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The British Dye-producing Industry.

In a letter to the *Yorkshire Post* of September 12, Prof. W. M. Gardiner returns to the national problem of the British dye-producing industry, which is rapidly approaching the supreme crisis in its post-War history. Recognised at the outbreak of hostilities in 1914 as an essential factor in our national security and industrial welfare, the new dyestuffs corporation was then brought into existence in response to a general demand for the establishment of a home manufacture in dyes and intermediates.

Upwards of 7,000,000*l*. of government and private money have been expended in the land, building, plant, and general equipment of the British Dyestuffs Corporation Ltd. alone, and the other makers, of whom there are more than twenty, have also spent large sums in the extension of old works and the erection of new. On the technical side, the chemists employed in this new industry have made advances which are certainly revolutionary. Essential intermediates, hitherto not produced in Great Britain, are now manufactured in large quantities and of superior quality, and the range of British dyes includes eighty per cent. of the present requirements of our dye users.

On the economic side, however, the makers are in a position which is almost desperate. In spite of the fact that shareholders of dye-producing firms have received only meagre return on their capital outlay, the dye consumers are pressing continuously for reduction in prices because their foreign competitors have access to dyewares sold at prices with which no country with a stabilised currency can compete. At present, foreign dyes for which there are British equivalents are not admitted into Great Britain unless the British makers' price is greater than three times the pre-War price, and this measure of protection is being threatened. But even if the makers could get down to pre-War prices, it is doubtful whether the controversy on costs of production would cease, for in existing circumstances the German producer could profitably quote at far lower prices than those prevailing in 1914.

The chemists of the organic chemical industries, including dyewares, have shown themselves capable of the necessary concentration and patience required to build up the new scientific trades, but these essential national developments are doomed to failure in the near future unless the administrative leaders of the country in general, and of the dye-using industries in particular, can acquire what Dr. Duisberg, the head of one of the largest German colour works, speaking during the War, said England lacked, namely: "the faculty of fixing the eye on distant consequences and not merely on monetary results."

More Applications of Physics.

A Dictionary of Applied Physics. Edited by Sir Richard Glazebrook. In 5 vols. Vol. 5: Aeronautics—Metallurgy—General Index. Pp. vii + 592. (London: Macmillan and Co., Ltd., 1923.) 63*s*. net.

THE fifth and final volume of the "Dictionary of Applied Physics," now well known and justly famous, edited by Sir Richard Glazebrook, deals with two of the youngest physical sciences, aeronautics and metallography. The former occupies about two-fifths, and the latter the remainder of the book. The same plan is adopted as in previous volumes, *i.e.* there is a limited number of articles dealing with important aspects of the two sciences, written by men of high standing and authority in their subjects. Interspersed between these is a series of headings in alphabetical sequence, containing references to the articles in question. It is natural that many of the articles should have been contributed by present and former members of the staff of the National Physical Laboratory, Teddington. Whether, however, it was wise to make the proportion so high as it is in the metallurgical section of the volume may be questioned. A dictionary of this kind should represent as wide a range of authoritative opinion as it is possible to secure, and we think that the editor would have been well advised to draw, more than he has done, on the knowledge of metallographers occupying positions in the metallurgical industries.

The section on aeronautics opens with a valuable article on full-scale aerodynamic research by Mr. M'Kinnon Wood. The subject of experimental tests of the strength of aeroplane structures is dealt with lucidly by Mr. William Douglas, while various aspects of the theory of aeroplane structures are comprehensively treated by Mr. Cowley. Two articles by Mr. Guy Barr on aeroplane wings follow, one dealing with dopes, the other with fabrics. Mr. Barr also contributes a lengthy and interesting article on diffusion through membranes. The article on instruments used in air-craft, by Mr. Dobson, deals with many novelties. Prof. Bairstow contributes two articles, written with great authority, on the performance of air-craft and the stability of air-craft. A general outline of the theory of the air-screw is given by Mr. Arthur Fage, who also deals with the helicopter. This article may be studied in conjunction with that recently written by Prof. Bairstow in NATURE (August 18), entitled "The Helicopter: is it worth a prize?" The problem of the helicopter is that of an aerial machine "supported in the air by the thrust of one or more air-screws rotating about the vertical." As the author points out, many of these have been constructed, but only a few have supported their weight in the air, and none has been successful when judged from the point of view of practical utility. Experiments on air-ships constitute the subject-matter of an important article by the late Mr. J. R. Pannell and Mr. R. Jones.

The "engine" side of aviation is dealt with by the late G. H. Norman, Sqd.-Leader, R.A.F., in an article entitled "Air-cooled Engines for Air-craft." This contains valuable data on the comparative performances of air-cooled and water-cooled engines. At the present date the majority of engines are water-cooled, but the author evidently considers that there is likely to be a considerable increase in the use of air-cooled engines in the future. The saving in weight due to air-cooling may not be very great, and may in some cases be counter-balanced by increased head resistance. Its great advantage lies in the lower capital and attendance costs and the simplicity of the engine installation. Prof. J. C. McLennan contributes a short article on the production and use of helium. He estimates that from Empire sources, not more than about 12,000,000 cubic feet per annum can be obtained, the estimated cost being "not excessive." This, as he points out, would only keep a very few of the large air-ships in commission, even if diluted with 15 per cent. of hydrogen. The best method of extraction hitherto discovered consists in producing the refrigeration necessary to liquefy all the gases, except helium, by the cold obtained from the natural gas itself.

The subject of "Model Experiments in Aeronautics, their Theory and Methods," is dealt with comprehensively by Messrs. E. F. Relf and H. B. Irving, and the section closes with an article on "The Hydrodynamical Theory of Wing Surfaces," by Mr. H. Glauert.

Part II. of the volume is entitled "Metallurgy," but almost the whole of the subject-matter relates to what is usually called "Metallography." Dr. Haughton contributes excellent articles dealing with typical alloy systems, the construction of equilibrium diagrams, and the relationship between structure and physical constants. It is a pity that the constitutional diagram of the aluminium zinc alloys, on page 229, has been reproduced, since it is inaccurate in certain respects, and the correct diagram was published more than a year ago. This might well have been used and would have rendered unnecessary the footnote on page 230. Dr. Haughton has drawn his diagrams with the horizontal ordinates indicating weight percentages. It is not clear why he has preferred this arrangement. The system of plotting atomic percentages on the horizontal ordinates has many advantages. The diagram of the iron nickel system reproduced on page 235 is incomplete in the upper range of temperature where the δ to γ inversion of iron takes place. The only metal the metallurgy of which is described in this volume is aluminium, presumably on account of its use in air-craft, but it is not the only metal used, and it may be questioned whether it was worth while introducing it. The metallurgy of aluminium is adequately described in a number of text-books. Similarly, it is not clear why the electrolytic refining of copper has been singled out for treatment. A general article on the principles of electrolytic refining giving illustrations from various metals, would have been more useful.

Mr. Francis FitzGerald has compressed a remarkable amount of information into his article on electric furnaces. It gives exactly the kind of treatment of the subject that is required in a volume of this kind. Mr. Coad-Pryor has written two articles, both of them very good. That on "Furnaces for Laboratory Use" is of moderate length, while the one on "Refractories" is of considerable dimensions. They are packed full of information and the treatment is admirable. Of very solid merit also are the two articles by Dr. Hanson, one on iron carbon alloys, the other on the defects and failures of metals. The former, however, is rather perfunctory in its reference to cast-iron. It deals with pure iron carbon alloys, and has only a very slight reference to commercial cast-irons containing silicon, manganese, phosphorus, and sulphur. The article on the defects and failures of metals is most valuable. It represents what may be called National Physical Laboratory experience at its best. The author, however, is incorrect in attributing the growth of cast-iron on repeated heatings to the pressure caused by the formation of oxides of iron. The main cause, at any rate, is the volume increase caused by the separation of silica. The statement on page 372 that "a 'crystalline' fracture (one containing bright facets along which rupture of the crystals has occurred—not an intercrystalline fracture) indicates by the size of the facets, the general size of the crystal structure of the material," is scarcely correct in this unqualified form, seeing how greatly the fracture may be made to vary according to the method of producing it.

Dr. Rosenhain contributes seven articles, and these constitute between one-third and one-quarter of the entire metallographical section. He deals with (1) some special alloys, (2) aluminium alloys, (3) the microscopic examination of metals, (4) the relations of strain and structure in metals, (5) the thermal and mechanical treatment of metals, (6) the thermal study of metals, and (7) the microstructure of metals and alloys. The most considerable of these is the article on the relations of strain and structure and the conception of amorphous metal. The subject is handled with the author's well-known ability. It is well to remember, however, that the conception of amorphous metal is not by any means generally accepted to-day among metallographers, and it may be doubted whether anything is gained by such a sentence as appears on page 397—"At the present moment indeed, even those who, on certain grounds, vehemently oppose this theory have no alternative to offer which can afford any satisfactory explanation of the great group of facts which this theory so readily co-ordinates." In the section headed "Tempering and Quenching" (page 411), Dr. Rosenhain attributes the hardening of a carbon steel by quenching to "the development of a very large number of minute crystallites of both α iron and cementite," and the existence of an "envelope of amorphous iron which is so highly viscous as to be, in effect, an intensely hard solid." As to this, there is no evidence of the formation of cementite in a properly quenched steel. More causes operate in the hardening of steel by quenching in water than are indicated in this article.

Sir George Beilby's striking work on metal aggregates receives attention in two articles written by Mr. W. D. Haigh on the aggregation of solids and the flow of solids. There is a long and very useful article by Dr. W. H. Hatfield on "Special Steels," which, with the valuable article by Sir Robert Hadfield on "Manganese Steels," does something to bring the "works" atmosphere of applied science into this section of the dictionary. The volume closes with a detailed index of the subjects dealt with in aeronautics and metallurgy, and finally with a general index of the principal articles in the five volumes.

H. C. H. CARPENTER.

Tubicolous Worms.

(1) *A Monograph of the British Marine Annelids.* Vol. 4, Part 1: Polychæta—Hermellidæ to Sabellidæ. Pp. vii + 250 + plates 112–127. 50*s.* net. (2) Vol. 4, Part 2: Polychæta—Sabellidæ to Serpulidæ; with Additions to the British Marine Polychæta during the Publication of the Monograph. Pp. xii + 251–539 + plates 115 – 117 and 128–138. (Published for the Ray Society). By Prof. W. C. McIntosh. (London: Dulau and Co., Ltd., 1922–23.) 50*s.* net.

THE volumes under notice constitute the last two parts of "A Monograph of the British Marine Annelids." The Council of the Ray Society in the preface to the final volume, issued with the last part, "believe that they are interpreting the feelings of the members of the Society in offering to their President congratulations on the completion of this monograph, of which the first part was published no less than half a century ago." This is an expression in which all zoologists would wish to join, and rejoice that Prof.

McIntosh sees in his eighty-fifth year the completion of his magnificent work. Through the years he has pursued with such admirable singleness of mind, amid many other occupations, the study of this neglected group of marine animals. When he so modestly "hopes that they are left in a better state than he found them, thanks to the greater attention zoologists in every clime have bestowed on the Marine Polychaets," we can only reply that his name stands foremost among investigators of the Polychæta during a period of great and unexampled progress, in which his broad comprehensive studies have been supplemented, and are now necessarily succeeded, by the work of specialists in the different families.

The Ray Society is scarcely less to be congratulated on the way in which it has persevered with the production of the final parts of the monograph during the lean years after the War. So much stands to the credit of the Ray Society in the past for its wonderfully illustrated volumes by Allman, Alder and Hancock, and many others, which have done so much to create the reputation of British marine zoology, that we cannot sufficiently praise the vigour and enterprise, with unimpaired excellence of execution, which the Society still displays. It is earnestly to be hoped that it may receive the increased support from zoologists which it now so greatly needs.

(1) "Such synonymes as would signify *mason* or *potter*, might be aptly applied in explaining the character and habits of the Terebella. Nothing could be more appropriate, for this animal is alike distinguished by address and perseverance in producing works of art." This tribute to one of the despised tribe of worms is paid by Sir John Dalyell in "The Powers of the Creator declared in the Creation," a book which embodies his patient and extended observations on the habits of marine animals. In the first part of the last volume of Prof. McIntosh's great monograph five families of tube-building polychæts are described; the Hermellidæ, Amphictenidæ, Terebellidæ, Ampharetidæ and Sabellidæ, and the first three exhibit in the highest degree that craftsmanship which always awakens a sympathetic chord in the human observer.

The Terebellidæ, of which twenty-four species are here described, is the best known of these families. The basis of the tube which they inhabit is a secretion of the skin glands which often hardens to the consistency of parchment. In this while it is still soft the animal embeds, on the outer surface, the foreign bodies which it so assiduously collects. It is a common but always fascinating sight to see the countless tentacles of a terebellid spreading in all directions from the opening of its tube. With a lens, a multitude of particles can be detected moving along the ciliated groove on the surface of each tentacle, toward the mouth. Prof. McIntosh quotes the following passage from Dalyell describing this never-ceasing activity: "Nothing is more surprising than the attention of so humble an artist being directed towards such a variety of operations at the same time. Many tentacula are searching after the materials—many in collection—many bearing them to the edifice—some quitting their hold—others recovering the load—while the architect itself seems occupied in kneading masses in its mouth, disgorging them successively, or in polishing the rude workmanship resulting from its labours." The worm thus described, the "Potter" of Dalyell, *Amphitrite figulus*, builds tubes of mud, but others like *Lanice conchilega* use grains of sand or even carefully select fragments of shell. There are still more fastidious forms like those Japanese examples mentioned by Prof. McIntosh as collected by the *Challenger*, which gather pine needles and stick them lengthwise on the tube, and in the Cretaceous there occur tubular structures composed of bones and scales of fishes which Bather assigns to the activities of Terebellids.

The Amphictenidæ include such well-known forms as *Pectinaria belgica*, a very abundant worm. The reviewer remembers seeing the Belgian coast in 1917 strewn with millions of this form washed out of the sand after heavy weather. Their slightly curved tubes are miracles of workmanship. Prof. McIntosh in his description of this and other forms has quoted largely from the work and reproduced some of the drawings of Mr. A. T. Watson, to whom we owe so many fascinating accounts of the methods of annelid artificers.

If the tubes of the Terebellids and Pectinaria are usually hidden from view, Sabellaria among the Hermellidæ often forms conspicuous masses of firmly cemented tubes between tidemarks covering large surfaces of rock. Unlike other "social" polychæts (e.g. Filograna, Phyllochætopterus and *Potamilla torelli*, all described in this work) they do not reproduce asexually, and some other explanation must be sought for their gregarious nature.

The Sabellidæ again are among the most interesting of tube builders. The crown of finely divided processes around the head, so beautifully portrayed in Prof. McIntosh's plates, are referred to here (as is usual elsewhere) as branchial, but we venture to think that Bounhiol's experiments, made in 1890, show that they have no special respiratory value. But, indeed, the comparative study of the respiration of the tubicolous worms offers a very profitable investment for the time of a biologist.

(2) In the second part of Vol. 4 the description of the Sabellidæ is continued, and the last family, the Serpulidæ, is treated. Here the tubes are always

calcareous, and one of the cephalic filaments is usually modified to form an operculum. One of the most interesting features of the family is the remarkable pigmentation of the cephalic filaments, often very variable in the same species, giving the animal a charming flower-like appearance, a phenomenon which has still to be investigated thoroughly. Among British species the condition is best developed in *Pomatocerus triqueter*, which, nearly everywhere, whitens the stones and rocks between tidemarks. Other characteristic British forms, amply treated here, are *Serpula vermicularis*, so often attached to the shells of Pecten in the coralline zone, and Filograna, the coral-like masses of which are frequently taken in the dredge.

Lastly there is an addendum of no less than seventy-eight species which have been discovered or described as British, too late to appear in their proper places. Of the many co-workers whom the author cites as responsible for these additions to the British fauna, there must be specially mentioned Mr. Southern, of the Irish Fisheries Department, who, working in the years just before the War, at Clare Island and elsewhere, obtained a plentiful harvest of unsuspected forms, including eighteen entirely new species. "Truly the riches of the marine fauna of the west coast of Ireland are by no means exhausted," Prof. McIntosh is constrained to exclaim, and we must hope that Mr. Southern may be able to complete his faunistic work.

The wonderful charm of the drawings by the late Mrs. Gunther and Miss Walker, and the success of their reproduction, have so often been commented upon by reviewers of earlier parts that we can do no more than re-echo their praise. One feature of the volume is, however, almost unique: that is the bibliographical collation of the parts as issued, compiled with the index by Mr. G. A. Smith.

Universities and National Life.

The Older Universities of England: Oxford and Cambridge. By Albert Mansbridge. Pp. xxiv+296+8 plates. (London: Longmans, Green and Co., 1923.) 7*s*. 6*d*. net.

MR. MANSBRIDGE scores with both barrels. He appeals to both of the classes into which (relative to his book) the world is divided—those who have been at a university and those who have not. In any case, although he has the detachment which comes from never having been through the university mill himself, he not only loves and appreciates the university and what it stands for, but also has actually added something to its nature and functions. By his initiation of the Workers' Educational Association, he gave a new and fuller content to the whole extra-mural side of university activity, and helped to spread the universities' influence more rapidly and more extensively than could have been done in any other way. Add to all this that he was a member of the recent Royal Commission on Oxford and Cambridge, and it will be seen that he has advantages that the most learned historian cannot despise.

For it is as a historian that Mr. Mansbridge, wisely enough, chooses to treat his subject. In his pages we see the genesis of English universities in the ferment of the twelfth century, the beginnings of the college system, its expansion by such men as William of Wykeham, Henry VI., and Wolsey, the involvement of the universities in politics, the submergence of their original purpose beneath the flood of wealth and birth in the eighteenth century, the gradual reappearance of that purpose from the middle of the nineteenth century onwards, the adjustment of the curriculum to modern needs, the growth of a new university organ in extra-mural education. . . .

We are not allowed to forget the continuity and vitality of the current of scholarship and learning, nor to lose sight, under a mass of academic detail, of the university's position in the body politic. Nor is that all; Mr. Mansbridge, for all his idealism (which may prove almost embarrassing to a certain type of over-worked and matter-of-fact "don"), can appreciate and even be affectionate to the failings of Oxford and Cambridge. The noblemen and gentlemen-commoners, even at their most foppish, amuse him; he sees through to the human heart below donnishness, and smiles indulgently on port.

For this alone the book is worth reading—because it is a short and well-written and appreciative history of our two oldest and greatest seats of learning. But it is worth reading for more important reasons. It is worth reading by the university-trained man, partly because Mr. Mansbridge's wistful regret at his own lack of that training helps to fuller realisation of its meaning and values, and partly because his concern for the extension system and the W.E.A.'s fine work puts the university in a new setting for him, relates it to new aspects of national life. It is worth reading also by all those who have not received a university education and yet are concerned in any way with domestic politics, because it will help reveal to them what a university can and should be—what an ideal to the individual, what a force in the community.

Mr. Mansbridge is a rebuke to the diehard (generally Tory, practical, and well-to-do), who exclaims that education is a curse and a burden and higher education in particular an unpractical folly; and a rebuke no less to those violent spirits of the Left who see in all universities, and especially in Oxford and Cambridge, some dodge of capital, and hate the aristocracy even of learning. To him the university is simply the corporate and social expression of civilisation's mind; and, as with the mind of an individual, although its fullest cultivation is in one sense a luxury, yet in another and broader view, it is the highest necessity.

Avian Minstrelsy.

Songs of the Birds. By Prof. Walter Garstang. Second edition. Pp. 115. (London: John Lane, The Bodley Head, Ltd., 1923.) 6*s.* net.

WE have before us the second edition of this agreeable and very suggestive little book, the original issue of which was noticed in NATURE of August 12, 1922. A new song has been added and two passages have been revised, but otherwise the alterations are merely verbal. Mr. Shepherd's quaint little sketches of the songsters again add to the pleasure of the reader.

The book, we may recall, begins with an important essay in which Prof. Garstang discusses the nature of avian song, the rôle it plays in the life of the birds, and the very interesting evolutionary aspects of the subject. From that he proceeds to the vexed question of the symbolic representation of song, and after having propounded his thesis on this point he begins his series of representations of the music of the different species. The reasons which he gives for the adoption of his particular form of representation cannot fail to carry some measure of theoretical conviction to the reader, based as they obviously are on a thorough appreciation of bird song aided by a knowledge of music and a sense of poetry. It is harder to apply the practical test as to whether the representations do indeed convey more adequately than former attempts an idea of the various songs, for one has to bear in mind the existence of individual differences both in the hearing of the songs and in the interpreting of the written symbol: one hesitates, indeed, to express a definite opinion until students of the subject have had further experience in using the new method. If, however, either these "first fruits" of Prof. Garstang's studies or some future elaboration of them can in time be regarded as making possible the adequate representation of different songs on paper, he will have succeeded in making good a deficiency of which the present existence is evident in every text-book of ornithology.

In the preface to the new edition the author replies vigorously to such of the reviewers of his first edition as were hostile in their criticisms, and in so doing he also takes to task our own by no means unappreciative notice for not having discussed his auxiliary verses from a scientific point of view. Lest we may seem unjust in this respect we may here quote Prof. Garstang's own account of his method and of the part which his verses play therein: "The peculiar quality or *timbre* of each bird's voice and the resonance of each sound have been imitated as closely as possible by a selection of human consonants; the composition of the song has been represented by the appropriate repetition, modification, or contrast of selected syllables; the syllabic rendering has been cast in a corresponding rhythm; and round this chosen sequence of syllables a song has been woven to capture something, if possible, of the joy or of the attendant circumstances which form the natural setting of his song." We have certainly no wish to quarrel too seriously with our author as to where scientific method properly ends and where more emotional vehicles of thought properly begin. In his new preface he quite truly says that "The exploration and illustration of the borderlands of Science and Art will not end with my adventure": we may add the hope that even his own adventure into these fields is by no means concluded.

Prevention of Vibration and Noise.

The Prevention of Vibration and Noise. By A. B. Eason. (Oxford Technical Publications.) Pp. xii + 163. (London: H. Frowde and Hodder and Stoughton, 1923.) 15*s.* net.

THIS volume, as the author states in his preface, does not profess to contain anything not already known, but is a more or less classified account of the work of various experimenters on the subject of which it treats. Beginning with a useful but not complete bibliography, and a note on the problems to be investigated, later chapters treat of "annoying" vibrations and their amplitude; the means and apparatus which have been used to measure them, the vibrations of buildings, bridges, and other structures; means of damping vibration, the transmission and isolation of noise; and ending with an account of balancing machines, *i.e.* machines for determining whether, and how much, any revolving part is out of statical or dynamical balance.

As showing what has been done in these matters, the book is useful for reference, but its value would have been much increased by a more critical examination of the elements of the whole subject. It is difficult in many places to know whether the author is giving his own views or restating those of the experimenters whose results he summarises.

In defining "annoying" vibration, scarcely sufficient attention is given to the differences in surrounding conditions. What would be "annoying" in Mayfair might be unobjectionable in Poplar. Where wood or asphalt pavement prevailed, the introduction of granite sets would certainly cause complaint. In describing the different forms of apparatus which have been used for measuring vibrations, no hint is given as to the trustworthiness of the results. This is an important omission, for in the greater number of those instruments the records are an imperfect catalogue of peculiarities of the instrument rather than of the magnitude of the external vibrations which they were designed to measure. All such instruments have natural periods of their own, and one of the most important points in their design should be to arrange that neither the slowest nor any of the more rapid natural periods shall approach those of the imposed vibrations, and since in most cases the imposed vibrations are (like white light) made up of a great many arbitrary disturbances, this is not a condition which it is easy to fulfil. Many mistaken diagnoses have been made from neglecting the effects of resonance on the recording apparatus, and from supposing that a large recorded amplitude necessarily indicates a large external vibration.

Perhaps the most interesting chapter is that on the isolation and damping of sound, in which many examples are given of successes and failures in practical attempts in this direction. In most of these the actual results might have been anticipated. In speaking of the minimum audible sound (as in reference to the least sensible vibration) insufficient prominence is given to the effect of the surrounding conditions. In an absolute silence many experiments have shown that a sound, the wave amplitude of which is a twenty-five millionth of an inch, can be heard, but in the midst of other noises, if the amplitude of the loudest of these is taken as unity, another sound with an amplitude of 1/15 is only just audible, so that the greatest and least intensities which can be appreciated simultaneously are something like two hundred to one.

With regard to the isolation of sound, an absolute barrier to the propagation of vibrations may be set up either by complete reflection or complete absorption, but when the amplitude is large and the absorption rapid, a gradual change may probably occur in the absorbent. The secular change in the efficiency of sound-absorbing materials is not mentioned.

In reference to the acoustic qualities of halls and rooms, most of the experimenters whose work is quoted seem to consider that "good" and "bad" depend on the rate at which vowel sounds and musical notes are damped, but it is not uncommon to find rooms which are good for music but bad for speech, and it is the effect of the resonance of the room on the consonants rather than on the vowels which determines whether spoken words are clearly heard.

Though there are many published papers on the subjects which come under the head of "vibration," Mr. Eason's is the only book in which any collection of their results has been attempted, and notwithstanding some defects (chiefly of omission), it should form a very useful addition to the literature of the subject. A. M.

Our Bookshelf.

Advanced Practical Physics for Students. By B. L. Worsnop and Dr. H. T. Flint. Pp. vii+640. (London: Methuen and Co., Ltd., 1923.) 21*s*. net.

TEACHERS of experimental physics will find much that is useful and suggestive in this volume. Though some experiments of an elementary character have been included, the work is intended for advanced students who are working for a pass or honours degree. The bulk and the price of the book might have been reduced materially by the omission of much that is common to many elementary text-books. In some cases full experimental details are given, while in others the description is insufficient to enable an ordinary student to carry out the necessary manipulations. Little attention is given to the degree of accuracy to be expected.

Many recent experiments and modern forms of apparatus have been described. We may mention in particular the determination of the ratio of the charge to the mass for an electron by means of the Zeeman effect using a Lummer-Gehrcke plate, and also by Sir J. J. Thomson's method. From the account given in the book the student might infer that the latter method is due to Braun. There is a useful chapter on the quadrant electrometer (in which Wheatham should be Whetham), and a section on the three-electrode valve.

The most striking feature of the work is the stress laid on the theoretical side of the subject, the aim being to make the course practically independent of other treatises, at least as regards immediate reference. To aid this scheme an introductory chapter on the calculus has been included.

It is to be regretted that the proof-sheets were not submitted to a literary critic, as there are too many examples of careless or ungrammatical construction, and the punctuation needs amendment in many places. The wholly inadequate table headed "Units" needs revision: the value for the electrochemical equivalent of hydrogen has long been superseded, and to give the charge on an electron as $4{\cdot}71 \times 10^{-20}$ E.S.U. is unpardonable.

Mechanical Testing: a Treatise in Two Volumes. By R. G. Batson and J. H. Hyde. Vol. 2: Testing of Prime Movers, Machines, Structures and Engineering Apparatus. (The Directly-Useful Technical Series.) Pp. xi+446. (London: Chapman and Hall, Ltd., 1922.) 25*s*. net.

THE first volume of this work dealt with the testing of materials of construction; the present volume concludes the treatise and contains a great deal of matter which will be of service to all who are interested in the testing of machines and structures. The selection of a suitable dynamometer is of vital importance in the testing of an engine or machine, and, roughly, one-quarter of the volume is devoted to different types of this instrument. This section includes traction dynamometers such as are used in railway work, and the Lanchester machines for the testing of worm gears. Other sections deal with lubricants, friction tests on bearings, vibration tests, and static and dynamic balance.

The part of the volume devoted to tests on structural elements contains methods of testing concrete slabs and beams, plain and reinforced, and also columns of various types. Much of the work which has been done on this subject has been carried out in America, and we note that the authors have dealt justly with it in the space at their disposal. Tests on cutting tools, aircraft models, and other miscellaneous tests conclude the volume. As was the case in the first volume, a good deal of the apparatus described is installed at the National Physical Laboratory, but the authors have not forgotten that research cannot be confined to one place, nor to one investigator or group of investigators. The complete treatise will be welcomed by all who are engaged in the testing of engineering materials and appliances.

(1) *Oil Power*. By S. H. North. (Pitman's Common Commodities and Industries.) Pp. ix+122. 3*s*. net.
(2) *Internal-Combustion Engines*. By J. Okill. (Pitman's Common Commodities and Industries.) Pp. xi+126. 3*s*. net.
(3) *The Diesel Engine*. By A. Orton. (Pitman's Technical Primers.) Pp. x+111. 2*s*. 6*d*. net.
(London: Sir Isaac Pitman and Sons, Ltd., 1923.)

THE general reader who desires information regarding oil fuel and the practical methods of using it will find much of interest in these three little books. The greater part of (1) is occupied with descriptions of oil burners as used in furnaces. This system is employed to a large extent in marine and locomotive boilers. The question of oil storage at various ports is of vital importance for the supply of oil-fired vessels, and is dealt with towards the end of the volume. The first thirty-two pages in (2) are devoted to the gas engine, and the greater part of the remainder deals with oil engines of different types. The book is up-to-date in the matter of the engines selected for description, and there are sections on aero-engines, tractor engines and turbines. The Diesel engine is of sufficient commercial importance now to warrant a separate volume, and this is provided in (3). Here we find descriptions of the arrangements and methods of working of both four-stroke and two-stroke Diesel engines, and a short discussion of the power developed and the efficiency. The student of heat engines will of course require a great deal more than is contained in these books. They are, however, very suitable for those readers who wish to be informed as to what has been accomplished in this important branch of engineering.

British Museum (Natural History). British Antarctic (Terra Nova) Expedition, 1910. Natural History Report. *Botany*, Part 3: Lichens. By O. V. Darbishire. Pp. 29-76 + 2 plates. (London: British Museum (Natural History), 1923). 7*s*.

DR. DARBISHIRE's account of the lichens is the third of the reports to be issued on the botany of Captain Scott's Antarctic expedition of 1910. Reports on the seaweeds (by Mr. and Mrs. Gepp and Mme. Lemoine) and on the freshwater Algæ (by Dr. Fritch) were published in 1917.

Seventeen species were collected, eight of which proved to be new, and are described and figured in the present publication. With the exception of one Lecidea, the new species belong to the genus Buellia. The lichens were all found on rocks, mainly granite and gneiss, at Cape Adare and Evans Cove in South Victoria Land. When describing the lichens brought back by the Swedish Antarctic Expedition (1901–3) in 1912, Dr. Darbishire gave a summary of the species known at that time from the Antarctic area; their number was 107; this has now been increased to 208, mainly by the material brought back by the second French Antarctic Expedition of 1908–10, which was reported on by the late Abbé Hue. The value of the present brochure is enhanced by the inclusion of a complete list of the species recorded from the Antarctic area, that is, from localities to the south of the 60° S. parallel, to which are added keys to the genera and species. Twenty-three per cent. of the species are also found in the Arctic regions, and the author notes a striking similarity of the Arctic and Antarctic lichen flora in regard to the proportion among the known species of the chief lichen forms.

The Preparation of Plantation Rubber. By S. Morgan. With a Preface and a Chapter on Vulcanisation by Dr. H. P. Stevens. Pp. xvi+331. (London, Bombay and Sydney: Constable and Co., Ltd., 1922.) 21*s*. net.

BOTH editions of Mr. Morgan's useful book on plantation rubber are now out of print, and in preparing a third edition the opportunity has been taken to revise completely the original work, and to incorporate in the new volume the results of the experimental research in practically all branches of the business of preparing rubber for the market which has been carried out by Mr. Morgan in the course of his work as Scientific Officer to the Rubber Growers' Association in Malaya. In doing so, the book has been virtually re-written, and it now forms a complete and authoritative guide to the modern practice of a rubber plantation, from the planting of the tree to the packing of the rubber for export. The subject has been usefully rounded off by the addition of a series of three chapters on the vulcanisation of rubber, including an account of the methods of testing the material for industrial use. This section of the book has been specially written by Dr. Stevens, consulting chemist to the Rubber Growers' Association in London, and is based on the researches on vulcanisation carried out by him for the Association over a period of about ten years. Altogether the volume is an admirable handbook, and with periodical revision should remain the standard work on the subject.

Die Stereoskopie im Dienste der Photometrie und Pyrometrie. Von Carl Pulfrich. Pp. iv+94. (Berlin: Julius Springer, 1923.) 3*s*. 4*d*.

THE physiological optical effect on which the photometrical method made use of in the instruments described in Prof. Pulfrich's book is based was described in NATURE of May 12, p. 648, and May 19, p. 691. In one of Prof. Pulfrich's instruments a pair of fixed and moving marks is employed, which is observed by both eyes simultaneously through a pair of telescopes provided with a suitable system of prisms; in others two pairs of marks are made use of, one of which is seen in the middle of the field of view of each of the two telescopes, so that the appearance is that of a single pair. The two moving marks are geared together, and driven either by hand or by a small hot-air motor. If the fields of view of the two telescopes are equally "bright," the mark appears to move to and fro, horizontally, in a straight line, its point passing just above the point of the fixed mark; a difference of brightness makes it appear to revolve round the fixed mark. This is independent of the colour of the two lights which are being compared. It is also possible to adjust the two sides of the apparatus to equality of brightness with an accuracy of 2 to 3 per cent., however great the difference of colour may be, provided the observer has sufficient experience, and good spectroscopic vision. In the stereospectral photometer, two monochromators are employed, one for each telescope, so that practically monochromatic light of different wave-lengths can be employed. A form of photometer, which enables one-half of the spectrum to be balanced against the other half, promises to be valuable in pyrometry.

Malaya: the Straits Settlements and the Federated and Unfederated Malay States. Edited by Dr. R. O. Winstedt. Pp. xi + 283. (London, Bombay and Sydney: Constable and Co., Ltd., 1923.) 12*s.* net.

THIS authoritative and comprehensive handbook will come as a boon to all who are interested in or in any way connected with the Malay Peninsula. The editor, a well-known authority and the author of several works on the Malayan language, is himself responsible for the chapters on the population, the ethnology, and languages of the Peninsula; Malayan literature; arts and crafts; religion and beliefs; and history and archæology, as well as the account of the Eurasian, Chinese, and other races of the country.

Other chapters are the work of experts in their respective departments. Mr. J. B. Scrivenor, the Government Geologist, describes the geography, geology, and mineralogy of the country, as well as its mining industry. Dr. F. W. Foxworthy deals with the flora and forests, and Mr. F. C. Robinson of the Federated States Museum with the fauna. Mr. B. J. Eaton, Director of Agriculture, deals with this and other industries, while Mr. Pountney, Financial Adviser to the Straits Settlements, analyses revenue and expenditure. The sections on the Straits Settlements, the Federated and Unfederated States, which will be found particularly helpful, are the work of the editor. An adequate, if not lengthy, bibliography is an excellent guide to those who seek further information. The book is well illustrated and well produced.

A Tested Method of Laboratory Organisation. By S. Pile and R. G. Johnston. Pp. xx + 98. (London: H. F. and G. Witherby, 1923.) 7*s.* 6*d.* net.

THE authors of this little book were associated with a co-operative laboratory established during the War by a number of Birmingham brass firms, and their conclusions are mainly based on experience gained in that laboratory. They give many useful notes on the equipment and arrangement of works and control laboratories, on the preparation of samples, and on the methods of recording the source of the sample and the results of its examination, whether analytical, mechanical, or physical. Their treatment of the subject of laboratory books and the entering of results is very thorough, and they go so far as to describe a system of costing in units by means of which a monetary value may be attached to each operation. While the scale of the work is too small for it to serve as a manual of laboratory equipment, it will be found particularly useful by those who have to instal a small laboratory in a works, especially in one of the metallurgical industries. The question of the relations between the superintendent and his staff is also dealt with, but the closing chapters, under such headings as "The Mentality of the Scientist," seem rather out of place in an essentially practical note-book.

Among Unknown Eskimo. By J. W. Bilby. Pp. 280 + 16 plates. (London: Seeley, Service and Co., Ltd., 1923.) 21*s.* net.

THE Eskimo of Mr. Bilby's title can be accurately described as "unknown" only in relation to the public for whom he writes—a public which normally does not have access to scientific publications. His account of the customs, modes of life, and beliefs of the Central Eskimo of Baffin Land is, however, something more than a book with a merely popular appeal. A residence of twelve years among these tribes qualifies him to give ritual and belief their proper setting and perspective in the everyday round in a manner which is not always possible in an analytic study. This has a value which anthropologists will readily acknowledge; but Mr. Bilby's intense appreciation of the native attitude of mind to tribal observances, and his keen insight into the dynamic relation of such observances to conduct, have obscured the fact that these do not necessarily tell the whole story. Accordingly, he is prone to offer as an interpretation of native practices the immediate social effect and the psychological factors which come into play in certain elements of ritual, to the neglect of deeper causes. An appendix gives a valuable list of some fifty departmental deities of the Eskimo with their attributes.

Edmund Loder; Naturalist, Horticulturist, Traveller and Sportsman: a Memoir. By Sir Alfred E. Pease. With Contributions by St. George Littledale, Charles G. A. Nix, Lord Cottesloe, J. G. Millais, and W. P. Pycraft. Pp. x + 356. (London: John Murray, 1923.) 18*s.* net.

THE friends and acquaintances—and of a man so accomplished and of such wide interests as was Sir Edmund Loder, these are many—will be glad to possess this "miniature" of his remarkable personality. Sir Alfred Pease has not attempted to depict a life-size portrait; but by wise selection, and with the assistance of other contributors, he succeeds in conveying a very clear impression. The reviewer can perhaps pay no higher tribute than by stating that though he was not privileged to know Sir Edmund personally he closed the book with the feeling that he knows well what manner of man he was.

Letters to the Editor.

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

The Control of Malaria in the Malay Peninsula.

BEFORE Sir Ronald Ross's epoch-making discovery, there was no more puzzling problem in medicine than the cause of malaria; no secret in Nature more cunningly hid than the malaria secret. Malaria was known to be connected with swamps, and to be reduced by drainage and cultivation. Yet, as if merely to confuse, men found that to flood some swamps actually improved health; and elsewhere that drainage and the cultivation of the soil produced the most serious and devastating outbursts of the disease. Yet again, malaria was found not only in swamps, but also often on hills and dry sandy deserts. Some jungle-covered land was singularly free from malaria: other jungle land was intensely malarial. In fact, malaria existed on soils of every conceivable variety, of every age in geological time. It was impossible to point to any mineral, chemical, or vegetable condition essential to its presence. It was, and had been for hundreds of years, a dark, inscrutable mystery.

Sir Ronald Ross's genius changed darkness to light, and inaugurated a new era in tropical colonisation. To many, of course, the discovery that malaria was carried by mosquitoes merely confirmed them in their pessimism that the control of malaria was beyond human effort. They were wrong; and briefly I give two examples of what has been done in the Malay Peninsula in the past twenty years under different physical conditions. I would premise that the places of which I speak are within three degrees of the equator, have a rainfall round about 100 inches a year spread throughout the year, that the country as a whole is naturally covered by an ever-green damp jungle, and that mosquitoes exist in myriads at all times. One example is of malaria on low-lying land; the other of malaria on hill land.

CAREY ISLAND.

Twenty years ago or less, if the tropical sanitarian had been asked what was the class of land least likely ever to be freed from malaria by the control of mosquitoes (or by any other means for that matter), he would unhesitatingly have named the low-lying coastal land, with high ground-water, heavy clay soil, liable to flooding from the sea. He could easily have justified his choice. Such land had ever been known to be pestilential almost beyond description; it had given rise to innumerable speculations on the cause of malaria—the decay of coral, the mixing of fresh and salt water, to name but two. In every part of the tropical world examples of the deadly power of malaria in coastal regions could be given. In the Malay Peninsula and Archipelago, for example, the Governor, Sir Frank Swettenham, in 1901 ordered the new port called after himself to be closed, so overpowering was the malaria. On the opposite side of the Straits of Malacca, the port Belawan in Sumatra was so malarial that the Dutch left it every night, retired to a town some twenty miles inland, to return by the first train the following morning. Many other examples could be given.

Carey Island is situated on the coastal belt of such land. It is, indeed, an island just above sea-level in its highest parts, and obviously has been formed by the alluvium from the hills. Surrounded by water, on one side by the sea, on others by large rivers or riverine estuaries, containing salt water, it is fringed by mangrove swamps and covered by dense virgin jungle. Throughout its length and breadth it was swamp, either of fresh water or salt.

In 1906, a pioneer planter of Malaya, the late Mr. E. V. Carey, took up a concession of 30,000 acres on the island and began the planting of rubber and coconuts. The island was bunded and drained. Tide gates were necessary. Enough was known of the control of malaria to enable the labour to be kept free from malaria from the first, and opening rapidly proceeded. To-day some 14,000 acres (or roughly 20 square miles) are under cultivation. No European —of a population of from 20 to 30—has contracted malaria on the island since 1912. In 1922 the average Asiatic population was 4344. There were 26 cases of malaria, 14 clinical cases, and 12 in which parasites were found. This is a rate of 6 per mille. The lowest rate recorded in Panama was 14 per mille. There were at the end of last year 962 children, of whom 9 or 0·9 per cent. had enlarged spleen. In about all, but not absolutely in every case, both adult and child, there is reason to believe the infection had been contracted elsewhere. Steps are now being taken to end the last possible source of malaria, namely the disused and neglected wells in the small private gardens of the coolies. When these are properly supervised, I am convinced malaria contracted on the island will be as unknown as malaria contracted in the centre of London. The death-rate of the labour force in 1922 was 8·2 per mille. This freedom from malaria has been achieved by good drainage and by the selection of suitable sites for buildings. It costs the Estate practically nothing; while the absence of malaria makes the Estate one of the cheapest producers of both rubber and coconuts in the East. This is an example of the control of malaria carried by two species of anopheles, namely *A. umbrosus* and *A. Ludlowi*.

THE CITY OF SINGAPORE.

Following the control of malaria in the coastal regions, a new and apparently even more difficult problem confronted us, namely, malaria on hill land. In the ravines or valleys, when under jungle, malaria was carried by *Anopheles umbrosus*; when the jungle was swept away, when, for stagnant swamps in the valleys, swift clean running streams were substituted, malaria was of even greater intensity; in many places death claiming over 300 out of every 1000 of the population per annum. The mosquito carrier which lived in these streams was *Anopheles maculatus*. It is not my purpose here to detail the various methods by which this malaria has been successfully controlled, even in small rural areas; it has been done at a cost well within the reach of a commercial undertaking; indeed the money spent has been recovered within a short period by the greater efficiency of the labour and a lowered cost of production.

I prefer rather to speak of the excellent work done in the city of Singapore. Prior to 1911 a malaria wave swept over the city almost every year. As will be seen from the chart (Fig. 1), it generally reached its maximum in the month of May. In 1911 I was asked to advise the anti-malaria committee, and drew up plans for the control of malaria in a selected area. The late Dr. W. R. C. Middleton was then Health Officer. For the first two years Dr. Finlayson was seconded for the supervision of the work, which was carried out by Mr. McGee, the engineer engaged for the purpose. Since 1914 the work has been under the control of Dr. P. S. Hunter, now Health Officer of Singapore. He has extended the area greatly; to him the success of the work is mainly due. Dr. Hunter has also extended the work to the fortified island of Blakan Mati, with great advantage to the garrison. Indeed Singapore has now ceased to be malarial, so far as the troops are concerned. The area under mosquito control is almost six square miles. There are $8\frac{3}{4}$ miles of concrete channels and

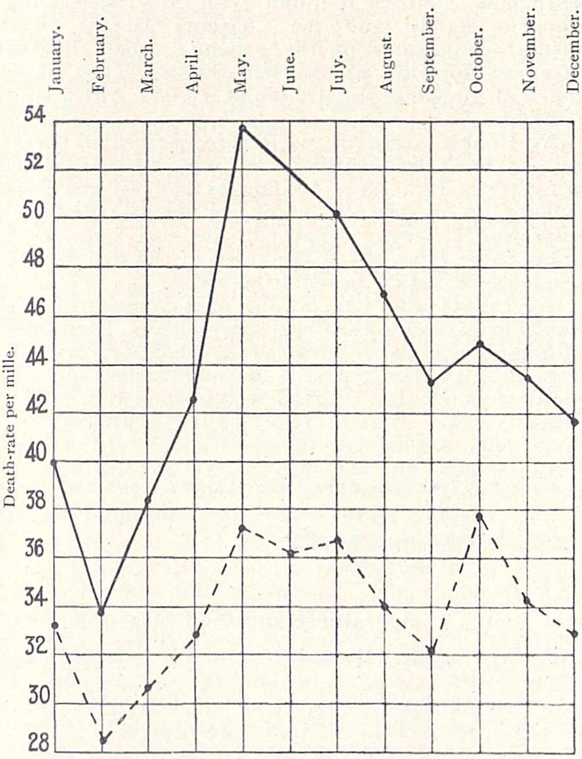

FIG. 1.—Death-rates of city of Singapore.
Average 1903–1912 ·——·——·
Average 1913–1922 · – – · – – ·

31 miles of subsoil drainage. A sum of approximately 350,000 dollars (say 38,000*l*. sterling) has been spent on capital and maintenance accounts. This year there is a vote of 100,000 dollars (say 12,000*l*.) for maintenance and extension of anti-malarial and general anti-mosquito work.

Further details will be found in the chapter on the "Malaria of Singapore," which Dr. Hunter contributed to my "Prevention of Malaria in the Federated Malay States" (London: John Murray, 1921): see also NATURE, March 16, 1922, p. 334. Following the anti-malarial work, the spleen rate of the children fell progressively from about 50 to zero. The great malarial wave, which raised the death-rate in the month of July 1911 to 85·83 per mille, has been so flattened that the influenza peak of 1918 is now responsible for the highest point. The wave will not entirely disappear until the work in Singapore is completed, and until the surrounding country ceases to dump its sick on the city. Anti-malarial work is being extended into the rural districts by Dr. Scharff.

The peak of the malarial wave in May averaged

	per mille.
for the 10 years 1903 to 1912 . .	53·76
,, ,, 1913 to 1922 . .	37·27
a reduction of	16·49

The average annual death-rate from all causes was

	per mille.
for the 10 years 1903 to 1912 . .	44·11
,, ,, 1913 to 1922 . .	33·73
a reduction of	10·38
The average population 1913 to 1922 was	312,763
The saving of life is therefore . .	32,214

The saving of life is from all medical and sanitary measures, but the most important is the control of mosquitoes.

Finally, I may add that in the 25 years since Sir Ronald Ross's discovery, more than 100,000 lives have been saved in Malaya alone, owing to that discovery; and the work is just beginning.

The Far Eastern Association of Tropical Medicine meets in Singapore this year. Arrangements have been made to show members over the anti-malarial work in Singapore, and an excursion to Carey Island has been arranged. MALCOLM WATSON.

Klang, Federated Malay States,
June 24.

Some Consequences of the Gravitational Deflexion of Light.

THE results of the eclipse expeditions of 1919 and 1922 leave little doubt that the deflexion of 1·75″ predicted by Einstein for a ray of light passing close by the sun is a fact. Moreover, as a result of the experiments of Lebedew and Poynting, it is admitted generally that such a ray possesses momentum as well as energy. It does not appear to have been noticed that these experimental results lead to certain important consequences when they are combined with the generally admitted principles of conservation of momentum and of energy.

Let us suppose for the sake of argument that the energy of the ray of light, and consequently also the *magnitude* of its momentum, remains unaltered in spite of the deflexion. Since the *direction* of the momentum has been changed, its component along the real axis of the approximately hyperbolic path has been reversed; if we retain the principle of conservation of momentum for the system sun-light-ray, we conclude that the sun has acquired momentum along the real axis and therefore kinetic energy also. According to the principle of conservation of energy, the energy of the light-ray must have diminished by an equal amount—a conclusion which contradicts the original assumption. Thus we are led to a dilemma: either we must reject one or other of the two principles of conservation of momentum and of energy for the action between the light-ray and the sun, or we must admit that the energy of the light-ray has diminished, as well as its momentum.

It is difficult to imagine a mechanism by which the energy lost by the light-ray is transferred to the sun on the wave theory, though no doubt the pressure of light will play the predominant part, but it is obvious according to the quantum theory. Without entering into details, which must be reserved for a future paper, I may be allowed to refer to one important consequence of the assumption that the light-ray loses part of its energy, namely, that its wave-length is increased by a small amount.

In fact, if the deflexion be δ, the light quantum makes the angle $(\pi-\delta)/2$ with the major axis initially and finally on opposite sides of it. Consequently its loss of momentum in that direction is $(2\nu h/c)\cos(\pi-\delta)/2$, or $(2\nu h/c)\sin\delta/2$ with the usual notation, and this is also the gain of momentum of the sun. Hence the energy transferred is equal to $(2\nu^2h^2/c^2m)\sin^2\delta/2$, where m is the mass of the sun, and it is also equal to $-h\Delta\nu$, where $\Delta\nu$ is the increase of frequency of the light quantum. Thus $\Delta\nu = -(2\nu^2 h/c^2 m)\sin^2\delta/2$, and $\Delta\lambda = -c\Delta\nu/\nu^2 = (2h/cm)\sin^2\delta/2$, a value which is independent of the wave-length, at any rate if δ be so.

For a light quantum passing close by the sun we have $m = 2 \,.\, 10^{33}$ gm., $\delta = 1{\cdot}75'' = 8{\cdot}5 \,.\, 10^{-6}$ radian; hence with $h/c = 2{\cdot}18 . 10^{-37}$ we find $\Delta\lambda = 3{\cdot}9 \,.\, 10^{-81}$ cm., a change which is far too small to be detected by experiment.

If, however, we assume that the negative electron behaves like a very minute gravitating mass, though acting according to a different law on account of its charge, we obtain a connexion with A. H. Compton's recent quantum theory of the scattering of X-rays (*Physical Review*, May 1923, p. 483). Although this theory in its present form does not account for the excess scattering, it is very successful in explaining the small scattering of γ-rays as well as their softening. To this extent it supports the present view of the deflexion of light. I have worked out the orbits of light corpuscles for a gravitating electric charge, but the full discussion of the results and of their bearing on the structure of the electron must be reserved for the paper already referred to.

G. A. SCHOTT.

University College of Wales, Aberystwyth,
September 3.

Suggested Botanical Exploration of the Higher Summits of the Cape Verd Islands.

IT is somewhat surprising that in our much explored world there is still a group of large islands in the Atlantic which in a botanical and probably also a zoological sense may be said to be imperfectly known. For until we know what lives on the cloud-capped summits of islands like Fogo and San Antonio, which attain elevations of 8000 and 9000 feet above the sea, it can scarcely be said that the Cape Verd Islands have been scientifically explored. Surely here would be a good piece of work for an English yachtsman and two or three investigators from Lisbon. Allowing two weeks for each island, the examination of Fogo and San Antonio would only involve about a month's absence from St. Vincent, the assumed starting-place, and a host of botanical and other curiosities would be gathered in the deep ravines and on the uplands of those mountainous islands. With government aid it could be carried out by one of the learned societies of Lisbon.

Fogo is reckoned to be the healthiest of the islands, and it promises to be the most interesting for the naturalist. But whoever goes will have to be prepared for living in damp conditions, as in perpetual fog and mist.

Anything may be in hiding on those cloud-capped uplands. Concealed in the ravines may still survive plants that have become extinct in other Atlantic groups, or which exist only in islands of other oceans or in distant parts of the world, such as the Tree-Compositæ of St. Helena, the Tree-Labiatæ of Juan Fernandez, the Tree-Lobelias of the mountains of tropical Central Africa.

Then, again, American genera, like Clethra, that have died out in the Canary Islands, may still survive in the Cape Verd group, and the same may be said of numerous other plant-types that have died out in other parts of the world, or are almost extinct there. Within the rain-belt of these mountainous islands may still linger remains of once predominant laurel woods and their associated plants, such as are now so characteristic of the Azores, Madeira, and the Canaries.

The most significant features of island-floras are presented in their connexions with distant regions, and it is on this feature that are largely based the hopes of important results arising from the examination of the summits of the mountainous islands of the Cape Verd group. Thus, Tree-Lobelias link Hawaii in the Pacific Ocean with the highlands of Kilimanjaro in tropical Africa; the islands of Bourbon and Mauritius in the Indian Ocean possess species of Acacia trees that are scarcely distinguishable from a tree common in the Hawaiian mountains. So again the affinities of the endemic genera of Juan Fernandez connect its flora with St. Helena, the Canary Islands, and the Chatham Islands. The distant connexions of the endemic genera of the Socotran flora are equally remarkable. They cover much of the globe and are found in Asia, Africa, and America.

As Hooker urged in his lecture on insular floras, islands have frequently served as sanctuaries for plant-types that have become extinct on the continents, and in the same way we would expect the Cape Verd Islands to harbour the kith and kin of many plant-types that have failed in the struggle for existence in distant parts of the world.

We cannot afford to let slip opportunities of this kind for increasing botanical knowledge. The island of Fogo has probably already lost much of its original flora through the agency of the woodcutter, and not many trees remain. Barker-Webb, Hooker, Schmidt, Krause, Vogel, Christ, Hemsley, and Coutinho have done much to elucidate the plant-history of the Cape Verd Islands, but the most interesting features of their flora may be not yet disclosed.

H. B. GUPPY.

Red House, Fowey, Cornwall,
August 29.

Polar Temperatures and Coal Measures.

I THANK Mr. Bonacina for his sympathetic comment in NATURE of September 22, p. 436, on my letter on "Polar Temperatures and Coal Measures" and for the added clarity he has brought to this subject. He mentions disagreement with me on one minor issue only, and that relating to the south polar regions. In that connexion I am glad of the opportunity to confess that my thinking on the subject of polar coal measures has really been based almost exclusively upon my knowledge of the Arctic. My suggestion that similar conditions might explain Antarctic coal was a sort of parenthetical remark made without any special consideration of the Antarctic problem.

Mr. Bonacina says: "I do not, however, fully support Dr. Stefansson in expecting that a lowland south polar continent surrounded by an ice-chilled ocean would be liable, at least so often, to the high summer temperature of the Arctic lowlands." A reading of Mr. Bonacina's letter in comparison with mine will show that this partial disagreement is apparent only, due to my faulty expression. I did not mean to say that if the postulated low Antarctic continent were somewhat larger than the actual present continent, high temperatures would be as frequent there as they would be in the Arctic if the land masses of North America and Asia were connected across the North Pole by continuous low land. All I meant to say was that such a hypothetical low southern continent might have temperatures high enough for the development of a coniferous forest.

Mr. Bonacina gives the explanation which I have supposed correct for the lowering of summer temperatures in the northern Mackenzie valley by almost continuous winds blowing from the north.

He suggests that such winds would be even more persistent in the hypothetical southern continent. In that connexion we must remember that in spite of the northern cold summer monsoon the Mackenzie coniferous forest does extend more than 150 miles north of the Arctic circle, and indeed north of the southern limit of the maximum "tides" in the Mackenzie (by tide we here mean the rise of five or six feet in the eastern Beaufort Sea caused occasionally by westerly gales. The tide, proper, is less than one foot).

No such extremes as the occasional Arctic +95° F. are necessary for the prosperity of conifers. Mr. Elihu Stewart, the Forestry Commissioner of Canada, put on record in the publications of his department (in 1907 or 1908) that he had seen trees 100 feet high more than 100 miles north of the Arctic circle in the Mackenzie delta. Trees above 75 feet in height abound forty or fifty miles farther north. I do not know of any systematic temperature observations taken in the Mackenzie delta at the approximate northern limit of the conifers, but I suppose that 70° F. in the shade is there exceedingly rare. I should judge then that any hypothetical conditions in the Antarctic considered adequate to produce maximum temperatures of 75° F. (even though rarely) would give an adequate heat factor for coniferous forests. VILHJALMUR STEFANSSON.

New Court, Middle Temple, E.C.4,
September 5.

Can the Geostrophic Term account for the Angular Momentum of a Cyclone?

IN meteorological discussion it is sometimes implied that the rotative velocity of the air comprising a cyclone is primarily accounted for by the geostrophic term in the equation of motion.

If considerations of a second order of magnitude be ignored this hypothesis is capable of simple treatment in its main features and is worth examination. Imagine an initial circulation round an axis, of any magnitude whatever, and consider an elemental mass δm at distance r from the axis.

The radial velocity of this element is then denoted by dr/dt taken positive outwards.

The increase in the angular momentum of δm about the axis in time δt due to the geostrophic term is

$$2\omega \sin \phi \,.\, r \,.\, \delta m \,.\, \delta t \frac{dr}{dt},$$

taken positive clockwise in the Northern Hemisphere.

In the limit this becomes $\omega \sin \phi \,.\, \delta m(2r \,.\, dr)$, or $\omega \sin \phi \,.\, d(r^2 \,.\, \delta m)$.

If ϕ be taken as constant, and we sum up for the whole mass of the cyclone, we see that the increase in the total angular momentum in a given time is equal to the product of $\omega \sin \phi$ into the corresponding increment in the moment of inertia about the axis.

The extent to which the moment of inertia can vary is represented by the deepening or filling up of the cyclone, and a rough calculation shows that the possible angular momentum so accounted for is very small, and is, moreover, of the opposite sign to that required by the hypothesis under consideration.

In the above analysis two things have been ignored: (1) The question of the variability of ϕ; (2) the resistance of the earth's surface. If it be supposed that there is a systematic difference between the latitude of the surface inflow and that of the outflow above, there is the possibility of the existence of a term of appreciable magnitude in the case of a large cyclone. On this point observational evidence is weak, and all that can be said is that for a small system the effect must be small, and for large ones we have no reason to suppose it to be large.

The resistance of the earth's surface continually tends to reduce the rotational velocity, and the magnitude of the term concerned is, moreover, large compared with (1), which is of the nature of a differential effect.

On the whole, it seems clear that the angular momentum of a rotating system cannot be accounted for by the geostrophic term, and that its origin must be sought in the initial relative velocities of masses of air subsequently included in the circulation.

L. H. G. DINES.

Benson, Wallingford, August 31.

Zoological Nomenclature: Spirifer and Syringothyris.

IN accordance with prescribed routine, the Secretary of the International Commission of Zoological Nomenclature has the honour herewith to notify the members of the zoological profession that Miss Helen M. Muir Wood, of the British Museum of Natural History, has submitted the generic names Spirifer, Sow, 1816, and Syringothyris, Winchell, 1863, to the International Commission, for suspension of rules, with the view of retaining *Anomia striata* Martin as genotype of Spirifer, and *Syringothyris typa* (s. *Spirifer carteri* Hall) as genotype of Syringothyris.

The argument is presented: (1) that under the rules *Anomia cuspidata* Martin is type of Spirifer, and Syringothyris is synonym of Spirifer: (2) but for seventy years, practically all authors have, in conscious opposition to the rules, taken *A. striata* as type of Spirifer, and *Spirifer carteri* s. *Sy. typa* as type of Syringothyris: (3) so many species are involved in this instance that the application of the rules would present greater confusion than uniformity.

The secretary will postpone vote on this case for one year, and invites expression of opinion for or against suspension in the premises.

C. W. STILES,
Secretary.

Hygienic Laboratory, Washington, D.C.

Colour Vision and Colour Vision Theories.

PROF. PEDDIE states in his letter in NATURE of September 8, p. 362, that the facts that I have given as totally opposed to the trichromatic theory can be explained by it. If he will show how this can be done I can then deal with his explanations. Directly the trichromatic theory is put in a definite form its failure becomes evident. For example, it has been stated frequently by others that the construction of the trichromatic theory given to explain simultaneous and successive contrast will not explain colour blindness, and *vice versa*. There is no fact that directly supports the trichromatic theory. In numerous cases papers written to support the trichromatic theory are found on examination to give facts strongly adverse to it. Prof. Frank Allen has written a number of papers supporting the trichromatic theory. In a paper on the Primary Colour Sensations (*Philosophical Magazine*, vol. xxxviii., July 1919, p. 81) Prof. Allen writes: "But it is difficult to understand why the exceedingly complex region between $\lambda \cdot 470\,\mu$ and $\lambda \cdot 570\,\mu$ should exhibit, as it does, persistency curves with only one elevation in the green." The reader should note that it is only on the trichromatic theory that this region is complex. On my theory it is quite simple and the results should be as stated.

F. W. EDRIDGE-GREEN.

London, September 10.

Transport and its Indebtedness to Science.[1]

By Sir HENRY FOWLER, K.B.E.

PROBLEMS of transportation have been solved more or less successfully in all ages, and some of them, such as the moving of stones to Stonehenge, etc., still excite our wonder and admiration. Such works, and similar ones of much greater magnitude in the East, could be accomplished by quite crude methods if there was unlimited labour available, and if time were of no consequence. The transportation which aids civilisation is that which cuts down the wastage of power to a minimum and reduces the time occupied in carrying this out. It is here that science has helped in times past, and will help increasingly in the future if we are to go forward. In no other branch is Telford's dictum that the science of engineering is "the art of directing the great sources of power in Nature for the use and convenience of man" so well exemplified, and this utilisation has been carried forward at ever-increasing speed during the last hundred years. If we take the definition of science as "ordered knowledge of natural phenomena and of the relations between them," as given by W. C. D. Whetham in the "Encyclopædia Britannica," we shall easily see how transportation has been dependent upon it.

Transport is mainly dependent upon three things—the method of propulsion, the material available for use, and the path over which traction takes place. I propose to confine my remarks to the first two. Advance in traction really became rapid when methods of propulsion other than those of animals and the force of the wind became available. The greatest step forward—wonderful as some of the achievements of aeronautics have been of recent years—came with the development of the steam engine.

Like most great achievements in the world, it was not a lucky and sudden discovery of one individual, although here as elsewhere we associate the work with the name of one man especially. This has usually been the case, and without wishing to detract from the work of the individuals who are fortunate enough to utilise the ordered knowledge available to the practical use of man, one must not forget the labours of those who have sought out that knowledge and have given it freely to the world, thus placing it at the disposal of the one whose imagination and creative faculty were great enough to see how it could be utilised in the service of man.

The first attempt at traction by using a steam engine was a failure because of the lack of this knowledge. I refer to the work of Jonathan Hulls and his attempt in 1736–7 to apply a steam engine to the propulsion of a boat on the River Avon in Worcestershire. He failed because of the lack of that knowledge, although undoubtedly he possessed the necessary imagination.

Although James Watt is not directly associated with traction, it was his application of science to practical use that finally gave the greatest impulse to transportation that it has ever had. No advance had taken place after Newcomen's engine of 1720 until Watt's work of 1769. His knowledge of Black's work at Glasgow on the latent heat of steam, and his own experiments with the Newcomen model, led to the success of his improvements of the steam engine. His scientific knowledge is clearly shown in his patents and publications, for he dealt with steam jacketing in 1769, with expansive working in 1782, and he devised his parallel motion in 1784. His direct connexion with transport includes the reference to a steam carriage and a screw propeller in 1784, while the firm of Boulton and Watt corresponded with Foulton for a period extending from 1794 to 1805.

Although Cugnot in 1770 and Murdoch in 1786 had made models of vehicles propelled by steam, it was Richard Trevithick with his steam carriage in 1801 and 1803 and ill-fated railway in 1804 who first showed the practical application which could be made. It is probable that the engine which his assistant, Steel, took to the wagon-way at Wylam in 1805 turned the thoughts of George Stephenson to the work that has meant so much for us.

No one can read the early life of the "father of railways" without appreciating that he was from young manhood a searcher after scientific knowledge. The advances he gave to the world of transport were all due to his practical application of the knowledge he had obtained himself or had learned from others. It is so often thought that because the early inventors and engineers of the beginning of last century had not received what we now call a scientific education that they were not in any sense of the term men of science. It must be remembered that at that time the knowledge of natural phenomena was very limited, and it was possible to know much more easily all the information available on a subject than at the present day, when we have such a mass of miscellaneous information to hand on every conceivable subject. It was ordered knowledge which led Stephenson to adopt the blast-pipe of Trevithick. It was the desirability of obtaining ordered knowledge that caused him to carry out those experiments which showed to him the advantages of using rails, and it was the scientific appreciation of the necessity of increased heating surface that made him adopt the suggestion of using tubes through the water space in the boiler of the "Rocket." His appreciation of the advantages of science was shown by his acceptance of the presidency of the Mechanical Science Section (then as now Section G) of the British Association in 1838, and it is interesting to note that one of the earliest grants in Section G was for a constant indicator (for locomotives) and dynamometric instruments in 1842–43, while Stephenson was still alive.

From the time of Stephenson the progress in propulsion on rails by steam locomotives was steady if slow. The investigations for a long while were largely confined to the question of expansion and condensation, and although the results attained were noteworthy in the case of steamships, on the rail there was little advance in the principle of propulsion, although the improvements in materials allowed a steady growth in power and size. Although work was done by compounding and using higher pressures, the greatest

[1] From the presidential address delivered to Section G (Engineering) of the British Association at Liverpool on September 14.

advance came to steam locomotives by the use of superheated steam. This was no new thing, for Papin in 1705 seemed to have an appreciation of its value. As pressures and the resultant temperatures increased there came difficulties with lubrication. With the increased use and knowledge of mineral lubricants Dr. Schmit was in 1895 able to devise methods of using superheated steam which have been of the greatest use to transport and to the community.

In spite of the fact that the idea of the utilisation of steam for giving rotary motion is old, its commercial adaptation in the turbine is modern. Rarely, if ever, has there been such a direct and instantaneous application of science to practice. We are too close at present to the matter to realise what a change has taken place in the world owing to the introduction of the steam turbine. One realises the work done by De Laval, Curtiss, Rateau, and the brothers Ljungstrom, but the name which will always be associated with the steam turbine as firmly as that of James Watt is with the inception of the steam engine is that of Sir Charles A. Parsons. The success of his work is due to his application of scientific principles to the many points of the turbine and its accessories. Apart from its application to marine work, it has made possible the economical production of electrical energy, which is doing so much, and will do so much more in the future, for rail transport.

The last means of propulsion that I can deal with is the internal-combustion engine. This, as we almost universally have it to-day, is the result of the cycle adopted by N. A. Otto in his gas engine in 1876. Here again the engines we have are the result of careful and studied investigation, and the advance made has been so much more rapid than in the case of the steam engine and electrical machinery because of the more advanced state of scientific knowledge.

In relation to transport the work has proceeded on two distinct lines, the Daimler and the Diesel engines. In 1885 Gottlieb Daimler produced the engine associated with his name, which utilises a light spirit supplying a carburetted air for the explosive mixture for the cylinder. The development of this engine has itself proceeded in two directions. In one it has been made very much more flexible and silent in its adaptation to motor-car work, while in the other the great desideratum has been lightness and in association with the improvements in the necessary materials has rendered possible the aeroplane as we have it to-day. In both cases the development to the degree reached has been due to a careful study primarily of the pressures, compression, and composition of the mixture.

The Diesel engine was invented in 1894 by Rudolph Diesel, and works by the injection of oil or pulverised fuel into the engine cylinder. Its development has taken place both on the four- and two-stroke cycle, and although considerable progress has been made with land engines, it has been used chiefly for marine transport.

The internal-combustion engine has not been largely used for rail transport owing to its comparatively high cost of fuel per horse-power and its lack of flexibility. The latter is particularly the case when one remembers the high torque desirable, which can be attained in both the steam and electric locomotives in starting.

The early efforts of Hulls have been mentioned, and it was only natural that the work of Watt on land should be followed by application of the new power available to propulsion on the water. Although the growth after the work of Symington, Fulton, and Bell may have seemed to be slow, it was continuous, and constant experiments and research were made both in marine engines and in their application. Saving of fuel has played a much more important part here than with the locomotive, and since more space was available and greater power required, the advantages of the expansion of steam were rendered more imperative and had greater scope than in the other long-established method of mechanical transport. The great advance came with the turbine, and it is interesting to notice that whereas in early days engines were geared up, most of them now are geared down to the screw. Scientific methods have been applied to all those details of measurement and experiment that have led to transport by sea being carried on at increased speed and with decreased cost per ton carried. The application of liquid fuel and the introduction of Diesel engines, both with the object of increasing the space available for cargo, have been carried out on true scientific lines.

Of transport by road it may be said that its commercial inception came at a time when scientific knowledge was well advanced, and its progress was in consequence more rapid. The development of the motor-car engine is a case of the careful application of the fundamental principle developed with ever-increasing care until we get engines as noiseless, as efficient, as trustworthy, and as flexible as we have them to-day.

Much could be said of the indebtedness of aeronautics to science, but I will only speak of the aeroplane. It was not until the development of the internal-combustion engine that the matter became really practical. The War was naturally a great incentive to the advancement of our knowledge of aeronautics. In the means of propulsion, research has given an engine of such size and so light in weight per horse-power that what was a laboured struggle against the effects of gravity has changed into the ability to rise at considerably more than 1000 feet per minute to heights where the rarefaction of the atmosphere renders it necessary for oxygen for breathing to be obtained artificially. The safety of flying as the result of the work of Busk has rendered the machines stable even in such a medium as the air. There is no greater example of the indebtedness of transport to science than the rapidity with which the possibilities of transport by air have advanced.

The other point I would deal with in some detail is the question of materials. We, to-day, have no basic metal or material which was not known when transport first turned to mechanical methods for assistance. The change which has come about has been as largely due to the advances made in metallurgy as to the inventions in mechanics that have led to the improvements in means of propulsion and in machinery. The early builders of steam engines were not only troubled through inability to get their engines machined properly, but also with the difficulties of obtaining suitable material for the parts they required. Steel has been known for thousands of years, but its rapid and economic production is of very recent growth. It has very truly been said that every great metallurgical discovery has led to a rapid advance in other directions. I will as before deal with the railway as an example.

We can scarcely appreciate now the conditions which existed from a metallurgical point of view on our railways when the British Association first met at Liverpool in 1837. Iron—made laboriously, heterogeneous in character and expensive of production not only in money but also, owing to the heavy character of the methods employed, detrimental to the very character of the workman—was the only material available for the various parts of the mechanism of the locomotive and for the rails. However improved the methods of manufacture were, there could never have been a universal development of rail traction if it had depended upon material made in such a way.

The demand was met at the Cheltenham meeting of the British Association in 1856 when Bessemer made public the invention he had already been working on for two years, which was to ensure a cheap method of production of a material so essential to transport. One should also mention with Bessemer the name of Mushet, whose work helped so materially in getting rid of the red shortness which in the early days gave such trouble. We are apt at the present day to belittle somewhat the work of Bessemer in view of the more improved methods now employed, but his name must for ever stand out as the one who made cheap transport possible. After the use of manganese in one form or the other as a deoxidiser and a " physic " for sulphur, there remained, however, the baneful effect, due to phosphorus, which prevented the use of the ores of more general occurrence. There have been few more epoch-making announcements made at meetings of technical subjects—although this was not appreciated at the time by many of the audience—than S. G. Thomas's announcement of the discovery of the " basic " process, which he made at the meeting of the Iron and Steel Institute in March 1878. His work, associated with that of his cousin, Gilchrist, was the result of close scientific research.

Another investigation which has given great results in transport has been the ever-growing use of alloy steels. For the scientific inception of these we owe a great debt to Sir Robert Hadfield. His first investigations materially affect transport to-day. Mushet had previously worked on self-hardening tool steel containing tungsten, but the work was only carried out on a small scale. In 1882 Hadfield had produced manganese steel. This is a most remarkable product with its great toughness, and is extensively used for railway and tramway crossings, where resistance to abrasion is of great value. This was the first of a remarkable series of alloys which have made possible the motor car and the aeroplane as we have them to-day.

Continuing his investigations, in 1889 Hadfield produced the compound of iron and silicon known as low hysteresis steel. Indirectly, this is of the greatest interest from a transport point of view, for when used in transformers it not only reduces the hysteresis losses, but also allows of a considerable saving in the weight of core material.

From these early uses of alloy steels there has grown up a large number of alloys, many of which are of the very greatest use for various transport purposes. It is not too much to say that the modern aeroplane is the result of the material now at the designers' disposal both for the engine and for the structure itself. The strength of some of the chrome-nickel steels combined with their ductility is extraordinary, and is due not only to the composition of the metal, but also to the results which have been obtained by patient scientific investigations relating to their heat-treatment. Taking one other example, one may quote the use of high chrome steel—for the early investigations into which we owe so much to Brearley, and to its later developments to Hatfield also—for the valves of aeronautical engines, subjected as they are to high temperatures. At one time it looked as if the advantages which follow high compression and its resultant high temperatures might be lost owing to the inability of ordinary steels to resist this heat, but the employment of 13 per cent. chrome steel allowed work in this direction to be continued.

It is not only with steels that we have been benefited so much from research. The case is as marked with light alloys, which have aluminium as a base. The latter itself is the result of investigation along scientific lines, and in aeronautical work particularly much has been done towards giving a metal both light and strong by the work of Walter Rosenhain, F. C. Lea, and others.

It may be said that all I have dealt with up to the present has been the result of special investigation, and that " ordered knowledge " is not of assistance to an everyday engineer. The results I have obtained with the assistance of my colleagues, especially L. Archbutt and H. A. Treadgold, dealing with the solid locomotive crank axle are of interest in this connexion. Not only is the axle subjected to stresses set up by revolving it while it is loaded with the weight of a portion of the locomotive on its axle-bearings and by the steam pressure on the pistons transmitted to the crank-pins, but it has also to withstand the shocks set up by its running on the rails, which cannot be calculated. For about twenty years we have endeavoured to get the knowledge we have obtained into an ordered state, from observation and discussion with the metallurgists attached to the various manufacturing firms. Certain points are obvious, such as the necessity of a good micro-structure, and we can with confidence say that the steel " shall be as free as possible from non-metallic enclosures, and that the micro-structure should show uniformly distributed pearlite in a sorbitic or very finely granular or lamellar condition and be free from any nodular or balled-up cementite. It must also be free from any signs of segregation and from any coarse or overheated structure." (Extract from Midland Railway specification for crank-axle forgings.) Toughness rather than strength is required, and the studied consideration of these points has led to an increased life in miles of the crank axles of the 3000 locomotives owned by the Midland Railway Company, in spite of the fact that they have been constantly growing in size, in pressure on the pistons, and in the work expected from them.

It will be appreciated that the above result, which is unquestionably the result of "ordered knowledge of natural phenomena and the relation between them," is only one example, if perhaps the most marked one, in our experience. A somewhat similar record could, however, be written on locomotive tyres and other matters.

I think I have shown adequately the debt which transport, as well as other branches of our profession, owes to the study of "ordered knowledge." That in the future this will be even more marked than at present, one can say without fear of contradiction. Not only so, but there must be more and more interdependence between science and engineering. More and more as we advance in the knowledge of natural phenomena will the necessity of the practical application of this knowledge on a large scale become necessary, to confirm it and to bring out fresh features.

The Influence of Science on Christianity.[1]

By Canon E. W. BARNES, F.R.S.

IT is a commonplace that all religions, even though their formularies and sacred books seem to guarantee absence of change, are constantly modified. Unless religion is moribund it is dynamic and not static. It is a living process within the spirit of man; and, as such, it is profoundly affected by the ideas and emotions of the community in which it exists. Religious thought and feeling alike are influenced, for good or ill, by contemporary political, social, and intellectual movements. During the last century there has been a movement of human thought as influential and as valuable as that of Renaissance humanism. The assumptions and methods of science have affected the whole outlook of educated men. In particular, those branches of science which are concerned with the domains of physics and biology have radically changed our conceptions both of the structure of the visible universe and of the development of life upon this earth.

The effect of the scientific movement, alike on organised religion and on private faith, has been prodigious. In any circumstances it would have been far-reaching. But unfortunately, representative Christian leaders, with the eager support of their communions, opposed the new scientific conceptions as they appeared. Science was then compelled to fight for autonomy on its own territory; and, as Dr. Hobson says in his recently published Gifford lectures, the result has been a prolonged struggle "in which theology has lost every battle." As a consequence it is now widely believed by the populace that Christianity itself has been worsted.

At least a generation must pass before it is generally recognised that, with regard to religion, science is neutral. Educated men know that the traditional presentation of the Christian faith must be shorn of what have become mythological accretions. But Christianity resembles a biological organism with a racial future. In the struggle for existence it gains strength and power by utilising its environment. It seeks both freedom from old limitations and increased mastery of hostile forces. Amid all change its essential character is preserved, for it rests on historical facts combined with permanent intuitions and continually repeated experiences of the human spirit. The great pioneers, whether in science or religion, are few. Men usually accept both scientific and religious truth at second-hand. The expert speaks with the accent of what seems to us to be unmistakable authority. We make such imperfect tests as we are able to apply to his teaching; and perforce rest content.

We must never forget that all human activity, and not merely those aspects which we call science and religion, rests upon unproved and unprovable assumptions. The existence of such assumptions is often ignored. They are there, none the less. Often lazily and hazily we conceal them under the term "commonsense." Faith, however, is a necessity of existence. Zealots sometimes have contended and still contend that there is a moral value in blind faith. But the modern world, so far as it has fallen under the sway of scientific method, demands that faith shall be reasonable and not blind.

In science we build upon the assumption that the processes of Nature can be represented by schemes that are, to us, rational. There is, we postulate, a unity between Nature's processes and the working of the human mind. The address given this year by the president of the British Association shows how extraordinarily fruitful this assumption has proved to be. But, when we consider the vast domains of science which still remain to be explored, we must grant that the rationality of the universe remains a postulate of reasonable faith. As we pass from science to philosophy and religion, we have to assume the existence of a universal Mind in order to bind together the sequences of phenomena which science observes and describes. Then, as the basis of religious faith, we further assume that the values, which we instinctively deem supreme, express the quality of this Mind to whom all natural process is due. We thus assert that goodness, beauty, and truth are not private values of humanity, but attributes of God.

The different processes of the human mind, thought, will, and feeling, cannot be decisively sundered. As a consequence, the search for truth made by men of science has in our own time profoundly affected our religious outlook. Science has not merely created a new cosmogony against which, as a background, religion must be set. But, as the character of its postulates and the extent of its limitations have become more clear, science has given us a new conception of what we mean by reasonable faith. In so doing, it has strikingly altered the way in which we approach religion. Some old modes of argument and their attendant dogmas have rapidly become obsolete. A great gulf has opened between constructive and merely defensive types of theology. Among religious communions there is, in consequence, much confusion, some bitterness, fear of change combined with recognition of its necessity. The direct influence of science

[1] From a sermon preached in the Lady Chapel of Liverpool Cathedral on Sunday morning, September 16, in connexion with the visit of the British Association to the city.

and its more obvious triumphs are known to all. The earth is not the centre of the universe; its age must be measured by hundreds of millions of years; man upon it is the derivative of lower forms of life. No orthodox theologian, in classical or medieval times, held or would have dared to assert such facts. Henceforth they must find their place in any dogmatic scheme of faith.

The indirect influence of scientific method, its patient induction, its readiness to admit divergent conceptual representations of observed facts, its absence of exaggeration, its hostility to evasive language, and, above all, its abhorrence of argument which pretends to be free but is pledged to reach assigned conclusions—this influence has not yet made itself fully felt. Theological thought, which claims to be scientific and is still widely accepted, preserves bad traditions. The work of the best contemporary theologians is free from blame. But to any one familiar with the scrupulous honesty of modern scientific research the dogmatic inconsequence of much current religious apologetic is painful. For this reason young men and women, who have had a scientific training at our universities, often complain bitterly that they cannot get adequate religious teaching. They have no more desire for undogmatic religion than for hazy science. But they demand that religious dogmas shall be taught with the same frankness, the same readiness to admit progress through change, the same absence of elaborate and unnecessary complication as they are accustomed to get in scientific instruction. Especially do they resent the use of archaic language, which they suspect, not always unjustly, to be used as a cloak beneath which awkward problems are concealed. As the influence of the methods of scientific investigation increases, the dissatisfaction to which I have alluded will spread. There is only one way in which accredited religious teachers can overcome it. They must use scientific method. They must avoid, whatever the cost, the snare of obscurantism.

At the present time we suffer from what I feel forced to regard as an unfortunate development in the religious history of England. A century ago the dominant type of English religion was evangelical. The language used had at times the over-emphasis which is common in devotional literature; but men spoke of realities which they had experienced. That their convictions were genuine, their good works abundantly showed. Their faith was a power. Unfortunately it was joined to a cosmology which was fated to be destroyed by the progress of science. The ravages made in their scheme by geology were already ominous in the year 1823. The faith, it was felt, was in danger. Wisdom pointed to the acceptance of new scientific truths. But it is given to few to "greet the unseen with a cheer." So the Tractarians, the religious reformers who then arose, men of piety and ability, turned to the past for safety. The system which they embraced not only contained the cosmology now repudiated by educated men, but was also a synthesis of religious ideas of pagan origin combined with philosophic concepts now obsolete. English religion is still struggling with this burden: and, as I see the matter, no healthy reconciliation between science and organised Christianity is possible until it is cast aside.

Men of science can do much to help the community during the period of transition through which we are now passing. Their reverence for truth can be made an inspiration of especial value to pious souls. Among men of science there is the moral austerity without which the finest intellectual work is seldom, if ever, achieved. During the last generation, moreover, they have shown a steadily increasing sympathy with religion, an enhanced appreciation of the unique power of Christianity, at its best, to serve the human race, to foster spiritual progress while preserving spiritual freedom. I would urge all men of science whom my words may reach to take every opportunity to set forth their religious ideals, to show how, in their own minds, Christianity and science interact. Personally I think it unreasonable to demand that their language should be orthodox. The great master to my thinking is Hort, the only theologian of the nineteenth century who began with a thorough scientific training; and Hort said progress in theology must come "by perilous use and perilous reform." A faith worth having needs no artificial protection. Individually each one of us may make mistakes: in the end truth will prevail through honest argument. The religious sincerity of able men with trained minds is of value in itself; and, I am convinced, the essentials of Christianity will survive by their own inherent strength.

The Swiss National Park.[1]

By Prof. C. Schröter, Federal Technical High School, Zürich.

Seldom has a movement of a purely idealistic character spread so rapidly and victoriously through the world as the movement to protect Nature against the civilisation which threatens to overwhelm it. Everywhere is heard the cry, "save, what may yet be saved, of the original face of mother earth."

Many are the tasks of those engaged in this movement: the preservation of natural geological monuments and prehistoric sites, the protection of rare plants, fine old trees, interesting plant-communities (*e.g.* those of moorland, steppes, or dunes), and the prevention of the extermination of animals. But most effective and profitable of all is the creation of Nature reserves where landscape, plants, and animals alike being protected from the encroachment of man, the sway of Nature is paramount. Such areas may be called "Complete Nature Reserves" or, to borrow an American term, "National Parks."

In 1906 a movement arose in the Schweizerische Naturforschende Gesellschaft, which resulted in the formation of a Commission for Nature Protection, with Dr. Paul Sarasin, of Basel, as president. This

[1] For the translation of the original manuscript the author is much indebted to Prof. R. H. Yapp, University of Birmingham.

Commission, which consists of geologists, botanists, zoologists, and archæologists, serves as a co-ordinating centre for the various efforts for Nature protection throughout Switzerland. Local sub-commissions have been appointed in all the Swiss Cantons, which suggest, for their respective Cantons, local laws for Nature protection. Already the Commission has secured the preservation of about 400 erratic blocks and 50 trees of special interest; further, some 13 moors, lake margins, bird sanctuaries and nesting-places have been

FIG. 1.—The Scarl Pass near Schembrina; in the background Murtèra la Tamangur (2998 m. above sea-level). The wood consists of larch and *Pinus cembra*.

FIG. 2.—Piz Linard (3414 m. above sea-level), seen from Zernetz. (This mountain is not in the National Park, but one of the finest sights from the Park.)

declared protected areas. The chief work of the Commission, however, has been the creation of a Swiss National Park. After many attempts an area of about 140 sq. kilometres in the Ofen district of the Lower Engadine was secured (between the years 1909 and 1914) as a Complete Nature Reserve.

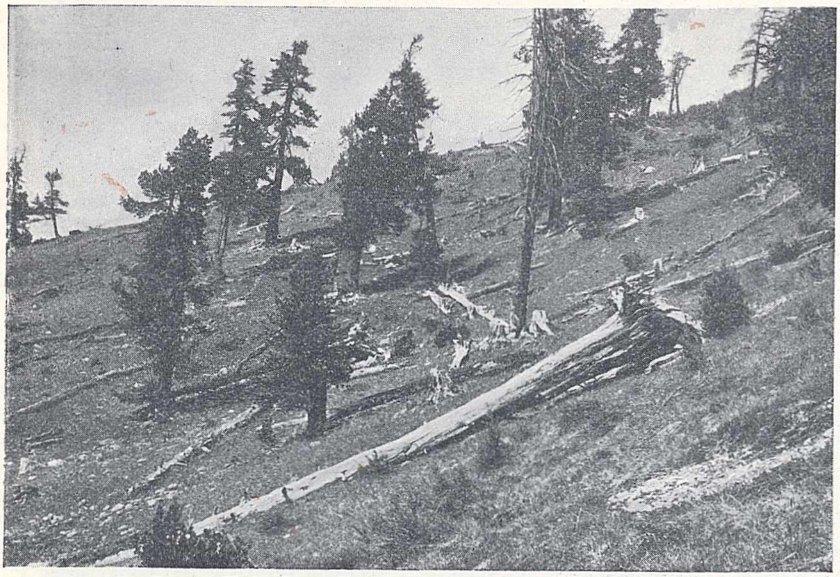

FIG. 3.—Timber line at Munt la Schera. (Larch and *Pinus cembra*.)

This district is peculiarly suitable for the purpose for the following reasons: Its mean elevation above sea-level is considerable, in consequence of which the snow line lies as high as 3000 metres and the alpine tree limit at 2300 metres. Alpine life, therefore, can be widely distributed within the area. In wildness and naturalness, as in loneliness and seclusion, it is scarcely surpassed anywhere in Switzerland. It is very sparsely populated, so that the prohibition of forestry and grazing operations involve but little hardship for its human inhabitants. It possesses extensive forests, of which the 2600 hectares of dense forest of the erect mountain pine (*Pinus montana*, var. *arborea*) deserve special mention. There are also magnificent forests of *Pinus cembra*, mixed woods of spruce and larch (*Picea excelsa* and *Larix europaea*), a peculiar mountain race of Scotch fir (*Pinus sylvestris*, var. *engadinensis*), and extensive areas occupied by the creeping mountain pine (*Pinus montana*, var. *prostrata*). In addition to the great abundance of conifers there is also a rich herbaceous flora, the great variety of geological substrata rendering possible the existence of both calcicole and calcifuge plants. The dividing line between the floras of the western and eastern alps passes through the region. In the National Park there is, therefore, a mingling of eastern and western forms, many eastern species occurring, so far as Switzerland is concerned, only in this district. Animal life, too, is abundant, chamois, marmots, deer, foxes, black game, golden eagles, etc., enlivening the landscape.

The greater part of the National Park is leased by the State from the owners of the land for a period of ninety-nine years, the State alone having the power to terminate the contract. The State has further pledged itself to contribute a sum not exceeding 30,000 francs per annum for the rent of the Park. Human interference is absolutely excluded from the whole region. Hunting, fishing, manuring, grazing, mowing and wood-cutting are entirely prohibited. No flower or twig may be plucked, no animal killed and no stone removed; even the fallen trees must remain untouched. In this way absolute protection is secured for scenery, plants, and animals; Nature alone is dominant. Any one may visit the Park, but only simple alpine shelter huts are provided—no hotels are allowed to be erected. Camping and the lighting of fires are prohibited. The custodianship of the Park is entrusted to four resident keepers.

FIG. 4.—Alp la Schera with Munt la Schera (2588 m. above sea-level).

The Schweizerische Naturforschende Gesellschaft has undertaken to carry out a thorough scientific investigation of the National Park, and its Scientific Park Committee is now engaged on this work. The initial task is the preparation of complete lists of species inhabiting the reserve. Further, by means of exact surveys of selected areas, repeated from time to time, it is hoped to study—as the previous influence of man and his domestic animals becomes more remote—the gradual restoration of the original flora and fauna, the re-conquest of pasture by forest, and so on. By the work of successive generations of investigators, it will be possible to follow the truly natural successions and changes occurring within the area, and to study in detail the natural relations between soil, climate, and organisms. The safeguarding from interference by man and beast will also be utilised to study the slow secular changes of land and water. In this unique laboratory, the naturalists of Switzerland will find themselves united in a common work. Maintenance expenses, such as the wages of the four park keepers and the upkeep of roads and huts, as well as the cost of the scientific investigations, are provided by the Schweizerische Bund für Naturschutz, an association which at the present time numbers more than 30,000 members.[2] Thus the Swiss National Park is a commonwealth in which alpine Nature can recover and develop undisturbed: a refuge, a sanctuary for plant and animal life. It is an island of primeval Nature, unaffected by the devastating waves of human civilisation which break about its shores. During visits to this Nature reserve one cannot fail to be impressed by the grandeur of the scenery and the wealth of plant and animal life. But still deeper is the feeling of patriotic pride that a whole nation is pledged to preserve this fragment of primitive Helvetia, unexploited for purposes of material gain, as a heritage for generations yet unborn. It is a piece of idealism especially valuable in this materialistic world.

[2] The annual membership subscription is 2 francs, life membership 50 francs. Foreign members are welcomed; any one wishing to join is invited to communicate with Dr. St. Brunies, Sekretär des Naturschutzbundes, Basel, Oberalpstrasse 11.

Obituary.

DR. E. F. BASHFORD, O.B.E.

AN outstanding figure in cancer research has been removed by the death, from heart failure, of Dr. Ernest Francis Bashford. After a most distinguished medical career at the University of Edinburgh, he pursued laboratory investigations in Germany, especially under Ehrlich, and became assistant to Sir Thomas Fraser in pharmacology. Even in the short time he spent in that laboratory, he enriched pharmacology by a memorable contribution on the antagonism of atropine and morphine.

When the organisation now known as the Imperial Cancer Research Fund was started in 1902, the committee appointed Bashford as general superintendent and director of the laboratories. So well was the confidence of the committee justified that in a few years his researches were known all over the world, and the laboratory, housed originally in the upper floors of the College of Surgeons' hall on Victoria Embankment, was recognised by all as the leading institute in the world for the experimental study of cancer. The position achieved was the outcome of intense work by a brilliant staff of colleagues inspired and directed by a forceful, imaginative, and tireless personality. The memorandum of proposed research submitted to the committee by Bashford at the commencement is still on record and demonstrates how surprisingly he, a young man with little previous acquaintance with the problems and quite inexperienced in the responsibilities of an institute, had grasped the essential fact that cancer must be studied as a problem in comparative biology. The exact statistical investigations of cancer in human beings in Great Britain and the collection of reports of its occurrence in civilised and uncivilised races early occupied his attention, and his writings proved convincingly that the incidence of the disease could not be correlated with many of the factors that impressed, and still impress, the imagination of the uninitiated. When there was added to this the study of the zoological distribution of cancer, the insistence on the breadth of the problem became obvious.

The first real advance in the biological study originated from the discovery by Jensen of the transplantability of a mouse carcinoma. The avenues thus opened up were enthusiastically explored, and there followed in rapid succession contributions dealing with the cytology of malignant new growths, the source of their cellular constituents, the specific reactions of the host, the induction of artificial resistance to growths, the study of refractoriness or susceptibility, the demonstration of the essential similarity of malignant neoplasms throughout the animal kingdom, biochemical investigations of great importance, and a host of other observations over the whole field which may be found in the first five Scientific Reports of the Imperial Cancer Research Fund published under Bashford's direction. Ill-health compelled him to resign his appointment in 1914. During the War he served in the Army in France as a pathologist, and was at the time of his death adviser in pathology to the British Forces on the Rhine. His work marks the beginning of the era of the scientific study of cancer in Great Britain.

ARCHIBALD LEITCH.

LORD MORLEY, O.M., F.R.S.

LORD MORLEY, whose death on September 23, at eighty-four years of age, we regret to record, was a great statesman and intellectual leader, the memory of whose work and noble character will long be cherished. As a writer on literary, historical, and biographical subjects, he covered a wide field in a style at once delightful and stimulating, and in the field of public life he preserved the best traditions of sincerity and truth. Though Lord Morley was not directly concerned with scientific research, he was sympathetic towards it, and was elected a fellow of the Royal Society in 1892 under the rule which permits the Council to nominate for election persons who "either have rendered conspicuous service to the cause of science, or are such that their election would be of signal benefit to the Society." He was a trustee of the British Museum, 1894–1921, chancellor of the University of Manchester from 1908 until last March, and one of the first members of the Order of Merit created by King Edward VII. in 1902. Lord Morley was made an honorary LL.D. of the Universities of Glasgow, 1879, Cambridge, 1892, St. Andrews, 1902, and Edinburgh, 1904, and an honorary D.C.L. of Oxford in 1896.

Lady Shaw.

Deep sympathy will be felt by a large section of the scientific world at the bereavement which Sir Napier Shaw has suffered by the death on September 22 of his wife, Lady Shaw, who was well known in scientific circles. Lady Shaw was for some time lecturer in mathematics at Newnham College, Cambridge, and was the author of an original little book entitled "First Lessons in Observational Geometry," published by Messrs. Longmans, Green and Co. in 1904. In this book, a course of observational and experimental geometry was outlined similar to that afterwards adopted in schools on the recommendations of committees on geometry as the best introduction to the formal study of the subject. Lady Shaw took a very active part in many organisations and institutions concerned with education, science, and progressive development generally. She was a member of council of Queen's College, London, and of the Women's Local Government Society. She served on several committees of the British Association, and was the secretary of the Citizenship Committee which has prepared and issued some valuable reports. Lady Shaw was also a member of Council, the Executive Committee, the Education Committee, and the Health Committee of the British Science Guild, and the members of these bodies, as well as all others associated with her, hold her memory in grateful remembrance.

Prof. W. Roser.

Prof. Dr. Wilhelm Roser, one of the directors of the Farbwerke vorm. Meister Lucius und Bruening in Hoechst-on-Main, died at Frankfort-on-Main on May 20. He was an important contributor to the development of the German industry of pharmaceutic products and coal-tar dyestuffs.

Prof. Roser came from an old-known Swabian family; his father, Prof. W. F. Roser, was an eminent surgeon of the University of Marburg, and there W. Roser was born on January 30, 1858. At this University he first studied mathematics, a science to which he devoted his hours of leisure. Afterwards he changed over to the study of chemistry under the guidance of Zincke. After a short stay with Fittig in Tübingen, he returned to Marburg and received his doctorate in 1882 for a research upon terebinic acid. For his studies regarding phthalyl-derivatives he received the *venia legendi* in 1885, and researches concerning pyridine and quinoline derivatives enabled him to clear up the constitution of narcotine, an opium alkaloid.

After his nomination as a professor in 1892, the Hoechst firm engaged Prof. Roser as director of the scientific department of their works, at a time when the German chemical factories, having successfully produced acetanilide, phenacetine and antipyrine, were devoting themselves to the further investigation and production of medicines. Prof. Roser was able to direct this work with success. He took part in the elucidation of the constitution of adrenaline and in the synthesis of rivanol, while in the dyestuff branch he was also very successful. It was his main task to introduce young chemists who had come from the High Schools into the works, to the way of working and thinking necessary for technical practice. Several generations of technical chemists owe him their education. He himself was a taciturn man of keen observation and wide knowledge, highly esteemed by industrial chemists as well as by men of science.

We regret to announce the following deaths:

Mr. Malcolm Fraser, late Registrar-General and Government Statistician of Western Australia, on September 17, aged sixty-six.

Dr. F. J. H. Jenkinson, since 1889 Librarian of the University Library, Cambridge, on September 21, aged seventy.

Prof. R. Pumpelly, formerly professor of mining geology at Harvard University, and for many years on the United States Geological Survey, on August 10, aged eighty-five.

Current Topics and Events.

It would appear that the protests which have appeared in the *Times* and elsewhere against the proposed erection of a wireless station at Avebury have been successful. Sir Charles Oman in his presidential address to the Gloucestershire Archæological Society, as reported in the *Times* of September 14, announced that he had received a letter from Sir L. Worthington Evans, the Postmaster-General, stating that the proposal would probably be dropped. Recent experience has made it clear that existing legislation for the protection of sites of archæological importance is inadequate, while it affords no guarantee in the case of any site which is not scheduled under the Protection of Ancient Monuments Act. In the present instance, it is peculiarly disturbing that Government Departments were concerned in what can only be described as an act of vandalism. During the recent meeting of the British Association at Liverpool, reference was made to this matter on more than one occasion, and before the Association dispersed, a resolution was passed which, while instancing the cases of Holmbury Hill, Avebury, and Lulworth Cove, urged strongly in general terms the extension of the powers which may be exercised in the protection of sites of natural beauty or archæological interest.

The use of pulverised coal is spreading steadily, and at the present time more than 20,000,000 tons per annum is being burnt in the United States and Canada alone, largely in the cement, iron and steel, and glass industries. Also the use of coal in a fine state of division is being considered in connexion with the manufacture of briquettes, low-temperature carbonisation, and total gasification processes, such as producer gas. The most striking progress, however, during the last three or four years has been in the use of pulverised coal for steam generation. Since 1920 some of the largest and the most important power stations in the world have adopted this method of firing, and we understand that to-day more than 1,000,000 tons per annum is being burnt under steam boilers on the " Lopulco " system, while in the next few months, as soon as plants now in course of erection or conversion are completed, the figure will exceed 2,500,000 tons. The pioneer large boiler plant installation for pulverised fuel is the " Lakeside " station of the Milwaukee Electric Railway and Light Co. on Lake Michigan, 40,000 kw. of which was started up in December 1920. This boiler plant is held to be the most efficient in the world, running all the year round at 85-86 per cent. efficiency. The first large pulverised fuel boiler plant in Europe is now being erected at the Vitry power station, Paris.

JUST forty years ago, on September 29, 1883, Prof. Dr. Carl Duisberg entered the employment of the Farbenfabriken Bayer and Co. in Elberfeld, and the influence he has exerted upon the development of the German industry of coal-tar dyestuffs and pharmaceutical products has made his name renowned throughout the world of applied chemistry. Prof. Duisberg received his doctorate at Jena; he then went to Munich in order to complete his education under Adolf von Baeyer, and at that time laid the foundation of the great friendship which for the future connected him with that eminent chemist and with a large number of his pupils. Shortly after he entered the Farbenfabriken, and succeeded in making essential improvements in the manufacture of substantive cotton dyestuffs. He thereupon became the head of the firm's scientific laboratory, in which he mainly endeavoured to put the purely chemical work on a broader basis than heretofore. At the same time he began to organise the whole business, first by dividing the work of the chemists according to the different kinds and classes of dyestuffs, etc., and then by uniting in one working concern the four principal German firms which make direct cotton dyestuffs. This was the first step in the formation, later on, of the "I.G.," the large concern of German coal-tar dye makers. The site of the works in the narrow Wupper valley of Elberfeld having become insufficient for the rapidly increasing manufacture, it was resolved to build large modern works, and under Prof. Duisberg's direction a magnificent plant was erected at Leverkusen, near Cologne. During the War, after some years of keen competition, the remaining dye-making firms joined this first amalgamation, chiefly through Prof. Duisberg's influence, thus forming one large combine in which the firms preserve their individualities but, at the same time, all proceedings are directed by a uniform programme, and each firm partakes of the profits of the whole concern according to its share in the work. In addition to his activities at the Farbenfabriken, Prof. Duisberg is well known by many other achievements in chemistry, while his great versatility is manifest from the volume containing his essays and speeches published by the Farbenfabriken on the occasion of his jubilee.

THE intellectual stimulus to China of the revolution of 1911 is still manifest by increased scientific and intellectual activity. Despite the political disturbances of the last two years, the scientific institutions are growing in number and usefulness. The Geological Society of China was founded last year, and held its first annual meeting at Pekin in January under the presidency of Dr. V. K. Ting. This year has also seen the establishment of " the China Society of Science and Arts," of which the *China Journal of Science and Arts* is the official organ. It is also the journal of the Shanghai Chemical Society. The fourth number, issued in Shanghai in July (price 2 dollars, pp. 303-424), edited by Mr. A. de C. Sowerby and Dr. J. C. Ferguson, includes an interesting series of papers and notes on scientific and artistic work in China. The articles deal with the Chinese fisheries of Amphioxus, which in places is a food-fish; the Chinese "Mudskipper," *Periophthalmus cantonensis*, which Mr. Sowerby suggests is not merely in the process of evolution to a terrestrial life but may give rise to a race that may replace the higher vertebrates; " The Dragon Mines," by Dr. J. Gunnar Andersson, who describes the ancient Chinese excavations for fossil vertebrates for use as medicine, and also the recent research on Chinese vertebrate palæontology; the war on insect pests, and on the rôle of bacteria; ancient Chinese coins, by E. F. S. Newan; Chinese female names, by J. C. Arlington; Chinese landscape gardening, by Miss Ayscough; a recent exhibition of Chinese pictures; a journey to the Yangtze gorges for photographic work, by H. F. Carey; the dissociation of prehnite, zoisite, and epidote, by E. Norin; the conditions of the Chinese soap manufacture, by Mr. Hsu; and the aborigines of Western China. There are also various reviews and notices of the work of the Chinese scientific societies. The Journal is well illustrated, and deserves the support of all interested in China, as it gives a useful general review of scientific, artistic, and literary work in and in connexion with China.

SIR HUMPHRY ROLLESTON will deliver an inaugural address on " The Problem of Success for Medical Women " at the London (Royal Free Hospital) School of Medicine for Women on October 1, at 3.30 P.M.

THE Research Association of British Flour Millers has been approved by the Department of Scientific and Industrial Research as complying with the conditions laid down in the government scheme for the encouragement of industrial research. The secretary of this Association is Mr. G. H. Ball, 40 Trinity Square, E.C.

THE *British Medical Journal* announces that the Canadian Medical Association is arranging for a Lister Oration to be given once every three years. The first of these will be given next year at the annual meeting in Ottawa by Dr. John Stewart, of Halifax. Dr. Stewart was one of Lister's house-surgeons in the early days of the latter's work in Edinburgh.

ACCORDING to the New York correspondent of the *Times*, a number of fires broke out in many counties of California on September 17, one of which spread to the residential district of Berkeley. Some six hundred houses were destroyed, including the residence of Dr. B. I. Wheeler, president-emeritus of Berkeley University, but all the buildings of the University itself were saved. The damage is estimated at 2,200,000*l*.

THE Institution of Petroleum Technologists is now installed in its new offices at Aldine House, Bedford Street, Strand, London, W.C.2. In addition to a general office, council room, and a well-appointed library, a large room has been fitted up as a members' room. As a house-warming for the new offices, the president and council will receive members and their friends on Wednesday evening, October 3, from 8 to 10 P.M. During the evening scientific apparatus will be exhibited and demonstrated. Admission is by ticket only.

THE lectures on recent excavations given during the summer by Miss Claire Gaudet will be repeated this winter on Thursdays, commencing October 4, at the British Museum. The subject, as before, will begin with the earliest known civilisation as shown by the discoveries made within the last few years in Mesopotamia, and will include the excavations at Ur and this year's work at Kish, now known to have been the capital of the first Empire in the world's history, and said to date from about 5000 B.C. The evolution of architecture from these early times until the Roman and early Christian periods, showing the classical influence on all subsequent art up to the present day, will form the basis of the lectures, including whenever possible the arts and crafts of the people. Further particulars may be obtained from the Hon. Secretary, 120 Cheyne Walk, Chelsea.

SIR ARTHUR KEITH, in his annual report on the museum of the Royal College of Surgeons, refers to the completion of the series of exhibits illustrating the principles of pathology. In 1910, Prof. Shattock and Mr. Cecil Beadles commenced to select, arrange, and catalogue specimens. The War interfered with this work; but six further stands were interpolated this year with the noteworthy result that, for the first time, "a complete and systematic treatise on disease has been written, not in words, but in illustrative specimens," and the scope of the pathological section is regarded as fixed. Mr. Cecil Beadles is now in charge of the National War Collection, which will soon be arranged in accordance with an approved scheme. The president of the Royal College of Surgeons of Edinburgh has been given leave to make a selection from War specimens left in store, for the museum of his college. Among notable additions made to the Museum during the past year are a cast of the tooth held by Dr. H. F. Osborn to indicate the existence of a human genus, Hesperopithecus, in N. America during the Pliocene period; a skeleton, probably of Anglo-Saxon date, showing evidence of infantile paralysis, "the earliest trace of this disorder in England"; and the late Celtic remains found at Wortley, Hants, presented by Mr. R. W. Hooley.

PORTO SANTO, the northern island of the Madeira Archipelago, has a population of nearly three thousand, and the inhabitants have the reputation of being free from dental caries. Dr. M. C. Grabham visited the island recently and examined six hundred natives, twenty-eight of whom were found to be cases of well-established caries. All except seven of these people, however, came from Madeira, and only two of the seven showed the sign which characterises the Porto Santo dentition and is associated with immunity from caries. Early in life, natives of the island develop this characteristic, which consists of a slight yellow band on the upper incisors, and whenever this yellow stain is present, a sound set of teeth accompanies it. The line or band occurs and develops with a regularity which gives evidence of the permeation of the blood fluids in the interstices of the columnar enamel and is associated with an influence protective against the access of caries. Both the stain and the protective influence appear to be derived from the highly mineralised water of the island, the springs of which are rich in chlorides, carbonates and sulphates, in contrast with the sweet waters of Madeira. Dr. Grabham found no scurvy on the island, but many cases of pulmonary disorder. Diarrhœa and alimentary ailments were singularly absent, and the mineralised waters seemed inimical to intestinal parasites. There was no existing instance of malignant disease. Traditionally some cases have occurred, but no form of cancer has taken root at Porto Santo, and Dr. Grabham is inclined to associate this exemption with the simple feeding of the people and with the absence of animal fats, except lard, from the food, and lard is known to be deficient in the vitamin necessary to promote growth and prevent rickets. Food is taken cold; there is no milk or green vegetables, and nothing to involve grinding mastication. The main sustenance is derived from maize boiled with a modicum of lard, with the occasional addition of fish and an onion or two. At the Liverpool meeting of the British Association, where Dr. Grabham described the results of his inquiry, he showed a skull (since deposited in the Hunterian Museum) of a Porto Santo man of about sixty years of age, taken promiscuously from an exposed grave, whose teeth were all sound: and also exhibited many specimens of the soil, the vegetation, and the mineral water with analyses.

AMONG the forthcoming books announced by the Old Westminster Press is the 3rd edition of "Popular Fallacies" by A. S. E. Ackermann, which contains 696 pp. of new matter, and deals with 1350 fallacies, including the 460 of the 2nd edition.

THE Oxford University Press will publish shortly an original work, by Mr. R. T. Gunther, on the instruments used by early men of science, under the title "Early Science in Oxford." The work will be issued in two volumes—one on chemistry, mathematics, physics and surveying, and the other on astronomy. No university is richer in the apparatus and records of bygone men of science than Oxford. Mr. Gunther's illustrated account of her early science is the outcome of a first attempt to direct attention to those instruments, and to early descriptions of instruments, by which scientific studies in the university have been advanced.

DR. D. H. SCOTT is bringing out through Messrs. Macmillan and Co., Ltd., "Extinct Plants and Problems of Evolution," a volume founded on a special course of lectures given in 1922 at the University College of Wales, Aberystwyth, the object being to sketch, in broad outline, the geological history of the plant-kingdom, in its bearing on the theory of descent. Messrs. Macmillan also announce "Life in Southern Nigeria: The Magic, Beliefs, and Customs of the Ibibio Tribe," by Amaury Talbot, Resident, Nigeria; vol. iii. (Mammalia) of Prof. von Zittel's "Text-book of Palæontology," revised by Dr. Max Schlosser, translated under the direction of the late Dr. C. R. Eastman, by Marguerite L. Engler and Lucy P. Bush, and revised by Dr. A. Smith Woodward; and a new and revised edition of Prof. W. J. Sollas's "Ancient Hunters."

Errata:—In the article on "The Earth's Magnetic Field for 1922," by Dr. Louis A. Bauer, in our issue of August 25, the formula on p. 295 should be given the number (1); the second author mentioned in the fourth paragraph, third line, p. 296, should be Mr. H. Furner instead of Prof. H. H. Turner.

Our Astronomical Column.

THE SOLAR ECLIPSE OF 1922 AND EINSTEIN'S THEORY.—The current number of the Lick Observatory Bulletin, No. 346, contains the results of the observations on the deflexion of light in passing through the sun's gravitational field made during the total solar eclipse of September 21, 1922, at Wallal, Western Australia. The authors, Prof. W. W. Campbell and Mr. R. Trumpler, give all details for this particular research, which represents only a part of the programme of the William H. Crocker Eclipse Expedition from the Lick Observatory. Two very interesting diagrams show at a glance the type of the results obtained. The first of these is a star chart of the neighbourhood of the eclipsed sun containing the 92 stars actually measured for the investigation. The observed relative displacements of the stars are indicated by short lines oriented according to the directions of displacements. The outline of the brighter parts of the corona as well as the limit of the faintest traces of coronal light are indicated. The second instructive diagram shows the observed radial displacements for each star as a function of the star's angular distance from the sun's centre, while for comparison sake a curve is given indicating the values predicted by Einstein's theory. This graphical representation demonstrates the coincidence between the observed and the predicted light deflexions. By arranging the stars in groups according to their distance from the sun's centre the observed relative radial displacements can be seen from the accompanying table.

Group.	No. of Stars.	Weight.	Mean Dist. from Sun.	Obs. Rad. Displ.	Theoretical Rad. Displ.
			°	″	″
1	8	9·09	0·64	+0·64	+0·70
2	11	19·42	1·06	+0·35	+0·37
3	10	20·15	1·40	+0·30	+0·24
4	8	22·41	1·66	+0·16	+0·17
5	9	21·10	1·90	+0·17	+0·13
6	8	24·67	2·00	+0·15	+0·11
7	11	21·32	2·22	+0·08	+0·08
8	13	21·37	2·55	−0·09	+0·02
9	14	22·78	2·97	−0·04	−0·03

It will be noted that the observed radial displacements given in this table are in remarkably good agreement with the values predicted on the basis of Einstein's theory. The authors point out also that even the stars between 1·25° and 2·25° from the sun's centre, which lie entirely outside of any trace of the corona, show the light deflexion well marked, an effect that would be difficult to explain by an extended solar atmosphere.

EPHEMERIDES OF ALGOL VARIABLE STARS.—At the meeting in Rome of the International Astronomical Union in 1922, the representatives of the Cracow Observatory undertook the calculation and publication of these ephemerides. No. 1, containing these calculations for the second half of 1923, has lately come to hand, edited by Th. Banachiewicz. The explanatory matter is printed both in Polish and in Peano's flexionless Latin, the latter being easy to read.

Comment is made on the fact that from the date January 1, 1925, the astronomical day will begin at midnight, which will cause a break of continuity in formulæ that use the Julian day (beginning at noon). To avoid confusion, it is suggested that a new cycle of days be employed for this purpose, the zero date being the midnight at the beginning of January 0, 1801 (Greenwich). This is adopted in the present work, and tables are given to reduce calendar dates to it. Tables are given for 31 stars, including Algol, the adopted elements being corrected by recent observations, made in several cases by J. Gadomski at Cracow. The times of minimum are given to the third decimal of a day (about $1\frac{1}{2}$ minute).

Since all the minima occurring on each day are arranged on the same page and in the same line, it is a very simple matter to draw up a programme of work on any given night.

FURTHER SEARCH FOR INTRA-MERCURIAL PLANETS.—Though we know from the presence of the Zodiacal Light that there is a considerable amount of scattered matter inside the orbit of Mercury, it becomes more and more unlikely with each total eclipse that there is any single body of sufficient size to be separately discerned or photographed. Prof. Campbell and Mr. Trumpler have made a careful search on the large plates (17 inches square) taken for the Einstein problem in the eclipse of September 1922. They embrace an area of $15° \times 15°$, and show 550 stars, the faintest being of magnitude 10·2. They were compared, star by star, with the comparison plates taken in Tahiti four months earlier. Nothing was detected in the search; it is noted that rapid motion might weaken a planet's image, but, allowing for this, there could not have been any planet as bright as magnitude 8·5 in the region of the plates, unless it was in the denser parts of the corona. Perrine's search in 1908 covered a region $25° \times 8\frac{1}{4}°$, but did not reach quite such faint stars as the present series.

Research Items.

MAGLEMOSE CULTURE IN EAST YORKSHIRE.—The discovery of the Maglemose harpoon at the lacustrine deposits at Skipsea has led Mr. A. Leslie Armstrong to examine, in search of further examples of Maglemose culture in Yorkshire, the strata exposed by recent erosion on the Holderness coast. In the September issue of *Man* he describes a number of flint implements found in the course of his exploration. He remarks that "it is significant that when placed side by side with a series of the usual East Yorks artifacts from the surface, these deeply stained examples from the silt and peat beds are as distinctive therefrom in type as they are in patination, and that they can be paralleled in both patina and type only by certain implements of a dark brown and highly lustrous patina found upon one or two restricted areas in the vicinity of Skipsea and Atwick, upon elevated ground, which there is reason to believe represent former islands in the ancient marshland and sites of early occupation."

NEOLITHIC MAN IN PATAGONIA.—In "Habitantes Neoliticos del Lago Buenos Aires" (*Revista del Museo de La Plata*, xxvii. pp. 85-160), Dr. José Imbelloni describes human remains from Lago Buenos Aires—a place far away in the south-west of Patagonia, which must not be confused with the town of Buenos Aires. It would appear that the number of prehistoric skeletons found in Patagonia diminishes rapidly from north to south. The description, therefore, of a number of finds near Lago Buenos Aires, in the south-west, is of special importance. The ten skulls described were found so long ago as 1897 by Dr. S. Roth under constructions called *chenques*—erections consisting of stones heaped over the bodies more or less symmetrically without there being any form of dug graves. A number of these *chenques* occur in the region of the lake in question. Their age is stated to be Neolithic, though the only proof appears to be the absence of metal (other than precious) from the funeral furniture associated with the burial. Neolithic culture it may be, but of what date in time? To the student of the physical structure of the early inhabitants of this part of the world Dr. Imbelloni's brochure will be of interest, for a long and detailed description of the skulls is given. Comparisons with similar remains from further north are also included. Mention is made of some of the prehistoric skulls of the Old World, but, though interesting, it is to be doubted if any real correlation between types and even cultures of the New and Old Worlds is ever really likely to be fruitful.

SURVEYS IN GREENLAND.—The work of the Danish bicentenary expedition to North Greenland under Mr. Lange Koch included important explorations in Peary Land. Some account of this work with preliminary maps appears in an article in the *Geographical Journal* for August. The expedition filled in the surveys of the north coast between De Long Fjord and Cape Bridgman, thus practically completing the general survey of the coasts of Greenland. On the return journey the southern part of Peary Land was explored and surveyed, and the problem of the so-called Peary Channel reported by the late Admiral Peary in 1892 was finally solved. Erichsen in 1907 found that the channel as a seaway did not exist, but Mr. Koch has now discovered the reason of Peary's mistake. The course of the "channel" between J. P. Koch Fjord and Bronland Fjord is occupied by a long low valley, the flow of which is about 200 metres above sea level. Wandel valley, as it is named, separates Peary Land from the rest of Greenland. Peary Land is thus virtually an island, and probably during the period of greatest glacial subsidence in the past was entirely separate. It consists of a northern mountain mass of two parallel chains each rising to above 2000 metres and a southern plateau nowhere over 1000 metres. This plateau is low in the east and higher in the west. Local glaciers fill many of the valleys. The expedition also did important surveys in Wulff Land at the head of Sherard Osborn Fjord and in Washington Land, east of Kennedy channel.

EARTHQUAKE IN THE BAY OF CHIJIWA.—The Journal of the Meteorological Society of Japan for January contains an article by Mr. Saemontaro Nakamura on the earthquake which occurred near Nagasaki on December 8, 1922, when 27 persons were killed, 11 were injured, and 182 houses were destroyed. Microseismic observations at several stations, the directions and durations of the earth-sound in the epicentral region, and the direction and intensity of the shocks, indicate an epicentre in the Bay of Chijiwa. It had the typical tectonic characteristics with regard to the time of distribution of after-shocks, and the distribution of the direction of the first movement at stations about the epicentre. The axis of the dislocation deduced by the first movement coincides with a geographical, or geological feature of the locality. It caused no changes on Mt. Unzen, an active volcano quite near the epicentre of the earthquake. It may be supposed that this earthquake has no direct relation with the volcanic eruption of Mt. Unzen. The locality affected is situated about 500 miles to the west-south-west of the recent intense earthquake which involved Tokyo, Yokohama and the surrounding country.

WEATHER IN CANADA.—The meteorological service of the Dominion of Canada publishes regularly a monthly Weather Map, and the map for July last has recently reached us. Observations of air temperature and rainfall are shown for the several meteorological stations comprised in the chart. The differences of temperature from the normal are indicated by lines, much as we show isotherms. Rainfall amounts are shown by a varying degree of shading. July temperatures were higher than normal over most of the interior of British Columbia, in Alberta, Saskatchewan, Manitoba, and Kenora, Rainy River and Thunder Bay regions of Ontario. From the eastern end of Lake Superior to the Atlantic Ocean they were below normal. The greatest excess of temperature, about 8°, occurred in Manitoba, and the greatest defect, about 6°, in northern New Brunswick. Precipitation over the greater part of the wheat region of the Western Provinces ranged from three to seven inches. Coupled with the meteorological notes, the conditions of crops and fruit are shown for the different parts of the Dominion.

SALT-MARSH MOSQUITOES.—The valuable work of Mr. J. F. Marshall and his associates on the Hayling Mosquito Control has already been commented upon in these columns (NATURE, August 19, 1922, p. 261) in reviewing the first report of that body. Since then steady progress has been made, as instanced in the second report (issued in May last) and in a recent article and letter in the *Field*. For any success in mosquito control work it is essential to arouse public interest and co-operation, and Mr. Marshall has succeeded in doing this at Hayling Island. Further, it is satisfactory to learn that the example of Hayling has already been copied by Gosport, where a similar local "control" has been organised under the energetic direction of Surgeon-Commander D. H. C. Given. In the words of Mr. Marshall, "Both in Hayling and Gosport the mosquito nuisance has already decreased by an almost unbelievable extent." This satisfactory result is largely due to the preliminary biological investigations. These showed, first, that practically the whole of the nuisance was due to one particular species, *Ochlerotatus detritus*. Not only was it found that this species far outnumbered all the others put together (in the proportion, it is said, of not less than 1000 to 1), but also it was found that the domestic *Culex pipiens*, present in fair numbers, was not addicted to sucking human blood. In the second place, the very important discovery was made that *O. detritus* will only breed in more or less salt water which is allowed to stagnate. The control of this species is therefore largely a matter of ensuring that no salt water is allowed to become cut off from tidal action, and by united effort this can be done in any of the coastal towns where this particular species is the chief offender against the comfort of the inhabitants. Such work must, however, cover a considerable area, for *O. detritus* has been found to spread at least four miles from its breeding-grounds. The experiences at Hayling should prove valuable in any attempts which are made in the control of our second salt-marsh species, *Ochlerotatus caspius*, which is now known to be the chief cause of the mosquito nuisance in the London area, as well as at some East Coast resorts. In this case, however, the problem is complicated by two difficulties: in the first place, *O. caspius* does not breed *exclusively* in salt water, and, secondly, its range of flight appears to be much greater than that of *O. detritus*. It can scarcely be doubted, however, that a much closer study of the distribution and biology of *O. caspius* would reveal facts of which practical use could be made in reducing its numbers. The prime importance of such biological work has been well illustrated at Hayling.

CAINOZOIC AND RECENT AUSTRAL RHYNCHONELLIDS.—In NATURE, vol. 110, p. 262, 1922, the fate that has overtaken the genera Terebratula and Rhynchonella, mostly under the penetrating eye of Mr. S. S. Buckman, was mournfully recorded. Mr. F. Chapman (Proc. Roy. Soc. Victoria, vol. 35, p. 175, 1923) now finds that Hutton's *Rhynchonella squamosa* must become the genotype of a new genus (here called by a misprint "sp. nov."), which he names Tegulorhynchia. A critical description, with figures and a bibliography, is given of the Cainozoic and recent rhynchonellids of the austral region.

HARD X-RAY TUBES.—In the issue of *Die Wissenschaften* for September 7, Prof. Knipping, of Heidelberg, gives a summary of his work on the cause of the inability to transmit electric current which is found in X-ray tubes after they have been in use for some time, even when the pressure of the residual gas in them is raised to 0·01 mm. of mercury by the regenerative arrangement with which they are generally provided. He finds that the effect is due to the absence of positive nuclei of hydrogen atoms which are necessary to render any gas at low pressure conducting. In their absence a gas at the above pressure behaves towards the passage of electricity like a perfect vacuum, and the author speaks of such a gas as a pseudo high vacuum. In normal circumstances the hydrogen nuclei are provided by the moisture which is condensed on the walls of vacuum tubes, and continued use of the tubes exhausts this supply. Prof. Knipping is continuing his investigation, and points out that the present theory of the emission of electrons from heated bodies requires modification to include the effect of the surrounding medium.

COLLOIDAL PROPERTIES OF RICE STARCH.—It is well known that the granules of starches vary not only in their appearance according to their origin but also in their properties; thus sago, tapioca, and cassava starches yield more glutinous sols than others. This difference is well marked between the common and glutinous rice starches, and Messrs. T. Tadokoro and S. Sato have made this the subject of an interesting paper in the Journal of the College of Agriculture, Hokkaido Imperial University (1923, vol. 13, p. 1-65). These authors show that there is a difference in the behaviour of the two kinds of granules towards iodine, and both in suspension and in dilution the affinity of glutinous starch for iodine was less than that of ordinary starch. Coagulation of the solutions by the addition of alcoholic hydrochloric acid or by solutions of metallic salts was obtained more readily with ordinary starch. The colloidal properties as shown by the hydrating power, water retention, viscosity and protective action (gold value) of the strong solutions was greater in the case of glutinous starch, thus indicating the greater dispersion of this substance in solution. In the formation of a jelly by the addition of tannin solution, a greater quantity of the reagent was required for the glutinous starch, and the ultramicroscopic appearance of the gel resembled a network instead of a foam as shown by the gel of ordinary starch. Further differences were shown by the two varieties of starch with regard to the decomposition of the blue iodine compounds by X-rays and various reagents, and the adsorbent power of charcoals derived from the starches by ignition. In spite of the many differences in colloidal behaviour of these two starches, there was no noticeable variation in their ordinary chemical properties. The observed differences are attributed to a different degree of polymerisation between the starches.

LIQUID FUELS IN AUSTRALIA.—The Australian Commonwealth Institute of Science and Industry has issued a bulletin (No. 24) compiled by R. E. Thwaites on "The Production of Liquid Fuels from Oil Shale, and Coal in Australia." The main part of the bulletin is occupied with a survey of mineral oil supply viewed as a world problem. It gives an interesting and comprehensive review, both technical and economic, together with speculations as to the future sources of liquid fuel. The problem is then analysed as it bears upon Australia itself. There the conditions seem to resemble those of Western Europe. Proved deposits of mineral oil are scanty or non-existent. Home produced liquid fuel will have to be derived from oil shales, lignites, and bituminous coal, of which considerable deposits are now exploited or known. The oil shales though rich are limited in quantity and an existing industry engaged in their distillation is at a standstill, rendered unremunerative for the moment by high working costs. The proved deposits of such shales would not, however, furnish Australian requirements at present rates of consumption for more than ten years. The supply in the future will have to be based on coal and brown coal both occurring abundantly. The existing towns' gas industry, carbonising coal at high temperatures, already makes a useful contribution of liquid fuel. The author looks for greater production in the future from this source and from developments of carbonisation at low temperatures. The technical and economic problems involved are recognised and a plea is advanced for the institution of a fuel research laboratory to explore the subject with special reference to Australian conditions.

Royal Photographic Society's Exhibition.

THE sixty-eighth annual exhibition of the Royal Photographic Society was opened on Saturday, September 15, at the Society's house, 35 Russell Square. It will remain open until October 27, and admission is free.

The scientific and technical section is, this year, divided into nine subsections, and it would have been a great improvement if this division had been maintained in the exhibition itself, for those interested in these matters prefer a clear classification to symmetrical hanging. There is a total absence of astronomical exhibits, and the exhibition is the poorer for it. Still, the space available, which is more than heretofore, is well filled with good and interesting work. Any one who delights in animals of all sizes, birds, insects, etc., will find a selection of work that probably has never been excelled. Of special interest is Mr. Oliver G. Pike's demonstration of the use of kinematography in his enlargement from a film showing in eight stages at half-second intervals a cuckoo approaching a meadow pipit's nest, taking out one of the eggs, laying its own egg, and flying off with the stolen egg, which it then eats.

The American Raylo Corporation illustrate Mr. H. C. J. Deek's three-colour process, which does for colour prints on paper what the introduction of gelatin plates did for ordinary negative making. It simplifies the operations and eliminates many of the difficulties. The three negatives are taken consecutively, side by side, on a small plate, but the changing of the screens and the shifting of the plate are done mechanically, and the total time occupied may be as short as one quarter of a second. Each record on the triple negative measures 1 in. × $1\frac{1}{2}$ in. Development is done in a metal box, no dark room being necessary. The final prints are 5 in. × 7 in. The negative is enlarged upon a sheet which has upon it side by side the necessary red, yellow, and blue pigmented and sensitised gelatin films, each on a thin sheet of celluloid. It is developed in warm water, and the superposition of the three is done by means of a special adjusting frame, so that the accurate register is very easily secured.

The radiographic prints exhibited are specially noteworthy. The human hand taken with an exposure of one-twentieth of a second by Mr. A. A. Campbell Swinton is compared with the radiograph made by Mr. Campbell Swinton in 1896 (the first made in England) which required 20 minutes' exposure. Dr. Robert Knox shows, among others, radiographic records of the movement of the left border of the heart, in a normal condition and in a case of heart block. These are taken with a slit diaphragm and a moving film.

There is a considerable section of photomicrographs which includes examples of almost every possible kind. Mr. F. Martin-Duncan has prepared specimens of the hairs of the primates by a special mounting process and illuminated them in a special manner, so as to show the extremely delicate cuticular scales on the outer surface. These are of great importance as a certain means of identification and classification. Mr. J. H. Pledge shows a series which demonstrates the variation of stem structure in successive years of a twig of mistletoe.

Specimens of the use of the Low-Hilger Audiometer are shown by Prof. Low and also by Messrs. Hilger. These include the Melba trill, the Melba exercise for the cure of corns on the vocal chords, and sound wave records of several musical instruments.

The Royal Air Force has a series of photographs taken from aeroplanes, which demonstrate to what a wonderful degree of perfection this method of work has been developed. Two aeroplanes in collision at Northolt last June were photographed at the critical moment by Mr. G. V. Grundy. Mr. H. Roussilhe shows drawings of the apparatus used for the correction of aerial photographs and the production from them of plan maps, with specimens of the steps in the process.

Among the stereoscopic prints, lantern slides, and colour transparencies will be found many of excellent quality. The "Cine-Kodak" and the "Kodascope," which reduce the cost of taking "moving pictures" to one-fifth that of the standard apparatus, will be demonstrated at 11.30 A.M. and 3 P.M. each day. These machines have already been referred to in these pages (NATURE, September 1, p. 333).

The European Drought of 1921.

A LENGTHY discussion of diverse aspects of the great drought is afforded by Prof. Filippo Eredia in a paper entitled "La Siccità del 1921," published on the authority of the Ministry of Public Works, Rome, in 1922. Although the dry weather of that year appears to have affected in varying degrees practically the whole of Europe, and in conjunction with the political situation led to the terrible famine in Russia, the region dealt with in this communication is limited to Italy, Switzerland, France, and Britain, and for the last-named country the author avails himself of the material supplied by Messrs. Brooks and Glasspoole (Quart. Journ. Roy. Meteor. Soc., vol. 48, 1922).

In Ireland, and in Scotland except on the east coast, the rainfall of 1921 did not, as a rule, fall below 80 per cent. of the normal, and as over much of these two countries the normal amount is heavy, the deficiency of 20 per cent. did not mean any real condition of drought except, perhaps, for quite brief periods now and then during the course of the year. But in eastern and southern England, and the major portion of France, the total fall in 1921 only amounted to from 60 to 50 per cent. of a much lower average, so that the economic consequences of a deficiency equal to half the average were very serious. Locally in the extreme S.E. of England the rainfall of 1921 was less than 50 per cent. of the average, while in many places in southern and eastern France, Switzerland, and northern Italy it barely exceeded 40 per cent., *i.e.* a deficiency of nearly 60 per cent. In London the rainfall of the year was the lowest for at least 150 years, and was actually less than the evaporation—a very rare occurrence in the damp, cool climate of England. But whereas in England, France, and Switzerland the most intense phase of the drought coincided with the midsummer heat of June and July, in Italy the dearth of rain did not become acute before September, after which in northern or continental Italy there was practically no rain till the beginning of 1922, the month of October, normally the wettest in the year, being absolutely rainless at Milan and other places—a unique occurrence for that month.

In central and southern Italy, on the contrary, the deficiency of rainfall in the last three months of 1921 was less marked than in the north, while the normal summer Mediterranean drought of peninsular and insular Italy was actually less rigorous than usual. In continental Italy the snowfall both in the mountains and plains during the early months of 1921 was very light, and this coupled with the almost entire absence of rain in the autumn caused the Alpine streams at the end of the year to fall lower than had ever been remembered. Perhaps the most interesting feature in the geographical distribution of the drought, as concerns the four countries named, is the general intensification from England in the N.W. to Italy in the S.E.—that is from a more oceanic to a more continental regimen of climate. (See article in NATURE on "Climatic Continentality and Oceanity," April 21, p. 549.) It is known that both excesses and deficiencies of rainfall with respect to the average are normally more marked in continental than in maritime regions, and the reason is not difficult to understand when one reflects that rainfall is but a by-product of the circulation of the atmosphere and the changes of temperature, in the several strata, associated therewith. Hence, one would expect vicissitudes of rainfall to bear some relation to continentality, because all variations of temperature, seasonal, diurnal, or irregular, tend to be accentuated on land and damped out on sea.

In France and England the drought, which was essentially a summer one, commencing about February and terminating about November, was connected with a marked excess of barometric pressure over central Europe. There seems to be no doubt that the normal Mediterranean high pressure was in the summer of 1921 displaced northward, permitting secondary depressions to develop now and then over the Mediterranean Sea, with alleviation of the ordinary summer drought in that region as stated above. In England during the summer we were commonly located in the northern portion of the French anticyclone, with the usual westerly winds but without the usual moisture. More usually we lie farther towards the polar edge of the south-westerly winds, which are then associated with the convergent air-streams of barometric depressions; but evidence has been adduced ("British Rainfall, 1921") that in 1921 there was a greater preponderance of divergent air-currents.

It is important that students endeavouring to understand something of the origin of rainfall in England should co-ordinate the more distant point of view of the physical geographer who associates our rainfall with the abundant moisture supplied to the south-westerly winds by the warm Atlantic Drift, with the more immediate point of view of the meteorologist who relates it to the incidence of barometric depressions, that is, of convergent and ascending air. Students, too, accustomed to think of the proverbial dryness of east winds in Great Britain, are often greatly puzzled by the persistent rain we not infrequently experience with wind from that quarter. There is no discrepancy, however; for in many cases of rain with east wind on the northern side of a depression, the moisture is supplied by an Atlantic current above the drier easterly current through which the rain is falling.

L. C. W. BONACINA.

University and Educational Intelligence.

LONDON.—An attractive series of free public lectures during the Michaelmas term has been arranged at King's College. Prof. A. Dendy is giving nine lectures on Wednesdays, commencing October 17, on the biological foundations of society; Mr. R. Aitken, five lectures on the geography of Spain and typical Spanish institutions, on Thursdays, commencing November 1; Prof. H. Wildon Carr, four lectures on the Hegelian philosophy and the economics of Karl Marx, on Tuesdays, commencing October 9; and Miss Hilda D. Oakeley, three lectures on the roots of early Greek philosophy, on Tuesdays, commencing November 27. In addition, Prof. R. J. S. McDowall, of Edinburgh, is giving an inaugural lecture in the Department of Physiology on the position of physiology in science and medicine on October 4, and Prof. W. T. Gordon is giving the Swiney lectures (12) on geology on Mondays, Wednesdays, and Fridays, commencing November 19, taking as his subject "Gem Minerals and their Uses in Art and Industry." The lecture hour in every case is 5.30 P.M.

AT University College, the list of public lectures includes the following: introductory lecture by Sir Flinders Petrie on religious life in Egypt, on October 4 at 2.30 P.M.; three lectures on the new Babylonian creation and flood stories, by Dr. T. G. Pinches, beginning on October 4; an introductory lecture by Prof. C. Spearman on psychology as transfigured behaviourism; and a course of lectures by Prof. J. A. Fleming on ionic and thermionic valves, beginning on October 24. Single lectures are to be given by Miss Margaret Murray, on primitive religion, on October 5; by Prof. G. Dawes Hicks, on the philosophy of Bernard Bosanquet, on October 8; by Mr. Morris Ginsberg, on the sociological work of the late Dr. W. H. R. Rivers, by Mr. A. H. Barker, on the heating equipment of a small house, and by Miss I. C. Ward, on the application of phonetics to the curing of speech defects, at various times on October 10; and an inaugural lecture by Prof. A. V. Hill, on the present tendencies and future compass of physiological science, on October 16. Particulars of the lectures and courses should be obtained from the Secretary of University College.

A COURSE of six lectures on the bearing of psychoanalysis upon sociological problems has been arranged by the Sociological Society, Leplay House, 65 Belgrave Road, Victoria, S.W.1. The lectures are to be given on Tuesdays, and commence on October 9 with an introductory lecture by Dr. Ernest Jones. Succeeding lectures will deal with man as an individual, the family, politics, education, and vocation. Half-price tickets are available for a limited number of students.

A SERIES of "Celebrations," arranged by Dr. F. H. Hayward, Inspector of Schools, of 87 Benthall Road, London, N.16, will be held during the winter on certain Saturday evenings (6 o'clock) at the Birkbeck Theatre, Birkbeck College, Fetter Lane, E.C. Four of these in particular may be of interest to readers of NATURE, namely: Two homage celebrations, "The Geologist," December 1, and "The Scientist" (in general), March 1, 1924, and two memorial celebrations, "Leonardo da Vinci," January 12, 1924, and "Goethe," February 9, 1924. All these four have a predominant scientific interest. Though we understand that Dr. Hayward has found it difficult to discover music and poetry that can be effectively employed in the glorification of science and its devotees, he has discovered some, and he thinks that the main purpose of the celebrations will be achieved, namely, the creation of emotional associations in connexion with the history and the methods of science. Recent studies in psychology and sociology have pointed to the conclusion that knowledge and reason are more closely related to instinct and emotion than was formerly believed. Without an emotional basis, they cannot flourish or even receive adequate recognition among the mass of mankind. Hence the importance of Dr. Hayward's attempt to employ "mass" methods and other devices.

Suggestions and criticisms are invited. Mozart's "Magic Flute" will supply some items of music, especially on March 1. Admission will be free, without ticket.

SECONDARY education in the United States in 1921 and 1922 is reviewed in Bulletin, 1923, No. 12, of the Bureau of Education, Washington. The outstanding achievement within the past few years has been an extension downwards of the secondary school system in many parts of the United States, especially in cities. Typically, the extension has taken the form of substituting for the normal sequence of 4 years of high school work following 8 years (ages 6 to 14) of elementary schooling, a system sometimes described as the 6-3-3, meaning 6 years (ages 6 to 12) of elementary schooling followed by 6 years of secondary school work divided into two administrative units of 3 years each, namely, the junior high school and the senior high school units. Essentially the change implies that the passage from the elementary to the secondary type of curriculum should synchronise with the commencement of the physical changes of adolescence. It is generally agreed in America that at this stage the pupil needs in his studies change, variety, and human interest rather than completeness and logical arrangement, and that consequently in place of the traditional seventh and eighth grade courses there should be a general survey of the chief departments of knowledge: "English literature, general social science, general mathematics, general science, foreign languages for those who desire them, music, art, physical education, and the practical arts." This holds good both for those who are to leave school at 15 and for those who are to pass on to the senior high school.

A STATISTICAL survey of education in the United States is given in Bulletin No. 16 of 1923 of the Federal Bureau. It shows the following total enrolments in 1919-20 (in thousands): kindergarten 511, elementary 20,383, secondary 2430, university, college, and professional school 462, teachers' college and normal school 163; grand total 23,950, being 22·7 per cent. of the total population. Included in the above are the following enrolments in private, that is non-state, institutions: kindergarten 30, elementary 1486, secondary 229, university etc. 281, teacher-training 14. The estimated cost of all this education, except private elementary and private secondary, is 1301 million dollars, or, in dollars per head: elementary 39, secondary 127, university, college, and professional 460, teachers' college 131, other normal schools 189. The figures are exclusive of city evening, private commercial, nurse-training, and Indian and Alaskan schools. Enrolments in these amounted to 587, 336, 55, and 32 thousands respectively. Gifts and bequests to education in 1920 reached the unprecedented total of 67 million dollars, the highest previous record being 37 million in 1916. The extent to which women teachers have taken the place of men during the past 40 years in elementary and secondary schools is strikingly shown in a table in another Bulletin, No. 29 of 1922, giving the percentage of men teachers in 1880 and at the end of each subsequent quinquennium up to 1920: 43, 37, 35, 33, 30, 24, 21, 20, 14. The average annual salaries in dollars of all teachers, men and women, in the same years are given as 195, 224, 252, 286, 325, 386, 485, 543, 871, but the last figure includes supervisors and non-teaching principals. During the past 50 years the ratio of pupils in secondary schools, compared with the total enrolment in elementary and secondary schools combined, increased from 1·2 to 10·2 per cent.

Societies and Academies.

LONDON.

Institute of Metals (Manchester Meeting), September 10.—Sir Henry **Fowler**: The use of non-ferrous metals in engineering (Autumn Lecture). Of the non-ferrous metals used by engineers, the one which has been in longest use is copper, and it is at present the one most closely associated with engineering work. The uses to which its comparatively simple alloys with tin and zinc can be put are endless. The next in importance is tin, which, alloyed with copper, lead, and antimony, gives us those white metals which are used to make bearings in machines. Aluminium is still most generally used in connexion with aeronautics.

September 11.—E. A. **Bolton**: The cause of red stains on sheet brass. The stains occur through reactions of copper oxides in the scale formed during annealing and in the pickling medium. Cupric oxide, contrary to the usual opinion, is as harmful as cuprous oxide. The presence of these oxides may be due to careless washing after pickling, resulting in the presence of acid and salts during annealing, the presence of iron in the brass or upon its surface, the use of impure rolling oils, etc. The main cause of the oxidation of the copper is the use of old-fashioned annealing furnaces in which the flames impinge directly upon the brass. Possible remedies for the red-stain trouble are suggested.—H. W. **Brownsdon**: Brinel hardness numbers. Brinel numbers for non-ferrous metals should be expressed in figures that are comparable. This could be done if balls and loads are used for which the ratio L/D^2 (the load in kilograms divided by the square of the ball diameter in millimetres) is constant. Some one ratio for L/D^2 should always be used for one class of alloys; for the copper alloys with Brinell hardness numbers from about 40 to 200, the choice should rest between the ratio 5 as standardised in the United States or the ratio 10 which is favoured in some quarters in Great Britain.—A. H. **Mundey** and John **Cartland**: Stereotyping. Stereotyping is generally regarded by printers as almost a trade secret. The process was invented by a practical metallurgist, William Ged, an Edinburgh goldsmith, in 1750. Stereotyping was traced from the plaster-of-Paris process to the use of papier-maché flong, and from the simple stereo plates for flat-bed machines to the elaborate requirements of the modern newspaper. A high degree of accuracy is demanded in the mechanical and metallurgical details in order to produce the good results which are a commonplace to everyone.—J. D. **Hannah** and E. L. **Rhead**: Crystallisation effect on galvanised iron sheets. Manufacturers of galvanised iron and steel goods always seek to produce a zinc-covered surface having large characteristic spangles. Small spangles or lack of spangles is disliked. The metal—iron or steel—has practically no influence on the result if the temperatures are satisfactorily maintained. Pure zinc does not yield large spangles, and too high a temperature interferes by producing large quantities of a zinc-iron compound which crystallises in needles on the metal. The presence of tin or aluminium does not produce the desired result, but lead is effective. The separation of the impure zinc into conjugate solutions, lead-rich and zinc-rich, at the dipping temperature, and the method of subsequent crystallisation, may be the causes of these effects.—R. C. **Reader**: Effects of rate of cooling on the density and composition of metals and alloys. The densities of pure metals, and of alloys which solidify at a constant temperature, are not affected by the rate at which they solidify.

With alloys which solidify over a range of temperature, the slower the rate of solidification the lower is the density, and when they are prepared in cylindrical chill moulds, they are less dense in the centre than at the outside. When prepared in chill they are richer on the outside in the component of the lower melting point.—A. H. **Mundey** and C. C. **Bissett**: The effect of small quantities of nickel upon high-grade bearing metal. Nickel is now added to the well-known bearing metal consisting of tin 93 per cent., antimony 3·5 per cent., copper 3·5 per cent. Tensile, compression, and hardness tests gave no indication of improvement. The comparison of hardness at varying increased temperatures exhibited no improvement. In the case of the alloy with no nickel, the hard copper-tin constituent is very marked in its characteristic crystalline formation as seen under the microscope. The presence of nickel even in small quantities results in a great diminution of this crystalline structure.—Hikozo **Endo**: The measurement of the change of volume in metals during solidification. In the casting process it is very important to know to what extent a change of volume occurs during solidification. In 1888, Vincentini and Omodei calculated the change of volume of some fusible metals during solidification from the change of density at the melting point. E. Wiedemann, Paul Pascal, and Louis Hackspill also used this method. M. Toepler studied the change of volume by means of a dilatometer; he suggested a relation of the change of volume of a metal at melting point to its atomic weight. K. Bornemann and F. Sauerwald measured the density of metals at various high temperatures, using the principle of Archimedes, by means of a mixture of sodium and potassium chlorides as liquid. The method of investigation now used for metals having melting points up to 1100° C., which was suggested by Prof. K. Honda, consists in the measurement of the change of buoyancy of a metal suspended in an inactive liquid during its solidification or melting by means of a thermobalance.

September 12.—Marie L. V. **Gayler**: The constitution and age-hardening of the quaternary alloys of aluminium, copper, magnesium, and magnesium silicide. Alloys containing up to 6 per cent. copper, 4 per cent. magnesium, and 4 per cent. magnesium silicide were used. When copper, magnesium, and magnesium silicide are present in aluminium, any two of these components have a marked effect on the solubility of the third and ultimately $CuAl_2$ and Mg_2Si are both thrown out of solution. If copper and magnesium are present in a ratio greater than 12 to 5 approximately, then the alloys when quenched from high temperatures age-harden at room temperature, owing to the difference in the solubility of Mg_2Si at the quenching and ageing temperature. Age-hardening of alloys of the "Duralumin" type is due primarily to Mg_2Si, and the addition of magnesium and copper is important since both reduce the solubility of Mg_2Si at high and low temperatures and consequently reduce the maximum age-hardness due to Mg_2Si.—Ulick R. **Evans**: The electro-chemical character of corrosion. There are two main types of corrosion: (1) that accompanied by evolution of hydrogen is characteristic of reactive metals placed in acid solutions, but the velocity varies greatly with the degree of purity of the metal; (2) slower corrosion, determined by the diffusion of oxygen to the metal, and comparatively independent of the purity. When a metal is immersed in a solution of potassium chloride, alkali is produced at the cathodic portions, the chloride of the metal at the anodic portions, and the hydroxide is precipitated where these meet. The electric current produced accounts for the greater part of the corrosion actually observed. Generally the cathodic areas are those to which air has free access, while the anodic areas are those protected from aeration. Corrosion usually proceeds most rapidly at the comparatively unaerated places—hence the intense corrosion observed in "pits" and over areas covered up by porous corrosion-products.—Douglas H. **Ingall**: Experiments with some copper wire; cohesion a function of both temperature and cold work. Five samples of copper wire were used: soft annealed and four degrees of cold work given by 25, 40, 50, and 75 per cent. reduction of area by drawing. The cohesion at high temperatures was determined by placing given loads on the wire at atmospheric temperature, heating the wire and determining the temperature at which it broke. All the samples gave similar graphs in which with rise of temperature the cohesion decreased along a straight line to a constant critical temperature of 350° C., beyond which the cohesion was represented by a sharply descending curve. The equations to the straight lines $C = a - bT$ and to the curves $TC^n = k$ (where C = cohesion and T = temperature) showed that the percentage increase of the constant b and the percentage decrease of the constant n were represented by the corresponding percentage reductions for any given cold worked wire, with the exception of 75 per cent. reduced wire. At the critical inflection temperature the material was comparatively extremely fragile.—D. **Hanson**, C. B. **Marryat**, and Grace W. **Ford**: Investigation of the effects of impurities on copper. Pt. I.—The effect of oxygen on copper. The effect of oxygen, up to a concentration of 0·36 per cent., on *pure* copper, was investigated. The mechanical properties are not much affected by small quantities of oxygen, and copper containing as much as 0·1 per cent. differs very slightly from pure copper. The electrical conductivity does not fall rapidly, and values exceeding 100 per cent. of the International Standard are obtained in all annealed materials containing less than 0·1 per cent. of oxygen. This is due to the low solubility of the oxide in solid copper. The oxygen-bearing metals can be considered as a heterogeneous mixture of pure copper and finely divided particles of cuprous oxide. There is a soft ductile copper matrix, in which harder particles of cuprous oxide are distributed so as to form a mechanical mixture.—Hugh **O'Neill**: Hardness tests on crystals of aluminium. Brinell tests showed that at low loads the different crystallographic planes resist penetration to different degrees, and give indentations of different shapes. In the Brinell sense the (110) face is the "hardest" and the cube (001) face appears to be the "softest." But the load required to immerse the ball is apparently the same in all cases. Crystal boundaries are without any appreciable effect in increasing the resistance of aluminium to penetration.—H. I. **Coe**: The behaviour of metals under compressive stresses. Compression tests carried out on small cylinders of metals show that with successive increments of loads plastic flow occurs, after the elastic limit has been exceeded, at an increasing rate. At a certain load the rate of flow changes abruptly, metals such as tin and lead becoming perfectly plastic, harder metals becoming more plastic than under preceding loads and immediately succeeding loads. The term "critical plasticity" is used to indicate the change in the rate of plastic deformation which most metals exhibit at a particular load. Annealed metals flow at a comparatively low load and the rate of flow increases up to the load corresponding to critical plasticity; when worked, they are more resistant to compressive stresses until they approach the load corresponding to a critical plasticity, when they suddenly collapse and a marked temporary flow occurs.—Albert M.

Portevin and Pierre **Chevenard**: A dilatometric study of the transformations and thermal treatment of light alloys of aluminium. Dilatometric methods, using the recording differential dilatometer, permit of the study of the transformations and the mechanism of heat-treatment of the light alloys of aluminium-magnesium-silicon, and in general, of alloys containing two-phase, univariant transformations. The study of the constant temperature transformations by the differential dilatometer, using a high sensitivity apparatus, leads to general expressions representing the phenomena as functions of time and temperature. Quenching and tempering in these alloys can be interpreted by the known variations in the solubility of Mg_2Si in the solid state, without assuming any further transformations.—P. **Soldau**: Equilibrium in the system gold-zinc (based on investigations of electrical conductivity at high temperatures). The alloys of gold and zinc belong to the type of AR-brasses, where A is a metal belonging to the first and R to the second group of the periodic system. These alloys are of considerable practical importance, as in their chemical nature they are very close to the ordinary brasses. For the determination of electrical conductivity at high temperatures, a special apparatus was constructed which was checked by determining the transformation temperatures in iron and steel and comparing the results with those obtained by other methods.

PARIS.

Academy of Sciences, September 3.—M. A. d'Arsonval in the chair.—Alfred **Errera**: A theorem of linkages.—Alexandre **Rajchman**: The Riemannian theory of trigonometrical series.—M. **Puthomme**: Contribution to the study of the secondary X-rays. Two metallic wires, in the form of a cross, give a single sharp radiographic image, but if a metallic screen such as a sheet of lead, be placed between the X-ray bulb and the wires, then three images are observed, one on each side of the initial image. The two additional images are due to secondary rays starting from the edges of the lead screen. The fact that a needle imbedded in the body may sometimes give a faint extended image rendering it difficult to locate is probably due to the same phenomenon.—E. F. **Terroine**, P. **Fleuret**, and Th. **Stricker**: The rôle of the deficient proteids in supplying the minimum nitrogen requirement. Experiments on the nitrogen assimilated by growing pigs from ammonium citrate and from gelatin. The amount assimilated varies greatly with the individual animal. Gelatin proved to be superior to ammonium citrate as a source of nitrogen.—Mme. **Randoin**: Study of the vitamins in molluscs. The presence of the antiscorbutic factor in the oyster. From experiments on guinea pigs it is concluded that the addition of oysters in suitable quantity to a diet not containing vitamin-C is sufficient to prevent symptoms of scurvy.—M. **Athanassopoulos**: The tunny fish of Greece.

Official Publications Received.

Arkiv för Matematik, Astronomi och Fysik utgivet av K. Svenska Vetenskapsakademien, Band 17, No. 19. Meddelande från Lunds Astronomiska Observatorium, No. 102: Contributions to the Analytical Theory of Sampling. By S. D. Wicksell. Pp. 46. (Stockholm: Almquist and Wiksells Boktryckeri A.-B.; London: Wheldon and Wesley, Ltd.; Berlin: R. Friedlander und Sohn; Paris: C. Klincksieck.)

Meddelanden från Lunds Astronomiska Observatorium. Serie II, Nr. 29: Flächenhelligkeiten von 566 Nebelflecken und Sternhaufen, nach photometrischen Beobachtungen am 49 cm. Refraktor der Universitäts-Sternwarte, Strassburg (Elsass), 1911-1916. Von Carl Wirtz. Pp. 63. Serie II, Nr. 30: Star-gauges by William Herschel and John Herschel. Edited by C. V. L. Charlier. Pp. 29. (Lund: Scientia Publisher.)

Kungl. Fysiografiska Sällskapets Handlingar, Band 34, Nr. 2. Meddelanden från Lunds Astronomiska Observatorium. Serie II, Nr. 31: Star-gauges at the Observatory of Lund. By C. V. L. Charlier, F. A. Engström, P. B. Fänge, K. A. W. Gyllenberg, C. I. Lundahl, K. G. Malmquist, J. B. Ohlsson, S. D. Wicksell. Edited by C. V. L. Charlier. Pp. x+207. (Lund: C. W. K. Gleerup; Leipzig: Otto Harrassowitz.)

The North of Scotland College of Agriculture: County Extension Department. Bulletin No. 28: Reports on Field Experiments with Oats, Turnips and Potatoes carried out on Farms in the College Area during the Years 1919, 1920, 1921. Pp. 76. (Aberdeen.)

The North of Scotland College of Agriculture. Bulletin No. 29: An Experiment on the Control of Finger-and-Toe by Liming. By Prof. James Hendrick. Pp. 15. (Aberdeen.)

Queensland Department of Mines: Geological Survey of Queensland. Publication No. 272: Geology of the Walloon-Rosewood Coalfield. By J. H. Reid. Pp. 69+2 maps. (Brisbane: A. J. Cumming.)

Department of the Interior: Bureau of Education. Bulletin, 1923, No. 20: Recent Advances in Instruction in Music. By Will Earhart and Charles N. Boyd. Pp. 21. Bulletin, 1923, No. 21: Specimen Junior High School Programs of Study. Compiled by W. S. Deffenbaugh. Pp. 28. Bulletin, 1923, No. 28: Vocational Education. By William T. Bawdon. Pp. 26. Bulletin, 1923, No. 34: Higher Education 1920-1922. By George F. Zook. Pp. 33. (Washington: Government Printing Office.) 5 cents each.

Department of the Interior: United States Geological Survey. Bulletin 717: Sodium Sulphate; its Sources and Uses. By Roger C. Wells. Pp. iv+43. 5 cents. Bulletin 718: Geology and Ore Deposits of the Creede District, Colorado. By William H. Emmons and Esper S. Larson. Pp. ix+198+12 plates. 40 cents. Bulletin 738: The Commercial Granites of New England. By T. Nelson Dale. Pp. xv+488+34 plates. 50 cents. Bulletin 745: The Kotsina-Kuskulana District, Alaska. By Fred H. Moffit and J. B. Mertie, Jr. Pp. ix+149+19 plates. 40 cents. Bulletin 750-A: Ilsemannite at Ouray, Utah. By Frank L. Hess. Pp. 16+2 plates. (Washington: Government Printing Office.)

Department of the Interior: United States Geological Survey. Water-Supply Paper 469: Surface Waters of Wyoming and their Utilization. By Robert Follansbee. Pp. x+331. 40 cents. Water-Supply Paper 495: Geology and Ground-Water Resources of Sacramento Valley, California. By Kirk Bryan. Pp. xi+285+19 plates. 60 cents. Water-Supply Paper 496: The Industrial Utility of Public Water Supplies in the United States. By W. D. Collins. Pp. iv+59. 10 cents. (Washington: Government Printing Office.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 32: The Cotton Plant in relation to Temperature and Rainfall. By C. B. Williams. Pp. vi+2 charts. (Cairo: Government Publications Office.) P.T. 2.

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March 1923. With Appendices. Pp. 34. (London: H.M. Stationery Office.) 1s. 6d. net.

Bulletin of the National Research Council. Vol. 6, Part 2, No. 33: On the Formulation of Methods of Experimentation in Animal Production. By E. B. Forbes and H. S. Grindley. Pp. 54. 1 dollar. Vol. 6, Part 3, No. 34: Causes of Geographical Variations in the Influenza Epidemic of 1918 in the Cities of the United States. By Ellsworth Huntington. Pp. 36. 75 cents. Vol. 6, Part 4, No. 35: Apparatus used in Highway Research Projects in the United States. By C. A. Hogentogler. Pp. 91. 1.50 dollars. (Washington: National Academy of Sciences.)

Year Book of the Michigan College of Mines, 1922-1923, Houghton, Mich. Announcement of Courses, 1923-1924. Pp. 125. (Houghton, Mich.)

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, St. Kitts-Nevis, 1921-1922. Pp. iv+44. (Barbados.) 6d.

The East London College (University of London). Calendar, Session 1923-1924. Pp. 164. (London: Mile End Road.)

Diary of Societies.

MONDAY, OCTOBER 1.

SOCIETY OF ENGINEERS (at Geological Society), at 5.30.—A. Ferguson, Improved Method for Mass Production of Tank Glass Bottles, Jars, etc.

WEDNESDAY, OCTOBER 3.

SOCIETY OF PUBLIC ANALYSTS (at Chemical Society), at 8.—J. H. Coste, E. R. Andrews, and W. E. F. Powney: The Sampling of Coal; the General Problem and some Experiments.—H. G. Stocks: A New Test for distinguishing Castor Oil.—A. E. Etheridge: The Volumetric Estimation of Vanadium in Steel.—C. L. Hinton and T. Macara: The Iodimetric Determination of Sugars.

THURSDAY, OCTOBER 4.

CHILD-STUDY SOCIETY (at the Royal Sanitary Institute), at 6.—Discussion opened by Miss Norah March: The Report of the Commission in relation to the Teaching of Biology in Schools.

CHEMICAL SOCIETY, at 8.—E. B. R. Prideaux and A. T. Ward: A Revision of the Dissociation Constants of Weak Inorganic Acids. Part I. Boric Acid. Part II. Phosphoric Acid.—C. N. Hinshelwood and C. R. Prichard: Two Heterogeneous Gas Reactions.—C. N. Hinshelwood and C. R. Prichard: A Homogeneous Gas Reaction. The Thermal Decomposition of Chlorine Monoxide. Part I.—R. G. W. Norrish and E. K. Rideal: The Direct Union of Oxygen and Sulphur.—W. R. Ormandy and E. C. Craven: Note on Aqueous Formaldehyde Solution.—H. Hawley and H. J. S. Sand: The Interaction of Potassium Tetroxide with Ice and with Dilute Sulphuric Acid.

PUBLIC LECTURES.

THURSDAY, OCTOBER 4.

UNIVERSITY COLLEGE, at 2.30.—Sir Flinders Petrie: Religious Life in Egypt (Introductory Lecture).

LONDON SCHOOL OF ECONOMICS, at 5.—Sir Arthur Newsholme: Measurement of Progress in Public Health (William Farr Lecture).

UNIVERSITY COLLEGE, at 5.15.—Dr. T. G. Pinches: The New Babylonian Creation and Flood Stories. (Succeeding Lectures on October 11 and 18.

KING'S COLLEGE, at 5.30.—Prof. R. J. S. McDowall: The Position of Physiology in Science and Medicine.

FRIDAY, OCTOBER 5.

UNIVERSITY COLLEGE, at 5.—Miss Margaret A. Murray: Primitive Religion.