the world. Capt. C. J. P. Cave contributes cloud photographs which define admirably the technical terms used by meteorologists in this connexion.

A topic of urgent social importance is raised by Dr. J. S. Owens's apparatus for measuring atmospheric pollution, comprising a standard gauge for dust-deposit, an automatic intermittently acting recorder for suspended matter, and a photometer for measuring the obstruction of light by dust. Terrestrial magnetism and atmospheric electricity are illustrated by maps, records, and instruments (Dr. C. Chree and Mr. C. S. Wright), the Milne-Shaw seismograph and some seismological maps are shown by Prof. H. H. Turner and Mr. J. J. Shaw, and Col. H. G. Lyons and Col. H. S. L. Winterbotham are responsible for a study of the progress made in the mapping of the Empire. It is surprising to learn that after the immense amount of work already accomplished in the latter connexion, two-thirds of the Empire has been only roughly mapped and one-fifth has not been mapped at all. This exhibit is supplemented by some photographs taken during the climbing of Mount Everest, a scale model of which, to be found in the Government Building, is to register the progress of the third expedition as reports are received.

C. W. H.

Obituary.

MR. KENNETH J. J. MACKENZIE.

BY the death of Kenneth James Joseph Mackenzie, which occurred in a nursing home in London on June 5 after a prolonged illness, the University of Cambridge has lost an outstanding personality and the agricultural world a man of distinguished eminence. He was the son of Major A. C. C. Mackenzie, and was born at St. Helena on May 1, 1867. He was educated at Fort Augustus College, the Agricultural College, Wye, the British Dairy Farmers' Institution, Reading, and abroad. He afterwards became professor of agriculture at Wye.

In 1907, when the School of Agriculture at Cambridge was in process of rapid development, Mackenzie joined the teaching staff and became director of the University farm; very soon after, he was appointed University lecturer. He added greatly to the strength of the School, and by his highly attractive and stimulating teaching acquired a great influence which was spread widely by his many students, not only in Great Britain but also throughout most parts of the world. Mackenzie joined Christ's College, where he was always very welcome at the high table and in the Combination room. He received the honorary degree of M.A. from the University, and in 1914 was elected reader in agriculture. He afterwards became consultant to the Institute of Animal Nutrition. He was a Governor of the Royal Agricultural Society and a constant attendant at the "Royal" Shows, and was at one time editor of the Society's Journal. His services were greatly in request as a judge, for he was an acknowledged authority on most classes of stock, and particularly cattle and pigs. He represented the British Government at the Brussels Exhibition in 1910. During the War he went to France on behalf of the War Office and the Y.M.C.A., to lecture to the troops on the home food supply. He also took a prominent part in assisting the Government in the then difficult problem of food production.

Mackenzie's published writings include a constructive work on "Cattle and the Future of Beef-Production in England," and numerous papers, on certain aspects of bacon-curing, on milch cows and the production of store stock, on economic cattle-rearing, and on the "mutton-points" of sheep. It was always one of his aspirations to introduce into Great Britain the methods

of the "Zootechnie" as carried out in France, Belgium, and Holland, to which countries he had paid many extended visits. "Zootechnie" may be described as the scientific study of domestic animals in every aspect, and more particularly in relation to agricultural practice. Within this sphere, he had done much useful work, and one of his latest papers was on the points of the ideal bacon pig, read before the Farmers' Federation at Cambridge in May of last year.

It was probably as a teacher, however, that Mackenzie was greatest. Many instructors in agriculture have been content to teach their subject according to the traditional methods of the text-books. Mackenzie, however, was never satisfied with second-hand knowledge, but spent all his available time and much of his available cash in seeking, and, so far as was in his power, in obtaining, a direct personal experience of every phase of agriculture, from bacon factories in Wiltshire and Essex to mountain sheep breeding in Wales and Scotland, and from the small holdings of Belgium and Holland to the extensive farming of Australia. This characteristic, combined with his vivid personality, was probably the main secret of his success.

About Mackenzie's activities as a lifelong Catholic, this is not the place to speak in detail. Suffice it to say that he was president of the Cambridge University Catholic Association and an active member of the Universities' Catholic Education Board. He took a leading part in the corporate life of the Catholic community in Cambridge, and he ever showed a deep devotion to the faith of his forefathers. He was a bachelor and a man of many friends. Throughout his repeated illnesses he preserved a calm and cheerful demeanour which was an impressive example to all who saw him. F. H. A. MARSHALL.

SIR ASUTOSH MOOKERJEE.

THE death of Sir Asutosh Mookerjee on May 25, shortly before attaining the age of sixty years, deprives the University of Calcutta of a leader rich in power and devotion, and scholars throughout the world of a friend. It is the extinguishing of a source from which was radiated encouragement, sympathy and inspiration to all intellectual workers of Bengal—of a beacon which showed all India the pathway to honour and greatness.

Sir Asutosh Mookerjee was until quite recently a Judge of the High Court in Calcutta and also vice-chancellor of the University of Calcutta, having held the first office for close on twenty years, and the second honorary office concurrently with it for several long periods. He was an Indian who had never left India, but was known throughout the world as an accomplished mathematician, an accomplished lawyer, an accomplished Sanskritic scholar, and above all as an apostle of culture. After winning all honours possible to a university student in Calcutta, he commenced active life as a youthful professor of mathematics; but soon achieved that eminence as a lawyer which led to his appointment to the Tagore professorship of law, and later to the High Court Bench. He was a fellow of the Royal Society of Edinburgh, the Royal Irish Academy, and other British and foreign learned societies, president of the Asiatic Society of Bengal, 1907–9, and chairman of the trustees of the Indian Museum since 1909.

So great were Sir Asutosh Mookerjee's working powers that his exacting professional activities seemed little more than preliminary to the manifold unselfish and gratuitous labours devoted to the welfare of his beloved University, to which he was wont to proceed daily from the High Court, and to the promotion of culture. It was his ambition that Calcutta should become a centre of learning and research; and he understood well how to inspire the enthusiasm of youth, the settled persistence of middle life, and the chastened hopes of later years, to contribute to this end. Characteristic of his capacious mind was his intimate acquaintance with the careers and personal circumstances of individual students and ex-students of the University and all concerned with or likely to be concerned with university work. The conversion of the University from a purely examining and inspecting body into a teaching institution would no doubt have been effected even without his efficient help; but the addition of numerous schools of active research was almost entirely due to his efforts.

Sir Asutosh Mookerjee was a great man because of the encyclopædic store of knowledge and information which his marvellously capacious mind contained ready for immediate use, because of his instant power of judgment and action and his clear vision of the right, and because of his power of influencing others through his intense sympathy with all strivers after truth and betterment. Every earnest intellectual worker, however humble or however eminent, would find in him a wise and understanding friend, and could talk to him as to a co-worker and an equal. Specialists in the most diverse literary and scientific subjects would find him familiar with the latest relevant literature. To every band of men engaged in the quest after truth and light his help and encouragement was freely and unselfishly given; and in learned societies and gatherings he was a dominant figure, giving appreciation where it was due and advice where it was needed. Typical of his prodigality in service were his relations to the Calcutta Mathematical Society, of which he was president from the time of its foundation at his instigation. Owing to the many other claims on his services during the week, the meetings of the Society were held on Sunday afternoons; and he never failed to be present in his presidential capacity, and to take an active part in the proceedings. He was the author of numerous papers on mathematical subjects in the publications of several learned societies.

Sir Asutosh was a dominant power in the Senate and all departments of the University of Calcutta. In troublesome debates his rising to speak almost invariably meant that the right course would be made clear and adopted. In times of open warfare with others, when his ruthless scorn of all subterfuge made compromise difficult, he fought only for the pursuit of knowledge. His death is the passing of a valiant warrior whose battle-cry was:

"Let knowledge grow from more to more."

C. E. C.

Current Topics and Events.

IF the Senate of the University of London at its next meeting on June 25 approves of certain proposals which will be laid before it by the Academic Council, a new and important departure will have been made in scientific teaching in London. The object of these proposals is to establish a course of study in the history, principles, and methods of science, leading to an M.Sc. degree. Only those who have already obtained a B.Sc. degree in natural science will be allowed to take the course. The design of the new course is to extend the influence of scientific ideas beyond the ranks of those who propose to devote their lives to research in some special science. In a word, it is hoped to give a liberal education in scientific concepts to men who intend to take up administrative work; to apply to their minds the broadening influence of a study of history and the mental discipline of a thorough investigation of the basal principles underlying scientific theories, which are often subconsciously assumed rather than stated by scientific workers. That too early specialisation has been the bane of scientific education, has long been realised by teachers of science. Accordingly, in the new course all students—chemical, physical, or biological—will be required to know a good deal about the early history of *all* science. Each group will then devote special attention to the later developments of a particular branch. The origin of the whole movement can be traced to the indefatigable enthusiasm of Prof. Whitehead, the chairman, and Dr. Charles F. Singer, the secretary of the new Board of Studies: they have already secured the co-operation of a brilliant panel of lecturers drawn from all the colleges of the University to give the first series of lectures.

FOR many years the growth of coniferous trees in Kew Gardens has been unsatisfactory, owing to the increasing contamination of the air by London smoke. Conifers are more sensitive than other plants, as their leaves have sunk stomata, which become readily clogged with particles of soot. Assimilation of carbon dioxide from the air is in consequence lessened, and the tree is starved for lack of food. It is now impossible to show at Kew the wonderful growth of trees like Sitka spruce, Douglas fir, and *Abies grandis*, which are used in modern afforestation. Scientific workers and foresters are liberally granted access to the fine collections of conifers that are scattered over the country; and places like Dropmore and Woburn in England, Murthly and Benmore in Scotland, and Powerscourt in Ireland, are known to arboriculturists of all nations. It was felt, however, that a new national pinetum, accessible to the public at large, ought to be established, and preferably at no great distance from London. The Kew authorities, acting in co-operation with the Forestry Commission, have selected a site at Bedgebury in Kent, which is ideal as regards soil and climate. Kew will supply the trees and superintend the planting, while the ownership and management will be in the hands of the Forestry Commission. Fifty acres of the Bedgebury property have been allotted for a botanical collection of the various species and varieties. This is only a beginning, as the area can be expanded indefinitely; and it is hoped that the planting of experimental plots, under forestry conditions, of species likely to produce profitable timber in Great Britain, will be undertaken in the near future.

ON June 13, at the annual general meeting of the Research Defence Society, Dr. Andrew Balfour, Director of the London School of Hygiene and Tropical Medicine, demonstrated a film illustrating the natural history of malaria and the preventive methods against that disease. This film, prepared by the Rockefeller Foundation, has been widely used for popular teaching in America. Great Britain is free of malaria, but many countries of the British Empire suffer grievously from this infection; and the result of it, over the whole world, is something like a million deaths yearly. In India, for example, there is no general and successful employment of preventive methods against malaria. Sir Ronald Ross, who spoke at this meeting of the Research Defence Society, said that the facts which the film illustrated had been known for twenty-five years, and that America had gone far ahead of England in the popular teaching of these facts. Certainly, in Great Britain much good might be done by the exhibition of films illustrating those epidemic or endemic diseases from which the country suffers most heavily. The trouble is, of course, that films of this sort are imperfect instruments. They are too much given to diagrams; and they are too much given to acting. Still, in the present worship of the kinema, there is plenty of opportunity for some good films illustrating the natural history and the preventive methods against this or that common infection in Great Britain. It would be excellent if the Ministry of Health could undertake more popular teaching. It does much; it might do more. What are wanted, as things are, are little teaching-shops or lecture-rooms in the great cities. People like to hear straight health-talks, and to look down microscopes, and to watch films. The Ministry of Health might try starting popular education on these lines.

SIR ARTHUR EVANS, in a telegram recently published in the *Times*, announces the important discovery of evidence for the existence of a portico with a rising line of supporting pillars up the stepping of the south slope of the Palace at Knossos, forming a prolonged state entrance. Facing this, excavation in a bed of alluvial deposit indurated by gypsum springs has revealed the cyclopean piers of a Minoan bridge-head and viaduct, the most imposing structure yet found in Crete, and dating back four centuries earlier than Mycene. It represents the abutment of the great south road across the island. On the terrace level beyond has been found what appears to be a caravanserai for travellers with stabling in the basement. The central feature of this is a little pavilion in which remains of a frieze, with paintings of plants and birds,

are visible. In the next room are arrangements for washing the feet, and a passage and descending steps lead to an underground chamber which had become, in the late Minoan age, the scene of a cult. These discoveries have now solved the problem of the main entrance to the palace, which hitherto had seemed to possess no worthy means of access.

A POINT of both practical and scientific interest appears to be raised by Sir David Prain in his Chadwick Public Lecture at the Chelsea Physic Garden on June 4. As the value of the quinine in cinchona bark was realised, fresh forest areas were exploited where cinchona grew in sufficient abundance to make commercial exploitation possible. In the process, different species of cinchona were utilised in turn, no attention being paid to any other alkaloid than the quinine. As the available natural forests have diminished, the cultivation of cinchona begins, the manufacturer paying for the bark on the basis of its content in quinine. The yellow bark, *Cinchona Calisaya*, from Bolivia contains most quinine, and as Java is the region outside Bolivia where this species grows best, the industry survives there and suggests a Dutch cinchona monopoly. But besides quinine there are other alkaloids in all the cinchona barks, the uses of which in medicine have never been explored. Quinine may be best for malaria, but the inquiring mind, turned to consider the properties of the other alkaloids that form 25 per cent. of the alkaloid obtained from crown bark, *C. officinalis*, may yet find an economic use for these and so bring back an Imperial industry. Sir David Prain points out that the Empire no longer supplies its own requirements in quinine.

AT a meeting of the Optical Society on June 12, Col. L. E. W. van Albada, of Amsterdam, after discussing the advantages of wide-angle ortho-stereoscopy, exhibited a series of stereo-photographs taken by means of wide-angle lenses. Remarkably realistic effects were obtained when these photographs were viewed in a stereoscope provided with special wide-angle lenses free from colour and distortion over a field of 80° and having approximately the same focal length as those used in taking the photographs. With these lenses the magnification and field of view are such as to make the objects appear in their natural size and with no exaggerated perspective. The impression on the observer is that of looking through a window at the actual scene. The use of such lenses should render the stereoscope of considerable value in certain types of survey work and also enable the instrument to regain the popularity it once enjoyed as a form of entertainment.

IT is announced that an expedition of the National Geographic Society has left Washington to begin the fourth year of exploration of the ruins of Pueblo Bonito in the Chaco Canyon National Monument, New Mexico. Previous explorations of these ruins have cleared three hundred rooms of the pueblo, which is estimated to have contained originally eight hundred rooms and to have stood four storeys high with accommodation for more than 1200 persons. Dr. Neil M. Judd, who is in charge of the expedition, is of the opinion that some cultural connexion with the Maya of Yucatan and Guatemala may possibly be found; but he states emphatically "there absolutely is no chance of tracing any relationship between our prehistoric south-western tribes and those of the Old World."

THE General Committee of the British Association recently received deputations from the Borough and University College of Southampton, and from the University and City of Oxford. Local officers were appointed for the Southampton meeting next year, and the date of the meeting was fixed for August 26-September 2. The Oxford deputation presented an invitation for the meeting of the Association to be held there in 1926, and this was accepted unanimously. This meeting of the General Committee took place, by kind invitation of the Council of the Zoological Society, in that Society's rooms at Regent's Park, and the members were afterwards entertained to tea in the Gardens by the Secretary of the Society, Dr. P. Chalmers Mitchell, and had the opportunity, which was freely made use of, of inspecting the Gardens and the new aquarium.

BENZENE, the material from which a large number of modern dyestuffs manufactured is primarily derived, was first prepared in the Royal Institution laboratory by Faraday, who announced his discovery to the Royal Society on June 16, 1825. The Managers of the Royal Institution, in association with the Chemical Society, the Society of Chemical Industry and the Association of British Chemical Manufacturers, have decided to celebrate the event on June 16 next year. The arrangements are in the care of a joint committee of the four bodies.

COMMEMORATION DAY at Livingstone College was celebrated on May 31, Sir William J. Simpson being in the chair. The Principal reported that 36 students had entered the College during the present session. The College has to depend largely on the fees of students for its upkeep, and about 500*l.* is needed to balance the cash account before September 30, for which donations are urgently solicited. Sir William Simpson spoke of the great value of the College course to the missionary in order to teach him how to care for his own health and to win the hearts of the people amongst whom he works, and the Rev. G. H. Eastman of the Gilbert Islands gave striking instances of the value of the training he had received at the College in ministering to the medical needs of those islands, so distant from qualified medical aid.

IT may safely be said that no branch of botany has made more marked or rapid progress during the last decade than plant pathology. An enlightened Ministry of Agriculture has freely aided research in Great Britain by grants from the Development Commission; and in the United States, with its infinitely greater range of crops, heavy appropriations have been allotted. As a natural consequence specialisation developed, and also the frequent holding of meetings and conferences between workers in their respective

countries. The first effort to call an international meeting was by the American Phyto-pathological Society in 1919, when a field conference was organised on Long Island, the special subject for consideration being the so-called degeneration or physiological diseases of the potato which are known the world over. The meeting was highly successful. Similar gatherings have since been held annually in America, and on each occasion they have attracted plant-pathologists from Europe and many other parts of the world. The need of similar gatherings in Europe has been fully recognised, but owing to various difficulties no meeting was held until last year. On the initiative of Prof. Quanjer, an International Conference of Phyto-pathology and Economic Entomology was held at Wageningen, which was attended by representatives from nearly all European countries as well as from other continents. The Conference was eminently successful (see NATURE, August 4, 1923, p. 181), and a Committee was elected to continue the work and to prepare for future meetings. The Report of the 1923 Conference has now been issued (obtainable from Dr. T. Schoevers, Wageningen, Holland, price seven shillings), in which all the papers read at the meetings are published in full, and also others which were crowded out at the time. As is to be expected, it contains many papers dealing with international relationships, and the various points of view of different countries are put forward. On the purely scientific side some 30 papers dealing with mycological or allied diseases are included, and an odd dozen bearing on plant injury caused by insects, the whole being well illustrated. The Report should find a place in every institute dealing with plant pathology and economic entomology.

THE report of the Survey of India for 1922–23 marks another year of progress. During the year 61,648 square miles of topographical survey were completed. This exceeded the previous year by some 17,000 square miles and surpasses the former record of 1913–14 by about 6000 square miles, although the number of topographical parties still remains twelve. There now remain to be surveyed in India 1,133,383 square miles, an area about equal to twice that which has been completed. A survey party has been formed to carry out traverse work in Bhopal state, and two survey detachments were at work on the north-west frontier. New sheets published during the year include 88 on the one-inch scale, 56 on the half-inch scale, and 20 "degree sheets" (quarter-inch scale). A satisfactory feature is the increased demand for maps on the part of the public, last year's issues being double the number of the previous year.

THE *Lancet* has for some time been publishing a series of special articles on "Modern Technique in Treatment," which is designed to afford to practitioners résumés of up-to-date information regarding diagnosis and treatment of medical and surgical conditions. No. 70 of this series (*Lancet*, May 10, 1924), dealing with infections of the hand, will be of interest to heads of laboratories. Small cuts, pricks, skin abrasions, and similar minor injuries to the hands are of common occurrence, especially in chemical laboratories, and, as they do not often lead to serious developments, are apt to be neglected. The *Lancet* article is a useful reminder, therefore, of the necessity of prophylactic treatment even in such cases, and it is recommended that the wound should be liberally painted with iodine, and a dressing applied. The article is, however, mainly concerned with the treatment of the various types of septic hands resulting from the neglect of such injuries. So far as the head of a laboratory is concerned, his duty would appear to be to see that the victim consults a medical man, if any untoward symptoms are experienced, since even a slight prick may result in acute lymphangitis, which if not recognised and dealt with, may prove serious, if not fatal.

WITH the end of 1923 the Carnegie United Kingdom Trust completed the tenth year of its existence. Although the period 1914–18 was comparatively one of stagnation, and the following quinquennium one of difficulty—owing to the abnormal cost of building—nevertheless the experimental work carried out by the Trustees has already yielded satisfactory results. The support of borough libraries no longer forms a plank in the programme of the Trust. Promises of financial help in this direction will lapse if not claimed by the end of 1925. On the other hand, the development of rural libraries under county authorities has proceeded with such rapidity that a hope is expressed in the Report that "few counties will be without a library system by the close of 1925." Considering that little work was done in this direction before 1921, the results already obtained must be regarded as satisfactory. The cost of the county service is, in the majority of cases, covered by an equivalent of a ¼*d.* rate. The essential feature of the Rural Community Councils scheme is the adoption of the county rather than the village or other unit, and the co-ordination of the work of statutory bodies and voluntary associations within the county for educational and like purposes. This scheme is still in the experimental stage. On the purely scientific side the grant of 6000*l.* to the National Institute of Industrial Psychology should be noted.

PROF. E. BATAILLON, of the University of Montpellier, has been elected associate of the Royal Academy of Belgium, in succession to the late Dr. J. Loeb.

THE summer meeting of the Association of Women Science Teachers will be held at Sheffield on Saturday, July 5. The programme includes visits to works in Sheffield and to the Glass Technology Department of the University of Sheffield.

WE learn from *Science* that at a meeting of the Franklin Institute of Philadelphia, held on May 21, Franklin medals and certificates of honorary membership were awarded to Sir Ernest Rutherford, Cavendish professor of physics in the University of Cambridge, and to Dr. Edward Weston, president of the Weston Electrical Instrument Company.

AN International Congress on Architectural Education, organised by the Royal Institute of British

Architects, will be held in London at the house of the Institute, on July 28-August 2. A number of papers and discussions on architectural education in America, France, Italy, and England, in the past, at the present time, and in the future, have been arranged for the three morning sessions respectively. Excursions promised include one to the British Empire Exhibition and another to Cambridge. Applications to attend the Congress should be made before June 30.

AN assistant mycologist is required at the pathological laboratory of the Ministry of Agriculture and Fisheries at Harpenden. Candidates should possess an honours degree in science (including botany) of a British university, or equivalent qualifications, special knowledge of mycology in relation to horticultural and agricultural plant diseases, a working knowledge of French and German, and have had at least two years' research work since graduating. Forms of application, which must be returned by June 30 at latest, are obtainable from the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1.

IN the last annual report of the Madras Government Museum, Dr. F. H. Gravely announces the reopening of the invertebrate and fish galleries after re-arrangement. The recording of languages by gramophone has been continued. Collections are being made to illustrate the flora of Madras city, and a popular illustrated guide is being prepared to them. In spite of lack of funds, much work has been done and the number of visitors has greatly increased.

THE Royal Meteorological Society has recently issued No. 5 of Bibliography of Meteorological Literature, prepared with the collaboration of the Meteorological Office from literature received from January to June 1923. Much of the literature is from foreign sources. Until somewhat recently the Bibliography was incorporated in the Quarterly Journal of the Royal Meteorological Society, but from 1920 it has been published as a separate issue, and now in six-monthly parts. Meteorologists will be greatly helped by the bibliography, for the advances which are being made in Great Britain and other countries make it increasingly difficult to keep abreast with the many branches of the science, especially with regard to upper air developments.

THE 23rd edition of the Physical Apparatus Catalogue of Messrs. F. E. Becker and Co. (W. and J. George (London) Ltd., Proprietors), "Nivoc" House, 17-29 Hatton Wall, London, E.C.1, is a well-bound quarto volume of 532 pages, of which 15 are devoted to a detailed index. It contains no less than 2664 illustrations of apparatus, while as compared with previous editions a considerable economy of space has been secured by omitting descriptions of apparatus almost or quite obsolete. Wireless apparatus gets about 20 and balances about 30 pages. The sectional index and the block type headings to each page make reference easy. With the exception of a few proprietary articles, the apparatus described is manufactured by the firm.

A MOST useful practical account of methods of investigation of fresh-water regions is given in Abderhalden's "Handbuch der biologischen Arbeitsmethoden" (Lieferung 115, Abt. 9: Methoden zur Erforschung der Leistung des tierischen Organismus, Teil 2, Hälfte 1, Heft 1: Methoden der Süsswasserbiologie. Untersuchung bestimmter Gewässer. Pp. 284. Berlin und Wien: Urban und Schwarzenberg, 1923, 12·40 Schw. francs). There are very good descriptions of the various forms of sampling apparatus. The methods dealt with are mainly biological and physical, and particular attention is directed to the practical study of the plankton and the bottom deposits. The work can confidently be recommended to those engaged in the study of the pollution of river and lake water areas.

BESIDES supplying information which is of value to the professional microscopist, the publishers of *Watson's Microscope Record* endeavour by means of this publication to assist also the amateur and generally to encourage a wider and more popular interest in the use of the microscope. A recent issue contains an interesting article by Rev. M. Yale Allen giving useful suggestions for those who, having a microscope available, have not yet used it in the study of pond life. The examination of living specimens, readily secured in the waters of almost any stagnant pool, reveals to the beginner unknown wonders of absorbing interest. Another article describes R. Macer's method of exhibiting microscopically a living fly protruding its proboscis and feeding from a piece of sugar. Of a more technical nature are the notes on the use of dark-ground illumination for various purposes, the use of blackened glass as a polariser, and the discussion by W. B. Stokes of the penetrating power of the microscope. Copies of the *Record*, which is issued bi-monthly, may be obtained free of charge from the publishers, Messrs. W. Watson and Sons, Ltd., 313 High Holborn, London, W.C.1.

THE catalogues issued from time to time by Dr. W. Junk, the well-known scientific bookseller of Berlin, are not mere lists of books with prices. They contain a wealth of bibliographical and historical information of the greatest service to workers and students. The Catalogue of Publications, 1899–1924, is no exception to this. It includes a complete list of all the biological works of which Dr. Junk has the only available stock or of which he is the actual publisher, and also a list of the more important second-hand books on his shelves. A special feature of this catalogue is the information given concerning the actual contents of the numerous papers, especially journals, offered, with precise details as to title and date. Of the many services rendered to biological science by Dr. Junk, two deserve special mention: the issue of encyclopedic catalogues of special groups

of animals and plants, *e.g.* Coleoptera, Lepidoptera, fossil plants and animals, and the reprinting of rare and otherwise unobtainable works on natural history at a price within the reach of most libraries. Two new catalogues are announced, those of the Aphaniptera and the Aptera, and two new reprints, F. Marten's "Spitzbergische oder Groenlandische Reise-Beschreibung" and Brauer und Bergenstamm's Diptera. Among other new books one may be specially mentioned, "Index Fabricianus," by K. W. v. Dalla Torre, an index to the entomological work of J. C. Fabricius which should be indispensable to workers in that branch of biology.

THE miscellaneous Catalogue (No. 422) of second-hand books just circulated by Messrs. Bowes and Bowes, Cambridge, will be interesting to readers of NATURE, mainly because of the sections dealing with biography and travel. In the former, several lives of men of science are listed at reasonable prices.

BEARING in mind that many visitors from the overseas dominions and dependencies are in London at the present time, the appearance of Catalogue No. 459 (British Empire Series, No. 2) of Mr. F. Edwards, 83 High Street, Marylebone, W.1, is opportune. It gives particulars of about 600 books and engravings relating to Australia, New Zealand, Tasmania, New Guinea, and the Pacific Islands. Copies can be had of the bookseller upon request.

THE special catalogues of Messrs. H. Sotheran and Co. are always worthy of perusal, and the one (No. 81) just issued by their branch in Piccadilly is especially interesting and valuable from a bibliographic point of view. It is mainly devoted to the library of books on British ornithology formed by Major W. H. Mullens, and gives the titles of, and, in many cases, useful notes on, hundreds of volumes in this large collection. Many rare books are listed; the catalogue should certainly be seen by bird-lovers.

Our Astronomical Column.

JUNE METEORS.—Mr. Denning writes: "If the shower connected with Pons-Winnecke's comet is of annual recurrence, it may be observed on about June 28. There will be little moonlight this year to interfere with observations, and the meteors should be attentively looked for if the atmosphere is favourable. In 1921 they were seen between June 28 and July 5. The meteors are rather bright, and are directed from a radiant point in the region of Iota Draconis. There seems, however, to be a companion shower from about 245° + 64° near Eta Draconis. It will be important to determine the exact position of the radiant point, for when the shower was discovered at Bristol on June 28, 1916, the radiation appeared to be diffused over a rather extensive region. The same feature has been remarked in reference to the November meteors from Biela's comet. The perturbations in regard to Pons-Winnecke's comet which have taken place in recent years have brought the orbits of the earth and comet very near together at the end of June, but it is not likely that any very rich display will take place before that month in 1927, when the two bodies appear likely to make a very near approach to each other."

NORMAN LOCKYER OBSERVATORY, SIDMOUTH, DEVON.—This institution was inaugurated by the late Sir Norman Lockyer in 1913, and is supported almost entirely by voluntary contributions. Notwithstanding its small staff, consisting of the Director and two assistants, a considerable amount of interesting work has been accomplished. The recently issued annual report gives details of the instrumental and discussional work undertaken during the year April 1, 1923, to March 31, 1924. Observations were made on 160 of the 161 fine nights recorded. With the 12-inch McClean prismatic camera 644 negatives were obtained, having an average exposure of 30 minutes. The two observers work on alternate nights, one taking the spectra of types O, B, A; the other, stars of types F, G, K, M. Several spectra of *o* Ceti at maximum were obtained. The 9-inch Kensington prismatic camera has been used for the routine programme of obtaining the spectra of all available stars down to fourth magnitude, special attention having been devoted to stars showing bright hydrogen lines. Various small cameras of large aperture-ratio have been used on the same mounting for photographing star fields, comets, meteors, etc. The spectra are being utilised for the determination of stellar parallaxes by Adams's spectroscopic method, and papers dealing with the results for (1) B type stars, (2) F, G, K, M type stars, have been communicated to the Royal Astronomical Society during the year. Special investigations are being made of the spectra of ζ Tauri, P Cygni, and *o* Ceti.

In addition to the research work carried on at the Observatory, facilities are given every Wednesday afternoon for visitors to inspect the instruments. This privilege is evidently appreciated, and 284 persons availed themselves of it during the year. About 250 visitors also attended two special evening demonstrations.

The report is accompanied by an excellent illustration showing four types of stellar spectra, prepared by means of a new enlarging apparatus for widening the narrow spectra which are primarily obtained in the stellar camera.

THE ARCETRI OBSERVATORY, FLORENCE.—A memoir just received from this observatory contains the welcome announcement that the generous donations of Prof. G. E. Hale and Mr. J. W. Ellsworth have enabled the tower telescope, erected on similar lines to the Mount Wilson one, to be completed with the exception of the dome that protects the upper mirror.

It further contains determinations made by Prof. G. Abetti, of the spectroscopic parallaxes of 159 stars of Secchi's Type I. (ranging from B 8 to F 6). They are divided into three groups—*s* denoting sharp spectral lines, *n* diffused ones, *sn* intermediate.

The *s* group is concluded to be brighter by about half a magnitude than the *n*. The mean absolute magnitudes diminish from 0 for type B 8 to 2·5 for F 5.

The following comparison is given between the parallaxes obtained at Mount Wilson and Arcetri:

Type.	Mount Wilson minus Arcetri.	No. of Stars.
B 7 to A 1	+0·003″ ±0·0015″	29
A 2 ,, A 4	+0·001 ±0·0030	24
A 5 ,, F 2	+0·003 ±0·0032	25

A comparison is also made with Luyten's formulæ connecting parallax with proper motion. It is concluded that a different formula is needed for each spectral type.

Research Items.

RACIAL MIGRATIONS IN CENTRAL AFRICA.—In the Frazer Lecture of the University of Cambridge for 1923, which is now published by the Cambridge University Press (price 2*s.* net), Canon J. Roscoe reviews the evidence for racial immigration into the Great Lake region of Central Africa. It would appear that at least three races have occupied this area, although there may have been more. The earliest inhabitants, of whose character and affinities nothing is known, have left behind them megalithic monuments, built up of boulders to represent a great figure four times the height of a man, stone implements, and traces of buildings with stone enclosures. There are also holes of considerable depth which are held to be the remains of ironstone workings. Their knowledge of stone working far surpassed that of the people whom the first European travellers found in the country, and everything points to their having been a race of considerable intelligence. They were followed by an agricultural negro people, whose descendants inhabit the land at the present day. The most primitive are found on the ridges of Ruwenzori and Elgon, and live in family groups without common ruler or chief. The later pastoral tribes, the Baganda, Banyankole, Bakitara, etc., who are probably connected with the Galla, and entered the country from the north or north-west according to their own traditions, assumed the lordship of the agricultural peoples. Notwithstanding the exclusiveness of the pastoral peoples, the tendency is for their customs to break down. Among the Baganda the fusion of pastoral and agricultural is now complete.

AUA ISLAND, BISMARCK ARCHIPELAGO.—In the *Australian Museum Magazine* for April, Capt. Pitt-Rivers publishes some interesting notes on the inhabitants of Aua Island, who, with the natives of the neighbouring Matty Island, being Malayo-Polynesians, differ in racial characteristics from the other populations of the Archipelago and British New Guinea mainland. Up till 1904 the Aua natives used sharks' teeth and shell exclusively for cutting implements. Yet in the building of both houses and canoes they attained a very high degree of excellence. The island is divided into three districts, each ruled by a *puala*, or head chief, and containing a number of hamlets. Each hamlet has a *pāavi*, or subordinate chief. Descent among the *pualas* is paternal, and among the *pāavis* sometimes paternal, sometimes maternal; but at times this office passes to a specially prominent or influential member of the *aua-aua*. These are a class of experts in the arts of peace and war—makers of the best spears and fighting weapons, builders of canoes and houses, and experts in agriculture. The commoners are strictly matrilineal and matrilocal. Both man and woman on marriage remain with their own kin. The matrilinear inheritance of property does not affect the man's use and control, notwithstanding the fact that it is held in the name of the mother's kin.

COPPER IMPLEMENTS IN POLAND.—In *Man* for June, Dr. J. Kostrzewski, local correspondent of the Royal Anthropological Institute for Poland, discusses the origin of the copper objects found in that country and the probable route by which they reached it, in the light of the study of their form and distribution. Although, strictly speaking, there is no copper age in Poland as there is in Hungary, the number of both implements and ornaments of this metal which have been found is considerable. Implements predominate, especially flat celts; but axes, both single and double, hoes, and knives are of more or less frequent occurrence. The ornaments include beads, pendants, double spiral discs, rings, buttons, pins, and spiral armlets. Most of these were found singly, only four cases of hoards being known. The copper is not of native origin, and it is probable that most of the articles were imported in manufactured form, it may be presumed from Hungary, where many closely analogous forms are found. In distribution, finds are most dense in Middle Silesia and Great Poland, and they are probably to be connected with a trade-route running from Hungary, through Moravia and Middle Silesia, to the Oder near Breslau, thence by way of the Oder and Vistula to Cujavia on one side and to the Baltic on the other.

"NUCLEAR" CHARACTERS IN CLASSIFYING MARINE GASTROPODS.—The so-called nucleus in marine gastropods consists of the protoconch, the succeeding larval or nepionic coils, and sometimes a transitional part prefiguring the adult sculpture. Dr. W. H. Dall (Journ. Washington Acad. Sci., vol. 14, No. 8, April 1924) states that, in common with most students, he has for some years regarded the characters of the "nucleus" as more or less indicative of genetic affinity, but recently, having had to work over large numbers of deep-water species, especially toxoglossate forms, he has found that the view involved so many apparently preposterous combinations of unlike things and separation of similar things, that he has come to the conclusion it can no longer be maintained. The most common form of the horny nucleus, with oblique reticulation, was originally taken in the tow-net and described under the generic name Sinusigera. The author remarks that no sedentary, parasitic, or exclusively littoral species is known to have a sinusigera nucleus, and that the simple inflated nucleus is found chiefly among species living in relatively deep water, and becomes more general in species of whatever genus from still deeper water—he knows of no example of a species with a well-developed nucleus of this type which has a floating larva. He concludes that the differences are due to adaptation for a floating larva or the reverse, and should not be regarded as genetically fundamental.

LONGEVITY OF PARASITIC WORMS.—Dr. J. B. Christopherson (*Lancet*, April 12) directs attention to the longevity of certain parasitic worms. He quotes a record by Dr. Vevers showing that *Gastrodiscus ægyptiacus* lived in a zebra for at least nine years—a long period, which was more remarkable in that the parasite lived in the intestine where the vicissitudes of existence are greater and more numerous than in the blood or tissues. An infection of man with *Filaria* (*Loa*) *loa* is known to have existed for nine years. These periods are, however, far exceeded in the case of Bilharzia, for Dr. Christopherson records an instance in which infection took place in 1878 and eggs were being passed in the urine 28 years afterwards. How much longer than 28 years the worms continued to produce eggs is not known, but the patient (a zoologist and doctor of medicine) was of opinion that some of the worms still survived in 1923 (45 years after the infection), for he was troubled with urinary irritability in August and September. Dr. Christopherson concludes that Bilharzia worms have a long potential longevity, and that they do not conform to the conditions which Sir Ray Lankester (1870) laid down as favouring longevity. Their individuation is not high, their structure is not complex, and their bulk not large. They display considerable energy throughout their frequently long

life; their generative energy is great, commencing early and continuing throughout life, and the number of eggs deposited is enormous.

RELATION OF FAULTY NUTRITION TO *EPITHELIOMA CONTAGIOSUM*. — *Epithelioma contagiosum* (fowl-pox: canker) is a disease of birds characterised by the appearance of warty growths about the head where feathers are scanty and on the combs, wattles, and eyelids. The nodules are epithelial growths not unlike warts in structure. The disease is caused by a filtrable virus which is present in the blood and internal organs and in the juice of the nodules, and may be transmitted by inoculation. Lieut.-Col. Robert M'Carrison (Indian Journ. Med. Research, vol. 11, No. 4, 1924, p. 1119) has made observations on the conditions favouring transmission of the disease. He finds that the disease is with difficulty transmitted to healthy birds, but in birds subjected to a vitamin-deficient diet is much more readily transmitted. These results may have some bearing on tumour development in general.

LARCH MANNA.—Chemists and bacteriologists who have tried to obtain melezitose for experimental purposes will read with interest an article in the *Pharmaceutical Journal* of April 12, 1924, by Prof. Augustine Henry, on "larch manna," one of the few sources of this sugar. This material was formerly supposed to occur only in the forests of the French Alps, near Briançon, and it was from this locality that Berthelot procured the supplies from which he isolated melezitose. In 1919 larch manna was recorded for the first time from Switzerland, and its abundance in the hot, dry summer of that year made it possible for Swiss naturalists to investigate its formation. It appears clear from the work of Dr. Keller, of Zurich, and others on this subject, that this peculiar substance is not produced directly by the larch but is a honey-dew, formed by the aphis, *Lachnus laricis*, which sucks the sap out of the larch foliage. In hot, dry summers the honey-dew rapidly loses its water and thus forms on the branches and leaves the incrustation of larch manna. This explanation is not universally accepted, and Davidson, who has examined occurrences of a similar manna on the Douglas fir in British Columbia, regards it as excreted directly from the leaves of the fir. If the manna is produced by the intervention of insects, the interesting point arises whether melezitose occurs in the sap of the larch or is produced by the insect. So far, the sugar has not been recorded as occurring in the sap of conifers. Prof. Henry's article is a very complete résumé of information regarding honey-dews and mannas, and it is clear from it that a number of interesting points in connexion with these products still remain to be settled. In a later issue (April 26) of the *Pharmaceutical Journal* the same author publishes a short note on another minor product of the larch, the so-called "larch agaric," *Polyporus* (*Fomes*) *officinalis*, a fungus, which used to be collected and dried for use in medicine and still appears to find application in this direction in some continental countries.

INHERITANCE IN BARLEY.—In a further paper on inheritance in barley Mr. F. L. Engledow (*Journ. Genetics*, Vol. 14, No. 1) presents varied data on the fluctuation of the awns, the lateral florets, and the ear-width. The form of the lateral florets is the basis of the division into sub-species, and the presence or absence of awns is an important genetic character. In former crosses the six-row habit was linked with presence of awns. The four chief forms of lateral florets constitute a quantitative series and were formerly regarded as multiple allelomorphs. Further breeding experiments, however, show that when crossed with awnless forms they behave differently, and this seems incompatible with the multiple allelomorph hypothesis. The linkage ranges from none to complete, and an absence of linkage is generally assumed to imply location in different chromosomes. A rare case of natural crossing in barley is also described.

CROWN ROT OF RHUBARB.—Not the least interesting feature in the paper by Mr. W. A. Millard upon the above subject, issued as publication No. 134 from the University of Leeds and the Yorkshire Council for Agricultural Education, is the author's analysis of the causes leading to the interesting fact that London and the main southern centres of population in Great Britain depend upon the industrial North for the bulk of the spring supplies of forced rhubarb. The reason appears to lie in the necessity for an early cessation of growth in the autumn so that the stock matures properly before its removal to the forcing shed. In the Leeds area, the cold autumn weather, helped perhaps by the sulphurous fumes from busy chimneys, ensure an early enough cessation of growth, and cultural methods developed and maintained by tradition have established around the city many acres given over to rhubarb cultivation and large forcing sheds into which thousands of root stocks are carried in the autumn, packed closely together and then lightly covered with soil. Immense crops of forced leaves are thus raised in the spring, the interior of a forcing shed being a very striking sight as indicated in the photograph in the paper. The only disease of importance to the grower, in spite of the congested condition of the forcing shed, is the crown rot described in the paper. This proves to be due to an organism named by Mr. Millard *Bacterium Rhaponticum*. Infection by the organism occurs from the soil; no varieties of rhubarb at present grown appear to be immune to it, and cure is not possible. Remedial measures suggested are the treatment with ammonia of refuse heaps and soil infected with the remains of diseased plants. Speaking generally, the author summarises the best preventive measures against loss from disease as "clean farming." The appearance of typically diseased plants are illustrated by photographs and two excellently reproduced coloured plates, so that the paper of 28 pages is good value for its price—sixpence.

FOSSIL PLANTS AND CLIMATIC CHANGES.—Prof. A. C. Seward's presidential address to the Geological Society of London on "The Later Records of Plant Life," issued in the Quarterly Journal of the Geological Society, Vol. 80, Part 2, surveys the palæobotanical record from the Upper Devonian periods until the Cretaceous. Some paragraphs convey an interesting criticism of too close a teleological interpretation of structure in terms of fitness to environment, and record Prof. Seward's impression that "many elaborately constructed plants which failed to attain the attributes that make for survival furnished, during their comparatively brief career, conspicuous examples of the capacity of plastic organs to vary within certain limits without being able to produce descendants endowed with the ability to persist." Critical attention is paid repeatedly to the evidence supplied by fossil records of climatic change. The Upper Devonian flora of Bear Island, the Rhætic Arctic flora, the Jurassic plants of Graham Land and of Alaska and the Cretaceous plants of Greenland are discussed on various pages with recurring scepticism as to whether we may safely interpret the difference between polar and tropical vegetation in the light of experience limited to the

living vegetation clothing these differently situated areas. Prof. Seward certainly makes it clear that with an inclination of the earth's axis which meant a very similar difference in duration of night and day in these contrasted latitudes, vegetation could succeed apparently in flourishing and developing almost a tropical luxuriance within the Arctic or Antarctic Circle. The question is then posed whether the temperature differences between these regions have varied very widely in bygone times or whether, on the other hand, we must regard with great distrust the use of the plant as a thermometer. Prof. Seward's discussions of these questions will be of great interest to ecologists.

GEOLOGY OF THE MIDDLE THAMES.—The gorge by which the Thames passes through the Chiltern Hills near Goring is one of the most picturesque and geologically interesting parts of the Thames Valley. Its relief, geological structure, and subterranean water supply are illustrated by a model on the scale of six inches to the mile in the Geological Survey Museum. A descriptive account of this model by Sir Aubrey Strahan has been issued by the Geological Survey (1924, 22 pp., 1 plate, price 6*d*.), and it serves as an interesting introduction to the geology of the middle part of the Thames. It deals especially with the relations of the geological structure to the course of the Thames and the distribution of underground water. It summarises the characters and nature of the drifts and their evidence on the geological history of the Thames. The author dismisses "Lake Oxford," to which the origin of the gorge at Goring has been attributed, as mythical, unsupported by evidence or simple explanation. He attributes the origin of this part of the Thames Valley to pre-Pliocene denudation.

THE STATIC ATOM.—The April and May issues of the Journal of the Franklin Institute contain an article of nearly eighty pages on radiation by Dr. W. H. Davey, of the Research Laboratory of the General Electric Company, in which a large proportion of the advances in physical theory during the past generation are brought under review. On the question of atomic structure, the author points out that while the facts of radiation are favourable to the planetary atom theory, a large mass of physical and chemical data support the static atom. Taking the Thomson form of the latter, he shows that if the distance at which the electron ceases to be attracted by the nucleus is put equal to the radius of each possible orbit in the Bohr atom, the static atom explains the spectral series on the same lines as the planetary atom. The effects of matter on radiation—as, for example, the photoelectric effect—he considers are best explained by some form of wave theory, in which the energy of the wave surface is concentrated at points of the surface. Silberstein's "dart" theory, according to which the radiation is sent out in "darts" of small and constant section and short length in every direction alternately, seems to him the most satisfactory. The "dart" replaces the light corpuscle of the older theory.

REVERSAL IN PHOTOGRAPHIC PLATES.—The Royal Photographic Society's Journal for June contains a communication from the Laboratory of Physical Chemistry, Uppsala, Sweden, by Prof. The. Svedberg, Oliver H. Schunk, and Hugo Andersson, on "The Relation between Exposure and the Number of Developable Centres." The authors point out that some deductions from previous work on this subject are probably vitiated by the gradual setting in of reversal, that is, the destruction of the developable centres by the light itself. Reversal, as is well known, sets in gradually, and it is natural to expect that reversal and the normal effect of exposure should progress in the plate side by side. The authors have proved that this is so, except for the very finest grains, by preparing "single layer" plates and comparing the curves obtained for grains of different sizes on untreated plates, and also after treating each plate with a reversal-preventing agent—a weak solution of acetone-semicarbazone, which was suggested for this purpose by Mr. F. F. Renwick. The authors conclude that in any further measurements of the relation between exposure and the proportion of developable grains produced, or the number of developable centres, parallel series with plates treated and not treated with a reversal-preventing agent will have to be carried out if any real information of the action of the light is to be obtained.

RELATIONSHIPS BETWEEN CURRENT AND WIND.—While a certain amount of work has been done in comparing the velocity of currents and the winds that generate them in coastal waters, comparatively little has been done on this problem in the open ocean. In the Quarterly Journal of the Royal Meteorological Society for April, Mr. C. S. Durst has a paper on the result of some observations taken far from land. The principle adopted was to compare the position of a vessel as determined by "dead reckoning" with that found by solar observation. The difference should be a measure of the current. The force and direction of the winds were taken every four hours. The coefficient of turbulence, as worked out by Jeffrey's formula, is found to be proportional to the square of the wind velocity. A significant conclusion is the decrease of the coefficient in tropical latitudes, where the current is out of proportion to the trade winds. This is due either to a definite tilting of the ocean surface or to the depth of surface current extending to regions of small turbulence.

WEATHER AT EASTBOURNE IN 1923.—The County Borough of Eastbourne has recently published its annual report of the meteorological observations for the year 1923, drawn up by the observer, Mr. A. H. Hookham. The mean temperature for the year was 50·6° F., which is 0·2° above the normal. July was the warmest month with 63·3° for the mean, and the coldest was December with the mean 41·1°. Bright sunshine was registered for 1869 hours during the year, which gives an average of 5·1 hours per day, and is 0·24 hour per day in excess of the normal. Rain fell on 195 days, yielding a total of 35·85 in., which is 5·11 in. more than the 35 years' normal. The wettest month was October with 7·10 in., and the driest was June with 0·65 in. The report has 30 tables, whereas the preceding year gave only 12. The tables of wind and visibility will be of service to aviators. The intensity of rainfall obtained by a special self-recording gauge under the supervision of the borough engineer is of great interest. Comparative tables showing the advantage or otherwise of different health resorts may not always tend to the scientific value of the reporting station. The amount of work undertaken is very considerable and some errors have crept in. At the head of p. 3 the observations are said to be for 1924; they are for 1923. Table 3, p. 14, has numerous omissions of day in both date columns of absolute extreme temperatures, though they are all well known. All the values in the table for years 1900 to 1909 are repeated. Table 14, p. 25, has the wrong total rainfall for 1916 and 1919; they should be respectively 36·87 and 31·53, according to the values given by the Meteorological Office. The year 1923 is commonly omitted from the head of tables, which leaves the date open to doubt to an ordinary reader.

Empire Mining and Metallurgical Congress.

THE Empire Mining and Metallurgical Congress was held at Wembley on June 3-6, and has proved to be an event of first-class importance for the great mineral industry of the British Empire. The Congress was fittingly opened by an inaugural address by the president, Viscount Long, who selected for his subject "The Mineral Resources of the British Empire," and contrived within a comparatively short address to present an exceedingly valuable summary of Imperial mineral resources. He pointed out the value of such a Congress to the mineral industry, which could scarcely be better expressed than in his own words:

"Mining will never cease to be a romantic and speculative business, but the more we learn about it, the more we can hope to reduce its uncertainties and difficulties. That is the purpose and hope behind this Empire Mining and Metallurgical Congress. I trust that it will be an effective means of establishing and maintaining contact between the mining men of the various parts of the Empire. Such contact cannot fail to be of great service to them individually, to the mining industry as a whole, and to the great Empire whose interests we all hold at heart."

The Congress was divided into four sections, dealing respectively with mining, petroleum, ferrous metallurgy and non-ferrous metallurgy, and of these the Mining Section was the most important and the most largely attended. Whilst many of the papers were of high technical value, it may be said at the outset that none of them gave or attempted to give any information of a strikingly novel character; it was felt by all that the papers presented to a Congress such as this should be directed rather to stock-taking, to presenting a picture of the present status of the mining industry, and that this was not the place for introducing any discussion upon novel principles or methods. The proceedings of the Congress will therefore be of value in the future mainly as showing the state of development to which the mining industry has attained at the present day.

Mining.

Three important general papers were presented, giving an account of mining and metallurgical practice in the great overseas dominions, Canada, Australasia, and South Africa; these are composite papers, to which a number of writers have contributed, and they form a valuable record of the existing development of the mineral industries overseas. The opening session was devoted to a discussion of three papers, on the economics of the coal-mining industry by Mr. Evan Williams, followed by one on the economics of metalliferous mining by Prof. Henry Louis and Mr. Hugh F. Marriott, and a series of papers dealing with the various safety problems that arise in mining. The two former papers showed generally the economic problems which the mining industry has to face; the paper on coal-mining dealt more particularly with these problems as they present themselves within Great Britain; the vast coal resources of the other portions of the British Empire are still in process of development, and the problems and difficulties which beset the home industry have not yet arisen or at any rate have not arisen in any acute form in the overseas portions of the Empire. On the other hand, the second paper dealt perhaps even more with mining outside the British Isles than within them, mainly, of course, for the reason that metalliferous mining within Great Britain has fallen off to such an extent that, with the sole exception of iron-mining, it has shrunk to negligible dimensions; the paper itself indicated some of the causes owing to which Great Britain has fallen so far from the premier position which it at one time occupied.

The problems of safety in mining were introduced briefly by Sir Edward Troup, chairman of the Safety in Mines Research Board, and was divided into sections dealing with coal-mining explosives, spontaneous combustion of coal, explosion of firedamp, coal dust explosions, electricity in coal mines, and miners' safety lamps respectively. It will be noted that although the title of this series implied that the problems of safety in mining as a whole were to be considered, the papers referred exclusively to these problems as they present themselves in coal mining, none of those incident to metalliferous mining having been touched upon. This is perhaps unfortunate, because it may give the impression that these problems are non-existent, whereas in truth they are real and pressing. It should not be forgotten that within recent years the accident death rate in metalliferous mines has been about as high and occasionally even higher than it has been in collieries. Among the most interesting of these is the brief review by Mr. Robert Nelson upon electricity in coal mines, in which he is able to put forward the remarkable claim that "the opportunity offered for future research with the object of securing greater safety in connexion with the use of electricity in coal mines is at the moment almost non-existent. What *is* desirable is that knowledge already gained should be everywhere applied." There are indeed few, if any, of the safety problems in coal mining for which a similar claim could be put forward with any justification, and having regard to the fact that electricity has only found its way into coal mines within comparatively recent years and was at the outset regarded with the profoundest mistrust by coal miners and most colliery managers, it represents a very remarkable technical achievement.

In the afternoon session, three papers directed mainly to improving the hygienic conditions in mining were presented, namely, papers on physiological problems in mining by Dr. J. S. Haldane, on miners' nystagmus by Dr. T. L. Llewellyn, and on mine ventilation by Prof. Douglas Hay and Mr. R. Clive. Of the three, the paper on nystagmus deals essentially with a coal mining problem, nystagmus being unknown in metalliferous mines, whilst the other two papers necessarily take a wider range and refer to both metalliferous mining and coal mining. Dr. Llewellyn's paper is an exceedingly important one and is interesting as showing the harm that can be done by ignorant though well-meant efforts to assist the miner. It is shown that owing to the readiness with which coal miners affected with nystagmus are able to obtain compensation over long periods of time, the recovery of such men is actually delayed and they are in some cases permanently injured, whereas if the same men were employed upon properly graduated surface work, they would in most cases make a rapid and complete recovery. Dr. Haldane deals among other subjects with miners' phthisis, due as he shows to the inhalation of dust, though only certain forms of dust cause the disease. Dr. Haldane shows why this is the case. He does not indeed suggest that the problem has been completely solved, and in fact it is still a subject of active investigation, especially in South Africa, as may be seen by reference to the general paper on mining and metallurgical practice in South Africa referred to above.

The papers submitted in the morning of the second

day of the Congress were on the Rhymney Valley compressed air installation, by Mr. E. L. Hann, problems in mechanical coal mining by Mr. S. Mavor, and preparation of coal for the market by Mr. F. S. Sinnatt and Mr. H. E. Mitton. Mr. Mavor's paper was particularly valuable inasmuch as it dealt not so much with the coal getting, conveying and other machinery used at the coal face, as with the organisation of a colliery on lines which would enable the greatest benefit to be derived from the employment of mechanical methods. He emphasises the importance of thorough systematic organisation and shows how in this way many of the difficulties that attend coal mining may be diminished or avoided. He insists on the fact that whereas mechanical coal getting has hitherto been applied mainly to thin seams, it should find an equally important field for usefulness in thick seams where the tonnages to be handled are proportionately greater. It is obvious that in the present condition of the British coal mining industry this suggestive paper will demand and will receive careful attention. It is surely a significant fact that although, on one hand, coal-cutting machinery is most extensively used in the United States, where the wages of the coal miner are higher than elsewhere, it is also being introduced into Indian coal mines, in spite of the fact that in the latter country the collieries have the benefit of exceedingly low-priced coolie labour, thus illustrating well the adaptability of modern coal-mining machinery. The afternoon session was devoted to papers on three special mining districts, namely, the Sullivan mine in the Kootenay district of Canada, the Kolar goldfield of India, and the tin mines of Malaya.

It will thus be seen that the mining section of the Empire Congress covered a very wide range of subjects, which may fairly be ranked under the three main heads of coal mining technology and economics, metalliferous mining technology and economics, and mining hygiene and safety. It is a significant fact, showing the trend of modern technology, that so large a proportion of the time of the Congress should have been devoted to the consideration of problems affecting the health, welfare, and safety of the men engaged in the industry, and it is safe to say that the greater part of recent mining research bears upon this aspect of the subject. It is surely gratifying to see that whilst every effort is being made to utilise to best advantage the great mineral resources of the Empire, even more care and attention is being devoted to the conservation and improvement of that still greater and more important Imperial asset, the men who compose the Empire.

Petroleum.

The eight communications presented and discussed before the petroleum section of the Congress covered in substance every branch of the industry; geological exploration and general petroleum geology, oil production, transport, storage, refining, and economics, including also a paper on oil-shale refining. With such a comprehensive programme the several interests of members taking part were all well represented, while a further advantage of this wide scope of subjects lay in the fact that geologist, engineer, chemist, and economist were alike able to appreciate current thought and progress in other phases of the technology than their own. The chief items of interest of the branch of the work of the Congress may be summarised as follows:

Sir Robert Waley-Cohen's paper on the economics of the oil industry dealt extensively with price fluctuation of petroleum and its products and showed that the causes of such fluctuations are essentially those determined by periodic changes in supply and demand, changes, incidentally, over which producers have but little control. It was mainly a defence of large organisations controlling the industry rather than the small companies, on the ground that in such an uncertain venture as oil-mining these organisations are better able to stand the strain of possible failure; his point, that powerful groups rather than small concerns are financially able to instigate scientific research into petroleum, is one the truth of which past events have undoubtedly established. Mr. T. Dewhurst's paper was in the nature of a review of the whole subject of petroleum geology, though it embodied certain views held by the author with regard to the significance of the wide range of oil measures throughout the geological record, and also stressed the importance of the association of oil with deposits formed under inland and semi-inland seas, lagoons, sheltered gulfs, bays, etc., though to this there are some important exceptions, *e.g.* the Trenton Limestone of North America. The author doubted the widespread development of lenticularity of oil-bearing sediments and leaned rather to the view that oil-sands are on the whole uniform and regular, an opinion which, however, may not meet with general acceptance. The concluding remarks in the paper dealt with the oil resources of the British Empire, and the author rightly directed attention to the fact that to all intents and purposes the Empire is dependent on foreign sources of supply.

In the evolution of oil-well drilling methods, Mr. A. Beeby Thompson sketched the progress of drilling from the earliest Chinese methods to the modern rotary system. The latter itself has undergone rapid developments during the last few years, and the introduction of hydraulic swivels to carry the increased weight of drill-pipe and tools, especially in these days of deep holes, the use of tougher steel in the construction of tools and hoisting gear, and the employment of twin-cylinder steam-engines (to which may be added the use of electricity for motive power), all testify to the progress made with this increasingly popular drilling system. Mr. C. Dalley later dealt with petroleum engineering with particular regard to storage tanks, pipe-line pumping plant, and power for refineries.

A communication by Messrs. A. E. Dunstan and J. Kewley gave some details of the results of physical and chemical research into certain of the crude oils obtained from fields in the British Empire. Apart from much valuable information recorded, the absence of trustworthy data concerning many of the crude oils produced shows clearly, as the authors pointed out, the necessity for further research into their nature and composition than has yet been undertaken. Until this is achieved, fundamental questions of the origin and metamorphoses of petroleum can scarcely be advanced beyond their present indefinite stage, at least from the chemists' and physicists' points of view. In many respects the same thing applies to oil-shale and its adequate refining; this source of fuel is one which must inevitably claim far closer attention, especially of the chemist, than hitherto; owing to the existent flood of mineral oil and its products, oil-shale still remains in the background of scientific inquiry. Mr. E. M. Bailey's contribution on the refining of oil-shale summed up the situation from this particular aspect, but we wish that he could have stressed more emphatically the need for re-design of retorts suited to the treatment of varying kinds of shale which do not yield good results with the well-known Scotch type of plant. Until such retorts are produced, many deposits of oil-shale at present known are at the moment of little commercial value.

Far too little is generally known about oil transport, particularly the tanker, its construction, and efficiency; and one of the most interesting papers submitted to this section of the Congress was that of Mr. Herbert Barringer, who explained very lucidly this highly technical subject. The rise of the tanker has proceeded steadily with the growth of the industry, and it is worthy of note that the latest tankers are of 18,000 tons (gross), fitted with double reduction geared turbines, somewhat different from the 2748-ton *Vaderland*, the pioneer tanker built in Great Britain and launched in 1872, though there is reason to believe that the latter carried water rather than "dangerous oil" in its tanks. Lastly, Sir Frederick Black's paper on the bulk distribution of oil, depots and storage, which in the unfortunate absence of the author was only briefly discussed, directed attention to the rapid advances made in the construction of storage tanks and reservoirs, to the ascendancy of oil over coal as a fuel for naval, military, air, and civil requirements, and to the methods now adopted for supplying oil-fuel for the purposes to which it is so pre-eminently suited.

Reviewing the work of that side of the Congress dealing with petroleum, it may be said that the papers presented, and the discussions which followed them, were invaluable as records of past developments and present trend of thought, progress, and activity within the several branches of the industry. The geologist, the chemist, and the engineer have a great task ahead of them; petroleum is an essential commodity; its waste is criminal; its location, economic development, and, if unhappily necessary, its conservation for vital uses, are essential. The academic problems of the origin, mode, and conditions of generation of oil, to cite only one or two time-worn controversies, will find their solutions in due course; but of far greater moment to civilisation is the need for still more scientific exploitation of the producing oilfields to-day, for the prudent search for new oil-pools, for the economic refining of oil into its numerous constituent products, and for the more efficient utilisation of these products in those operations for which they are best suited. Research in every phase of the industry is the only means by which such progress can be really achieved, and if the Congress pointed a moral at all, it most surely demonstrated this. Many members, it is believed, realised the urgency of this matter, judging from some of the discussions, and if the gathering did nothing else than point the way, it certainly accomplished something far greater than its promoters or participants ever anticipated.

Ferrous and Non-Ferrous Metallurgy.

Four days of struggling to attend as many of the sectional sessions as possible led one to the conclusion that the congress was a great success and yet unsatisfactory. Men soon tire of looking through windows and desire to pass out into the fresh air of realities. So after four days one felt that every exhibit and every paper was but a window through which one caught glimpses of vast fields of real life and work. With a vision far wider than usual we surveyed our position, and the papers we read and discussed were more in the nature of reviews than are the specific, specialised papers to which we have grown accustomed. The subjects considered had been well chosen. They included: fuel economy; blast furnaces; coke ovens; special, alloy, and railway steels; light alloys of aluminium; government research and Research Associations; metallurgical education, and finally five papers with a bias towards economics. So wide a survey brought many points of interest to one's notice, a few of which may be mentioned.

Sir Robert Hadfield's paper on "Works Problems and Methods in Fuel Economy" dealt carefully with general considerations of heat input, utilisation and losses. It further considered certain specific applications such as heat treatment furnaces, boilers and open-hearth melting furnaces. The last section of this paper was devoted to the temperature factor in fuel economy, and this may be regarded as the most interesting from the purely scientific as well as from the practical point of view. It is a subject of wide significance; indeed a knowledge of the temperature distribution in any fuel-consuming plant is one of the most important factors in the study of fuel economy. Little knowledge of the effects of high temperature is available, and research is much needed in this direction. The measurement of the temperatures used in metallurgical operations still presents great difficulties, and important decisions frequently depend upon the determination of such high temperatures. Those with experience in such work well know that flame can impair the accuracy of all known types of pyrometers. A pyrometer indicates the temperature of a small locality which may or may not be at the same temperature as the heated body under consideration. Unless these two be in thermal equilibrium the temperature indication is valueless. In this respect the human eye trained to a knowledge of temperature colours can be of great assistance. Sir Robert had taken great pains to have a massive temperature colour chart prepared to indicate the colours seen at temperatures within the range from 550° C. to 1600° C. The actual chart was exhibited with several pieces of apparatus for furnace gas investigation. A number of charts were also shown to illustrate the great value of graphical methods of determining waste heat losses in furnace gases. They were applicable to all fuels and gave values in practice with a total error of not more than one or two-hundredths of the total heat input. Printed copies of the temperature colour chart were distributed. Their use in practice is beset with a number of known difficulties; for example, they must not be used to estimate the temperature of flames or of objects illuminated by flames.

Few men are free from all traces of colour blindness, and an additional difficulty is that colour alone cannot give an adequate idea of temperature. Subconsciously the eye takes into account the intensity as well as the tint of the light. Considerable surprise was caused by the statement that there is no such thing as white light in metallurgy. In the region of a red heat "graduation of colour is the prominent factor, but at the higher temperatures of the steel melting furnace colour variations are almost imperceptible, but the glare on the eye, or brilliance, is intense." Nevertheless "the chart is perhaps as good as anything that can be done," as Dr. Hadfield stated in the discussion. Prof. F. C. Thompson mentioned that tests made by him upon students of three successive years had shown that few are not afflicted with some colour blindness. It would be quite possible, however, to adapt an optical pyrometer so that any observer could standardise it for himself over the whole range.

In the paper upon modern British blast furnaces, Mr. Clements again employed the clear tabular and diagrammatic style he has recently used so successfully in similar papers. This time he described four modern blast furnace units in blast at four different plants in Great Britain. Each is giving good service, and all four may be regarded as typical of the best practice in this country. It is therefore interesting to note that all are charged by the diagonal method,

and only in one case is a rotating bucket employed. The other three furnaces are skip charged. Once more the desirability of sizing ore, limestone and coke was preached with little evidence of its being practised. The distribution of the burden is especially provided for in only two of the plants. All four units employ water-cooled boshes and Cowper type hot blast stoves. In most other respects the plants differ somewhat because the great variety of the ore and fuel deposits in Great Britain has made uniformity of productive practice wellnigh impossible.

Mr. G. A. Hebden limited his "Comparative Survey of Coke-oven Practice" in various countries to the consideration of modern bye-product plants. Coal washing is universal, but coal blending upon scientific lines is much more common abroad. Coal transport over long distances is frequently necessary in other countries, whereas coking direct from the mine is the system almost invariably adopted in Great Britain; on the other hand, the amount of coal handled per man is four times as great in America as in Great Britain.

The part of his paper which Dr. Hadfield stressed was that which referred to the blitheness with which engineers legislate for ever larger masses of steel. In doing so he caused a considerable amount of discussion which did not always bear directly upon his paper, the title of which was "Modern Developments in the Metallurgy of Special Steels." Prof. C. H. Desch and Dr. W. Rosenhain thought the author pessimistic, for undoubtedly the steel industry will have to be prepared to meet ever higher demands. Commander Malden assured us that there was no blitheness; rather, a profound distrust of the steelmakers' capabilities, when the engineer felt himself forced to order large masses of steel. Mr. Turner stated that there were other methods of manufacturing generator rotors without the use of such large forgings, and suggested that turbine discs should be forged from special smaller ingots the centres of which had been removed. There was general agreement with the statement that sulphur and phosphorus should be kept as low as possible in such special steels. We have now much knowledge of the internal structure of steels and a better knowledge of their behaviour under diverse stresses. New steels are available, and the future of development depends largely upon the amount of real collaboration between engineers and metallurgists. It was only possible for Sir Robert Hadfield to present the briefest abstract of his sixty-page paper on "The Development of Alloy Steels." We have now almost passed out of the age of iron and simple steels into an era of alloy steels without the use of which our present civilisation could not exist. Sheffield is the natural home of most of these useful alloys, and British workers have played a predominating part in their discovery, but the annual production of such steels in America is enormously in excess of our own production. Dr. Hadfield pointed out that such steels cannot be casually heat-treated by any engineer. Greatly inferior properties will be obtained if the heat treatment is not exactly that specified by the maker for the particular steel in question. However, in our enthusiasm for alloy steels, we must not forget Prof. Desch's remark that the carbon steels also can be much improved by heat treatment. The latter speaker referred to certain American experiments which had shown that only closely related elements have a useful effect when alloyed with iron to form alloy steels.

The paper on railway steels read by Mr. Saniter was a short statement of the steels which have been used, with little alteration for many years past, for certain railway purposes. The short discussion dealt mainly with the great loss by rusting, visible on all railway lines, and upon the relative merits of acid and basic steels.

In their paper on light alloys of aluminium, Dr. W. Rosenhain and S. L. Archbutt had gathered together many points of practical value in a welcome form. So many highly technical papers have been written upon the various branches of this subject within the last ten years that it was high time a brief review of the position in regard to these alloys became available. Much of the experimental work in this direction has been carried out by the staff of the National Physical Laboratory and was therefore well known to the authors. The increasing importance of such alloys was pointed out by Colonel Belaiew and Dr. Moore. Some of the figures given in the paper are of an attractive nature. For example, certain wrought aluminium alloys have a specific tenacity more than three times as great as that of the well-known thirty-ton mild steel. The chief direction in which our knowledge of these alloys has been extended is that the phenomenon of age-hardening is better understood. It has been found that both Mg_2Si and $CuAl_2$ are concerned in the change. No less than 40 tons per square inch has been obtained on a wrought aluminium alloy, of only 3·1 gm. per c.c. density, when tested in the age-hardened condition. Strangely enough, it appears to have been impossible to increase the fatigue range of these wrought alloys, for which about ± 10 tons per square inch is the safe range of stress. The cast alloys have been much improved in this respect in that the fatigue range has been increased from ± 3 to ± 7 tons per square inch. It should also be realised that these alloys are, generally speaking, as resistant to atmospheric corrosion as are the constructional steels. No rapid deterioration need be feared if they are protected by suitable surface coatings. In the case of running machinery parts, the slight oil film serves as an adequate protection for such light aluminium alloys.

Prof. H. C. H. Carpenter's paper, "Metallurgical Education of University Rank in Great Britain," caused a considerable amount of discussion. Such a subject could not have been considered elsewhere with such appropriateness. The author realised that there were many other excellently equipped institutions at present teaching metallurgy, but it had been necessary to draw a line somewhere; hence his paper referred only to the facilities and plans of instruction of institutions of university rank. Colleagues in all the metallurgical departments under review had supplied the author with particulars of their own schools. He had arranged these particulars in order according to the date of foundation. Thus the London Royal School of Mines came first, having been founded in 1851. Then followed the Metallurgical Departments of the Universities of Sheffield, Birmingham, Glasgow, Newcastle-on-Tyne, Cardiff, Manchester, Leeds, Cambridge, Liverpool, and finally Swansea, the establishment of which was so recent as 1920. After considering the position, the author came to the general conclusion that the facilities for metallurgical training in Great Britain are very considerable and, in his opinion, ample. Further resources which become available for education should be devoted to strengthening the existing departments rather than to establishing new ones. Too frequently the discussion of this paper turned to the fact that the A.R.S.M. qualification is not a university degree although it actually demands a wider training than some degree examinations. That is a domestic matter for the Royal School of Mines and for the University of London. Prof. T. Turner raised the question of the relative merits of the

block system of training and of the sandwich system which has been adopted of necessity by all the newer universities. The block system is apparently still preferred by several professors who have had experience of the working of both methods. Mr. Barclay mentioned that he knew of cases where graduates had been wrongly placed in works or laboratories. The practice of giving each fourth-year student a piece of research might help to indicate whether he was suited for works' or for laboratory work.

The paper by Dr. Haughton indicated that the Government possesses in its various laboratories excellent facilities for metallurgical research. Dr. Hutton and Mr. J. G. Pearce showed by their papers that the British Non-Ferrous Metals Research Association and the British Cast Iron Research Association must be regarded as distinctly successful developments of the Department of Scientific and Industrial Research. These Associations fill gaps in our national development not covered by other institutions. They are now firmly established and are doing valuable work.

In conclusion, it is pleasant to record the fact that the reading of those papers which dealt with the economics of our present-day metallurgy left one in an optimistic frame of mind.

The Structure of the Cotton Hair.

DR. W. L. BALLS has published in the *Empire Cotton Growing Review*, vol. 1, No. 2, April 1924, the lecture he delivered before Section K of the British Association at Liverpool upon the structure of the cotton hair, reproducing at the same time a number of the fine photographs taken at the Laboratory of the Fine Cotton Spinners' and Doublers' Association, Rock Bank, Bollington, near Macclesfield, with which it was illustrated. Dr. Balls gives a fascinating account, as little technical as the subject permits, of the extraordinarily interesting conclusions as to the structure of the cotton hair, and therefore as to the structure of a fairly typical plant cell wall, reached as the result, in great part, of the long series of researches carried out in this laboratory by himself and his colleagues.

The cotton hair is a single epidermal cell of the cotton ovule, which extends in length while still within the boll, for some 25-30 days, and then for about another 30 days thickens by successive deposits of cellulose, the daily rings of growth predicted and afterwards discovered by Balls, here beautifully illustrated by photographs both of crushed and sectional hairs. When the boll opens, the hair collapses as it dries into a long flattened tube, with many spiral convolutions frequently reversing in direction along its length. Dr. Balls has now shown that these are to be associated with the longitudinal "pit" spirals, also reversing at intervals, which are found accurately superposed in every successive layer of wall thickening, so that the ultimate structural unit of the wall would seem to be one of these spiral fibrils, whilst the position of this in the wall in every layer would seem to be predetermined in some way by the structure of the original wall of the unthickened hair. This spiral pattern has, however, not yet revealed itself in this original wall, although by special treatment Dr. Balls has demonstrated a twinned, slower "slip" spiral, so called because it coincides in angle with the cleavage surfaces developed in the hair under stress. The "pit" spirals are so named because the long axis of the oval pits in the cell wall coincides with the pitch of this more rapid spiral, so that the pits seem to arise by partial divergence from one another of two contiguous spirals (a divergence which is repeated through successive daily layers of wall). It is very suggestive that there are, in a single adult hair, in the neighbourhood of thirty complete reversals of the "pit" spiral, a hint, as Dr. Balls remarks, that each reversal may represent a day's growth in length, though an intriguing footnote states that further research has shown this "guess to be largely wrong, but the true story even more interesting."

Some day the structural unit, the spiral running fibril, has to be associated with one of the main chemical units concerned, the cellulose molecule. It is extremely suggestive that the pit spiral and slip spiral structures have largely been elucidated with the aid of polarised light, and that the optical axis of the wall is determined by the direction of the pit spiral, so that the chemical molecules are presumably definitely orientated in the pit spiral. One extraordinarily important biological and technical result that emerges is that structurally the cotton hair wall is a wonderfully organised sponge, in which a relatively dense cellulose framework provides an enormous surface and is interpenetrated in Nature presumably by an aqueous medium in which important diffusion, adsorption, and chemical processes are proceeding.

The Royal Observatory, Greenwich.

ANNUAL VISITATION.

THE annual visitation of the Royal Observatory, Greenwich, took place on Saturday afternoon, June 7, when the Board of Visitors and a large number of astronomers and their friends took part in the inspection of the Observatory and instruments.

The Astronomer Royal presented his report, which deals with the work of the Observatory for the year ending on May 11. He directed attention to the changes that have been made in the bearings of the transit-circle. The former bearings were 5 inches long, and there was evidence that the pressure was not uniform over the surface, but that changes of level produced bad alignment. Much shorter bearings, slightly convex in the E.-W. direction, were substituted. It is hoped that the change will improve the time determinations. Wireless time-comparisons have revealed larger discordances between different stations than would be expected by the probable errors of each; it is thought that bad contact with the bearings may be one of the causes of this.

A full list is given of the errors in the tabular places of the moon in the Nautical Almanac during 1923, the first year in which Brown's Tables have been used in the computations. There is a constant error of some 7″, but the range of the different months is very small. It was known in advance that this constant error would be present, as it has been found impossible to represent the moon's motion for long periods without using at least two empirical terms. Brown preferred to use only one, so as to keep as near as possible to pure gravitational theory.

Extra-meridian observations of the moon with the

altazimuth have been suspended for the present. The instrument is being used for the observation of fundamental stars in the Prime Vertical. The results show a fairly uniform discordance from Boss P.G.C. of about $\frac{1}{3}''$ in declination.

The 28-inch equatorial has been used as before for double stars, and the Thompson equatorial for stellar parallaxes, 46 of which have been determined during the year, making a total of 241 up to date.

The 30-inch reflector is used to obtain the effective wave-lengths of stars in the region within 26° of the north pole. With the astrographic equatorial, new photographs are being obtained to give the proper motions of the stars in this region, by comparison with the plates taken twenty-five to thirty years ago. Out of 10,000 stars examined, about 700 have been found to have proper motions of 5″ or more per century: a 12th magnitude star has been found with a proper motion of 50″ per century.

Advantage has been taken of the quiet state of the sun to make two investigations on the faculæ; one of them dealt with their variations in area and latitude during the sun-spot cycle, the second with the rotation-periods in various latitudes derived from them.

Details are given of the new magnetic station at Abinger, near Gomshall, Surrey, 26 miles from Greenwich. The removal was considered necessary owing to the electrification of railways near the Observatory. Simultaneous observations will be continued long enough to determine the constant differences between the elements at the two stations.

The following are the chief meteorological elements for the year at Greenwich: mean temperature, 48·7°, 0·8° below the mean; rainfall, 23·90 inches, 0·34 below the mean; bright sunshine, 32 per cent. of the possible duration. The magnetic elements are: Declination, 13° 35·1′ W.; horizontal force, 0·18452 C.G.S. units; vertical force, 0·43187 C.G.S. units; dip, 66° 51·9′. A new departure in time-signals has been the sending of signals by telephone to the British Broadcasting Co. for distribution by wireless twice a day. Full details are given of the Paris, Bordeaux, Nauen, and Annapolis wireless time-signals. The Paris and Bordeaux rhythmic signals are in the mean $\frac{1}{10}$ second late on Greenwich.

Mr. H. Spencer Jones left the Observatory on his appointment as H.M. Astronomer at the Cape. His place has been taken by Mr. W. M. H. Greaves.

Bradford Meeting of the British Medical Association.

THE ninety-second annual meeting of the British Medical Association is to be held at Bradford on July 22-25, and a provisional programme has been arranged. The annual representative meeting will begin on Friday, July 18, and the incoming president, Mr. J. Basil Hall, of the Royal Infirmary, Bradford, will deliver his presidential address on July 22. The annual exhibition of surgical appliances, foods, drugs, and books will be opened on July 22, and will remain open until July 25. Sir Henry J. Gauvain will deliver a popular lecture on "The Sun Cure" on Friday, July 25. Below are given the presidents and secretaries of the various sections: *Medicine*: Dr. Arthur J. Hall; Dr. E. P. Poulton, 36 Devonshire Place, London, W.1, and Dr. Wm. Wrangham, 33 Manor Row, Bradford. *Surgery*: Sir Cuthbert Wallace; Mr. Cecil A. Joll, 23 New Cavendish Street, London, W.1, and Mr. Colin Mackenzie, 11 Mornington Villas, Manningham, Bradford. *Obstetrics and Gynæcology*: Mr. John S. Fairbairn; Miss Edith M. Hall, Royal Free Hospital, Gray's Inn Road, London, W.C.1, and Mr. Peter McEwan, 7 Blenheim Mount, Manningham, Bradford. *Pathology and Bacteriology*: Dr. C. H. Browning; Dr. Cuthbert E. Dukes, 18 Gordon Square, London, W.C.1, and Mr. Charles James Young, Royal Infirmary, Bradford. *Neurology and Psychological Medicine*: Dr. T. Grainger Stewart; Mr. J. R. Gilmour, Scalebor Park, Burley-in-Wharfedale, and Dr. C. C. Worster-Drought, 19 Cavendish Square, London, W.1. *Ophthalmology*: Dr. A. Maitland Ramsay; Mr. J. D. McCulloch, 2 Walmer Villas, Manningham Lane, Bradford, and Mr. Humphrey Neame, 20 Devonshire Place, London, W.1. *Public Medicine and Industrial Diseases*: Mr. Herbert Jones; Dr. G. W. N. Joseph, Health Department, Sankey Street, Warrington, and Dr. Harold Vallow, 50 Little Horton Lane, Bradford. *Diseases of Children*: Dr. Leonard Findlay; Mr. Donald H. Paterson, 14 Devonshire Street, London, W.1, and Mr. A. H. Smith, 2 Blenheim Road, Manningham, Bradford. *Laryngology and Otology*: Dr. W. Jobson Horne; Mr. T. H. Just, 16 Upper Wimpole Street, London, W.1, and Mr. Donald Watson, 103 Manningham Lane, Bradford. *Dermatology*: Dr. J. M. H. MacLeod; Mr. J. B. Dunlop, 15 Spring Bank, Bradford, and Dr. Henry C. Semon, 58 Queen Anne Street, London, W.1. *Orthopædics*: Mr. R. C. Elmslie; Mr. P. Maynard Heath, 12 Upper Wimpole Street, London, W.1, and Mr. H. A. Rippiner, 82 Toller Lane, Bradford. *Medical Sociology*: Mr. Arthur Manknell; Dr. J. T. Kitchin, City Hospital, Leeds Road, Bradford, and Mr. Wm. Paterson, 12 Craven Park Road, Harlesden, N.W.10.

Included among the discussions which have been arranged are the following, the opener's name being in brackets: Smallpox, with special reference to diagnosis (Dr. W. McC. Wanklyn); tissue culture, its bearing on pathological investigation (Dr. Alexis Carrel, New York); immunity, with special reference to specificity (Dr. R. A. O'Brien); diet and public health (Dr. J. B. Orr); industrial welfare (Dr. W. F. Dearden); radio-therapeutics in dermatology (Dr. J. H. Sequeira). The honorary local general secretary of the meeting is Dr. W. N. West Watson, Victor Lodge, Manningham, Bradford.

University and Educational Intelligence.

BRISTOL.—A research assistant is required in the Physical Chemistry Department of the University as from September next. Particulars of the appointment may be obtained from Prof. J. W. McBain.

CAMBRIDGE.—Prof. A. C. Seward, Master of Downing College, has been elected Vice-chancellor for the academic year 1924–5. Sir Percival Maitland Laurence, honorary fellow of Corpus Christi College, has increased an earlier gift of 2500*l.* to a total of 10,000*l.* to be applied for the upkeep of the University Library and the encouragement of classical studies, especially that of ancient history and of Greek and Roman antiquities. Sir Jeremiah Colman, Bart., St. John's College, has offered a sum of 2000*l.* to form a Library for the School of Biochemistry.

Dr. A. B. Appleton, Downing College, Mr. D. G. Reid, Trinity College, Mr. A. Hopkinson, Emmanuel College, Mr. V. C. Pennell, Pembroke College, have been reappointed as demonstrators in anatomy. Mr. T. C. Nicholas, Trinity College, has been reappointed demonstrator in geology, and Mr. W. M. Smart, Trinity College, has been reappointed chief assistant of the Observatory. It is proposed to authorise the Cavendish professor of experimental physics, Sir Ernest Rutherford, to appoint for three

years an assistant director of radio-active research at the Cavendish Laboratory, the Department of Scientific and Industrial Research having undertaken to provide the stipend for that period.

Sir Ernest Rutherford is to be the delegate of the University at the Centenary of the Franklin Institute in September next.

A Syndicate has been appointed to deal with a proposed extension of the School of Agriculture.

The Arnold Gerstenberg Studentship will be awarded in 1925 to the writer of the best essay on one of the following subjects: (1) The ultimate data of physics. (2) Philosophical aspects of the theory of relativity. (3) The philosophical bearings of the quantum theory. (4) Mechanical explanation and the problems of biology. (5) Heredity and memory. (6) Instinct and intelligence. The Studentship is open to all students who have secured honours in the Natural Sciences Tripos in the last five years, and candidates, if successful, must pursue a course of philosophical study.

The Council of the Senate has issued a very interesting report on the Jacksonian professorship of natural philosophy, which has been suspended since the death of Sir James Dewar. The professorship is only partly endowed and funds are not available to complete the stipend up to the normal scale. The Council, in the hope of attracting a succession of distinguished men of science from outside Cambridge, proposes that the professor shall not necessarily be required to reside and that he should be appointed for one year, the same person not to be eligible for more than two years in succession. This proposal, if adopted, would involve the creation of a new class of professorships in the University not subject to the ordinary regulations governing the regular teaching professors. It is to be hoped that this new experiment, which will be watched with much interest, may, if successful, provoke the practical sympathy of those who are in a position to endow fresh chairs of this class. Obviously chemistry and physics and their biological aspects, the subjects to which it is proposed to confine the Jacksonian professorship, are not the only ones which would stand to gain by the help and stimulus provided by the presence and inspiration of distinguished teachers from outside the University.

LONDON.—The following doctorates have been awarded: *Ph.D.* (*Science*), Mr. I. I. B. Hart (University College), for a thesis entitled "The Mechanical Investigations of Leonardo da Vinci, with special reference to his Researches on Flight"; Mr. J. W. D. Robinson, for a thesis entitled "The Famennian Beds of the North-East of France and the South-East of England"; Maneckbai Merwanji Mehta (Imperial College—Royal College of Science), for a thesis entitled "Physiological Study of the Common Bacteria of Air, Soil and Water with a view to their exact diagnosis."

GLASGOW.—Prof. Harold A. Wilson, professor of physics, Rice Institute, Houston, Texas, and fellow of Trinity College, Cambridge, has been appointed to the chair of natural philosophy. Prof. Wilson was Clerk-Maxwell Student at the Cavendish Laboratory, Cambridge, 1901–4, becoming afterwards lecturer and finally professor of physics at King's College, London. From 1909 until 1912 he was professor of physics at McGill University, Montreal. He acted as technical expert on anti-submarine devices at the Naval Experimental Station, New London, Conn., in 1917–19. Prof. Wilson is the author of numerous scientific papers on electricity and other branches of physics in the Philosophical Transactions of the Royal Society and other journals.

OXFORD.—Mr. H. W. B. Joseph, fellow of New College, has been appointed Herbert Spencer Lecturer for 1924.

SHEFFIELD.—Mr. G. M. Bennett, late fellow of St. John's College, Cambridge, has been appointed lecturer in organic chemistry.

ON the last day (June 21) of the League of Nations Union week at the British Empire Exhibition, Prof. C. K. Webster, of the University of Liverpool, will speak in Conference Hall No. 2 on "The League of Nations in the Universities, Colleges, and Schools."

APPLICATIONS are invited for the Drapers' Company's Research Scholarship in dyeing, at the Huddersfield Technical College. The scholarship is of the value of 100*l.*, with remission of fees, tenable for one year but renewable for a second year. Application forms and further information may be obtained from the secretary of the college.

THE Ellen Richards Research Prize for 1925, value 1000 dollars, is offered by the Association to aid Scientific Research by Women, and information concerning it and application forms can be obtained from Mrs. Samuel F. Clarke, Williamstown, Mass., U.S.A. Competing theses by women, based on independent laboratory research, must reach the secretary of the prize committee, President Ada L. Comstock, Radcliffe College, Cambridge, Mass., U.S.A., before January 15 next.

A PRAGUE correspondent writes: In the winter of 1923 we were able to announce the name of the first Englishman to be awarded a doctorate in the Bohemian (Charles') University. He was Mr. G. Druce, of London, and we concluded: "Vivant sequentes!" Now we can add two further names. On April 29 the degree of *Doctor Rerum Naturalium* was conferred upon John G. Kellett, a graduate of the University of Durham, who presented a dissertation on "The Yellow Sands of Northern England," and passed all examinations ("rigorosa") in English; and the degree of *Doctor Philosophiæ* was conferred upon Dr. Walter Seton, lecturer in Scottish history, fellow and secretary of University College, London.

"THE Rising Cost of Education" formed the subject of a much-discussed report published in 1922 by the president of the Carnegie Foundation for the Advancement of Teaching. In his annual report for 1922–23, he returns to this theme and, while admitting that a progressive increase in the cost of a sincere, intelligent, and fruitful school system is necessary and desirable, he attributes much of the increase during the past two decades in the cost of education to the addition to the curriculum of a great number of subjects and activities under conditions involving the neglect of the disciplinary side of education and the sacrifice of sincerity and thoroughness. He quotes with approval Dr. A. T. Hadley's definition of a liberal education as an education which fits for the exercise of liberty, civil and political, and the corollary that if breadth is purchased at the expense of self-reliance, as is too commonly the case, the education is an illiberal one—an actual detriment to the exercise of civil liberty. It would be better as well as cheaper to restrict the school curriculum to subjects, such as English, elementary mathematics, drawing, and a study of the government of the country, which are admitted by practically all teachers to be necessary. He points out that in any state or community budget, the margin of income upon which school expenditure must be based, is not a direct function of the gross income but rather a function of the income that remains after the primary wants of mankind have been met, and the taxes, enormously increased in the last decade, to meet governmental fixed costs, have been taken out.

Early Science at the Royal Society.

June 16, 1678. A farther discourse was occasioned concerning the revival of several creatures after they had been drowned, as also concerning the reviving of swallows after they had been taken out in clusters from under ice: concerning which it was affirmed, that Sir Gilbert Talbot having made particular inquiry into the truth of such relations by special order from the King, he had affirmed those relations.

June 17, 1669. The operator was ordered to attend the president at the Navy-office and to receive his lordship's orders how to fit some of the instruments to be sent to sea with the Lord Howard.—It was moved also, that that instrument might be fitted for the Lord Howard, which had been formerly contrived by Mr. Hooke for fetching up from the bottom of the sea what might be there, as stones, shells, plants, etc.; which is done by a couple of springs shutting and catching as soon as the instrument touches the ground.

June 18, 1668. Mr. Oldenburg presented a book from Mr. Joseph Glanvill, the author, intitled "Plus ultra." [Chapter xii. treats of the Royal Society, and to the question, *What have they done?* returns an answer. But with regard to those who would have had the Society give them the great elixir, the perpetual motion, the way to make glass malleable, and man immortal, or who objected that they had done nothing, the author observes that their impertinent taunts were no more to be regarded than the little chat of idiots and children.]

June 19, 1672. Mr. Oldenburg read a letter to him from Mr. Hevelius dated at Dantzick giving notice that he had printed a discourse of the observations of the late comet, made by himself, and had sent some copies of it by sea, to be distributed here. The letter was accompanied by a printed scheme, representing the motion of the said comet.

1679. There being but few members present, and Sir Robert Viner and Sir Robert Clayton being there, they were entertained by those members with a sight of the repository, library and weather-clock newly set up.—Mons. Papin showed a new kind of wind-fountain of his own contrivance.

June 20, 1666. Mr. Hooke mentioned, that he had observed a new spot in Jupiter different from those, which he had formerly observed in that planet, and in another belt. He added, that he had seen the satellites of Jupiter with Mr. Boyle's sixty-foot glass as bright as he saw Jupiter himself with the naked eye.

1667. Dr. Merret related, that he had long before given his son (then at St. Paul's school) to drink a bottle of Rhenish wine, wherein he had put some filings of steel; and that the youth forgetting to set it in a cellar, had put it on the tester of his bed; and after standing there about a month, it was as sharp as very good vinegar; but being suffered to stand longer, to observe what other changes it might have, in about two years after he tasting it found, that it had recovered its former goodness in all things; only it was of the colour of claret-wine.

1678. A letter was read from Mons. Huygens to Dr. Grew, expressing Mons. Huygens' desire to be informed of the inventions and proceedings of this Society, as he had formerly been by Mr. Oldenburg.

June 21, 1665. The president [Viscount Brouncker] having proposed an intermission of the meetings of the Society by reason of the present contagion in London, the Society approved of it and resolved to discontinue their assemblies on the Wednesday following, until the president by advice of the council, should summon them to meet again.

Societies and Academies.

LONDON.

Royal Microscopical Society, May 21.—Mr. A. Chaston Chapman, president, in the chair.—E. W. **Bowell**: Brief observations on the mounting and photomicrography of radulæ. Glycerin jelly preparations are only suitable for large objects, and the actual size of the radulæ which most need illustrating is exceedingly small compared to the size of the large pectinibranchs of which the appearance is familiar from text-book illustrations; the details which require figuring are often of the same order of size as bacteria. The only satisfactory way to deal with such objects is to stain them and mount them in Canada balsam or other normal medium.—R. J. **Ludford**: Experiments on the impregnation of the Golgi apparatus by means of osmium tetroxide. When small pieces of transplantable tumours, after fixation in Mann's corrosive osmic solution, are transferred to 2 per cent. osmic acid solution at various temperatures above room temperature, marked changes are subsequently seen in the structure of the cells. The following is the general sequence of changes observed: (i.) the Golgi apparatus first appears as granules or faint rodlets; (ii.) the rodlets become thicker and the cytoplasm commences to shrink; (iii.) the rodlets appear to be anastomosed to form a network, and the ground cytoplasm becomes coarsely granular; (iv.) the whole of the Golgi apparatus is impregnated deep black, and the ground cytoplasm is distorted so as to give the appearance of a tangled network, or reticulate structure, and there is considerable non-specific reduction of the osmic acid; (v.) thereafter, the cell becomes more and more deeply osmicated, until the cytoplasm appears homogeneously black. From the point of view of these changes, the Golgi apparatus is that region of the cytoplasm which brings about the reduction of osmium tetroxide at a lower temperature, or in a shorter time, than is required to produce a total blackening of the cell.

Physical Society, May 23.—Mr. F. E. Smith in the chair.—S. W. J. **Smith**, A. A. **Dee**, and W. V. **Mayneard**: The magnetism of annealed carbon steels. Smith and Guild have shown that the residual moment of a magnetised rod of annealed steel (of particular dimensions) does not diminish continuously towards zero as the temperature is raised, but changes sign at about 180°, reaches a maximum negative value at about 220°, and afterwards falls slowly until the temperature at which steel ceases to be ferromagnetic is attained. This reversal is primarily due to the laminated structure of the iron-iron carbide "eutectoid" which the steel contains. The reversal disappears when this structure is destroyed. Measurements have also been made to find how the intensity of the residual moment at 220° depends upon (1) the dimension-ratio of the bar, (2) the intensity of the field by which it is magnetised. Measurements of the kind described could be employed to obtain rapidly and in a simple manner useful information concerning particular samples of steel.—Some thermo-magnetic properties of nearly pure iron. Pt. 1, W. V. **Mayneard**: Experiments were made by the ballistic method upon Armco iron. Observations of the induction were made practically continuously during heating and cooling. The range chiefly studied extended from 15° C. to about 350° C. The most noticeable variations occurred in weak fields (of the order 0·1 C.G.S.) and they depend in a fairly definite way upon the previous thermal treatment of the material. For example, if the iron has been

previously heated to 700° C., the most noticeable features of the induction-temperature curve are a rapid rise to 50°, followed by a slow rise to about 230° C. This is followed by a fall which extends to about 300° C., after which the apparent permeability rises again. Strained iron shows none of the effects until it is annealed. The variation of the magnetic properties during the course of the annealing process can be observed. The magnetic changes are related to the electrical, mechanical and other properties of iron. Pt. 2, A. A. **Dee**: When rods of annealed iron are magnetised at air temperature and heated, the residual intensity curves show abnormalities over the range 100° C. to 130° C., and at 230° C. When the rods are magnetised at about 300° C. and cooled, the residual intensity falls with diminishing temperature until about 90° C. and then rises slightly. In addition there is an abnormality over the range 130° C. to 90° C. If the specimen has just previously been cooled from about 800° C. then, in certain circumstances, the first magnetic test over the range up to about 240° C. gives results which differ from those of subsequent tests. Cold drawn iron wires show no anomalies in their behaviour over the range up to 300° C.—E. A. **Owen** and G. D. **Preston**: The atomic structure of two intermetallic compounds. Mg_2Si.—A face centred cubic lattice of silicon atoms of side 6·391Å symmetrically intermeshed with a simple cubic lattice of magnesium atoms of side 3·19Å. There are eight magnesium atoms situated within each face centred cube of silicon atoms, dividing the four cubic diagonals in the ratio 1 : 3 and 3 : 1. Density from X-ray data, 1·95±0·05 gm./c.c. The magnesium atoms are separated by the same distance as in the pure metal. The sum of the "radii" of silicon and magnesium atoms is equal to the distance between these atoms in the compound. Al Sb.—A face centred cubic lattice of antimony of side 6·126Å intermeshed with an identical lattice of aluminium atoms; the corner of the latter dividing the cubic diagonal of the former in the ratio of 1 : 3. Density from X-ray data, 4·23±0·04 gm./c.c. The molecular volume of the compound is greater than the sum of the atomic volumes of its constituents. The volume of the lattice on which the antimony atoms are arranged is 4 per cent. less than the volume of the face centred rhomb found in pure antimony. The molecular volume of the compound is accordingly 4 per cent. less than twice the atomic volume of antimony. The closest distance of approach of aluminium and antimony atoms is 2·65Å, which is less than the sum of their "radii" as determined from the pure metals. —A. O. **Rankine**: An anomaly in frictional electricity. The effects were first noticed by Mr. T. Banfield during a lecture experiment. They concern the electrification by friction of two ebonite rods made from the same piece, one polished and the other unpolished, on pieces of Government flannel. When the flannel has been thoroughly washed and dried, it becomes highly insulating, and the sign of the electrification produced can be made negative or positive at will by light or vigorous rubbing. When, however, the polished and unpolished rods are rubbed together it is the *unpolished* rod that becomes *positive* and the *polished* rod *negative*.

CAMBRIDGE.

Philosophical Society, May 5.—Mr. C. T. Heycock, president, in the chair.—P. A. **MacMahon**: Researches in the theory of determinants.—W. **Burnside**: On problems of random flight, and the conduction of heat.—J. **Hyslop**: The integral expansions of arbitrary functions connected with integral equations.—F. **Bath**: On the condition that five lines, in fourfold space, should be on a quadric, or be chords of a quartic curve. —J. E. **Littlewood**: (1) Trajectories of small horizontal velocity in a resisting medium; (2) Two notes on the Riemann zeta-function.—C. G. **Darwin**: The optical properties of matter.—B. M. **Sen**: The applicability and deformation of surfaces.

EDINBURGH.

Royal Society, May 5.—G. P. **Thomson**: The cathode fall of potential in a high voltage discharge. The energy of positive rays is used, and it is shown that the cathode fall is much less than the whole potential difference of the tube if the latter exceeds a certain volume. A qualitative explanation is given, based on the theory of dimensions.—H. S. **Allen**: A static model for helium. On the assumption of the existence of a quantum force of the type postulated by Langmuir, static models may be obtained for the ionised helium atom, for the neutral helium atom, and for the helium molecule. For the atom, results are obtained in agreement with those given by Bohr's original model, but not yielding exactly the ionisation potential experimentally determined. The existence of a helium molecule is required for the explanation of band spectra. The moment of inertia calculated from the model is of the same order of magnitude as that determined by Curtis from the band spectrum. For certain purposes a static model may be usefully employed owing to the comparative simplicity of the mathematical processes and the physical conceptions involved.—E. B. **Ludlam** and W. **West**: Emission spectra of the halogens. Photographs of the ultra-violet emission spectra of the halogens were obtained by passing the discharge from a small Tesla coil through tubes containing the gases, using external electrodes. The spectra were discussed from the point of view of the electron affinity of chlorine, bromine, and iodine.—E. B. **Ludlam**: The Budde effect in bromine. Ordinary bromine gives the Budde expansion, but carefully dried bromine in silica apparatus gave no effect even with powerful light in the extreme ultra-violet. It is suggested that the pure bromine re-radiates the energy, while the impure bromine transforms it into heat.—R. E. **Gibson**: The electrolysis of a mixture of acetates and trichloracetates. Among other compounds, trichlormethylacetate, trichlormethyl trichloracetate, ethane, ethylene, methyl chloride, formaldehyde, and hexachlorethane are formed by the electrolysis of a mixture of potassium acetate and potassium trichloracetate in aqueous solution. No appreciable amounts of methyl alcohol are produced. The yields of trichlormethyl trichloracetate and ethane are very much smaller than would be expected from a consideration of the behaviour of the two salts when electrolysed singly, showing that the presence of each affects the reaction of the other in a very fundamental manner. An explanation is offered from the point of view of the oxidation theory of electro-synthesis.—T. H. **Bryce**: Observations on the early development of the human embryo. Three human embryos of the period of development prior to the appearance of the somites are described. Features of general embryological interest are the attachment of the yolk sac to the chorion by a long apical duct; the early appearance of angioblastic tissue in the chorionic mesoderm before there are any signs of the formation of vessels on the yolk sac; and the presence at the extreme anterior part of the embryonic shield of a cavity believed to represent a persistent portion of the archenteric canal such as is seen in the cat among lower mammals. This is associated with the appearance in the roof of the canal in this situation of cell groups resembling those described in an earlier stage of development in

Ornithorhynchus by Wilson and Hill and named by them " protosomites " ; they have not been observed in this position in any other mammalian embryo.

PARIS.

Academy of Sciences, May 26.—M. Guillaume Bigourdan in the chair.—L. **Lumière**, A. **Lumière** and A. **Seyewetz** : The development of the latent image after fixing. The exposed photographic plate, after fixing with thiosulphate, is slowly developed by a special solution, the composition of which is given. The gradual growth of the particles constituting the image is illustrated by a series of ten photomicrographs.—A. **Desgrez**, H. **Bierry** and F. **Rathery** : The fatty bodies in the diabetic ration. Experimental studies on the excretion of glucose, ketonic bodies, β-oxybutyric acid and total nitrogen by diabetic subjects, the diet being varied as regards quantity and nature of the fats.—Léon **Pomey** : The singularities of differential and integro-differential equations with one or more variables.—Paul **Noaillon** : Integral functions of genus less than two.—Maurice **Fréchet** : The notion of number of dimensions.—P. Y. **Myrberg** : Some applications of continued fractions.—Constant **Lurquin** : A functional operator.—J. **Sudria** : The theory of the Euclidian action of deformation.—Umberto **Cisotti** : Concerning d'Alembert's paradox.—Louis **Breguet** : The aerodynamical qualities of the aeroplane utilised by Pelletier d'Oisy in his Paris-Shanghai flight.—Bernard **Lyot** : Polarisation of the moon and of the planets Mars and Mercury.—W. **Abbott** : Observations during the recent transit of Mercury.—R. **Dugas** : The Jacobi equation of a point with mass varying with the kinetic energy.—A. **Buhl** : The common origin of electromagnetism and differential geometry.—M. **Holweck** : Improvements in high power three electrode valves with removable parts. In the model described in an earlier communication rubber joints were employed ; these have been replaced by water-cooled ground glass joints. As the effect of the electrons on the tap grease employed to lubricate these joints is the production of an appreciable volume of gas, they are shielded from the electron stream by a guard ring. A diagram is given of a valve furnishing 8 kilowatts of high frequency current used at the Eiffel Tower ; repairs can be carried out in from 10 to 15 minutes.—A. **Chipart** : Radiant vector and luminous ray in crystals possessing natural rotatory power.—Mlles. Irène **Curie** and C. **Chamié** : The radioactive constant of radon. This constant has been determined by a new method for which an accuracy of 1 in 2000 is claimed. The value, 3·823 days, is intermediate between that of Curie and of Rutherford (3·85 days) and Bothe and Leechner (3·81 days).—D. **Yovanovitch** and J. **d'Espine** : The magnetic spectrum of the β-rays of mesothorium-2. A repetition of the work of Hahn, von Baeyer and Meitner with some modifications. Some additional lines are given.—Thadée **Peczalski** : The cementation of copper by metallic salts.—René **Audubert** : The electron theory and the heats of formation of salts.—L. J. **Simon** : The oxidation of acetic acid by different metallic chromates compared with oxidation by silver bichromate in the silver chromate-sulphuric acid method for the determination of carbon. In the oxidation method with sulphuric acid and silver chromate, the effect of substituting other metallic chromates for silver chromate has been studied. In no case was the oxidation so complete as with the silver salt.—Andre **Graire** : The reaction of alkaline bisulphites and mercuric chloride. The proposed use of this reaction for the determination of sulphur dioxide in flue gases is not practicable, but the determination of sulphite or of mercury may be based on this reaction.—J. F. **Durand** : The action of permanganic acid on the different forms of carbon. In sulphuric acid solution, permanganic acid at the ordinary temperature completely oxidises acetylene black, diamond and graphite to carbon dioxide.—P. **Brenans** and C. **Prost** : The iodonitro-oxybenzoic acids and iodoamino-oxybenzoic acids.—L. **Bert** : A new method of preparation of the sulphinones.—Louis **Longchambon** : Crystalline rotatory dispersion.—André **Allix** : The prediction of avalanches.—Jules **Baillaud** : Study of the selective absorption of the atmosphere at the Observatory of the Pic du Midi. The observations, like those of Rosenberg and of Abbott, are in contradiction with the result of Nordmann (1907), that at night in France and Switzerland, during fine weather, the blue part of the spectrum is always less absorbed than the red.—Sabba **Stefanescu** : The phylogeny of elephants.—M. **Bridel** and C. **Charaux** : Orobanchine, a new glucoside extracted from the tubers of *Orobanche Rapum*. This glucoside gives caffeic acid, glucose and rhamnose on hydrolysis.—B. **Chouchack** : The analysis of soil by bacteria.—H. **Bordier** : The influence of diathermy on the plant cell. Biological consequences.—Pierre **Girard** : Oxidation-reduction in the course of exchanges through a septum. Outline of catalytic activation by a partition.—J. B. **Abelous** and L. C. **Soula** : The cholesterogenic function of the spleen. Details of experiments proving the importance of the spleen from the point of view of fat metabolism, and the production of cholesterol.—P. **Vignon** : The homotypical mimetism in some grasshoppers of tropical America simulating plant leaves.—Elie **Iwanow** : The artificial insemination of mammals and birds.—C. **Gessard** : The smell of pyocyanic cultures. The production of the smell peculiar to this organism is not invariable, and appears to depend on various conditions. The addition of tryptophane to the cultures favours the production of the odour.

ROME.

Royal Academy of the Lincei, April 13.—V. Volterra in the chair.—S. **Pincherle** : Separation of singularity in an analytic function.—Umberto **Cisotti** : Integration of the equation for viscous rotations.—O. M. **Corbino** : Limits and conditions for good reception in radio-telephony. From the expression representing a modulated wave, an equation is derived which indicates why waves as short as possible should be used for radio-telephonic transmission, and why audition is improved by increasing the capacity and diminishing the self-induction of the resonator and thus rendering the resonance curve of the receiver less acute.—Achille **Russo** : Varying rhythm of the division of the micro-nuclei during true conjugation in *Cryptochilum Echini* Maupas. The globular micro-nucleus of this organism, derived from the nucleus of a gametogen which extrudes part of its contents, undergoes three divisions before it constitutes the nuclear apparatus of the mixed individual, whereas the comma-shaped micro-nucleus, derived from a gametogen the nucleus of which loses none of its contents during division, divides more slowly and effects two divisions before attaining this state.—Paul **Dienes** : Second differentials and derivation of tensors.—Giorgio **Vranceanu** : Weierstrass's theorem.—Bruno **Finzi** : Motion of incompressible fluids with vortex normal to the velocity.—Antonio **Carrelli** : Tyndall's phenomenon.—C. **Porlezza** : New regularities in the spectrum of silicon tetrafluoride. Formulæ are given for three new groupings, six others, each of two components, having also been observed. For two of the principal groupings the co-ordination is shown by comparison with the results obtained by

Dufour in the study of the longitudinal Zeeman phenomenon.—Giorgio **Piccardi**: Thermal method for the study of gaseous systems.—S. **Berlingozzi** and P. **Badolato**: Action of chloropicrin on phenol. In the presence of potassium hydroxide, this reaction results in elimination of the nitro group, which effects oxidation and is reduced to ammonia, the principal products formed being ortho- and para-hydroxybenzaldehydes and the corresponding acids; considerable quantities of pararosolic acid are also produced, probably by condensation of the phenol with the salicylaldehyde.—Clara di **Capua** and Maria **Arnone**: Hardness of lead-cadmium and lead-tin alloys. The hardness curve for the former alloys changes its direction suddenly at about 1 per cent. of cadmium, this indicating, like the curve for electrical conductivity, the extent of the solubility of cadmium in lead in the solid state at the ordinary temperature. With lead-tin alloys the hardness curve is altered entirely in character by reheating the cast alloys for a long time at 150°. Tin dissolves from 1 to 2 per cent. of lead, and the latter about 10 per cent. of tin at the ordinary temperature.—Giulia **Degli Innocenti**: Eocene fossils from Istria.—M. **Sella**: Differential characters of the early stages of *Orcynus thynnus*, *Orcynus alalonga*, and *Auxis bisus*.—Enrico **Fossa-Mancini**: Eocenic fossiliferous rocks of Ladak: specimens collected by the Italian Expedition into Central Asia, 1913–1914.—Tullio **Gayda**: Influence of adrenaline on the tone of striated muscle.—Gaetano **Viale**: Behaviour of the catalase in the blood on variation of the surrounding temperature. When the air temperature is low, the catalase-content of the blood increases considerably.—Ermanno **Giglio-Tos**: Supposed migration of the chromosomes towards the poles during the ana-phase of karyokinesis. The view that such migration occurs is untenable.

Official Publications Received.

Proceedings of the Royal Society of Edinburgh. Session 1923–1924. Vol. 44, Part 2, No. 11: The Theory of the Mechanical Analysis of Sediments by Means of the Automatic Balance. By R. A. Fisher and Prof. Sven Odén. Pp. 98-115. (Edinburgh: R. Grant and Son; London: Williams and Norgate.) 1*s.* 6*d.*

Department of Agriculture, Ceylon. Annals of the Royal Botanic Gardens, Peradeniya. Vol. 8, May 1924. Edited by T. Petch. Pp. 170. (Peradeniya: Department of Agriculture; London: Dulau and Co., Ltd.) 8 rupees.

Wisconsin Geological and Natural History Survey. Bulletin No. 52A-D, Soil Series No. 16-19: Soil Survey Reports of South Part of North Central Wisconsin, Wood County, Portage County, and Door County. Pp. 108+86+79+72+14 plates+4 maps. Bulletin No. 54A-D, Soil Series No. 23-26: Soil Survey Reports of Buffalo County, Jackson County, Waupaga County, and Outagamie County. Pp. 76+85+84+78+14 plates +4 maps. (Madison, Wis.)

United States Department of Agriculture. Miscellaneous Circular No. 18: Instructions for Banding Birds. By Frederick C. Lincoln. Pp. 28. 10 cents. Farmers' Bulletin No. 1086: How Insects affect the Rice Crop. By J. L. Webb. Pp. 10. 5 cents. (Washington: Government Printing Office.)

Sammlung von Hilfstafeln der Hamburger Sternwarte in Bergedorf. G: Hilfstafeln für photographische Himmelsaufnahmen. Pp. iv+G11. (Hamburg.)

Department of Commerce: U.S. Coast and Geodetic Survey. Isostatic Investigations and Data for Gravity Stations in the United States established since 1915. By William Bowie. (Special Publication No. 99: Serial No. 246.) Pp. iv+91. (Washington: Government Printing Office.) 25 cents.

Zoologische Mededeelingen uitgegeven vanwege 's Rijks Museum van Natuurlijke Histoire te Leiden. Deel 8, Aflevering 1, 31 Mei. Pp. 72. (Leiden: E. J. Brill.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verhandelingen No. 12: A new Determination of the Eastern Longitude of Batavia. By Dr. J. Boerema. Pp. ii+27. (Batavia: Javasche Boekhandel en Drukkerij.)

Board of Education. Report for the Years 1921 and 1922 on the Science Museum. Pp. 23. (London: H.M. Stationery Office.) 9*d.* net.

Tulum: an Archæological Survey of the East Coast of Yucatan. By S. K. Lothrop. (Publication 335.) Pp. vii+179+27 plates. (Washington: Carnegie Institution.)

Alcohol and Human Efficiency: Experiments with moderate Quantities and dilute Solutions of Ethyl Alcohol on Human Subjects. By Walter R. Miles. (Publication No. 333.) Pp. x+298. (Washington: Carnegie Institution.)

Ministry of Agriculture and Fisheries. British Empire Exhibition, 1924: Guide to the Agricultural Exhibit in Gallery 2 of the Government Pavilion. Pp. 66. (London: Fleetway Press, Ltd.) 6*d.*

Diary of Societies.

MONDAY, JUNE 23.

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—Prof. A. Hopewell-Smith: The Non-innervation of Dentine.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.30.—Presentation of Royal Gold Medal.

TUESDAY, JUNE 24.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Langham Hotel, Regent Street), at 9.30 A.M.—E. Herring: Research Work. Its Past, Present, and Future.—A. F. Baillie: Oil Fuel as applied to Central Heating.

ROYAL COLLEGE OF PHYSICIANS, at 5.—Sir Leonard Rogers: Researches on Leprosy and their Bearing on the Treatment of Tuberculosis. (Croonian Lectures.)

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Capt. R. S. Rattray: Rites de Passage in Ashanti.

WEDNESDAY, JUNE 25.

INSTITUTION OF NAVAL ARCHITECTS (at Institution of Civil Engineers), at 10 A.M.—Sir John H. Biles: Ship Design.—S. F. Staples and Capt. D. J. Munro: Advanced Naval Bases.—G. S. Baker: Steering in Shallow Waters.—J. Anderson and R. Steele: Passenger Ship Design from an Independent Point of View.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—F. Raw: The Development of *Leptoplastus salteri* Callaway and other Trilobites (Olenidæ, Ptychoparidæ, Conocoryphidæ, Paradoxidæ, Phacopidæ, and Mesonacidæ).—Miss Mabel Elizabeth Tomlinson, with an Appendix by A. S. Kennard and B. B. Woodward: The River-Deposits of the Lower Valley of the Warwickshire Avon.

RADIO SOCIETY OF GREAT BRITAIN (at Institution of Electrical Engineers), at 6.—J. Hollingworth: A Résumé of Modern Methods for the Measurement of Radio Signal Strength. (Lecture.)

THURSDAY, JUNE 26.

ROYAL SOCIETY OF MEDICINE (Combined Meeting of Laryngology and Otology Sections), at 2.30.

ROYAL SOCIETY, at 4.30.—Prof. J. W. Nicholson: The Electrification of two Parallel Circular Discs.—J. F. Fulton: The Influence of Initial Tension upon the Magnitude and Duration of the Mechanical Response in Skeletal Muscle.—J. R. H. Coutts, E. M. Crowther, B. A. Keen, and S. Odén: An Automatic and Continuous Recording Balance. (The Odén-Keen Balance.)—Dr. R. W. Lunt: Chemical Studies in Gaseous Ionisation. Part I. and Part II.—D. W. Dye: A Self-Contained Standard Harmonic Wavemeter.—*To be read in title only*:—Prof. W. L. Bragg: The Influence of Atomic Arrangement on Refractive Index.—G. S. Currey: The Colouring Matter of the Blue Pansy.—R. Snow: Conduction of Excitation in Stem and Leaf of *Mimosa pudica*.—R. Azuma: Thermodynamic Phenomena exhibited in a Shortening or Lengthening Muscle.—H. Taylor: The Ionic Nature of Hæmoglobin.—Prof. A. V. Hill and H. S. Gasser: The Dynamics of Muscular Contraction.—Dr. J. Stephenson: The Blood-Glands of Earth-worms of the genus Pheretima.—H. Muir Evans: Supplementary Note on the Poison Gland of Trygon.—E. M. Crowther and A. N. Puri: The Indirect Measurement of the Aqueous Vapour Pressure of Capillary Systems by the Freezing Point Depression of Benzene.—B. Cavanagh: Activity-Measurement by the Partition Method. I.—Dr. J. E. Jones: The Determination of Molecular Fields. Part I. and Part II.—C. J. Smith: An Experimental Study of the Viscous Properties of Water Vapour.—E. M. Crowther and J. R. H. Coutts: Discontinuity in the Dehydration of certain Salt Hydrates.—W. R. Dean: The Elastic Stability of an Annular Plate.—R. C. Johnson and W. H. B. Cameron: The Effect of Argon on certain Spectra.—Dr. G. R. Goldsbrough: The Possible Ellipticity of Saturn's Ring.—E. C. Titchmarsh: The Double Fourier Series of a Discontinuous Function.

ROYAL COLLEGE OF PHYSICIANS, at 5.—Sir Leonard Rogers: Researches on Leprosy and their Bearing on the Treatment of Tuberculosis. (Croonian Lectures.)

FRIDAY, JUNE 27.

ROYAL SOCIETY OF MEDICINE (Combined Meeting of Laryngology and Otology Sections), at 10 A.M.

INSTITUTION OF NAVAL ARCHITECTS (at Institution of Civil Engineers), at 10.—Sir Archibald Ross: A Retrospect of Marine Engineering and Possible Lines of Development.—G. J. Lugt and H. Hunter: A New Type of Double-Acting Diesel Engine for Marine Purposes.—W. H. Riddlesworth: Displacement—Draught Formulæ.

PHYSICAL SOCIETY OF LONDON (at King's College), at 5.—Professor O. W. Richardson: The Electron Emission Constants of Metals.—L. Hartshorn: A Method of measuring Very Small Capacities.—Demonstrations: Fluorescence of Transparent Fused Silica, Dr. W. E. Curtis; Selenium Photometer, Dr. F. C. Toy; A New String Galvanometer, Prof. E. Wilson.

SATURDAY, JUNE 28.

ROYAL SOCIETY OF MEDICINE (Combined Meeting of Laryngology and Otology Sections), at 10 A.M.

PUBLIC LECTURES.

TUESDAY, JUNE 24.

UNIVERSITY COLLEGE (Department of Applied Statistics and Eugenics), at 5.30.—Prof. Raymond Pearl: Some Recent Experimental and Statistical Studies on the Alcohol Problem.

THURSDAY, JUNE 26.

UNIVERSITY COLLEGE, at 5.30.—Prof. A. F. Pollard: Re-conciliation in Anglo-American History.