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A National Water Policy.

THE Minister of Health has recently appointed a Standing Advisory Committee "to confer with representatives of the Ministry on questions of water supply." From a reference in the public announcement of this appointment to the final report of the Water Power Resources Committee of the Board of Trade, it would appear at first sight that the step is the outcome of one of the recommendations put forward by that Committee in its report of November 1921, which was reviewed in NATURE of February 9 last year (vol. 109, p. 161). The proposal therein made, it may be recalled, was for the formation by Act of Parliament of a controlling water commission having jurisdiction over England and Wales, with statutory powers and duties. In commenting on such a far-reaching and momentous proposal, we felt it desirable to deprecate the idea of setting up a fresh department with a retinue of officials and an additional burden of salaries for the taxpayer.

Our first impression, therefore, was one of gratification that apparently the departmental proposition had been dropped and that, in place of it, there was to be a "Standing Committee," presumably honorary, with advisory functions. On further consideration, however, we became less confident that the announcement covered all that it implied, and whether, in fact, it was in any degree a materialisation of the Water Power Committee's findings. Inquiry has confirmed the suspicion that the Ministry of Health is only concerned with the water question as regards supplies for domestic use, and that the terms of reference of the Advisory Committee, though unspecified, cannot possibly be stretched to cover functions which lie within the province of the Board of Trade.

An inspection of the list of the committee shows it to comprise the names of six gentlemen connected with municipal waterworks administration in various official capacities. With one exception, we miss altogether any name which appeared as signatory to the very full and comprehensive report of the Water Power Resources Committee. There is, indeed, a marked absence of that representation of broadly national, scientific, and industrial interests which should, in our opinion, form a prominent, if not a predominant, element in a committee dealing with the policy of development of the water resources of the country.

This is the more disappointing in that, according to the Press, the first meeting of the committee has already been held, and it is announced that it discussed two matters which were in the forefront of the Water Power Resources Committee's recommendations, and have been the subject of earnest advocacy by NATURE for a number of years past. These are (1) the formulation of the outlines of a national water policy, and (2) the survey of the water resources of England and Wales. We are not in possession of information as to the views of the members of the Advisory Committee on these points, but we conceive that they must have been somewhat seriously handicapped by the absence of assistance from the compilers of the very valuable report to which we have alluded. In regard to the second point, we note that the survey is already in hand, and is being made by the Engineering Department of the Ministry of Health. We confess that we are puzzled by this statement. Conservation and control of water power resources for industrial purposes is not very obviously a question of health, or of physical well-being. We are therefore at a loss for an explanation, unless it be, that the survey is limited to sources of water supply for domestic use. If so, this is not only regrettable as making it an inquiry of inadequate scope, but it is also inconsistent with the announcement that the survey is being prosecuted "on lines recommended by the Water Power Resources Committee in their final report." Turning to that report, we find the recommendation expressed as follows:

"That in view of the importance in the national interest of the utilisation of water power, wherever this is commercially practicable, the Board of Trade, or the Electricity Commissioners, should be charged with the duty of studying, supervising, and promoting the development of all water power. The (Water Power) Department should collect data concerning, and cause surveys to be made of water power resources, and they should give the widest publicity to the results of their inquiries."

Clearly it is not within the province of a Ministry of Health to prosecute such a research, which must lie outside the education and training of its officials. Our own suggestion was that the work might be done as a branch of the Ordnance Survey, as it is done in the United States by the Geological Survey.

A matter of such outstanding importance as national water power control demands the most careful and competent handling. It has been the subject of a searching and painstaking investigation by a committee thoroughly representative in character, the recommendations of which, after several years of exhaustive study and the issue of three reports, were to the effect that the matter did not admit of procrastination or delay, and that it should be dealt with on a generous and effective scale. They were "thoroughly convinced of the necessity of such action if the national water resources are to be properly conserved and fully and systematically utilised for all purposes, and that the work should be proceeded with unremittingly." We therefore urge that the matter should be entrusted to a committee with a scientific and technological element of adequate proportions, and that the survey should be placed in the hands of a department closely associated with this particular class of work.

The Gas Industry.

(1) *The Administration and Finance of Gas Undertakings: with Special Reference to the Gas Regulation Act*, 1920. By G. Evetts. Pp. xi+374. (London: Benn Bros., Ltd., 1922.) 32*s*. 6*d*. net.

(2) *Modern Gasworks Chemistry*. By Dr. G. Weyman. Pp. x+184. (London: Benn Bros., Ltd., 1922.) 25*s*. net.

(3) *Gasworks Recorders: their Construction and Use*. By Dr. L. A. Levy. Pp. xi+246. (London: Benn Bros., Ltd., 1922.) 35*s*. net.

(4) *The Distribution of Gas*. By W. Hole. Fourth edition, rewritten and enlarged. Pp. xv+699. (London: Benn Bros., Ltd., 1921.) 50*s*. net.

THE gas industry had its modest origin in the researches of William Murdoch, the "incomparable mechanic" to whom the Royal Society awarded its Rumford medal for his work in the production and utilisation of illuminating gas. Its rapid growth owes much to the co-operation of the scientific workers, although in the early days, even as now, there were not lacking prominent and distinguished men of science prepared to wail a Jeremiad over the industry. While to-day the nature and magnitude of its operations entitle the gas industry at least to contend for pride of place among applied sciences, whether chemical, mechanical, or physical, it cannot be too strongly emphasised that the industry is the child of pure science, and its present-day problems the problems of pure science. The industry asserts that pure and applied science are one and indivisible.

Scientific literature, apart from technical journals and the Transactions of various institutions, dealing with the fundamentals of the processes and control of manufacture of towns' gas is not at present very extensive. The volumes under review, together with Meade's "Modern Gasworks Practice" in the same series, and Prof. Bone's "Coal and its Scientific Uses," constitute practically the only modern English works dealing specifically with the scientific and other problems of the gas industry.

(1) Consider the magnitude of the industry. We learn from Mr. Evetts's book that in the United Kingdom the public supply of gas is in the hands of about 1630 undertakings. About 20 million tons of coal and 65 million gallons of oil are employed annually in the manufacture of gas in the country. By-products of

carbonisation amount to 10 million tons of coke, 180 million gallons of tar, 170,000 tons of sulphate of ammonia, and 45,000 tons of sulphur annually. About 87 per cent. of street lamps in the country are lit by gas. The annual make of gas is approximately 1200 million therms supplied to consumers through about 8 million meters. The figures are clamant for the maintenance of a due sense of proportion in criticism of the industry. We commend them to the notice of any inclined to regard the gasworks as the original home of the three-card trick, and the gasometer as the present-day residence of the Borgias.

Mr. Evetts has produced an extremely clear and readable account of the legislative and administrative aspects of the gas industry. Primarily intended to meet the requirements of the student, the junior assistant, and others desirous of qualifying for high administrative posts in the industry, the book will be welcomed by a much wider circle of readers.

The provisions of the Gas Regulation Act, 1920, enabling gas to be supplied and sold on the basis of its potential thermal value, are set out in Chapter 2. Although from the date of the publication by the Board of Trade of the brochure on Gas Standards the gas industry generally welcomed the suggested new method of supply (p. 34), it should be remarked that at a somewhat earlier date such suggestions were regarded favourably only by a very small minority of representatives of the gas industry considering the subject. The supply and sale of gas on the only conceivable scientific basis, namely, on a thermal basis, having regard to present-day uses of gas, we owe to the Board of Trade. The electrical unit of energy supply is termed the Board of Trade Unit. We suggest that correspondingly the unit of supply of gaseous energy should be designated the Board of Trade Therm.

Among the matters dealt with by Mr. Evetts are: the sliding scale of gas charges, parliamentary procedure when applying for a Bill, the model Bill, repairs and depreciation, hirings and fittings, arbitration and other workaday matters. Chapter 8, dealing with financial aspects of the sale of gas by therms, is a clear statement of the numerous facts to be taken into consideration before a calorific value is declared. Advocates of the supply of low-grade gas should ponder well the tables on p. 242, giving the costs of mains and the pressures necessary to deliver a definite quantity of energy in the form of gases of various calorific values. In this connexion we may remark that such changes in declared calorific value as have recently occurred have all been in the direction of supplying gas of higher calorific value.

(2) Dr. Weyman's book on modern gasworks chemistry describes the methods employed in the control of plant and processes employed in the manufacture of towns' gas. Chapters are devoted to coal, carbonisation, coke, refractory and insulating materials, tar, ammonia, oxide purification, steam raising, water supply, and lubricants. A great amount of work has gone to the collection of the very large number of analytical and other tests comprised in the volume We regret that frequently these are not sufficiently detailed or clearly described to afford working instructions. Occasionally, and more especially in regard to what would be regarded as essentially physical tests, the descriptions are inaccurate or meaningless. As examples, we would refer to the calorimetric radiation correction (p. 27), the standardisation of the Wanner pyrometer (p. 56), and the determination of thermal conductivity (p. 74). It is certain that the methods described for the determination of the thermal conductivities of materials will not yield results of much value in the hands of the works chemist. This class of work should, we think, for the present, until the gas industry is equipped with its own large central testing establishment, be allocated to the National Physical Laboratory. In any case, if this section of the book is to be retained in later editions, it should include a description of the simpler flow methods, developed at the National Physical Laboratory for the determination of thermal conductivity, and probably more suitable for adoption in industrial laboratories.

(3) Dr. Levy's work on gasworks recorders is the complement of Dr. Weyman's. Control of chemical processes can be based upon the results of snap-tests or the indications of recording devices. There is much to be said for both methods. Painful experience with some recorders forces the present writer to the unfortunate conclusion that generally the former method is to be preferred to the latter. Individual observers suffer from their "personal equations." Recording devices are not without their idiosyncrasies. Their value and trustworthiness are to be determined by the "acid test": How far is the record influenced by, and *only* by, variation in the characteristic to be recorded? Frequently the influence of disturbing factors, such as friction, temperature, and the rest, are completely overlooked in the design of such instruments.

Pressure and vacuum gauges, pyrometers, gravitometers, gas analysis and volume recorders, and densimeters are among the recorders discussed in this volume. The activity, born of the Gas Regulation Act, 1920, among makers of scientific instruments is evidenced by the chapter devoted to recording gas calorimeters. Prof. Boys's instrument, incorporating many novel features and points of geometric design, is worthy of the close attention of scientific instrument makers generally. Incidentally it may be mentioned that an important feature of this recorder, namely, that the calorific value is recorded in strict relation to the chart ruling, however the chart may be displaced on the drum, is omitted from the description of the chart on p. 127. The electrical flow meter of C. C. Thomas described on p. 208 *et seq.* is finding extensive application in industry, more especially in America. In all descriptions of this instrument with which we are acquainted, it appears to have been overlooked that the device is merely an application of the constant flow method of calorimetry introduced by Prof. Callendar, and is one more in the lengthy and lengthening list of contributions—not always acknowledged—made by pure to applied science. Considering that the platinum resistance thermometer is among the most accurate of all indicating or recording instruments, it is disappointing to find its calibration inaccurately described on p. 62 and the variation of the resistance of platinum with temperature wrongly given in Fig. 56.

The main defect of the present volume is what we may be pardoned for describing as its apparent partisan character. About one-third of the instruments described are the products of a single firm. This is certainly unjustifiable in a work claiming, according to the preface, to describe all recording instruments of utility in gas engineering. We are acquainted with at least five types of recording pyrometers which go unmentioned although they are of utility at least equal to that of any described. Scant justice is done to certain forms of carbon dioxide recorders, to depth gauges, to water or steam meters. The recording specialities of one firm are referred to in the advertisement pages included in the volume but are not found in the text! We register our protest against this growing tendency in English scientific literature of a certain type.

(4) Under the Gas Regulation Act of 1920, the gas undertaking is interested in the supply of gas right up to the point of combustion of the gas in the burner. Mr. Walter Hole, from his experience as superintendent of the City of Leeds Gas Mains and Distribution Department, is, we think, as well qualified as any one within the industry to undertake the task of compiling a standard work on the subject of gas distribution. That a fourth edition of his work has been called for is eloquent testimony that it supplied a need felt in the industry. We would suggest, however, that the subject of gas distribution is so large that a treatise to be adequate must be the result of the co-operation of a number of experts in its various branches. In these days of specialisation it is not to be anticipated that a single individual will be able to deal adequately with, *e.g.*, the jointing of steel mains and the laws of flow of gases in pipes. The result of such an attempt might be foreseen and is evident in the present volume. The section devoted to main-laying is excellent and constitutes the best part of the volume. That devoted to a theoretical discussion of the flow of gases in pipes is inaccurate and altogether inadequate. It would be well, we think, to include the work of Stanton and Pannell and the empirical formula deduced by Lees from their results in this section.

New chapters on inferential meters and gas for industrial purposes have been included. The former is not entirely adequate. The form of Pitot tube developed as the result of work carried out at the National Physical Laboratory is quite incorrectly attributed to Griggs. This error will serve to illustrate the author's apparent general lack of acquaintance with the more strictly scientific aspects of the subjects of gas distribution. The chapter on gas for industrial purposes is wholly commendable and illustrates the great development which has occurred within recent years in this direction, a development very much accelerated by the call for munitions during the War.

Summing up our impressions after carefully reading the four volumes, we would say that the gas industry has at long last started on the way to provide itself with a scientific and technical literature which shall be in some measure adequate to its needs and deserts. The four volumes here briefly reviewed stand in serious need of overhauling, and we suggest that when a further edition of any of the volumes is called for, the proof-reading should be a little more carefully done. Grammatical errors and split infinitives are in some of the volumes almost as thick as "leaves in Vallombrosa," and we are tempted to infer that the gas industry has its own peculiar variant of Kings' English. The prices of the volumes are, even in these days of inflated index figures, exceedingly high. A considerable portion of the text and illustrations in Mr. Hole's and Dr. Levy's volumes is available gratis in the form of trade circulars, and we believe that these circulars will, owing to the high price of issue of the volumes, continue to be the main source of information consulted by the great majority interested in gas distribution and gas-works recorders.

J. S. G. THOMAS.

The Earth under the Rule of Man.

Man as a Geological Agent: An Account of His Actions on Inanimate Nature. By Dr. R. L. Sherlock. Pp. 372. (London: H. F. and G. Witherby, 1922.) 20*s.* net.

THE Human period of the Quaternary era has set in. Disregarding epochs of the Pleistocene or of earlier periods in which man has left traces of his existence, his activity may be said to have begun when a clear field was given for migration. His rule on the earth's surface was assured by the disappearance of continental glaciation from the temperate zones. Henceforward, he began seriously to modify the earth. The improvement of the entrance to a cave was probably his first essay in denudation; the building of a barricade against wild beasts foreshadowed the vast works of transport and accumulation that are traceable in the Pyramids or in Cuzco.

By turning up the soil with pointed sticks, and later with some primitive form of plough, man assisted natural agents in the disintegration of hard rocks. As the soil developed under culture, with a constant renewal of its air-ways and water-ways, the subsoil in humid climates became modified in an opposite direction. Its interstices were choked by fine material washed in from above. There was a greater retention of water in the overlying soil, and acres that at one time were liable to run dry became available for the continuous growth of plants. When a patch became poor and temporarily exhausted, the early and unskilled cultivator moved to some adjacent area, just as the Berber of the Tell, with his camel-plough, or the Bantu in some forest-clearing, with his wooden hoe, is apt to do at the present day. In this way the earth was primarily and profoundly influenced by man. Let us remember that if our "civilisation" comes to us from the crowded life of cities, our "culture" reaches farther back, and was born with the first tillage of the fields.

This widely spread and continuous attack upon the land-surface does not appeal to Dr. Sherlock so much as might have been expected. He is more concerned with the localised and spectacular results of engineering pertinacity in recent centuries. These lend themselves to statistical treatment, and they can be compared with the slowly cumulative effects of natural, that is to say non-human, agents. Dr. Sherlock has brought together a large amount of curious information, and is able to tell us (p. 24) the total output of coal from Great Britain between 1500 and 1913 A.D., the area (p. 110) of England and Wales under pavements in 1908, and the height of the brick structure (p. 236) that forms the famous mound of Babylon. A fine example of his zeal for calculation appears on p. 73, where, by the use of average specific gravities, he records the output of quarries of eleven types of material during nineteen years in cubic yards in place of tons; 2·75, however, seems a slip for 2·25 in the case of gypsum; and is it scientific to use for quarried ironstone a factor so precisely stated as 4·017?

It was well worth while to direct attention to the enormous bulk of the artificial hills of slag or shale that are still growing in our mining areas. The illustrations facing pp. 203 and 207 are convincing evidence of the activity of man. The modification of an area of complex structure by the spread of a city over it is excellently typified in the chapter on London. The story of the origin of Moorfields in water that was banked up against the Roman Wall, and of the replacement of the alluvial mud of the Wall Brook and the Langbourne Water by the subterranean floors of some of our most monumental city buildings, might have been told in even greater detail. Dr. Sherlock, however, is not to be lured into the picturesque. He does not step aside to mention the lining of corridors in modern offices and hotels with the spoils of Egypt and Numidia, with slabs of imperial porphyry, "fiammeggiante come sangue," and with pale marbles voluptuously veined; or the accumulation of exotic blocks, exceeding in variety and length of travel the erratics of an ice-age, which man has brought together to deck, say, San Paolo fuori le Mura, even in an epoch of nineteenth-century restoration. The amount of Caen stone in the south of England, or of the corresponding oolite from Portland in the grey limestone areas of Ireland, suggests similar reflections. A conspicuous example of man's energy in geological transport is to be found in the Portuguese stone that was brought in carracks round the Cape to build the jutting fort on the coral shore at Moçambique.

Though the reader's imagination is not touched by Dr. Sherlock, plenty of facts are given on which to found an outlook. A sense of accurate hard work pervades the volume. The material has been quarried out, and the result of its accumulation is neither a slag-heap nor a cathedral. We have noticed only one misprint ("Berschlag" for "Beyschlag"), and few matters that the geologist could reasonably question. We wish that we could agree with the optimistic statement on p. 112 that "no sooner is a part of the road-covering destroyed than more material is brought from a quarry to replace it." In illustration of the denuding effect of ordinary traffic, a photograph of one of the deeply cut by-ways in the Folkestone Sand of Surrey would have been welcome as a touch of rural England. It would refresh one after reading of the 156,000,000 cubic yards of comminuted quartz-conglomerate on the Rand.

The construction of the volume is such that its main lines suggest attractive by-ways. The amazing transference of rock-material for agricultural purposes from Chile, Christmas Island, or the desert-edge of Gafsa, might well deserve a mention. The destructive action of man-made sulphuric acid in the atmosphere of our industrial towns has been pointed out by Mr. J. A. Howe. Dr. Sherlock, however, has provided us with ample material for developing the subject along such paths as may appeal to us most nearly. GRENVILLE A. J. COLE.

Comparative Psychology.

Handbuch der vergleichenden Psychologie. Herausgegeben von Gustav Kafka. Band 1: *Die Entwicklungsstufen des Seelenlebens.* Pp. viii+526. Band 2: *Die Funktionen des normalen Seelenlebens.* Pp. viii+513. Band 3:] *Die Funktionen des abnormen Seelenlebens.* Pp. viii+515. (München: Ernest Reinhardt, 1922.)

THE present is often said to be a psychological age, and certainly the recent rapid multiplication of psychological books and lectures would seem to justify the above statement. One happy result of the stimulus which popularity has given to the production of psychological literature has been to make that literature extensive and varied. Nevertheless a survey of that literature shows that the psychologist's library is by no means adequate to his needs. There are at least two regrettable deficiencies, deficiencies which are more obvious in English than in German psychological literature. There is, on one hand, no large-size and generally accredited work on theoretical or pure psychology, a work sympathetically mediatory between the several divergent schools of contemporary psychological thought, a work which provides a basis of theory for the co-ordination of the as yet somewhat scattered results reached in the various fields of psychological research. There are in existence many first drafts of and essays towards such a work, but none is detailed and comprehensive enough, apart from the fact that none of them can claim anything like general agreement; and this deficiency, however unavoidable, however much a symptom of scientific health, is obviously very disconcerting to students.

The second deficiency, the one most in question here, is the absence of a sustained and comprehensive attempt to describe the world of living beings from the psychological point of view. Twenty years ago this would have seemed an impossible, if not a thankless task. To-day it is at least possible to make a beginning. For one of the many indications of the psychologicalness (if the word may be permitted) of this age has been and still is the rapid and unresting invasion of one realm after another of concrete experience by the psychologist. From the somewhat supermundane and, to many, jejune science, closely associated with metaphysics, which it was in the last century, psychology has developed into a science which touches practical interests and activities at a thousand points. Education and industry, art and society, war and peace, all have begun to be at least discussed and often treated from the psychological point of view. And one result of this successful ramification has been the accumulation of material for such a description of the world.

What a fascinating gazetteer that would be, a psychological gazetteer of the world! A survey of the world through the eyes and from the vantage point of the psychologist! What tantalising glimpses one has of a psychological description of politics, of business, of courtship and marriage. . . . Those preserves of opinion which, as Mr. Trotter says, are deemed too lofty for knowledge and are reserved for conviction, would no longer be able to keep their sacrosanct aloofness. One would seek to understand not only the origin and persistence of the opinions but also the taboo itself. All phenomena, oaths, and tea-parties, morality and social rank, would be approached from the point of view of psychological interpretation. Ethical and æsthetic prejudgments would neither deter nor mislead, they would be explained. One would psychologise on a cosmic scale, never stopping till the psychology of the psychologist himself had been written.

There is scant prospect, alas, of anything of the quality and scale of the above for a very long time to come. Intensively and extensively contemporary psychology is not equal to such a task. On one hand, psychology, despite its recent advances, has not yet explored, much less cultivated, the full extent of its territory. Progress has been ragged, and while here the workers are many and progress rapid, there it is well if a bare seisin has been taken. On the other hand, psychological theory is as yet too limited and too sketchy, neither strong enough nor comprehensive enough, for the organisation and interpretation of the vast mass of data with which it would have to grapple.

But half a loaf is better than no bread, and if even relative finality cannot be looked for, yet a beginning is feasible. If no beginning has so far been made, with the possible exception of the late Wilhelm Wundt's obsolescent and inadequately conceived "Völkerpsychologie," the fault must lie with the necessary specialisation of contemporary psychology. The individual psychologist has been marooned, as it were, in his own field of work, ample though that field has often been; his tentatives towards communication and co-operation have been baffled by the immensity of the science, and few have had the courage and the vision even briefly and imperfectly to envisage that science as an articulate whole. So that even the little that was possible has been left undone, and the reader who wishes to gain even a cursory and incomplete conspectus of psychological experience must pursue his purpose through scores of ill-related and narrow volumes.

The student's labours have been considerably lightened, and the present unfortunate and unnecessary state of affairs significantly improved, by a recently published work. This is the "Manual of Comparative Psychology" edited by Prof. Gustav Kafka, of Munich, to which twelve psychologists, including himself, have contributed. The work itself is divided into twelve sections, each section constituting a specific department of psychology and being written by a specialist in that department. These sections are grouped, somewhat unequally, into three groups, each group corresponding to a volume of some five hundred pages. The three groups are: The Evolution of Mind (Animals, Primitive Mankind, and Children); the Functions of the Normal Mind (Language, Religion, Art, Society, and Vocational Psychology); and the Functions of the Abnormal Mind (Psychopathology, Sex, Dreams, and Criminals).

This list sufficiently indicates the scope of the work. It is easy to find omissions: law, industry, and morality are inadequately represented, for example, while the editor himself deplores the absence of a section on the psychology of science, an omission due to his inability to find any one to write the section. It is easy also to find fault with the arrangement of the subject-matter. To mention one point only, it is surely not justifiable to give the impression that sex and dreams are abnormalities. One might again stress the occasional overlapping, the occasional unevenness of treatment and of point of view, and the more than occasional stodginess of manner, due largely to excessive compression on the one hand, and to theoretical incoherence on the other hand. But this is a pioneer work and must be judged leniently. If the reader brings an active and organising mind to its perusal, then the defects will be neutralised and the solid qualities of the work appreciated. For this reason one hesitates to recommend the work to the general reader, above all to the general reader who knows little or no psychology, and to whom an overloaded and viscous style is repellent. To those better versed in psychology its comprehensiveness, its accuracy, and its excellent bibliographies will make their appeal. They will be grateful for the compact account of the psychology of language. They will be glad to have Sante de Sanctis' views on dreams, inasmuch as they are the views of a man who began the study of dreams before Freud published his "Traumdeutung"; and they will be appreciative of and grateful for much else in this timely work. The fact that it is written in German will constitute but one more reason for regret that an international language for science has not long since made the peculiar aptitude of the German for this type of work the common property of mankind.

Our Bookshelf.

Handbuch der Pflanzenanatomie. Herausgegeben von Prof. K. Linsbauer. II. Abteilung, 1 Teil: Thallophyten. Band 6: Bakterien und Strahlenpilze. Von Prof. Dr. Rudolf Lieske. Pp. iv+88. (Berlin: Gebrüder Borntraeger, 1922.) 4*s*. 6*d*.

THE purpose of this handbook, which is to be comprised in a series of monographs by specialists in the various branches of the subject, is to give, in brief compass, a critical presentation of the present state of our knowledge of plant anatomy and cytology. In the volume before us, Prof. Rudolph Lieske, of the University of Heidelberg, has brought together, in a commendably brief and useful form, a critical digest of what is at present known of the morphology of the bacteria and ray-fungi (Actinomycetes). The first part of the book contains an account of the bacteria. In reference to the nuclei and nuclear structures which have been so frequently described, it is concluded that, although there can be no doubt about the existence of minute granules with nuclear characteristics, the presence of true nuclei in the bacteria has by no means been proved. The author has some interesting observations upon the recently described symplastic stage in bacterial development, and on the so-called sexual reproduction of bacteria. Among other topics dealt with are pleomorphism and variability, filtrable viruses, and mycobacteria.

In the second part of the volume the ray-fungi are dealt with. In discussing the systematic position of the group it is pointed out these organisms have certain characteristics in common both with bacteria and fungi, and that they must be looked upon as an independent group standing between the two. The various forms of the Actinomycetes present an astonishing variability both in morphological and physiological peculiarities, and the characters which have been used by various observers to discriminate species are so inconstant that no dependence can be placed upon them.

A literature list accompanies each part of the work, and there is a good index.

Mathematics and Physical Science in Classical Antiquity. By D. C. Macgregor. Translated from the German of J. L. Heiberg. (Chapters in the History of Science, II.). Pp. 110. (London: Oxford University Press, 1922.) 2*s*. 6*d*. net.

THIS volume gives a general survey of the science of classical antiquity, laying special stress on the mathematical and physical aspects. It opens with an account of the Ionian natural philosophy, pointing out that science is the development of early attempts of man to see his way in the world outside. Next there is a chapter on the achievements of the Pythagorean school, followed by two others on the progress made in the fifth century B.C. One of these is on mathematics, still under the influence of Pythagoras, and the other on medicine, which then reached a level not surpassed before the Alexandrian age. The work of Plato and Aristotle is adequately dealt with, while the longest chapter in the book is assigned to Euclid, Archimedes, and the Alexandrian school. In the period of decline which followed (second and first centuries B.C.)

only medicine made any real progress, and a four-page chapter is sufficient to record the work of the Romans. The last chapter, a long one, is devoted to Greek scientific literature of the Byzantine empire, it being stated that the founders of modern science, such as Galileo, Copernicus, and Newton, learnt from the Greeks not only particular results but also the very meaning of science.

Naturally Prof. Heiberg's little book makes no pretence of being a complete history of science in classical antiquity. It puts the achievements of the different schools of thought into a true perspective, and the language throughout is free from technicalities. The book would be improved by the insertion of more dates, even when these are only known approximately. (A companion volume deals more fully with the medical and biological sides of the subject.) W. E. H. B.

Tested Methods of Metallurgical Analysis (Non-Ferrous). By S. Pile and R. Johnston. Pp. 128. (London: H. F. and G. Witherby, 1922.) 7*s.* 6*d.* net.

IN referring to the literature of metallurgical analysis the student, and even the worker of experience, frequently finds himself at a loss to select, from the mass of alternative detail offered, a method suited to his immediate requirements. The authors of the present work, while disclaiming any novelty in the methods given, have collected together a series of well-tried methods of which they have had personal experience. The book deals mainly with commercial metals and their more important alloys. It opens with a few introductory remarks on general analytical procedure, and on sampling. In the latter no mention is made of the frequent necessity for rejecting the first few drillings of a bar to avoid the introduction of skin impurities, as distinct, of course, from segregated elements. The suggestion of dissolving up a large quantity of metal, and working on an aliquot portion of the solution, is a good one, and worthy of more general adoption. The metals are dealt with in alphabetical order, several good methods being given for each metal, and special attention is paid to details of manipulation. The inclusion of "moisture" among the determinations is rendered possible by the somewhat "scrappy" reference to fuels and oils. A similar extension in the case of sulphur is treated at greater length. No mention is made of gold or its alloys.

With some exceptions, perhaps of secondary importance, the book is a sound and careful compilation, and should meet all the requirements of those needing, at the working bench, a trustworthy guide to assays coming within the scope of the book, familiar or otherwise.

Faune de France. 4: *Sipunculiens, Échiuriens, Priapuliens.* Par Prof. L. Cuénot. Pp. 31. (Paris: P. Lechevalier, 1922.) 3 francs.

To this excellent series, promoted by a federation of the French natural history societies, Prof. Cuénot, of Nancy, contributes an account of the curious marine animals that used to be classed together as Gephyrea. Nowadays it is supposed that the resemblances between the three groups mentioned in the title are due to convergence, and that each group was derived independently from some primitive ancestor of the annelids. Prof. Cuénot, whose writings of twenty years ago on some of these creatures are well known to zoologists, has here given a clear, interesting, and well-illustrated summary of the species living round the coasts of France. British zoologists, though they have the works of Shipley and the more recent paper by Southern, may none the less welcome this convenient aid to the study of a remarkable assemblage. F. A. B.

Manuel de filature. Par F. Rubigny. (Bibliothèque Professionnelle.) Pp. 366. (Paris: J. B. Baillière et fils, 1922.) 10 francs.

THE volume under notice is one of a series of technological works, written primarily for the use of workers in the several industries, and deals with the spinning of all kinds of fibres, including asbestos and artificial silk, and also with the spinning of paper yarn. The treatment follows similar lines to those adopted by other writers on spinning, but with rather more attention to function and less description of machinery details than is the case with English works on the subject. Though this book cannot, any more than similar works on spinning technique, be taken as a trustworthy guide with respect to the raw materials, yet considering the wide field covered in less than 400 octavo pages, the treatment is otherwise remarkably adequate; and the book should be found a useful supplement to the usual works on spinning.

Cours de physique mathématique de la Faculté des Sciences. Par Prof. J. Boussinesq. Compléments au tome 3: Conciliation du véritable déterminisme mécanique avec l'existence de la vie et de la liberté morale. Pp. xlviii + 217. (Paris: Gauthier-Villars et Cie, 1922.) 30 francs.

THIS book is in the nature of a supplement to a complete course of mathematical physics by the University of Paris professor. It contains an extraordinary variety of matter, not very well arranged, but its main purpose is to round off a natural philosophy course by including, or rather by reconciling, the mechanism of physical nature with the indeterminism of life and consciousness. To a certain extent this has been the intellectual problem since Leibniz. Prof. Boussinesq can scarcely be said to claim to bring forward anything distinctively new, but he discusses the problem with full scientific knowledge and keen philosophical interest.

Smith's Intermediate Chemistry. Revised and rewritten by Prof. J. Kendall and E. E. Slosson. Pp. xv + 566. (New York: The Century Co.; London: G. Bell and Sons, Ltd., 1922.) 8*s.* 6*d.* net.

THERE can be no doubt that this book, the first edition of which was reviewed in NATURE of October 14, 1920, p. 208, has been greatly improved by revision. It is now more balanced in treatment, is very well printed and bound, and is probably the best elementary treatise on chemistry of the day. The inaccurate historical note on oxygen (p. 28), which was mentioned in the former review, has been toned down, but is still somewhat incorrect. Apart from the very clear and modern account of the chemistry of the common elements, the book contains a large number of brief notes on important matters (vitamins, enzymes, atomic structure, isotopes) not often met with in elementary manuals.

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.*]

Origin of Radioactive Disintegration.

IN a letter to NATURE of September 16, 1922 (vol. 110, p. 379) R. N. Pease directs attention to the possibility that the radioactivity of the heaviest elements may be due to the disturbing effect of the electrons in the atom. This view may be traced back to the time of the discovery of radioactivity (cf. J. J. Thomson, *Phil. Mag.* 7, 265, 1904, and Lord Kelvin, *Phil. Mag.* 8, 525, 1904). The problem, however, has been seriously complicated by the circumstance that, on the basis of ordinary mechanics and electrodynamics, the outstanding difficulty has not so much been to understand that radioactive disintegration can occur as to understand the simple law of radioactive decay. For the latter question, it seems that the development of the quantum theory has prepared the way to a deeper insight in the sense that the same law may be shown to apply to transition processes between stationary states of quantised systems.

On the basis of the quantum postulates alone it is an open question whether the nuclear instability is a strictly spontaneous process solely dependent upon the state of the nucleus itself, or whether external influences also play an essential part. A tentative argument in favour of the latter view is perhaps afforded by the fact that the life-periods of the elements at the beginning of the disintegration series are very large. This fact suggests the idea that the nuclei may be intrinsically stable and the radioactivity of these elements induced by the action of an external field of force, the origin of which may be looked for in the surrounding electrons. The regular variation in the life-period of successive elements in the disintegration series seems to indicate that the disintegration, when once initiated, proceeds spontaneously until a stable element is reached. On the other hand, the occurrence of radioactivity in the elements of low atomic numbers (rubidium and potassium) might be due to an enhanced efficiency of the perturbations due to some sort of resonance in the interaction between the nuclear and the electronic motion.

The force exerted by the electrons at a point in, or close to, the atomic nucleus will increase rapidly with increasing atomic number on account of the decreasing dimensions of the electronic orbits belonging to a permanent group. It will, however, in addition, depend intimately on the nature of the electronic configuration. If this configuration at every moment exhibits central symmetry, the forces from the electrons will to a large extent neutralise each other. The case is essentially different in the recent theory of Bohr, according to which the electrons belonging to a particular group and moving in eccentric orbits will approach the nucleus in succession. The shortest distance from the nucleus will be attained by the electrons moving in orbits with azimuthal quantum number equal to 1, and will then be given by

$$d = \frac{d_0}{2N}(1 - \alpha^2 N^2) \quad . \quad . \quad . \quad (1)$$

approximately. Here N is atomic number, d_0 the radius of the orbit in the normal hydrogen atom, and $\alpha = \frac{2\pi e^2}{hc} = 7 \cdot 2 \times 10^{-3}$ is the constant occurring in the theory of the fine structure of hydrogen lines. For the uranium atom the above formula gives $d = 15 \times 10^{-12}$ cm. On the other hand, the inferior limit for the diameter of the uranium nucleus, derived from the energy of the α-particles from uranium on assuming this energy to be due to the electrostatic repulsion of the nucleus, comes out of the same order of magnitude as the above value of d. At the moment of closest approach these electrons will thus exert forces upon the individual particles of the nucleus which may be of the same order of magnitude as the electrostatic attraction or repulsion between the particles themselves. For still larger atomic numbers, d will rapidly decrease while the nuclear dimensions will be expected to increase. It is therefore seen that for some atomic number not far ahead of that of uranium the electrons in question would have to pass quite close to the nucleus, and thus exert large perturbing forces on the nuclear particles. For still larger atomic numbers a motion for which the nuclear field is treated as due to a point charge would become impossible as the electrons in question would have to collide with the nucleus. On the whole, it does not appear excluded that the presence of radioactivity among the heaviest known elements as well as the apparent absence of elements of higher atomic numbers may be connected with some sort of interaction between the nuclear and the external electrons.

The efficiency of this interaction will be expected to depend intimately on certain resonance conditions, as is the case for ordinary mechanical systems. The frequencies of the motion of the nucleus must in general be expected to be of an altogether higher order of magnitude than the frequencies in the motion of the electrons; but there remains the possibility that the nucleus as a whole will rotate and this rotational frequency may in some cases be comparable with some electronic frequency. The case when the nucleus rotates with an angular momentum equal to $h/2\pi$ is of special interest, as this value appears to be associated with the most stable state of quantised systems. The rotational frequency w may then be estimated from the expression

$$w = \frac{h}{4\pi^2} \cdot \frac{1}{Ma^2}, \quad . \quad . \quad . \quad (2)$$

where M and a are the nuclear mass and radius of gyration about the axis of rotation. Assuming the nuclear dimensions to increase from about 8×10^{-13} cm. in helium (Rutherford and Chadwick) to about 6×10^{-12} cm. in uranium (cf. above) this frequency is found to decrease from about 10^{20} sec.$^{-1}$ in helium to about 10^{16} sec.$^{-1}$ in uranium. The latter value is essentially larger than the value to be expected for valency electrons. This is also necessary in order to understand the fact that the radioactive properties hitherto on record are independent of chemical combinations. It will further be found compatible with the assumptions regarding the nuclear dimensions to assume the frequencies of nuclear rotation in potassium and rubidium to be of the same order of magnitude as the electronic frequencies of the K and the L electrons respectively in these elements.

The above considerations, however, are to be regarded merely as tentative suggestions, and our knowledge of nuclear structure is probably far too scanty to permit of any definite conclusions concerning these questions at present.

S. ROSSELAND.

Copenhagen, Institut for teoretisk Fysik,

February 12.

The New Marine Biological Research Station of the Bergen Museum.

FOR close upon one hundred years researches regarding marine fauna have been a prominent part of the work carried out by the Bergen Museum. The first biological station in Norway was built in the year of 1891 and was attached to the museum. On account, however, of the expansion of the city of Bergen, the pollution of the salt-water supply for the station gradually increased to such an extent that the biological work there had to be abandoned.

By the generosity of private donors, who realised that the fine traditions of the maritime research work carried out at Bergen should be maintained, the Trustees of the Bergen Museum have been enabled to build a new station. The biological station (Fig. 1) is now situated on the island of Herdla, about seventeen miles from Bergen. The station is thus right in the centre of one of the richest and most promising fields for research of the west coast of Norway, well known also through the investigations of such British naturalists as Norman, Jeffreys, Harmer, Punnett, and others. The open sea, the deep fjords, and the narrow sounds with their strong currents, offer here the most varied and changing conditions of life for marine fauna, which accordingly is extraordinarily rich and well represented.

FIG. 1.—Marine Biological Station at Herdla, seen from the fjord.

Any biological condition typical of the west coast of Norway may be reached within less than two hours' sail from the station. The salt-water supply is taken from a depth of approximately 25 metres, which guarantees salt water of excellent quality and without appreciable changes in temperature and salinity. Thus are present the best conditions for experimental and embryological research.

The object of the station is to serve as a basis for scientific investigations, as well as for the international courses in marine biology which were held at the Bergen Museum for a number of years until 1914, and with a large participation from abroad. The station is open to naturalists of all nations. During the period in the summer when no courses are held, the station has tables for ten scientific workers besides the staff. During the winter there are tables for five only. Being situated close to the open sea, which never freezes, the station can be kept open all the year round, and thus offers good opportunities for collecting material during the winter months. The station contains the necessary accommodation for housing naturalists visiting it.

A 25-ton research vessel, the *Herman Friele*, is attached to the station, and is equipped with appliances for research down to a depth of 1500 metres. Moreover, the station is provided with a smaller open motor boat and various rowing-boats.

By the opening up of this new station, facilities are afforded for utilising again the particularly favourable conditions for marine biological investigation offered by the west coast of Norway. I shall be glad to reply to any inquiries regarding the station or the reservation of tables.

A. BRINKMANN.
(Director.)

Museet, Bergen, Norway.

Industrial Applications of the Microscope.

WHILE one reads with satisfaction in NATURE of February 17, p. 239, of the ever-increasing examples of the application of the microscope to industry, the fact remains that the use of the mineralogical microscope with the small amount of knowledge of crystal optics necessary has up to the present been practically disregarded.

In 1918 a considerable amount of work was done in this connexion dealing particularly with explosives, but the results were never published, and hence it is thought that the following example may be of interest.

It was proved quite definitely at the Ardeer Factory of Nobel's Explosives Company that the degree of nitration in guncotton and nitrocellulose could be ascertained directly by the optical properties of the product. Thus it was found that the birefringence of ordinary cotton fibre before nitration was strong and of a positive character. The same cotton after being fully nitrated showed strong birefringence but of a *negative* character, while cotton with an intermediate degree of nitration was shown to be practically isotropic.

It was found afterwards that a corresponding work had been carried out by Dr. Phil Hans Ambron in Germany, and he published a table giving the actual values and character of the birefringence of nitrated cellulose and also nitrated ramie or China grass. It is, of course, true that the degree of nitration can be obtained quicker and more accurately by means of a nitrometer, but the two lots of information differ widely. The nitrometer gives the average nitration of the whole sample while the microscope gives the actual nitration of separate fibres, and is therefore a valuable test of the homogeneity of the sample.

During the War, when acetone was unobtainable, a substitute had to be found as a solvent for nitrated cellulose in the making of cordite. Ether-alcohol was the substitute used. Now, while cellulose and almost any form of nitrated cellulose are soluble in acetone, ether-alcohol will only dissolve nitrated cellulose of a certain percentage nitration, and the homogeneous nitration of large samples of cotton was by no means easy or altogether certain, and hence the microscopic method should have been invaluable. The results of these experiments were obtained too late to be used on a large scale, but they certainly show an example of the class of information obtainable.

Another application of a rather humorous nature can also be cited. A large consignment arrived in the factory of what was called ground silica. This was sent to the analytical department and its percentage of silica ascertained. It was pointed out, however, that the value of ground silica did not lie in the purity of the material but in its fineness and homogeneity. This was tested both by elutriation and the microscope. The microscope revealed the fact that the material was nothing but an inferior sand, with very little grinding. Ground silica must, of course, always show conchoidal fracture and not rounded grains. This sample was also shown to contain the mineral glauconite actually replacing the tests in small fragments of foraminifera, and hence had during its formation been closely connected with the sea. The price per ton indicated that the material was supposed to have been obtained by the grinding of vein quartz.

The identification of asbestos has been published before, but it bears repeating. Platinised asbestos was extensively used in the sulphuric acid plant. The asbestos was originally supplied from the continent, but during the war this supply was not available. The South African asbestos or the mineral crocidolite was used as a substitute with very disastrous results. It was decided, therefore, that the nature of the original asbestos must be obtained by chemical analysis and all samples similarly tested. The chemical analysis of a complicated silicate like asbestos is a long and by no means easy process, as the asbestos is seldom free from other complicated silicates. Now, it was found by a very simple mineralogical test that the original sample was the mineral chrysotile, and by similar tests it was quite easy to ascertain which of the other samples was also chrysotile and to pick out the purest. In this way, a dozen samples were tested in two hours, whereas the chemical analysis had already been in hand for three months, and was likely at the same rate to take another six and give no information whatever.

The simple test for chrysotile was mounting it on a microscopic slide in mononitrobenzene and rotating it between crossed nicols. The refractive index was obtained by the Becke method. The refractive index together with the birefringence and optical character render the mineral quite distinct from any other sold as asbestos. These are three of the very many occasions that cropped up so frequently.

ASHLEY G. LOWNDES.

Marlborough College, Wilts.

Factors of Odorous Strength.

IN the letter from Mr. J. H. Kenneth published in NATURE of February 3, page 151, a relation is indicated between the odours of certain substances and specific gravity. If, however, we examine the boiling-points of the odorous constituents of the four oils mentioned, we find that in order of increasing vapour pressure the oils stand as follows: sandalwood (305), cedarwood (280), origanum (230), and terebene (160), the figures in brackets being the approximate boiling points. This order is precisely that represented by the specific gravity quoted by Mr. Kenneth.

I scarcely think the phenomenon with which Mr. Kenneth's letter deals, can safely be ascribed to the specific gravity of the oils, although possibly in this instance the specific gravity is a property concomitant with volatility. Volatility alone, however, does not afford a completely satisfactory explanation of this and many other phenomena connected with the smell of an odoriferous substance. There are at least four factors concerned, namely: (1) Volatility; (2) solubility in the aqueous layers in the nose; (3) solubility in the lipoid fats of the nose, and (4) chemical reaction with osmoceptors in the nose.

A substance which fails to satisfy any one or more of these factors is odourless, and it is obvious that variations in the factors will produce variations in both the strength and the quality of the odour.

T. H. DURRANS.

The Dyson Perrins Laboratory,
South Parks Road,
Oxford, February 6.

WITH reference to Mr. Kenneth's letter in NATURE of February 3, p. 151, I should like to point out that, if the "votes" be counted on a sort of proportional representation scheme by adding to the first votes for each substance half the second, a third of the third, and a quarter of the fourth, we get the following results in votes:

S.	C.	O.	T.
18·66	11·56	9·33	6·33

This result seems to me to enforce Mr. Kenneth's argument.

FRANK H. PERRYCOSTE.

Higher Shute Cottage, Polperro R.S.O.,
Cornwall, February 17.

The Life-Cycle of the Eel in Relation to Wegener's Hypothesis.

IN NATURE of January 27, p. 131, under the title "The Distribution of Life in the Southern Hemisphere, and its Bearing on Wegener's Hypothesis," an account is given of a discussion at a recent meeting of the Royal Society of South Africa on this question. Opinions were divided, the geologists suspending judgment, while the hypothesis was opposed on botanical and entomological grounds as being unnecessary. On the other hand, it was said that the most important zoological evidence in support of Wegener's theory was provided by the distribution of the isopod, Phreatoicus.

It seems to me that strong evidence in favour of Wegener's hypothesis is to be found in the life-history of the European freshwater eel, as revealed by the brilliant researches of Dr. J. Schmidt, of Copenhagen. For something like eighteen years Dr. Schmidt has been engaged on this subject. He has published numerous papers and has summarised his results in the Philosophical Transactions, published a year ago, and quite lately in NATURE (January 13). It will be sufficient for the present purpose to allude only to certain of his results.

Of the two freshwater eels of the North Atlantic, the American species spawns somewhat to the south and west of the spawning region of the European species, and the larvæ attain full size and, after metamorphosis, enter the freshwaters of the American coast when about one year old. On the other hand, the larvæ of the European species, originating more to the east but still in the same region, are transported by the Atlantic Drift and its continuations, aided perhaps by their own efforts, it may be for thousands of miles, as shown in the chart, p. 51 of the article in NATURE of January 13. Still more to the point, the larvæ are about three years old when they become transformed into elvers and enter freshwaters. A larval life so extremely prolonged, as Dr. Schmidt points out, is quite unique. The rate of growth, moreover, is extraordinarily slow. At full size, after about three years' growth, the larvæ are approximately three inches long, although the temperature of the water in which they are immersed is comparatively high. In our own waters with much lower temperatures most young fishes would attain a corresponding length in as many months. The extremely slow growth of the larvæ of the European eel is thus an adaptation to the prolonged journey.

It is scarcely possible to understand this unique phase in the life cycle of the European eel on the hypothesis that the geographical conditions were formerly the same as now exist. But if Wegener's theory be accepted, the explanation is simple. As the coasts slowly receded from one another the larval life of what became the European species was more and more prolonged by natural selection in correspondence with the greater distance to be traversed. T. Wemyss Fulton.

41 Queen's Road, Aberdeen,
February 16.

The Stoat's Winter Pelage.

Sir Herbert Maxwell's letter on the above in Nature of February 17, p. 220, raises points of great interest. Presumably if his glacial explanation be correct, stoats taken from the Scottish Highlands to the south of England will still become white in the winter; whereas stoats brought from the southern counties to the north of Britain will remain the same colour the year round. Has this ever been put to the test?

It would be instructive to know whether winter coats intermediate in shade between brown and cream-white are ever assumed. I ask this from the point of view of mutation, which is so much to the fore at present. Have, for example, circumpolar white animals arisen from coloured ones through chance albinos being preserved and increased by Mendelian segregation, or have they appeared through the selection of paler and paler forms leading eventually up to white?

Then again, taking Sir Herbert Maxwell's explanation as correct, have we not here an example revealing how slowly evolution may work? The elimination of the arctic winter garb of the stoat in Britain is not yet complete, though some thousands of years at least must have elapsed since the last ice age.

One more point: Is the British stoat as regards its pelage reverting to the pre-glacial condition, and if so, how does this harmonise with the view that evolution is irreversible? John Parkin.

The Gill, Brayton, Cumberland.

Sir Herbert Maxwell's attractive thesis (Nature, February 17, p. 220), that latitude and not winter temperature regulates the seasonal change of the stoat's pelage from brown to white, does not meet all the facts of the case. Islay is farther north than Monreith, and yet in Islay a large proportion of the stoats retain their summer colour throughout the winter.

Having made arrangements some time ago to obtain specimens of the Islay stoat, regarded by Mr. Gerrit Miller as a distinct race, I was struck by the fact that individuals killed in December and February were in summer coat. This suggested inquiry as to the usual course of events in the island, and Mr. Macdonald reported that there white winter stoats are rather the exception than the rule: that of more than 20 stoats he had killed during the winter of 1921–22, only one was entirely white, although in the previous winter the proportion was higher, about six being white; but that only in exceptional years did the proportion of white individuals attain to about half of the total number killed.

Now the latitude of Edinburgh is not far off that of Islay, yet my impression is that here almost all the stoats become white in a normal winter.

These and other facts strengthen the old idea that climate is somehow involved in the colour-change, which seems also to depend to some extent on the condition of the individual animal.

James Ritchie.

The Royal Scottish Museum,
Edinburgh, February 21.

Sir Herbert Maxwell, in Nature of February 17, p. 220, directed attention to what he considered the conditions determining the winter change of colour in stoats, and inferred that the tendency to undergo such a change is usually the inherited characteristic of some particular strain or breed, rather than the outcome of any special present local severity of climate. He said the effect was most marked in the Highlands of Scotland and diminished regularly as one travelled south, until on reaching Cornwall the winter blanching seemed almost entirely in abeyance.

Since his observations appear to be confined to the island of Great Britain, Sir Herbert may be interested to learn that as a boy at Jersey, about the year 1880, I happened to come across a white stoat. This was shot by a neighbour, in St. Lawrence valley, and, after being stuffed, kept by us for some years. It represented a perfect ermine, the fur being pure white except for a black tail. I never heard of, or saw, any other specimen in Jersey, either white or brown. The case seems interesting, for the stoat belonged to a breed which must have been free from any extraneous admixture, particularly from the north, since that remote period in the past, when the French coast (on which the Channel Islands are situated) was finally separated from Great Britain by the English Channel. Further, the climate being mild and uniform, the tendency to assume a winter pelage can only have resulted from very ancient inheritance.

R. de J. F. Struthers.

Exeter College, Oxford.

The Subject Index to Periodicals.

May I add a few words of information to the appreciative review of the above publication which appeared in Nature of February 17, p. 214. Our headings are "The Subject Headings used in the Dictionary Catalogues of the Library of Congress" to which an annual supplement is published. These are linked up with the corresponding classes in the shelf-classification of that library. The advantage of this type of catalogue is that, if properly compiled, it combines system and uniformity with the property of immediate reference. It is in fact a class catalogue in which the headings are arranged in "index" order. Your reviewer's suggestion that we should print a list of the journals indexed in each Class List will be certainly adopted when our funds admit of it. Our Class Lists for 1915-16 contained such Lists as well as Authors' Indexes, and it was with the utmost regret that we were compelled to discontinue these features.

The following extract from an official letter now being circulated widely throughout the British Empire may interest some of your readers:

"In assuming responsibility for the Index the Council of the Library Association was actuated by the following considerations:

"(1) That, in view of the rapid growth of the periodical press, the analytical indexing of periodicals could be carried out with due regard to efficiency and economy only by co-operative effort.

"(2) That such co-operative publication should be controlled by a British professional body rather than be left to the enterprise of a foreign publisher.

"(3) That the Index should be compiled by trained library workers on a voluntary basis, and that the price should be fixed as nearly as possible to the cost of production, and without any idea of profit."

Every effort will now be made to bring the Subject Index up to date. We hope to complete the 1920 Class Lists this summer and commence the publication of the 1921 Lists in the autumn. For further particulars application should be made to the Hon. Secretary of the Library Association, Westminster Public Libraries, Buckingham Palace Road, S. W.

E. W. HULME,
Editor of "The Subject Index to Periodicals."

Gorseland, North Road, Aberystwyth,
February 23.

Time Relations in a Dream.

I HAVE read with much interest Dr. Atkin's letter in NATURE of January 27, and also Mr. Barcroft's letter in the issue of October 23, 1919 (vol. 104, p. 154) to which he refers. My own observations, made in various degrees of semi-consciousness, appear to show that there is no such thing as a definite time relation, as it depends entirely on the degree of consciousness, the time scale being enormously shortened in the semi-conscious state most remote from wakefulness, so that the images produced by the mind must succeed one another with extraordinary rapidity when in that state. As wakefulness increases, the time scale seems to expand, and the succession of events proceeds more and more slowly, until it practically stops or becomes normal as wakefulness resumes absolute control. I have been led to believe that the mind is *always* active —just like the heart always pulsates—whether we are asleep or awake, and that control and memory are the features of our waking condition, so that we do not remember the images it calls forth, except when we are beginning to awaken, and the degree of activity of our memory in our dreams and the extent of the dream memorised merely depend on the rapidity with which we reach wakefulness.

I have made a number of observations of hypnopompic pictures, or optical illusions, which occur while sinking into slumber or during gradual awakening. I described my first observations in the Journal of the Society for Psychical Research for April 22, 1921, but since then I made several curious observations, some of which concern the case in point.

The hypnopompic pictures which I have observed are generally landscapes passing *slowly* before one's closed eyes, when in an *almost awake* condition, one being fully aware of one's wakefulness, and having one's full reasoning powers *while the illusion proceeds*, so that one can make precise observations and experiments as to the effect of volition, etc. The pictures, which are extraordinarily sharp and full of detail, appear as an endless panoramic band or film passing *slowly* before one's mind's eye, so to speak. The film may pass in any direction, right to left, or the reverse, or vertically downwards, or obliquely. A film may snap, but it invariably slows down as consciousness increases, till it becomes motionless and *then* gradually fades.

It seems as if several such bands or films could exist at the same time, passing one in front of the other, and sometimes in different directions, the uppermost alone being visible of course, and its sudden ending by snapping allowing the one underneath to be visible. This would explain the sudden changes which are often noticed in dreams. The fact that the film is panoramic (and not cinematographic, that is, without perception of translation) is remarkable, as one would have expected it to be cinematographic in character. Once, attaining consciousness very rapidly, I glimpsed, for a couple of seconds, a blurred mass of lines such as one sees from an express train on a wall quite close to the track—lines caused by the persistence of vision of the details on the wall, combined with their motion relatively to the train. I have no doubt whatever that I had witnessed the hypnopompic "film" nearly at its normal speed, but with a mind already "slowed down" by the return to consciousness, and unable to cope with its speed and see the details which otherwise I am persuaded—by the agreement of all my observations—would have been visible.

The latter observation bears directly on the question of duration. At such a high translation speed, hundreds of times faster than the usual speeds I had hitherto observed, a whole panoramic view must pass in an extraordinarily short time. Moreover, at such a speed, cinematographic effects are possible, but I fail altogether to imagine by what mechanism they could take place, and so far my observations have given me no clue, although I have once or twice witnessed variations in the process which prevent me from despairing of getting further insight into this mysterious working of our minds. It seems as if control and memory slowed down the working of the mind so that the speed of succession of the images is an inverse function of the degree of wakefulness. M. GHEURY DE BRAY.

40 Westmount Road, Eltham, S.E.9,
February 10.

The Social Influence of Science.

IN his article in NATURE of February 17, p. 209, Mr. F. S. Marvin says: "When in the sixteenth century the mind of Ancient Greece awoke again . . ." The advent of modern science is here considered as a revival and continuation of Greek knowledge; an opinion very commonly held, but entailing some difficulty—a millenary period of stagnation and even retrogression. This is inconceivable; the very essence of science is progress, continuous but not steady, because the rate is increasing. This characteristic of science was pointed out in the Harveian Oration for 1897 by Sir William Roberts ("Science and Modern Civilisation," NATURE, October 28, 1897, vol. 56, p. 621).

Antiquity has been artistic, literary, philosophical with deductive reasoning; but is markedly deficient in the objective study of Nature and the inductive mentality. The philosophers' knowledge of things was part of their system, based on *a priori* principles. Their opinions were many and conflicting, with various degrees of credulity, a few of them by chance right. The influence, if any, on the birth and growth of modern science has been very limited; the method of working, by patient observation and experimenting, is exactly the reverse. The rise of the experimental inductive method was like a botanical mutation and inaugurated a new era in the evolution of mankind. AD. K.

Antwerp, February 17.

It is true that progress was made in certain directions during the "millenary period of stagnation," for example, the improvements in mathematics due to the Arabs. Yet the main fact in the re-birth of science in the sixteenth century is the discovery of the work of the Greeks, especially in geometry, astronomy, and geography. Descartes goes back to Pappus, Copernicus to Aristarchus, Toscanelli to Ptolemy. There is no question that in the general spirit with which the medieval mind regarded Nature there was retrogression, and that the Greek mind did come to life again at the Renascence, partly in its broader quality of rational inquiry, partly in the actual works of Greek thinkers.

F. S. MARVIN.

German Book Prices.

IN reference to Prof. Browning's letter in NATURE of December 23 (vol. 110, p. 845), I should like to point out an added difficulty in India and Burma. Not only are exorbitant prices charged for German books, but to the majority of our students such books are useless owing to their ignorance of the language. The Indian or Burmese student already has to learn English in order to study chemistry, and to ask him to learn German as well is too great a handicap and should be unnecessary.

The appearance of certain recent works on inorganic chemistry shows that British chemists are capable of compiling exhaustive treatises, and a dictionary of organic chemistry in English would be invaluable. The Society of Dyers and Colourists is preparing a colour index, and the combined strength of the Chemical Society and Institute of Chemistry should be able to produce a work on organic chemistry which would enable Indian or Burmese students to carry out research in organic chemistry without constant reference to German works.

D. H. PEACOCK.

University College, Rangoon,
February 2.

Single Crystals of Aluminium and other Metals.

THE brilliant account given by Mr. G. I. Taylor at the Royal Society (February 22) of the deformation of single crystals of aluminium leads me to direct attention to work done in this laboratory ten years ago by Mr. B. B. Baker and Dr. E. N. da C. Andrade. Mr. Baker showed that sodium and also potassium cylinders when stretched contracted laterally so as to lead to an approximately elliptical section, and when they broke they did so at a chisel edge. The surfaces are marked with a double set of slip lines. A photograph of the appearance is shown in the Proceedings of the Physical Society of London for 1913.

Dr. Andrade, who was experimenting at the same time on the traction of metals, showed that similar results were obtainable with tin and lead, and also with frozen mercury (*Phil. Mag.* 1914). He concludes that they are due to large uniform crystals of a size comparable with the diameter of the rod. From the regularity of behaviour over a length of several centimetres it may be concluded that both were dealing with single crystals several centimetres long in the case of each of these materials—at any rate in the same sense as that in which the crystals of aluminium are spoken of as being single.

The crystals of sodium are still in my possession, having been carefully preserved in anhydrous paraffin. They show the characteristics, even the fine surface markings, practically as well as when they were drawn.

ALFRED W. PORTER.

Physical Laboratory, University College,
London, February 26.

Paradoxical Rainfall Data.

AT Blue Hill careful measurements of rainfall have been made for thirty-seven years. There is no break in the record and the amounts are checked by more than one gauge. Data for the entire period 1886–1922 are given in Blue Hill Meteorological Observations. The average monthly values are:

January	101·1 mm.	July	104·1 mm.
February	101·0 ,,	August	100·8 ,,
March	109·2 ,,	September	103·1 ,,
April	94·1 ,,	October	96·4 ,,
May	94·0 ,,	November	97·7 ,,
June	86·3 ,,	December	97·9 ,,
Year	1185·7 mm.		
Month	98·8 mm.		

The driest month is June and the wettest is March. Yet the driest month in the whole period was March 1915, when the total rainfall was only 1 mm. What is equally remarkable, the wettest month was June 1922, when 274 mm. fell. It is difficult to explain these rainfalls on any theory of probability. The June rainfall was not due to abnormally heavy showers.

ALEXANDER M'ADIE.

Harvard University,
Blue Hill Observatory,
Readville, Mass., February 19.

Atmospherics.

MANY who have "listened in" must have been much interested by the peculiar sounds the telephone generally emits, in addition to those produced by the waves from the broadcasting station. Although atmospherics are produced by the electric discharges during thunderstorms, many would appear to have a very different origin.

In the discussion of a paper on "The Study of Radiotelegraphic Atmospherics in Relation to Meteorology," by C. J. P. Cave and R. A. Watson Watt (Journal of Meteorological Society, January 1923, pp. 35-42), Mr. L. F. Richardson asked Mr. Watson Watt "if he could explain the origin of the peculiar atmospherics which were experienced at Eskdalemuir on the telephone, which was connected with an overhead wire in a lonely valley. In addition to the ordinary clicks there was a 'swishing' sound. The frequency of the vibration diminished as the swish went on. This property was characteristic of the sound of a shell passing high overhead. Mr. Richardson had the idea, perhaps a mad one, that the swish might be produced by a meteorite."

Many of the atmospherics I have heard have had this character, and it may be suggested that the idea that they are produced by very small meteorites is not quite such a mad view as would at first appear.

In the higher atmosphere, there may be a very considerable electric potential gradient, and if a meteorite, entering it, ionised a path in it, an electric discharge might occur along this ionised path sufficiently strong to give off electric waves. There is indeed reason to suppose that the direction from which the waves come is influenced by variations in the sun's position (R. A. Watson Watt, Proc. Roy. Soc., vol. 102, 1923, p. 460).

R. M. DEELEY.

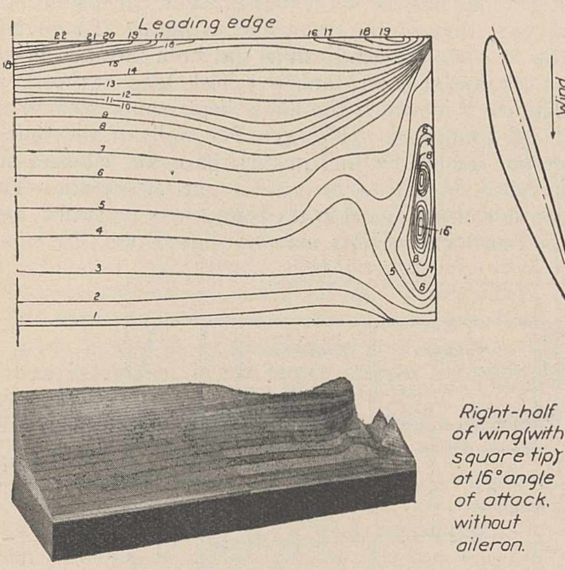
Tintagil, Kew Gardens Road,
Kew, Surrey, February 17.

Recent Aeronautic Investigations and the Aeroplane Industry.[1]

By Prof. JOSEPH S. AMES, The Johns Hopkins University, U.S.A.

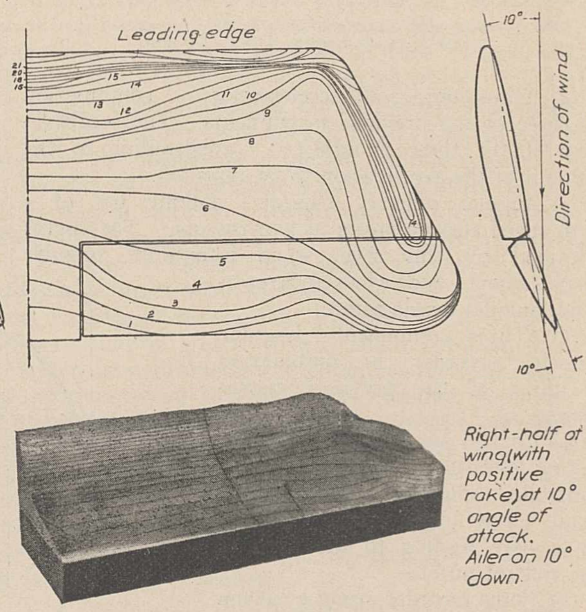
FEW industries offer better illustrations than the manufacture of aeroplanes of the intimate relation between purely scientific investigations and the practical application of their results. As an example of this fact, attention may be directed to three experimental researches in progress at the laboratories and flying-station of the National Advisory Committee for Aeronautics at Langley Field, Virginia. These researches were begun and are being conducted in order to add to our knowledge of the science of aeronautics, but their results are of the utmost importance to the industry and also to the art of aviation. Other illustrations might well have been selected, but these are, in many respects, of "actual" importance.

The first research deals with the pressure distribution over the wings, tail-surfaces, etc., of an aeroplane —an old problem, studied with marked success by the staffs of the British establishments at Teddington and Farnborough. What is novel in the present investigation is the extension of the problem to aeroplanes making manœuvres, and to wings of different plan form, varying the angle of attack and the aileron angle. The method adopted is simple: numerous series of small openings are made in the surface to be investigated; each of these is joined by a rubber tube to a capsule containing a metal diaphragm, to which is attached a tilting mirror; a beam of light is reflected from this on to a photographic film which may be shifted, thus permitting a series of observations to be made. The apparatus in use records the pressures existing at sixty points simultaneously. All the diaphragms are, of course, standardised and calibrated. (In the case of wind-tunnel experiments a number of liquid manometers are used.)



Plan and elevation showing contour lines, and built-up model.

FIG. 1.



Plan and elevation showing contour lines and built-up model.

FIG. 2.

Among the questions already investigated are: the change in pressure distribution produced by a loop, a roll, etc.; the effect of the shape of the wing-tip, square corners, elliptical, raked off, etc.; the influence of the air-stream from the propeller. In all cases the pressures are measured quantitatively, and the results are shown in two ways: by making plaster or wooden models, like a relief map; and by drawing contour lines of pressure (Figs. 1 and 2). From the knowledge thus obtained, the aeroplane engineer can decide upon the best shape of wing or elevator, etc., and upon the relative strength required in different parts of his structure; and further, if a breaking sand-load test is thought necessary, he can so distribute the load as to make it correspond to actual flying conditions.

The second research was undertaken to learn the actual motion of an aeroplane in alighting, taking off, making oscillations and manœuvring, and at the same time to record the motions of the control surfaces and the forces exerted by the pilot (Fig. 3). A large number of instruments are required, all of which were newly designed with special reference to lightness and compactness, as well as to accuracy. The central instrument is a photographic film wrapped on a cylinder which is in rotation, for all records are made upon this by beams of light reflected from mirrors which form part of all the various instruments. When in actual use on an aeroplane, the pilot simply presses one button at the beginning of a manœuvre, and this starts everything. The instruments in use at the present time are as follows:

(*a*) Chronometer, consisting of a constant speed

[1] Substance of a lecture delivered before the Franklin Institute, Philadelphia, on November 23, 1922.

motor, properly governed. Lines of light are recorded at definite intervals, *e.g.* two seconds.

(*b*) Air-speed recorder, simply a Pitot-Venturi nozzle attached to suitable pressure-recording capsules.

(*c*) Single component accelerometer, consisting in the main of a damped steel spring, one end of which is free.

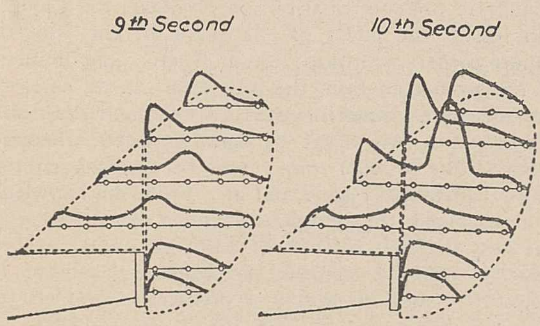


FIG. 3.—Showing the curves of pressure on the entire surface of the rudder at various intervals during a left turn.

(*d*) Three-component accelerometer, a combination of three of the previous instruments. The sensitiveness of the three is adjusted corresponding to the amount of the acceleration to be expected.

(*e*) Angular velocity recorder, making use of a high speed electric motor as a gyroscope. The curves obtained by this give, when integrated, angular displacement, and when differentiated, angular acceleration.

(*f*) Three-component angular velocity recorder, a combination of three of the previous instruments.

(*g*) Control position recorder, consisting essentially of three spring-controlled spools threaded on an axial screw, each spool actuated by a wire leading to the horn of the control surface.

(*h*) Force recorder, using a carbon pile resistance method.

Of course all these instruments are not used at the same time, but only as many as are needed for the study of each particular question.

From a practical point of view these instruments allow the performance of an aeroplane to be recorded accurately, in a manner quite free from the personal impressions of the test-pilot; and, further, the records taken in any manœuvre tell a story which is perfectly plain. Numerous questions, often raised by pilots, have already been answered, and pupil pilots have received great assistance.

The last research to be mentioned is one which is only beginning, but the apparatus has been carefully tested, and a few preliminary readings have been made. This refers to a new method of investigating the "scale effect." In the ordinary wind tunnel the forces and moments on a model of about one-twentieth the full scale are observed, and from these measurements deductions are made as to the promised performance of the full-sized aeroplane, or part thereof. It has been known for many years that in order for these deductions to be justified it would be necessary to have in the tunnel and in the flight of the actual aeroplane the same Reynolds's number, as it is called. This number is the fraction $\rho VL/\mu$, in which ρ is the density of the air, V is the relative velocity of the air-stream, L is a linear dimension of the aeroplane (or part), and μ is the coefficient of viscosity. It is clear that the Reynolds's number in the tunnel is about one-twentieth, or less, that of the aeroplane in flight. To obviate this, a complete wind tunnel has been installed inside an elongated steel tank—35 feet long, 15 feet in diameter—in which the air is kept compressed to 20 or 30 atmospheres (Fig. 4). The walls of the tunnel proper are hollow, and in this space the balances are installed, so as to be out of the air-stream. The attitude of the model in the tunnel may be varied, and the balancing weights may be shifted, etc., by small electric motors, controlled from outside the tank. Readings consist in viewing through suitable small windows a number of Veeder counters. The importance of this apparatus from the point of view of aerodynamics is sufficiently obvious, and from that of the aeroplane designer even more so.

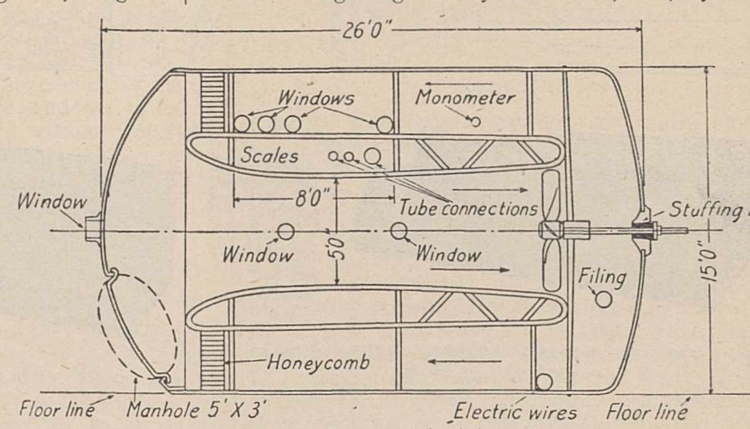


FIG. 4.—Compressed air wind-tunnel.

Radiography and Physics.[1]

By Dr. G. W. C. KAYE.

THE frail, untrustworthy X-ray tube of 1895 and the more robust and dependable tube of the present day do not differ in principle. The X-ray tube still remains a device for generating high-velocity electrons and suddenly depriving them of that velocity by hurtling them against a target. In fact, the tube possesses all the characteristics of a battlefield, except that as yet we lack the ability to give our shells speeds of the order of 50,000 miles a second. Then, just as a flash of flame accompanies the sudden stopping of the shell, so do the X-rays set out in all directions from the target, travelling in straight lines just as

[1] Abstracted from the opening address to the Society of Radiographers, October 31, 1922.

light rays radiate from a lamp. The X-ray tube is, indeed, an X-ray lamp in which the applied voltage is analogous to the temperature of a luminous lamp. If we raise the temperature of the latter, we shorten the average wave-length; so with the X-ray bulb, if we raise the voltage the average wave-length is diminished.

In the light of present-day knowledge, what do we know to be the factors which control output from an X-ray tube? The radiographer is concerned more with the general or continuous spectrum of X-rays than with the superposed rays characteristic of the target. In regard to the former the factors are three: (*a*) The number of the cathode rays or electrons which strike the target; (*b*) the speed of the electrons; (*c*) the massiveness of the atom of the target. (*a*) is represented by the current through the tube, (*b*) by the voltage across the tube, (*c*) by the atomic weight or, more precisely, the atomic number of the metal of the target.

To what extent do these several features come in? To settle these points let us call in the aid of the X-ray spectrometer and vary each of the factors one by one. The spectrometer spreads out into a continuous fan of rays all the various wave-lengths present, and tells us, moreover, the amount or intensity of each wave-length. So that if we plot wave-length against intensity, we get a curve which clearly reveals the composition of the beam. Furthermore, the area of the curve is a measure of the output. If we do this, we find that the several spectral curves show that the X-ray output is proportional to the current, to the atomic number of the target, and to the square of the voltage.

We notice that the voltage comes in as a second-power term, and the importance of measuring voltage by the radiographer not sporadically but as a routine procedure day in and day out should be stressed. For the applied voltage has a dual importance: it not only dominantly affects the output, but it is the sole arbiter of quality or penetrability or wave-length.

The time is approaching when we must gradually relinquish the use of the terms "hard" and "soft" X-rays and accustom ourselves to speak of wave-lengths. For example, in deep therapy we can say that the spectrum of rays employed lies between 0·06 and 0·2 Å.U., the mean effective wave-length being about 0·15 Å.U. or less. The radiographer who uses point spark-gaps up to, say, 6 inches long employs a spectrum of rays ranging from about 0·12 to 0·4 Å.U., the mean effective wave-length generally lying between 0·2 and 0·3 according to the filter and nature of the high potential generator. We might make a beginning by agreeing, for example, that "hard" rays refer to rays with wave-lengths shorter than 0·1 Å.U., and that "soft" rays have wave-lengths longer than 0·3 Å.U., the intervening rays being of "medium" hardness.

Let us consider the career of an electron in an X-ray tube impelled towards the target with a velocity which it owes to the applied voltage V. The chances that that electron will ultimately come into suitable conflict with one or more atoms in the target and so generate X-rays are slight—about 1000 to 1. The energy of the electron is, in fact, much more likely to be frittered away as heat. Assuming that the unlikely happens, one of two things may occur: the electron may lose all its energy at one encounter or it may do so by instalments in a succession of encounters. In other words, if we agree to think of its energy in terms of the original driving voltage (V), then it may lose the whole of V in one step or do so in a number of steps.

Now Planck's quantum relation tells us that whenever an electron has its speed altered the wave-length of the X-ray produced is inversely proportional to the energy given up by the electron; that is, to the equivalent loss of propelling voltage. It will be noted that no question arises of the nature of the target. To put it another way:

$$\left(\begin{matrix}\text{Loss of propelling}\\ \text{voltage on electron}\end{matrix}\right) \times \left(\begin{matrix}\text{Wave-length of}\\ \text{resulting X-ray}\end{matrix}\right) = \text{const.}$$

In those encounters where the whole of the energy of the electron is transferred in one fell swoop, the shortest-waved X-rays possible to that voltage will be generated. They will be accompanied by a variety of longer waves depending on the varied experience of other electrons, but always a short-waved limit is set by the magnitude of the full exciting voltage.

We are led to appreciate a number of other results. It is seen at once why we do not get (as was once imagined) homogeneous X-rays when a tube is excited by constant potential, and where all the electrons reach the target with the same velocity. Nevertheless, we should expect that the proportion of short waves would be greater with constant potential than it would be with fluctuating potential, the peak value of which is equal to that of the constant potential. Furthermore, from what is known of the effect of voltage on output, we should anticipate a greater X-ray output (and less heating of the target) with a constant voltage than when that voltage is diluted with lower voltages. Both these surmises as to the superior efficacy of constant potential are confirmed by the X-ray spectrometer.

With reference to the existence of a minimum wave-length or boundary to every spectrum of general X-rays, this is fully borne out by spectrometer measurements and photographs. Numerically, Planck's relation becomes:

$$\left(\begin{matrix}\text{Minimum wave-}\\ \text{length in Å.U.}\end{matrix}\right) \times \left(\begin{matrix}\text{Maximum}\\ \text{voltage}\end{matrix}\right) = 12{,}350.$$

This very simple relation provides us with a scale of quality which, if not perfect, is more exact than any which the radiologist has been in the habit of using. If we glance at typical spectral curves of X-ray emission, we see that they are not symmetrical—the centre of gravity of the curve is well towards the quantum limit—the shortest waves are the dominating ones, and still more so if the rays are subjected to normal type filtering. The mean effective wave-length of a spectrum of rays is seen to approximate to the wave-length of the peak of the curve; that is, the wave-length of maximum intensity. Now, there is some evidence that the "peak" wave-length is proportional to the limiting or quantum wave-length, and this fact enables us so to identify very fairly the quality of a mixed bundle of X-rays. No doubt something depends on the wave-form of the exciting potential, but the effect of this is probably less important as the voltage is raised. The precision of the method would be enhanced if steps were taken to standardise apparatus and technique, so that all work could be done by the use of, say, three or four spectra the distinctive features of which, including energy distribution, could be determined and specified.

Among the other interesting aspects of the X-ray tube is the distribution of the rays in different directions from the target. With the usual 45° target the rays are most intense at right angles to the cathode ray beam. For radiographical purposes it is often better to mount the target face more nearly at right angles to the cathode beam and thus employ a pencil of rays which leaves the target face at a relatively small angle. The width of the focal spot is thus foreshortened and definition enhanced.

If penetrating power is the important factor, then we may well endeavour to utilise the X-rays leaving the tube in the direction of the cathode rays, which X-rays are of appreciably shorter wave-length than in other directions. Thus a tube in which the target also served as a metal window would offer advantages on this score.

The proper choice of filter may do much to increase the effectiveness of a tube. For example, it is known that, weight for weight, silver is relatively more transparent than lead to short waves, but is relatively less transparent to longer waves. Again, copper is relatively superior to aluminium in letting through short waves, but relatively inferior as a filter if long waves are required.

What has the future in store for us as regards X-ray tubes? Higher voltages are coming—one hears rumours of 500,000 volt tubes in Germany; and both the United States and Germany have, I understand, developed transformers giving 1 million volts. The life of 200,000 volt tubes is none too long; there will be many difficulties to overcome before a 500,000 volt tube will become a practical proposition.

A crying need is more robustness in the X-ray tube, which must become more of an engineering job. The portable Coolidge tube with lead-glass walls ¼ inch thick and a window of soda-glass for letting out the rays is to be commended on this score. Equally robust is the new miniature dental tube of similar design which measures only 4 to 5 inches long and has a diameter of about 1½ inch. It is operated at 45,000 volts and 10 milliamperes, is mounted in the same oil-tank as the transformer, and gives excellent definition. It also contributes substantially to the protection which the radiographer has a right to demand. In this connexion we may confidently look forward to a time at no very distant date when, in the interests of the operator, all protective material and apparatus shall be certified by the National Physical Laboratory. This will be realised when I mention that different makes of lead-glass on the market differ by 100 per cent. in protective value. The same remark applies to lead-rubber.

What should be our ideal in radiography? To make the process as simple and noiseless as taking an ordinary photograph. The patient should hear nothing untoward, the apparatus should look no more formidable than a camera. Spark and brush discharges should be taboo; the rumble of rotating machinery anathema. Standardised technique must be the order of the day for much of the radiographer's work. The number of variables must be cut down.

It is possible that the future may witness the fuller development of the metal X-ray bulb of a design radically different from the present. Much work is being done on them at the present time. But in almost every section of a radiographer's X-ray equipment there is room for great improvement. How low the efficiency is may be gathered from the following. We may take it that the efficiency of the high-tension generator is of the order of 50 per cent., that of the X-ray bulb 1/1000. We may assume that half the rays emitted by the bulb are utilised, that half these useful rays are arrested by the object, and that 1 per cent. of the remainder is recorded by the photographic plate or screen (rather more, say 5 per cent., if an intensifying screen is used). Thus the overall efficiency of an X-ray equipment is of the order of 1 in 800,000.

An Inquiry into Dog Distemper.

FOR some considerable time it has been felt in this country that an investigation might be undertaken with advantage on the mystery of dog distemper, and the matter has recently been brought to a head by an appeal from the editor of the *Field* to dog lovers. A considerable sum of money has been promised, and the Medical Research Council has undertaken to organise an experimental inquiry with a view of finding out the causal agent of the disease and possibly a prophylactic. As announced in NATURE of March 10, a committee has been appointed under the chairmanship of Sir William Leishman, the other members being J. B. Buxton, S. R. Douglas, F. Hobday, and C. J. Martin. Other workers, it is suggested, will be co-opted for special investigations later on.

Distemper is an acute highly contagious disease, presenting symptoms somewhat analogous to measles in man. While some have regarded it as specific for the dog, others consider that it occurs in cats, young foxes, wolves, jackals, hyænas, and even monkeys. From its contagiosity it is certain that the cause is a microbe of some kind, which, however, has hitherto remained unmasked. Indeed, there is very little real scientific knowledge extant on the disease. This is in part, at any rate, due to the fact that what veterinary surgeons and the laity call distemper is almost certainly not one but several different diseases. That one of these is the specific disease distemper is, however, very probable.

At present the concept of "distemper" is entirely clinical. Thus, one finds descriptions in the literature of catarrhal, gastric, nervous, and exanthematic types of the disease. There is a great body of evidence to show that one attack of the malady confers a durable immunity on the survivor. The disease occurs in all countries and was apparently known in antiquity. On the other hand, there is a tradition—it is little more—

that distemper was introduced into Europe from South America in the seventeenth century. There have been many researches on the probable cause, and from the time of Semmer (1875) down to the present, every known type of microbe has been incriminated, many authors with great assertiveness having maintained that they had found the specific micro-organism.

Many have believed that Carré came nearest the truth with the idea that the *causa morbi* is an invisible microbe which can traverse bacterial filters. With filtrates obtained from nasal secretions he obtained lethal effects which were claimed to be identical with true distemper, and he regarded the visible bacteria found by others as of the nature of secondary invaders, which obtained a hold on the tissues as a result of the depressing effect of the real filter-passing virus.

This view is largely accepted without criticism, and is said to be the line along which the new committee will work. It may be pointed out, however, that Carré's work, which is not given in any great detail, has been adversely criticised by Galli-Valerio, and especially by Kreganow, who worked under the direction of Frosch, himself a known and successful worker on the filter-passer of foot-and-mouth disease. Filter-passers have been suggested or proved for a number of pathological conditions, notably the mosaic disease of tobacco plants, foot-and-mouth disease, Cape horse sickness, fowl plague, molluscum contagiosum, etc. These filter-passers have much in common. They are highly infectious, invisible, filterable, and non-cultivable. The causes probably constitute a new group of living things, which, if discovered in the case of distemper, may throw a flood of light on many unknown causes of disease in man, and it is for this reason that the work now being undertaken on distemper will be watched with unusual interest.

W. B.

Obituary.

PROF. E. E. BARNARD.

IT may safely be said that the whole astronomical world is mourning the death of Edward Emerson Barnard, which occurred on February 6, and very many will feel it as the loss of a personal friend even more acutely than as the removal of one of the world's most remarkable observers.

Prof. Barnard was born at Nashville, Tennessee, on December 16, 1857; he was left fatherless and destitute by the Civil War, and had to go out to work in a photographic studio in Nashville at the age of nine, after the most meagre opportunities of education. But his subsequent career is a remarkable proof of the adage that "where there is a will there is a way." He worked most faithfully for his employers, and at the same time devoted his evenings to private study; it was not till the age of nineteen that his attention was directed to astronomy by perusal of Dr. Dick's "Practical Astronomer." The next year he had saved enough to buy a 5-inch telescope, with which in 1881 and 1882 he discovered the first two of his large family of Comets.

In 1883 Prof. Barnard obtained a fellowship in astronomy at Vanderbilt University, which gave him the opportunity for perfecting his education and the use of a 6-inch equatorial, with which he did useful work on comets, nebulæ, and double stars.

In 1888 Prof. Barnard went to the Lick Observatory, where he had the advantages of a giant telescope and a splendid climate. Three years later he made the sensational discovery of the fifth satellite of Jupiter, the first addition to the retinue of that satellite since the days of Galileo. In 1889 he had observed an eclipse of Japetus by Saturn and the ring which gave important information on the transparency of different parts of the crêpe ring. He was also doing very useful photographic work, photographing the Galaxy and the tails of comets with the Willard lens. These photographs showed interesting detail, in particular the shattered tail of Brooks's Comet of 1893. He demonstrated the value of a lantern lens for depicting faint diffused nebulosity; in particular, he discovered a huge nebula with many wisps that wandered over the greater part of Orion, the former "great nebula" of which was but a pigmy compared with it. Besides discovering very many new comets, he was frequently first in the field in detecting periodic ones on their return; for example, Pons-Winnecke in April 1921, the position of which had only been roughly predicted. In 1896 he left the Lick Observatory for the Yerkes Observatory, but the change involved no real break in his work.

Prof. Barnard took up a new and fruitful line of work in recent years, making a minute study of the light changes of all the Novæ that have appeared in modern times. Many of them had become excessively faint and difficult objects, but he was able to prove that some of them were still varying in a more or less regular manner.

Mention should also be made of Barnard's discovery of the star of largest known proper motion; this was no mere accident, but a well-earned fruit of careful study of numerous photographs.

Prof. Barnard was both a fellow and an associate of the Royal Astronomical Society, and was awarded its gold medal in February 1897.

It is pleasant to record that Prof. M. Wolf named two of his minor planet discoveries Barnardiana and Rhoda after Barnard and his late wife. It is a testimony to the universal sentiments of affection and esteem that were felt towards them.

A. C. D. CROMMELIN.

PROF. J. RADCLIFFE.

PROF. JOSEPH RADCLIFFE, head of the department of Municipal and Sanitary Engineering in the Municipal College of Technology, Manchester, died on February 16 at his residence in Crumpsall after a brief illness, at the age of sixty-six years.

A native of Rochdale, Prof. Radcliffe was forced by circumstances to commence to earn his own living at a very early age, but managed to attend evening classes with such success that he was one of the first scholarship students sent by the Rochdale Pioneers' Co-operative Society to the then Owens College at Manchester. After serving an engineering apprenticeship in Rochdale, he passed into the Waterworks department, where he gained a special experience, which led to his later appointment as engineer to the Todmorden waterworks. In 1891 he commenced his career as professor in the Manchester College of Technology, where he had previously devoted untiring energies to founding the department by holding evening classes. In 1906, the Victoria University of Manchester conferred on him the degree of M.Sc.Tech.; and practically all the institutions and societies interested in his subjects had recognised his great abilities.

It is no exaggeration to say that the death of Prof. Radcliffe will be sincerely mourned all over the globe by former students, the numbers of which must literally run into thousands. Apart from his sound teaching, his wonderful kindness and modest, genial disposition have made his one of the most regretted losses his college and profession have ever sustained.

MR. T. W. STRATFORD-ANDREWS.

MR. T. W. STRATFORD-ANDREWS, who died on February 17, was a director of many companies connected with electrical industries. He was born in 1870 and educated at King's College, London, and his practical training in engineering was obtained at the works of Siemens, Schuckert, in Berlin.

Mr. Stratford-Andrews succeeded his father as managing director of the Indo-European telegraph line in 1899, but before assuming his new duties he took part in the expedition which went 800 miles up the river Amazon to lay an extension of the Western Brazilian telegraph cable. In 1897 also he rode on horseback through Russia and across the Caucasus to Teheran to inspect the route of the Indo-European land line. This journey he described in a little book entitled "Overland to Persia." In 1913 he covered the same ground again in a motor car accompanied by his wife and his sister. He was decorated by the Shah of Persia for his services, and received the thanks of the Russian Government.

Mr. Stratford-Andrews was the first to introduce direct automatic Wheatstone working on the Indo-European system. He also initiated, in conjunction with Sir Henry Kirk of the Indo-European (Government) department, direct operation at high speed between London and Karachi, a distance of 5600 miles. In his later years he took the greatest interest in radio-telegraphy and telephony, and he was chairman of the Radio Communication Company. His wide knowledge and technical insight were much appreciated by his numerous colleagues.

PROF. IGNAZ VOGEL.

THE death occurred on December 29 last of Prof. Ignaz Vogel, a well-known agricultural bacteriologist and mineralogist. He was born on April 15, 1871, at Altenkunnstadt in Franconia, and after studying chemistry under Emil Fischer at Würzburg he graduated in 1893. Taking up physiological and bacteriological research work, he became assistant to Prof. Dunbar at Hamburg, where he remained till 1900. He was then appointed to the position of bacteriologist at the agricultural experimental station of Posen, being transferred five years later to the Emperor William Institute at Bromberg. In 1914 he was called to Leipzig as director of the bacteriological department of the Agricultural Institute of the University of Leipzig, where he succeeded Prof. Löhnis, who had received an appointment as agricultural expert in the United States.

Prof. Vogel published at Marburg a number of researches on the occurrence and the transformation of the various kinds of sugar in the bodies of plants and animals, most of which appeared in the *Zeitschrift für Biologie*. Later he turned his attention to the study of the bacteria of the soil, and of solid and liquid manure. He published numerous papers concerning the fixation of atmospheric nitrogen in the form of ammonia, and the transformation of this substance into nitrates and albumen, most of which appeared in the *Zentralblatt für Bakteriologie*. In the "Handbuch der Milchwirtschaft" he edited the agricultural section.

The researches of Vogel have contributed greatly to the increase of agricultural production by showing how the various methods of manuring can be properly adjusted to the qualities of the soil. In his university work he trained a number of able pupils, being always willing to communicate his great knowledge to his colleagues. All those who have been able to enjoy his teaching and society greatly regret the loss that agricultural science has suffered through his premature decease.

PROF. A. N. FAVARO.

ON September 30 of last year, there passed away at Padua, Antonio Nobile Favaro, widely known for his numerous contributions to the history of mathematics and physics. Born at Padua on May 21, 1847, educated at the University of Padua and at the engineering schools at Turin and Zurich, he entered in 1875 upon his long career as professor of projective geometry at Padua. His "Lezioni di statica grafica" (1877) were soon after translated into French. So early as 1873 he began the study of the history of science by a contribution on the evolution of planimeters. For nearly half a century he worked assiduously on questions dealing with the history of mathematical instruments, with papers and letters of Tycho Brahe, N. Tartaglia, Leonardo da Vinci, and others.

The researches for which Favaro is best known, and which mark the crowning effort of his long career, are on the life and work of Galileo and his friends. In 1887, Favaro received a commission from the Italian Government to edit the complete works of Galileo. He devoted nearly thirty years to this task and brought out the "Edizione Nazionale" of Galileo's works in twenty volumes, which serves as a model to other governments as to what can and should be done in editing the works of great men of science. As by-products Favaro brought out a series of publications, "Amici e corrispondenti di Galileo Galilei," consisting of more than forty parts and constituting an important contribution to our knowledge of science in Italy during the sixteenth and seventeenth centuries.

FLORIAN CAJORI.

WE regret to announce the following deaths:

Dr. Norman Dalton, senior physician to King's College Hospital and formerly professor of pathological anatomy in King's College, London, on March 9, aged sixty-five.

Prof. J. D. Van der Waals, professor of theoretical physics in the University of Amsterdam, on March 8, aged eighty-five.

Current Topics and Events.

IT is fitting that some reference should be made in these columns to the fact that it was just fifty years ago that Mr. Edward Clodd, the veteran scientific thinker, happily still with us, published his first book, "The Childhood of the World." In 1920, at the advanced age of eighty, he published his "Magic in Names." In the period which elapsed between the appearance of these two books, Mr. Clodd devoted the leisure of a busy life of affairs to scientific research in branches of study connected with the physical and mental evolution of man. The results were embodied in a number of volumes dealing with various aspects of this central problem, of which the principal are: "The Childhood of Religion," 1875; "Myths and Dreams," 1885; "The Story of Creation," 1888; "The Story of Primitive Man," 1895; "A Primer of Evolution," 1895; "Tom Tit Tot," 1898, perhaps his best known and most enduring work; "The Story of the Alphabet," 1900; and "Animism," in 1906. In addition he produced monographs on his friends and associates—Bates, of Amazon fame, Grant Allen (1900), Huxley (1902), and a volume of "Memories" published in 1916. Mr. Clodd was one of a band of workers, of whom Huxley and Tylor were the best known, and who now, unfortunately, have nearly all passed away. To their untiring efforts to promote and popularise anthropology, its present position as a serious branch of scientific study is almost entirely due. Those of a younger generation who were first introduced to the evolutionary point of view in the study of man and of his religion and mental concepts through the lucid exposition and power of logical demonstration of which Mr. Clodd is a master, owe to him a debt of gratitude which is not likely to be forgotten.

FURTHER details of the progress of excavations at the Temple of the Moon God at Ur of the Chaldees, to which reference was made in these columns last week (see p. 336), are now to hand. Information given in a telegram published in the *Times* of March 7 indicates the relation of the present discoveries to those made by Dr. Hall in the course of his investigations—a point which previously was not clear. It would appear that the portion of the Temple discovered by Dr. Hall was the terrace of the main building which lay underneath. In the course of the present excavations, which have been made mainly in the south-east corner of the mound, one chamber has been found, which it is conjectured may be the innermost shrine, containing a valuable hoard of jewelry including many bracelets and necklaces, mostly of gold, and a tiled courtyard in which a gutter, such as was habitually used for collecting and carrying off the blood of a victim, suggests that it was the place of sacrifice. The cult of the Moon God was evidently re-established by Nebuchadnezzar, who made his daughters priestesses of the Temple, which he restored in the sixth century B.C., as is shown by an inscription. The upper bricks of the ruins were of this period, but those underneath were much earlier, and it is clear that in the restoration of the Temple the original foundations were, so far as possible, left untouched.

DR. CHARLES HOSE'S lecture on Sarawak at the Royal Colonial Institute on February 27 was opportune in affording material for a comparison in methods of administration and development with British North Borneo, an area which has attracted some little attention recently. Sarawak, a territory of some sixty thousand square miles, is perhaps best known in connexion with the romantic history of the Brooke family and as an independent native state under British protection, which has been ruled for nearly a century by a family of white men. It is, as Dr. Hose said, "perhaps the greatest achievement in state-making of the nineteenth century." It was founded by Sir James Brooke in 1840, and came under British protection in 1888 when its population numbered 600,000. The inhabitants include Malays, Dayaks, Kenyahs, Kayans, and a number of primitive tribes, still pagan, whose customs and beliefs have furnished, as readers of that valuable book "Pagan Tribes of Borneo," by Dr. Hose and Prof. McDougall, will remember, much material for the comparative study of religion, especially in connexion with their methods of divination and their belief in a spirit helper in animal form. The policy of the Brooke family has been to preserve, under an autocracy, as much of native custom as possible, retaining the great offices of state held by Malay nobles at the time of Sir James Brooke's accession to power, and associating the natives with the administration. As Dr. Hose pointed out in his lecture, several chiefs in bygone days endeavoured to establish peace through wide areas, but failed. To achieve enduring success the unifying influence of a central authority was needed. This has been furnished by the Rajahs, who, without breaking up old forms of society, have supplied elements lacking in the old system.

INFORMATION has been received that an All Russian Agricultural Exhibition will be held in Moscow on August 15–October 1. In a circular issued by the Russian Trade Delegation it is stated that foreign firms, institutions, and private persons are invited to participate in the exhibition, and that all privileges granted to Russian exhibitors will apply equally to foreign exhibitors. Special arrangements will be made to facilitate the delivery of exhibits, all such goods being given preferential treatment on the railways and waterways of the Republic, and for convenience of transit all foreign exhibits will be exempt from Customs examination at the frontier, provided that the goods bear regulation labels. Provision will be made for the insurance and safeguarding of exhibits, both during transit and at the exhibition itself. A fixed tariff of charges for space in the foreign section has been drawn up, all charges being payable in advance and not to be refunded if exhibitors renounce their allotted space or finally abstain from exhibiting.

THE Council of the Institution of Mining and Metallurgy has made the following awards: The gold medal of the Institution to Mr. Edgar Taylor, president, 1909–1911 and 1916–1918, in recognition of his services to the Institution since its foundation in 1892 and as an evidence of appreciation of his honourable record of work in connexion with the development of the mining industry, particularly in India; "The Consolidated Gold Fields of South Africa, Ltd." gold medal to Dr. Leonard Hill, in recognition of his valuable researches on ventilation and for his paper on "Ventilation and Human Efficiency," contributed to the Transactions; and "The Consolidated Gold Fields of South Africa, Ltd." premium of forty guineas to Mr. H. F. Collins, for his paper on "The Igneous Rocks of the Province of Huelva and the Genesis of the Pyritic Ore-bodies," contributed to the Transactions, and in recognition of his researches on the subject.

AN invitation is extended to Farmers' Clubs, Chambers of Agriculture and Horticulture, and other bodies interested in agriculture or market-gardening, to visit the Rothamsted experimental fields during the coming summer. The guide demonstrator is Mr. H. V. Garner, who for the past two summers has very successfully served in this capacity and has been able to make the visits both useful and interesting to farmers. Among important items of interest are: experiments on the manuring of arable crops, especially wheat, barley, mangolds, potatoes; manuring of meadow hay; effect of modern slags and mineral phosphates on grazing land, hay land, and arable crops; crop diseases and pests; demonstrations of good types of tillage implements, tractors, etc. At any convenient time between May 1 and October 1, there is sufficient to occupy a full day, and there is provision for assuring that the time shall not be lost, even if the weather turns out too bad to allow of close investigation of the fields. The director of the Station, Sir John Russell, will be happy to arrange full details with organisations of farmers, farm-workers, and others wishing to accept this invitation. Small groups of farmers are specially welcomed; if possible, arrangements should be made beforehand, but it is recognised that farmers' movements must often depend on the weather, and no one need stay away because he has been unable to write fixing a date.

THE departmental committee recently appointed to consider the present system of charging for coal gas on a thermal basis has now issued its report as a White Paper (Cmd. 1825, 6*d*.). The main recommendation is that the method of charging for gas on the thermal basis should be continued and extended to all statutory gas undertakings within the scope of the Gas Regulation Act. Thus is vindicated the really scientific method of asking the consumer to pay according to the amount of heat he receives. In the days of Argand and the flat-flamed fish-tail burners, light was produced by the combustion of the particles of gas in the surrounding air, and gas supply was then maintained at an illuminating standard. With the advent of the incandescent mantle, and the increasing use of gas fires, illuminatory properties in gas became of secondary importance to its heating values, and a calorific standard was introduced in 1916. The heat unit in common use in Great Britain for expressing the value of fuels has been, for many years, the British thermal unit, which is the amount of heat required to raise the temperature of 1 lb. of water 1° F. under appropriate conditions. This unit was used in gas calorimetry, and a gas was said to have calorific value of 500 British thermal units when 1 cubic foot gave out, when burned, sufficient heat to raise the temperature of 500 lb. (about 50 gallons) of water through 1° F. To obtain a conveniently practical unit, the therm, which is equal to 100,000 British thermal units, was adopted.

THE *Weekly Weather Report* for the week ending March 3, issued by the Meteorological Office, Air Ministry, gives a summary of the weather for the several districts of Great Britain for the past winter, comprised by the thirteen weeks from December 3, 1922, to March 3, 1923. The daily mean temperature for the period ranged from 40·1° F. in the east of Scotland to 46·9° F. in the Channel Islands. During the winter the extreme readings ranged from 61° in the Midland Counties to 15° in the east of Scotland, while in England the lowest temperature recorded was 22° in the Midland Counties and the south-east of England. Total rainfall was greatest in the north of Scotland, where the measurement was 18·52 in., which is 2·17 in. more than the normal; but the greatest excess on the average was 5·47 in., which occurred in the south-west of England. There was an excess of rain everywhere, the minimum excess being an inch in the east of England, where the total measurement was 6·53 in. Rain fell with greater frequency than the normal over the whole of Great Britain: the largest number of days with rain was 74 in the north of Scotland; the least, 53 in the north-east of England. The duration of sunshine was fairly equal to the normal in all districts. At Greenwich the mean temperature for the winter, December, January, and February, was 42·4° F., which is 2·9° above the normal for thirty-five years; temperature ranged from 57° to 24°. Rain fell on 49 days, which is 4 days in excess of the normal, and the total measurement was 6·60 in., which is 1·08 in. more than the average for thirty-five years. The duration of bright sunshine at Greenwich was 118 hours, which is 11 hours fewer than the normal.

NEWS received in Christiania, according to the *Times*, reports the arrival of Capt. R. Amundsen on December 15 at Nome, Alaska, from Wainwright, on the north coast, where he is wintering. His visit to Nome was to ascertain news of the *Maud*, which is now drifting across the polar basin. Capt. Amundsen expects to leave Wainwright or Point Barrow on his flight across the Pole to Spitsbergen in the middle of June. On March 6 a wireless message from the *Maud* reported her position as lat. 74° N., long. 170° 30′ E. The ship has drifted about half a degree north and three degrees west of her position in the middle of December. Her speed of drift is about the same as that of the *Fram* at the same time of year, but the *Maud* is still well to the east of the New Siberia Islands and has not passed beyond the shallow and partially charted waters of the continental shelf.

H.M. THE KING has approved the grant of a Royal Charter of Incorporation to the Institution of Royal Engineers. The Institution, then known as the Royal Engineers Institute, was established as a voluntary association in the year 1875 for the general advancement of military science, and more particularly for promoting the study of such subjects as are of importance to the military engineer. In pursuance of its objects, the Institution has directed its efforts to the advancement of the science and art of engineering, especially in relation to their application to military purposes, and has thus been able to afford material assistance to those engaged in dealing with the important problems of defence connected with the British Empire. The Institution has during the past 47 years published 950 occasional, as well as other, papers on military and other scientific subjects; these papers, except those which are of a "Secret" or "Confidential" character, are available to the general public. *Inter alia*, the Institution now administers an important fund established in connexion with the award of scholarships to the children of deceased officers and other ranks who have fallen in the performance of their duties while on active service.

IN an article in the *Fortnightly Review* for March, Sir Charles Bright discusses the relation between the Empire's telegraphs and trade. He concludes that it is of national importance that there should be a great all-round reduction in cable tariffs. As this would doubtless result in greatly increased traffic it would necessitate laying many additional cables on different routes. He also dwells on the importance of the immediate completion of the Imperial "wireless chain," as well as alternative wireless chains. On March 5, Mr. Bonar Law announced that the Government is to proceed with the erection in this country of a state-owned and operated station capable of communicating with any part of the Empire. At the same time licenses are to be issued to private companies for the erection of stations in this country for radio-communication with any part of the world, subject to the conditions necessary to secure British control. The Marconi Company has thus been granted the license for which it has long asked, and it intends immediately to erect five large power stations to communicate with the Dominions and South America, and five smaller stations for more local traffic. The cost of these stations will be about two million pounds. It seems to us that this extension of long-distance communication will be of immediate benefit to this country, and the ensuing reduction in the tariff may induce the cable companies to co-operate with the radio companies. As Sir Charles Bright points out, this country has considerable leeway to make up; America, for example, uses 3400 kilowatts for its radio stations, and France 3150, while the British Empire only uses 700 kilowatts.

THE Spring Foray of the British Mycological Society will be held at Bristol on April 20–23. Headquarters for the meetings will be at the botany department of the University.

AN exhibition of Carboniferous corals has just been completed by Dr. W. D. Lang and Dr. Stanley Smith in the Geological Department of the British Museum (Natural History). Polished specimens and transparent sections have been prepared to illustrate the structure of each genus, and explanatory diagrams have also been added.

THE second annual general meeting of the National Institute of Industrial Psychology will be held in the rooms of the Royal Society on Tuesday, March 20. Among the speakers will be the Earl of Balfour, Sir Lynden Macassey, Dr. C. S. Myers, Sir Robert Hadfield, and Sir Charles Sherrington.

AT a representative meeting of botanists held at the Linnean Society's rooms on Friday, March 2, it was decided to hold an Imperial Botanical Conference of British and Overseas botanists in 1924 about the beginning of July. An executive committee was appointed, with Sir David Prain as chairman, Mr. F. T. Brooks as honorary secretary, and Dr. A. B. Rendle as treasurer. An invitation to attend the conference will be sent at once to Overseas botanists.

PROF. JOSEPH S. AMES, who gives an account of recent aeronautic investigations in the United States elsewhere in this issue, has been chosen to deliver the eleventh annual Wilbur Wright memorial lecture of the Royal Aeronautical Society. The lecture, the subject of which will be "The Relation between Aeronautical Research and Aircraft Design," will be given at the house of the Royal Society of Arts on May 31.

THE Royal Irish Academy devoted its meeting on February 26 to a commemoration of the centenary of Pasteur. Addresses were delivered by Dr. W. R. Fearon, Prof. A. C. O'Sullivan, and Prof. Sydney Young (president of the Academy), dealing with various aspects of his work, and an address in French by Prof. R. Chauviré dealt with Pasteur as a typical Frenchman.

A SCIENTIFIC superintendent under the Fishery Board of Scotland will shortly be appointed. He will conduct and supervise the scientific fishery investigations which the board may consider necessary, and be in charge of the board's laboratories at Aberdeen. Applications for the post, accompanied by copies of any published papers of the applicants, if deemed desirable, and the names of at least two referees, must reach the secretary of the board, 101 George Street, Edinburgh, by, at latest, March 31.

THE Ministry of Agriculture and Fisheries will shortly appoint an inspector in connexion with agricultural and horticultural education and research. Applicants for the position must have taken a course in science or agriculture at a university or college of agriculture, and should have had special training in the science and practice of dairying. Forms of application and copies of the regulations governing the appointment may be had from the Secretary of the Ministry, 10 Whitehall Place, S.W.1. Application forms must be returned by March 26.

WE have received intimation of the opening at Lake Trasimeno of a laboratory for the study of the biology of the lake, including researches on the fresh-water fishes. The lake, which is about thirty miles in circumference, offers many opportunities for limnological work. It is to be hoped that this new station will receive the support which will justify its continuance. The premises have been provided by the University of Perugia, and Dr. Osvaldo Polimanti, professor of physiology in the University, has been appointed director, and intending workers should communicate with him.

MR. G. M. B. DOBSON will deliver a lecture to the Royal Meteorological Society on March 21 on "The Characteristics of the Atmosphere up to 200 km., as obtained from Observations of Meteors." Meteorological observations in the free atmosphere by means of *ballons-sondes* have not been carried to heights much greater than 30 kilometres, but Prof. Lindemann and Mr. Dobson have recently put forward a method of determining the temperature at much greater elevations by means of observations of meteors (see NATURE, December 9, 1922, p. 794). Those interested are invited to attend the meeting, which will be held in the Society's rooms at 49 Cromwell Road, South Kensington, London, S.W.7.

AT the annual general meeting of the Institute of Metals held on Wednesday, March 7, the following officers for the year 1923–24 were elected :—*President*: Mr. Leonard Sumner. *Past-Presidents* : Sir Gerard A. Muntz, Bart., Engineer Vice-Admiral Sir Henry J. Oram, Sir George Beilby, Prof. H. C. H. Carpenter, and Engineer Vice-Admiral Sir George Goodwin. *Vice-Presidents* : Sir John Dewrance, Mr. W. Murray Morrison, Sir Thomas Rose, Dr. W. Rosenhain, Sir William E. Smith, and Prof. T. Turner. *Honorary Treasurer* : Mr. A. E. Seaton. *Members of Council* : Mr. W. H. Allen, Mr. L. Archbutt, Mr. G. A. Boeddicker, Mr. T. Bolton, Dr. H. W. Brownsdon, Engineer Vice-Admiral R. B. Dixon, Prof. C. A. Edwards, Mr. S. Evered, Dr. R. S. Hutton, Mr. F. C. A. H. Lantsberry, Sir Charles A. Parsons, Mr. H. A. Ruck-Keene, Dr. R. Seligman, Mr. James Steven, Mr. F. Tomlinson, and Mr. H. B. Weeks.

Our Astronomical Column.

GREAT FIREBALL IN NORTHERN INDIA ON DECEMBER 28, 1922.—Mr. W. F. Denning writes that "letters have been received reporting a splendid fireball which appeared over the Punjab at about the time of sunset on December 28. It was observed by a great number of people, and accounts published in the *Civil and Military Gazette* (Lahore) include descriptions from Simla, Peshawar, Balloki, Moghalpura, Sargodha, Jhelum, Rawalpindi, Bakloh, Dharamsala, Lahore, Sharaqpur, Murpur, and other stations.

Many of the accounts are of little service, but Col. W. E. Pye and Lieut. Stephenson at Shagai, Khyber Pass, North-West Frontier, give an excellent description of the phenomenon. The observed path at the latter place was from 6°-43° to 20°-48°, and the fireball exhibited moderately slow motion. It left a long white streak which endured about fifteen minutes. A large number of the observers allude to the streak as perfectly straight at first, but it soon assumed a zig-zag shape, and drifted away from the place of its early projection. At one station the streak, which appeared to be vertical when formed, became horizontal in twelve minutes, the lower end having moved the required distance. At Sargodha, six minutes after the great illumination due to the meteor, loud rumbling sounds were heard, caused by the disruption of the object. These would indicate a distance of 75 miles.

From a comparison of the observations the fireball seems to have been an early Quadrantid with a radiant at 234° + 55°. The height was about 54 to 29 miles, and velocity about 25 miles per second. The luminous course was directed from N.N.W. to S.S.E. It crossed the river Chenab, and ended about 100 miles N.E. of Mooltan.

These results are only approximate. The object was one of great splendour, and it is hoped that further observations will be forthcoming.

STELLAR SPECTRA OF CLASS S.—In the current number of the *Astrophysical Journal* (December 1922) Mr. Paul W. Merrill directs attention to a number of red stars having spectra similar to that of R Geminorum, which differ from any of the well-known types of spectra which form the Harvard classification. In this classification the red stars are known as M and N types and each of these is subdivided, but no stars are known which have a spectra intermediate between them ; M stars have characteristic titanium flutings and N stars carbon flutings. This peculiarity has led to the adoption of a break in the main series of stellar evolution types of spectra.

Thus an M star of increasing temperature becomes consecutively in the evolutionary series a K, G, F, etc., type star, while an N star, also a giant, becomes an Ro, G, F, etc., type star in its progressive stages. Mr. Merrill shows in this paper that the stars he has discussed should properly form a third division of the giant series joining on to the main sequence of evolutionary stages between the types Ma and K. This progression may be likened to three sets of railway lines joining up at two positions near each other and continuing as a single line. Thus :

↙ Ro Na Nb Nc
B A F G K Ma Mb Mc
← ↖ S Se

It is interesting to note that the Harvard classification is based to a great extent on the replacement of metallic lines by ionised lines, and eventually by gaseous lines, the higher the temperature ; but Mr. Merrill points out that while some M stars show ionised lines, so also do the S stars ; this presents, as he says, "an anomalous circumstance which invites investigation."

Research Items.

AFRICAN SIGN WRITING.—Mr. C. W. Hobley in the Journal of the East Africa and Uganda Natural History Society, No. 18, March 1923, has given some examples of sign writing collected in East Africa. It includes reproductions of the large fauna of the country, giraffe, elephants, and the like, and their spoor, supposed to indicate to the friends of the artist the presence of game in the vicinity. Others seem to be marks of locality and property. The custom of using signs still survives among the natives. In Togoland, if a man calls on a friend and finds him absent, he will pull a little grass from the roof of his hut and attach it to a stick outside the door to announce to the owner that a visitor has called. Wemba hunters make marks on their arms to record the number of the bigger animals they have killed, and in some parts of Kavirondo the birth of each child is marked by a cicatrisation on the abdomen, possibly with some magical object. The facts collected by Mr. Hobley and the illustrations he has provided are interesting in connexion with the origin of writing.

THE CATHOLIC CHRISTIANS OF EASTERN BENGAL.—Little has hitherto been known of the remarkable community known as the Firingis or "Franks" of Eastern Bengal. The late Dr. James Wise gave some account of them in the very rare volume entitled "Notes on the Races, Castes, and Trades of Eastern Bengal," of which only twelve copies were privately printed in London in 1883, and even libraries like those of the British Museum, the University of Cambridge, and the Royal Anthropological Institute do not possess a copy. Some of the information was, however, copied by Sir H. Bisley in his "Castes and Tribes of Bengal." Some fresh details of this curious people have now been collected by Mr. H. E. Stapleton, special officer of the University of Dacca, and published in vol. xvii., 1922, of the Journal of the Asiatic Society of Bengal. They are believed to be descended from the Portuguese pirates who infested the Delta of the Ganges in the sixteenth and seventeenth centuries. They undoubtedly include many converts from the local races, they speak nothing but Bengali, are indistinguishable from Bengalis in dress and means of livelihood, and until recently they made no claim to Portuguese descent. They now number about 8500, but of these, 2000, under the French Fathers, are converted natives and have no claim to the name Firingi.

PRODUCTIVITY OF HILL PASTURES.—An inquiry conducted into the productivity of hill pastures in Exmoor, Wales, and Northern England ("University of Oxford Institute for Research in Agricultural Economics: The Productivity of Hill Farming," by J. Pryse Howell, London, Oxford University Press, 1922. 1s. net) has shown the value of artificial manuring of pasture and of more intensive cultivation in increasing the production of mutton, wool, and beef per acre. Much improvement in this direction is possible on the lower-lying ground, but it is less practicable on farms with an extensive range of high sheep-walks. The improvement of the latter will always be difficult owing to the considerable cost involved, but the committee of inquiry make certain recommendations which could well be carried out. Much depreciation of flocks occurs, especially in Wales, from the practice of allowing the rams to roam at will over the unenclosed sheep-walks, and it is recommended that a more efficient system of control of rams be instituted and enforced. The management of the "Commons" with grazing rights is very unsatisfactory, and joint action by the commoners is essential if matters are to be improved. Bracken, heather, and gorse are too often allowed to grow unchecked, thus reducing the feeding value of the land, and the systematic burning of heather and gorse, and the eradication of bracken, would prove most advantageous. The mortality among the flocks from various diseases is very heavy, and causes great monetary loss, and the committee emphasise the fact that a systematic inquiry into the diseases affecting sheep is a matter of the most urgent importance.

RUSTS IN SOUTH AFRICA.—The great economic importance of rusts, owing to the considerable loss in crops that they cause, renders it essential to determine the life history of as many types as possible in order to discover the second host where unknown. Infection experiments have shown that the common rust on *Vigna angustifolia* produces spermagonia and æcidia on this species from October to January, and then infects the Besem gras (*Tristachya rehmani*) by means of æcidiospores (M. Pole-Evans, Union of S. Africa, Science Bull., Nos. 1 and 2 of 1923). Uredospores and teleutospores are produced on the second host, the winter being passed in the latter stage, and with the fresh growth of the Vigna in spring, infection occurs by sporidia developed from the resting teleutospores. This rust on sweet pea and Besem gras is a new species of Puccinia which has not yet been described and named. A similar life cycle has been established for the mealie rust (*Puccinia maydis*), of which the spermagonia and æcidia occur from October to December on *Oxalis corniculata*. This connexion was originally established by Dr. Pole-Evans, and has now been confirmed by these infection experiments. Other species of Oxalis tested proved to be quite immune.

COLOUR INHERITANCE IN SEEDS AND FLOWERS.—In a paper showing the inheritance of certain brown and red pigments in the seeds of soy bean and rice varieties, Mr. I. Nagai (*Journ. Coll. Agric.*, Imp. Univ., Tokyo, vol. 8, No. 1) has also made experiments on the physiology of the pigments involved. They are in two groups, the anthocyanins and the reddish-brown phlobaphenes. The whole subject of the genetic physiology of these pigments is discussed, and the limitations in our knowledge of the relations between genes, chromogens, and enzymes in colour production are pointed out. In the same Journal, Dr. S. Ikeno describes the genetics of flower colour in *Portulaca grandiflora*. The condition of colour inheritance resembles that in various other genera, the factor C producing an orange colour, C+G yellow, C+R red, while magenta, which is probably the original colour, is produced by C, R, and a blueing factor B acting together. R and B generally show complete linkage, but occasional crossing over produces red-flowered plants. Reverse mutations were also obtained, from white to magenta or red, as well as bud mutations, which were already known. Drs. K. Miyake and Y. Imai (*ibid.* vol. vi. No. 4) similarly analyse the flower colours of *Digitalis purpurea*. The purple colour is due to the presence of two factors C and P. When P is absent the flower is white with red spots, while in the absence of C it is white with yellow spots.

THE STRENGTH OF THE PLANT CUTICLE.—Botanists have recognised the importance of this question since the investigations conducted at the Imperial College of Science under the direction of Prof. V. H. Blackman have led to the conclusion that some parasitic fungi pierce the cuticle of the uninjured plant purely by pressure. They will therefore find considerable interest in the conclusion drawn by recent writers in the Journal of the Textile Institute as to the surprising strength of the cuticle surrounding a cotton hair. From different lines of investigation this result is arrived at by R. S. Willows and his co-workers in the Research Department of Tootal, Broadhurst Lee Co., Manchester, in their experiments upon mercerisation (Journ. of the Text. Inst., xiii. pp. 229-40, December 1922), and by H. F. Coward and L. Spencer upon the absorption of caustic soda solutions by cotton (Journ. of the Text. Inst., xiv. pp. 832-45, Jan. 1923). All these investigators conclude that the swelling of the cotton hair in alkali may be considerably restricted by the resistance to expansion of the cuticle and give cogent grounds for this conclusion. Such a strong cuticle upon a hair which has largely matured within a closed fruit is at first sight a surprising phenomenon. It is interesting to note that H. J. Denham, in his study of the destruction of the cotton hair by micro-organisms (Journ. of the Text. Inst., xiii. pp. 240-48, Dec. 1922), inclines to the view that some of these organisms can penetrate the healthy cuticle. This cuticle resists cold alkalis at high concentration and its hydrolysis by any organism has yet to be detected; but in view of these studies upon its strength, the actual method by which the uninjured cuticle is penetrated would seem to deserve close investigation.

IMPOUNDING WATER FOR MOSQUITO CONTROL.—In Bulletin 1098 of the U.S. Department of Agriculture, 1922, Mr. D. L. van Dine describes a method of controlling the breeding of malaria mosquitoes in the lower Mississippi Valley. In this region the bayous or shallow streams of the delta, with their accompanying vegetation, greatly facilitate the breeding of anophelines. The topography renders drainage impossible, and a trial was therefore made of clearing a section of the bayous and impounding the water so as to convert what was practically a marsh into a lake. The essential points in this method are the preliminary clearing of all vegetation, the provision of a sufficiently high permanent level of water, to suppress the further growth of aquatic and semi-aquatic vegetation, and the maintenance of a clean margin. The experiment thus carried out is stated to have given good results.

GROWTH OF CASSAVA PLANTS.—T. G. Mason has an interesting note in the Scientific Proceedings of the Royal Dublin Society, vol. 17, N.S. Nos. 11-13, pp. 105-112, December 1922, upon the growth of some Bitter Cassava plants in St. Vincent, West Indies, under equivalent conditions save that half the plants were ringed through the phloem near the base of the stem, measurements of growth being made both before and after the operation. The experimental results show that this ringing did not affect the growth in length of the shoots for several weeks and then only to a relatively small extent; the fleshy roots, on the other hand, accumulated far less weight of reserve material upon the ringed plants. The author scarcely appears to put the simplest interpretation upon these experimental results when he declines to assume that the normal channel for the passage of this food to the root has been interrupted by cutting through the phloem, but assumes instead that the ring has blocked the passage of some mysterious correlating agency from the dominant apical shoot bud, and that in the absence of this unknown factor normal transmission of organic solutes in the xylem is impossible.

ORIGINS OF PETROLEUM.—In an important paper on the marine kerogen shales from the oil-fields of Japan (Sci. Rep. Tohoku Imp. University, Ser. 3, vol. 1, No. 2, 1922, Maruzen Co., Tokyo), Mr. Jun-ichi Takahashi describes a number of interesting deposits of Miocene and Pliocene age from various islands of the Japanese group, including a series where radiolaria, sponge-spicules, and diatoms are associated with what was originally sapropelic matter. The author concludes that the kerogen has arisen from "nectons and kelps" which have "been repeatedly buried by ash and detritus from submarine volcanoes." He illustrates the memoir by photographs of rocks and marine fossils, and of a remarkable series of thin sections of the sapropelic ooze.

CANNEL COAL, LIGNITE, AND MINERAL OIL IN SCOTLAND.—The Geological Survey has published recently volume xxiv. of its special Reports on the Mineral Resources of Great Britain, which gives an account of a number of minor occurrences of cannel coal, lignite, and mineral oil in Scotland outside the recognised Scottish oil-shale fields. The work has been done by a number of members of the staff of the Geological Survey, and the publication is edited by Dr. W. Gibson. It is of course important that all such occurrences should be put on record, although, as is pointed out in the memoir itself, they have little or no economic value; nevertheless they are of interest to the geologist, and the information here given may prevent waste of money and energy in attempts to develop them.

THE WARIALDA METEORITE OF NEW SOUTH WALES.—The Warialda meteorite, which is defined as a fine variety of hexahedrite, has been described, figured, and its analysis given by J. C. H. Mingaye (Rec. Geol. Surv. N.S. Wales, vol. x. part 1). It is identical in crystallographic structure with the Bingera and Barraba meteorites which were found in the same district, and the three are probably products of the same fall, of which it is hoped further specimens may yet be discovered.

ORTHOPTEROUS INSECT WING IN A SELENITE CRYSTAL.—In the Mount Elliott Copper Mine, North Queensland, at a depth of 260 feet from the surface, and embedded in a large crystal of selenite, enclosed in the actual copper lode worked in that mine, there has been found a portion of the wing of an Orthopterous insect. This interesting fragment forms the subject of a paper by Dr. R. J. Tillyard in the Records of the Geological Survey of New South Wales, vol. x. part 2. The crystal must have been formed by percolating waters long after the lode itself came into being; its age is, consequently, very uncertain, but the author inclines to the view that it is late Tertiary. The conclusion reached after a careful study of the fossil is that it represents an archaic type belonging to the family of long-horned grasshoppers (Tettigoniidæ), and does not belong to any genus known to exist in the world to-day. Accordingly it has received the name of *Austrodictya corbouldi*, n. gen. et sp., the trivial name commemorating the manager of the mine through whose instrumentality the specimen was saved from destruction and forwarded to the Survey.

NEW BRUNSWICK OIL-SHALE AND GYPSUM DEPOSITS.—Memoir 129 of the Geological Survey of Canada records the geology of the Moncton Map-area, which includes parts of the counties of Westmorland and Albert lying in south-east New Brunswick. Besides giving an account of the general geology of the district, incidentally the geology of the Carboniferous rocks for the most part, the memoir gives some new facts relating to the oil-shale deposits. These shales are associated with certain horizons in the Carboniferous sequence, and an effort has been made to elucidate the structures accurately to enable the extent of the resources available to be calculated. Actual oil and gas possibilities are practically negligible, but the shales at places like Albert Mines and Rosevale are both well known and valuable, while several other localities offer good prospects. Since May 1921, the D'Arcy Exploration Co. (a subsidiary of the Anglo-Persian Oil Co.) has been operating at Rosevale, mainly on experimental lines with a special type of retort (Wallace), and the results have so far proved quite satisfactory. The average recovery of oil from a ton of shale is about 30 gallons, the specific gravity of the product varying from 0·893 to 0·903. This compares favourably with that obtained from the Scotch retort on the same material, where the yield is less and the gravity of the oil usually higher. Some gypsum and anhydrite deposits described from the region also form interesting and economically valuable occurrences: these are in the Hillsborough Series of Mississippian age and are at present being worked in the Demoiselle and Hillsborough basins. The relationship of the gypsum to the anhydrite deposits appears to be obscure here, as is frequently the case elsewhere; but the theoretical problems to be solved have a direct bearing on the future working of the deposits.

CLOUD FORMATION.—The Royal Magnetical and Meteorological Observatory of Batavia, in Verhandelingen, No. 10, gives a discussion by Dr. C. Braak on cloud-formation, nuclei of condensation, haziness, and dimensions of cloud-particles. The data were determined by means of Aitken's dust counter. In addition to the observations made in the East-Indian Archipelago an appendix is given on observations made in the Indian Ocean during a voyage from Java to Europe. Observations were also made on dry fog in the Archipelago as well as in other regions. Individual observations are published, so that the details can be examined. The differences between land and sea are given, and the variations with height above sea-level. The number of nuclei in the open sea under humid conditions was 120 per c.cm., and in the open sea in the dry season 1620 per c.cm.; in the neighbourhood of the land the mean number was 2560. The variation with height above sea-level shows a great decrease in the number of nuclei with increased height. Seasonal variations are considered, dealing chiefly with observations in Java and Sumatra. Much of the haze experienced is attributed to smoke from forest and prairie fires. The size of the particles is said to have a larger influence than their number on the density of haze, careful observations being made with a microscope to test this view. Valuable generalisations have been made on the subject, and these will doubtless be tested by other observers. This paper was taken as the subject for discussion at the evening meeting at the Meteorological Office on February 5, and is referred to in the *Meteorological Magazine* for February.

THE ELECTRICAL CONDUCTIVITY OF GLASS.—The February issue of the Journal of the Franklin Institute contains a communication from the director of the Applied Science Section of the Nela Research Laboratories, giving the results of the research of Mr. L. L. Holladay on the conductivities of glasses at temperatures up to 500° C. Between 20° and 75° C. the resistance from the inside to the outside of the glass tubes used was measured, and at higher temperatures the resistance of a length of the tube. In all the eleven glasses tested the conductivity could be expressed as the product of a constant into a power of the temperature centigrade about $-\frac{1}{2}$, into ϵ, the base of the Napierian logarithms, to the power $-A/T$, where A is a constant and T the temperature centigrade. A table of values of the constants for the glasses tested is given.

HEATING IN ELECTRIC CONDUCTORS.—An important research on the heating of buried cables has just been communicated to the Institution of Electrical Engineers by Mr. S. W. Melsom and Mr. E. Fawssett. Most of the tests were made at the National Physical Laboratory, but some were made under actual working conditions, the cables being laid in all kinds of soils. The rating of a cable depends on the rate at which it can dissipate the heat generated in it by the electric current, and hence it was necessary to calculate what current it could carry under different working conditions. Apparently the thermal conductivity of the insulating material of the cables does not vary appreciably with temperature, and thus the solutions of the thermal problems which Fourier gave in his "Théorie analytique de la chaleur," published in 1822, apply. The thermal constants of various kinds of soil are given, and so by the help of formulæ the maximum permissible currents in the various cases can be readily computed. It was found that in certain cases existing cables could carry greater currents safely, and hence economies can be effected. The research, which was a costly one, has taken several years, and was carried out on behalf of the British Electrical and Allied Research Association.

A RECORDING SACCHAROMETER FOR BREWING.—Messrs. Negretti and Zambra have constructed an instrument known as a hydrograph or recording saccharometer, which is compensated for temperature. It has been designed and constructed to provide a simple and practical means of showing and recording the specific gravity of wort flowing to the under-back, copper, etc. It consists of a cylindrical vessel on the lower portion of which is a $\frac{3}{4}$-in. pipe, through which the wort is admitted. To prevent eddies in the vessel, an inlet pipe leads into an annular ring, which distributes the flow evenly round the vessel. A cylinder and copper gauze is also provided through which the wort percolates. An outlet pipe at the top of the external cylinder is provided, and here again there is another annular ring over which the wort flows, with the object of preventing eddies. Within the inner copper gauze cylinder a hollow float of thin nickel heavily coppered is suspended. The hollow float is completely filled with the liquid, and is connected with the recording instrument by means of a chain immediately above the vessel. The chain is connected with a grooved quadrant mounted on a knife-edged axis. On the opposite side a weight is provided to balance the float when it is in the liquid, the zero adjustment being provided by an adjustable weight. The indications of the instrument are rendered independent of temperature from the fact that the wort in the cylinder and in the float are at the same temperature. The clock carrying the chart revolves once in six hours, and the graduated portion of the chart is marked from 1000 to 1100° specific gravity, and subdivided to 2° specific gravity, which on the chart is equal to $\frac{1}{20}$th of an inch. The pen marks in a continuous ink line on the chart, and the readings can be made to $\frac{1}{2}$° specific gravity with the greatest accuracy. In an ordinary mash tun, however, the wort from the various taps are often running at different temperatures and at a different specific gravity, so that the measurements made with the wort from one tap will not of necessity give the average specific gravity of the whole wort. The objection does not apply if the wort is drawn off through one spend pipe or is running from the under-back to the copper.

Humanism in Technical Education.[1]

By Sir Thomas Holland, K.C.S.I., K.C.I.E., F.R.S.

VERY few questions have been more discussed than that of education, and the reason for it is quite obvious; for educational methods are as varied as the students who have to be educated, and perfection can be reached only when a system is designed to meet the special circumstances of each individual. Some plants want pruning, others require fertilising, to produce their best results. One pedagogue thinks discipline should be the cure for all students' evils; others preach the importance of making the work attractive. The clash of ideals is heard most in our technical schools. One authority wants full-scale machinery, another says that the college workshop is merely a misleading caricature of a commercial factory. We are told that the student of science and technology can never become an educated man without a dose, and a fairly large dose, too, of the so-called "humanities"; he must always be narrow otherwise, if not absolutely lopsided, and can never be prepared in an institute of science and technology efficiently to undertake the full duties of citizenship.

In a community of science workers discordant notes are similarly heard. One presses for pure science as the main requirement of the practical technologist; another urges training in purely technical methods. The practical man thinks he has used a very hard word indeed when he calls the science student a theoretical idealist, a dreamer. The student of science pretends to despise the practical man as a mere rule-o'-thumb worker, often, however, because he fails to grasp the principles which underlie, and the long process of expensive research that has evolved, the so-called rule-o'-thumb. The doctrinaire student of science very often is, as some one has said of the early riser, conceited all the morning and stupid for the rest of the day.

It is, however, impossible to lay stress on any one truth without apparently being unfair to some other truth. Somewhere between these extremes the maximum of truth is to be found. It is too often so that where science is taught, the student is crammed with the facts instead of trained in the methods. The product of the science class is sometimes handicapped by what Prof. Huxley, the greatest of my predecessors at South Kensington, called "precocious mental debauchery"—the result of too many bouts of book-gluttony and lesson-bibbing.

I do not intend this evening to follow up any of these apparently divergent doctrines. We have learnt now, if we never appreciated it fully before, that a country cannot defend itself in war, or fight the relentless battles of peace, without science and technology. But the technologist will not remain only an expert in the workshop. He has duties as a citizen and must face relations, and competitive relations too, with other human beings, with most of whom he is unable to communicate in technical terms alone—the technical terms that he learns in the class-room. To be appreciated, he must understand and be understood by others: he wants the "humanities."

Now what is meant by the "humanities"? A dictionary will tell you that classical learning is intended by the same word that we also use for a study of the dispositions and sympathies of man. Sure enough, the study of classical literature once had this meaning. Late in the middle ages the study of the classics revealed to the world the long-buried wisdom, especially of the Greeks—their art, their religion, and, more important, their science. That discovery gave rise to the great movement which we speak of generally as the Renaissance—the revolt of intellect from previous feudalism and theological bondage—resulting not only in the revival of literature, art, and that religious freedom which is generally known as the Reformation, but in the development also of scientific curiosity, what, to avoid the secondary meaning of curiosity, we now call research. It gave us the Copernican for the Ptolemaic reading of the solar system; it gave us also in practical form the mariner's compass and, with the exploratory spirit which accompanied it, the discovery of the Americas, of South Africa, India, and the Far East; it gave us the invention of gunpowder and that of paper and printing, which facilitated the distribution of the new learning to a wide world.

How many of these developments, which succeeded one another with the speed of a revolution, were due to independent origin and from other sources, and how many were quickened by the rediscovery of buried philosophies, we need not stop to inquire; but it is obvious that what would otherwise have been but slow combustion developed, because of this discovery, at the speed of an explosion. That discovery was specially the discovery of humanism in Greek literature. Greek literature acted on medieval scholasticism like nitric acid on a combustible cellulose; cotton was converted into guncotton.

The lesson to be learnt from the Renaissance is strengthened by a consideration of what happened afterwards to classical studies. With the passage of time, classical learning like an organism went through a period of vigorous youth, vitalising the world with new energy and new ideas, until it reached the stage of adolescence, and, with it, specialisation.

That is the life-history of every organism. With specialisation the study of the classics became narrowed to its linguistic, grammatical, and purely rhetorical aspects: its main object became obscured and stricken with a formalism and a pedantry that "has given us false ideas, and the narrow spirit of a mutually admiring coterie, that wrote Latin and Greek verses to one another and to no one else. It has engendered a wild form of pedantry that regarded a false concord or a false quantity in Greek, not at all as we should regard a similar mistake in French, but as a shock to the higher order of things, which deserved scorn and reprobation when committed by a man, cruel punishment when committed by a boy."

These are not the words of a prejudiced and jealous scientific man, but the judgment of a distinguished classical scholar, the present Vice-Chancellor of Oxford. Reviewing the situation in this way before the Congress of Universities in 1921, Dr. Farnell pleaded for the revival of humanism in classical studies, and I wish similarly to direct attention to the importance of humanism in science and technology, for we also are exposed to the very same danger that Dr. Farnell says has now nearly strangled classical scholarship in our public schools and younger universities. We can thus learn something from the classics; we can profit by their mistakes, knowing that it is never so easy to recognise our own as the mistakes of others.

[1] From an address delivered at the Sir John Cass Technical Institute on January 31.

During the middle two quarters of the nineteenth century, science went through what we might call its Renaissance period. In its philosophical aspects, it was a revolt in part against a widespread misinterpretation of theology, and, in educational policy, it was a revolt against the dominance of what we regard as a perverted and senile form of the classical humanities. We do not object to the humanities, but to that devitalised residue of the humanities that is without humanism.

I am not now going to discuss the relative merits of science and classics as educational media, but I want to bring home to you the danger of defeating the very end of science itself. Scientific men are also liable to succumb to that form of pedantry which in classics exchanged humanism for grammar and rhetoric, and that homologue of pedantry in most religions which tends to kill doctrine by ritual. Do not let us claim that science can give mental training as good, when really we mean as bad, as that afforded by classics. You may remember what Huxley said of Peter Bell, whose dead soul, according to Wordsworth, saw nothing in Nature:

> " A primrose by the river's brim,
> A yellow primrose was to him,
> And it was nothing more."

Huxley asked if Peter Bell's apathy would have been roused one whit by the information that the primrose is a dicotyledonous exogen, with a monopetalous corolla and central placentation. This additional information would have added no more to the humanising influence of the primrose on Peter Bell than any form of exegetical analysis of a Greek text in exchange for Greek philosophy and Greek art.

Let us take an illustration from one of the departments of this Institute—that of metallurgy. The syllabus of this subject refers to " Bessemer and open-hearth plant and processes." A fair summary of what I, as a junior student, had to learn under this head would be as follows: " The original Bessemer process, as conducted in a ganister (silicious) lined converter, does not effect the elimination of phosphorus from the pig-iron; but by using a basic (dolomitic) lined converter, Thomas and Gilchrist found it possible to eliminate the deleterious element that affects the quality of the resultant steel, so it is now possible to use a phosphoric pig-iron for steel making." Later, coming under the influence of a professor with a wider outlook of the world, I learnt that this so-called basic process changed the whole of our international relationships. It opened up the enormous phosphoric ores of Germany, Belgium, and America. It resulted, therefore, in a challenge to British supremacy in the steel business. Just think of what that meant to railway development, shipbuilding, machinery, and dozens of dependent industries! Obviously, realisation of this, to me, quite unforeseen meaning in a purely technical fact opened up a new world of human interest.

Who was Thomas and who was Gilchrist? Those were the first questions that occurred to one. Thomas, I found, was a magistrate's clerk who attended evening science classes at the Birkbeck, a college having an object similar to that of the Sir John Cass Institute, and named for the same good reason after its founder. Gilchrist was his cousin, and he proved to be much more interesting to me, for he was an old School of Mines student and a Murchison medallist.

Thomas and Gilchrist made, by their invention, a greater impression on the history of civilisation than any two Prime Ministers we have ever had, a greater influence than the sum-total of that exercised by one devoted to optimistic militancy and his counter-irritant, the apostle of tranquillity. Thomas had what the great Mr. Gladstone described, in reviewing his memoirs, as " an enthusiasm of humanity." I am ready to assert that a review on these lines of the way in which the basic process of steel-smelting has affected history, especially when so touched with the human relations of the two men to whom it is due, is all that is necessary for the student. He will soon satisfy his own curiosity about technical details; he will soon be studying the question himself in the library and the workshop.

This stirring of that form of curiosity that Dr. Johnson called " the thirst of the soul " and " the characteristics of a vigorous intellect " will give human, living interest to a student's work. The teacher's task is three parts done and faithfully fulfilled when he has inspired the student sufficiently to impel him to find out the rest for himself. Nothing appeals to a man like humanity.

In a thoughtful paper read before the Congress of Empire Universities in 1921, Prof. Cecil Desch advocated the adoption of the historical method in science teaching. But history consists of innumerable biographies. As Emerson said, " There is properly no history, only biography." History, divorced from biography, can be as dull and deadening as either Greek grammar or descriptive technology. The educational balance is not secured by requiring students to attend a formal course of classics or history as well as of science. That would be merely to double the offence. A physician does not apply a counter-irritant if he can get at the seat of the disease. It is not separate courses of history and science—a mechanical mixture—that are wanted, but the history of science itself, that is, a chemical compound. Giving two separate doses of two unrelated subjects to act as mutual correctives is equivalent to giving a man a metallic sodium pill with a sniff of chlorine gas, when what he wants is merely a pinch of common salt.

But for the power unwisely given to examiners to make or mar a student's career, I would like to try the experiment of covering a syllabus of, say, metallurgy or chemistry by lectures on biography alone. I believe students could be trusted to fill in the historical frame-work on their own account, and to find out for themselves all that is required in the way of technical details. They shall succeed, of course, in varying degrees just as they do now; but whether they succeed partially or wholly, all shall be better men for having made an effort inspired by a natural and healthy curiosity; they shall have had the very training which lays a sure foundation for what the scientific man calls research; and what the scientific man calls a training for research is the very kind of training which qualifies a man to face the problems of after life, when every difficulty that the student has to face after he has left the institute shall have no apparent resemblance to any question previously treated, either in the lecture-room or the laboratory. Every problem that the student meets with afterwards shall be a piece of new research to him.

Sir Richard Gregory, in his address to the British Association last year, defined education as the " deliberate adjustment of a growing human being to its environment; and the scope and character of the subjects of instruction should be determined by this biological principle." I agree, and as the technical student's environment will be human beings, with little or no familiarity with his own pet technical terminology, he wants to go into the world with a full appreciation of the human aspects and importance of his special subject.

The Flora of an Indian Island.[1]

As a preliminary to the faunistic study of Barkuda, one of several islands in the Chilka Lake, Dr. N. Annandale has investigated its climate, physical structure, palæontology, and vegetation. The lake is a maritime one in the extreme north-east of Ganjam, and is connected with the Bay of Bengal. The island, some three hundred acres in extent, though isolated for terrestrial animals, is within the range of insects of feeble flight and that of dispersal for many seeds. The climate is that of the coasts of the Circars to the south and Orissa to the north. The physical structure is simple and the geological formation uniform; the rocks are the quartz schists of the Ganjam Malias. The changes in the shore water-level, though of faunistic importance, scarcely affect the vegetation. The rocks contain no fossils, but sub-fossil molluscan shells abound in the soil of the island and the sand of its shores. These shells indicate that the island, as such, is recent; the age of the rocks has no bearing on its existing biological features.

Though the vegetation is restricted, several types occupy different areas. Much of the surface has been colonised primarily by species of Ficus, mainly *F. bengalensis,* with an undergrowth of Glycosmis and a partial thatch of woody climbers. This is gradually replaced by other species of Ficus accompanied by trees like *Melia Azadirachta* and *Strychnos Nux-Vomica,* while the undergrowth is reinforced by Capparis and Zizyphus. The foreshore vegetation is scanty. Where the coast is rocky the species present, though fewer than on sandy or gravelly sections, are arboreal and therefore more conspicuous. Behind the foreshore comes a Pongamia belt, broken in places by intruding Cratæva and Melia. Within this zone, besides surviving Ficus groves with Glycosmis undergrowth, are areas where the latter is replaced by *Weihea ceylanica,* the former by Cratæva, Odina, and Albizzia. Stony areas have a scanty plant-covering; the rock-flora of the interior includes masses of two arboreal Euphorbias, *E. antiquorum* and *E. neriifolia.* The commonest tree on the island is *Melia Azadirachta*; perhaps the most abundant herb indigenous there is *Oldenlandia Heynei.*

Dr. Annandale's ecological sketch is supplemented by a plant-list prepared from his specimens by two members of the Botanical Survey staff. This important adjunct to the paper is somewhat marred by typographical errors, and shows want of uniformity in citation. Messrs. Narayanaswami and Carter have not supplied an analysis of the vegetation from the point of view of plant-distribution to correspond with Dr. Annandale's discussion of the subject from the point of view of plant-association. Their carefully prepared list provides all the material required for the purpose, but they have made it more troublesome for those desiring to ascertain the facts by adopting a taxonomic system which, whatever its academic merits, has the inconvenience of differing from that used in the "Flora of British India."

The affinities of the Barkuda flora are South Indian. The list enumerates 139 plant-forms, of which two may be new while five remain undetermined. The remaining 132 include twenty-one, nearly 16 per cent., not reported from Orissa north of the lake, and seventeen, nearly 13 per cent., never found north of the Dekhan. One species, *Riccia crispatula,* has hitherto only been known from Ceylon; two, *Selaginella tenera* and *Weihea ceylanica,* have only been reported from Ceylon and from India south of the Dekhan. Thirty-five, more than 32 per cent., of the Barkuda species reported from North-eastern India, are themselves indicative of South Indian affinity. Seven are littoral plants that are North-eastern Indian only, because they occur on the Orissa coast and in the Sundribuns. The remaining twenty-eight include ten reported only from Orissa, which is a northward continuation of the Circars, and eleven reported only from Chutia Nagpur, which forms a north-eastern extension of the Dekhan, while the remaining seven have been met with both in Orissa and Chutia Nagpur but not in the Gangetic Plain.

[1] Memoirs of the Asiatic Society of Bengal, vol. 7, No. 4. "Introduction to the Study of the Fauna of an Island in the Chilka Lake," by Dr. N. Annandale.

The Sed Festival of Ancient Egypt.

At a meeting of the Royal Anthropological Institute held on February 20, Mr. P. E. Newberry presented a paper on "The Sed Festival of Ancient Egypt." This was perhaps the most ancient of all the many Egyptian festivals: it was certainly the most important. There are representations of it on monuments from the beginning of the Ist Dynasty down to Ptolemaic times.

Various interpretations of the festival have been given, but none of them are entirely satisfactory. According to the Greek version of the Rosetta Stone, it was a festival marking a period of 30 years, but there are records of it being celebrated in the 2nd, 15th, 22nd, and 25th years of different kings' reigns. It appears to have been a repetition of the festivals of a coronation and its celebration seems to have procured for the king a new lease of life. It certainly had something to do with the king's assumption of responsibility for the protection of Egypt. It should be especially noted that the king's daughters take a prominent part in the festival. On the mace head of Narmer-Menes is the earliest representation of it: here there is a princess seated in a palanquin and behind her are three men in the act of running: this scene is also found in the Sed festivals of Neusere (Vth Dyn.), of Amenhotep III. (XVIIIth Dyn.), and of Osorkon (XXIInd Dyn.), although in the later examples young princesses standing replace the figure in the palanquin. This ceremony is probably the most primitive one of the Sed festival and represents, Mr. Newberry believes, a *race,* and a race for no less a prize than the Kingdom. Frazer in his "Lectures on the Early History of Kingship" (p. 260 *sq.*) notes that something, apparently the right to the hand of the princess and to the throne, has been determined by a race, and he quotes instances from classical and other sources. "Such a custom," he says, "appears to have prevailed among various peoples, though in practice it has degenerated into a mere form or pretence."

Although it is often assumed that the kingship was hereditary, in the male line—that the son regularly succeeded his father on the throne—it is certain that in Egypt the king claimed his right to the kingship, not because he was the son of his predecessor on the throne, but because he married the hereditary princess who might be the widow or daughter of his predecessor. It is obvious, therefore, that the marriage ceremony must have been a very important one in ancient Egypt. Egyptian women marry early in life, sometimes at 10 or 11, oftener at from 12 to 14 years of age. No doubt the same custom prevailed in ancient times. At 13, or even earlier, a girl may be a mother, and from 40 to 45 she becomes incapable of bearing children. When she becomes incapable of bearing children the husband often takes a new wife: this may perhaps explain why the Sed festival was called the 30 years' festival; for if a girl is married, say at 12, she ceases to be able to bear children at 42, just 30 years after her marriage, and her husband takes another wife.

If the hereditary princess predeceased her husband, then it must have been necessary for the king to marry again so as to retain the kingship: this would explain the fact that the Sed festival was sometimes celebrated in years earlier than the 30th year of a king's reign. It also explains why a king sometimes married his own eldest daughter. If the hereditary princess survived her husband, then Mr. Newberry's theory explains why she is sometimes married to her husband's successor. This theory would also give a reason for it being a kind of repetition of the king's coronation and for its procuring for the king a new lease of power.

There is yet another fact which suggests the theory that the Sed festival was a marriage festival. It was celebrated in a booth or tent (called *Sed*) raised high above the ground; and with Semitic peoples the tent plays a very important part in marriage ceremonial, as Robertson Smith notes in his "Kinship and Marriage," p. 198 ff.

Chemistry in Industry.[1]

NATURAL science—and in this connexion chemistry must be given a position of great prominence—is by far the most important dynamic factor in human progress. Notwithstanding its liability to abuse, its discoveries have, on the balance, made enormously for the greater good and greater happiness of the human race.

The direct utilisation by the State of the services of the professional chemist is a matter not only of immediate concern to chemists themselves, but also of high importance to the community at large, and it is one of the functions of the Institute of Chemistry to ensure that the relations between the appointing authorities and those who hold official chemical positions are of a satisfactory character. Unfortunately, some public bodies do not appear to be aware of the lengthy and expensive nature of the chemist's training or of the difficulties and responsibilities connected with his work, and consequently the advertised conditions of some public posts are not commensurate with the importance of the services demanded. There is a tendency on the part of local authorities to utilise the services of unqualified or imperfectly trained persons for carrying out what are regarded as simple routine processes, a practice against which the council of the Institute has protested vigorously on the ground that it constitutes a serious danger to the community and involves a waste of public money.

The disinterested zeal of the scientific worker is without parallel in the whole world, but it is not wise for any country to presume too much on this disinterestedness. Science is one of the greatest and freest of all givers, but it has a right to demand that recognition in the councils of the nation to which it is entitled. The indirect effect of proper State treatment is very great and the rulers of Germany know this well. A leading German industrial chemist said recently that notwithstanding Germany's position of virtual bankruptcy, the State, at the instigation of the commercial committee of the Reichstag, had come to the help of the great chemical and physical societies, particularly to that of the Kaiser Wilhelm Institute, and if the State could not continue financial aid, the German people themselves must give their last mark to maintain science.

Although the supply of qualified chemists exceeds, for the moment, the demand, there is no cause for serious alarm. The profession attracted a larger number of young men during the last four years than in any previous corresponding period. Notwithstanding the increased output from the colleges and the intense industrial and commercial depression, the new members of the profession are being steadily absorbed. This absorption may be taken as a definite indication that chemistry is more highly valued by the manufacturer than formerly, and that the leaders of industry and commerce are turning more and more to science to assist them in the solution of their various problems.

[1] From an address delivered to the Institute of Chemistry at the annual general meeting on March 1, by Mr. A. Chaston Chapman, F.R.S.

An Intestinal Parasite of Man.

WE understand that Sir Ronald Ross is engaged at the Ministry of Pensions in the investigation of *Giardi intestinalis*, often known as *Lamblia intestinalis*, which, of the three or four common flagellates inhabiting the intestine of man, has the greatest claim to pathogenicity. Moreover, it differs from the others in being an inhabitant of the duodenum and upper part of the small intestine instead of the large intestine. It is probably the first parasitic protozoan to have been observed, for, as Dobell has pointed out, the famous Dutch observer Leeuwenhoek saw it in his own stools so long ago as 1681. From that time down to the present day there has been much controversy as to the significance of its presence in the human intestine. Some regard it as a definitely harmful organism, while others believe that it does not damage its host in any way.

The frequent occurrence of the flagellate in enormous numbers in certain cases of mucous enteritis seems to suggest that it may sometimes be pathogenic, though, like parasitic amœbæ and bacteria which are known factors in disease, it often occurs in perfectly healthy individuals, who are to be regarded as carriers. American workers have brought forward evidence that *Giardia intestinalis* may invade the bile duct and gall bladder and cause irritation in these organs. Flagellates belonging to the same genus occur in domestic animals, such as dogs, cats, rats, and mice, but it appears that these are distinct from the human form, though Grassi and others believed that human beings became infected by ingesting the encysted forms of the flagellate which escape in large numbers in the dejecta of these animals. Careful experiments have, however, shown that it is not possible to infect animals with the human parasite, and slight morphological differences point to the existence of a number of distinct species.

Reproduction of the flagellate is by a complicated process of binary fission. The organism also becomes encysted in ovoid cysts within which division into two takes place. These cysts are found in the dejecta, and are responsible for the spread of infection. It is only during periods of diarrhœa that the free-swimming flagellates occur in the stool, so that infection of human beings is generally recognised by the discovery of the cysts. There is no known method of ridding a human being of infection, and if it is correct that the flagellate may sometimes damage its host, the outlook for these unfortunate individuals is not a bright one.

University and Educational Intelligence.

BELFAST.—At the recent meeting of the Senate of the Queen's University, it was announced that the bequest of 57,000*l*. from the late Henry Musgrave, a well-known benefactor of the University, had been paid. Of this sum 30,000*l*. is left to the absolute control of the Senate, to be used and applied for such purpose as the Senate shall consider necessary. Mr. Musgrave directed that 7000*l*. be invested, and the income applied towards paying an additional reader in connexion with the chair of physics. The sum of 20,000*l*. is to be invested, and the income applied in perpetuity for the promotion and encouragement of research in pathology, physiology, physics, biology, and chemistry. The income is to be applied in founding and maintaining studentships for promoting research in these subjects. Each studentship shall be held for one year, but if the electors are satisfied with the work of the student he may be elected for a second year but no longer. If at any time there shall not be any suitable candidate, or if in any year there be a surplus, such surplus shall form a fund out of which special grants may be made to graduates of the University engaged in research. The Senate has agreed that the annual value of the studentships shall be 200*l*., and has appointed Prof. Ashworth, Prof. Lorraine Smith, Sir Joseph Larmor, and Prof. Collie, together with Prof. Symmers, Prof. Milroy, Prof. Morton, Prof. Small, and Prof. Stewart, to be the electors of the above studentships.

Mr. R. C. Johnson, Balliol College, Oxford, has been appointed lecturer in physics in succession to Dr. Gray, who resigned his appointment in December; Mr. S. P. Mercer, head of the Seed Testing Department of the Government of Northern Ireland, has been appointed lecturer in agricultural botany and plant diseases.

BRISTOL.—The Long Fox lecture will be delivered by Prof. F. Francis on Tuesday, March 27, at 5 o'clock. The subject will be "The Relation between Chemistry and Medicine."

The Coombe Memorial Scholarship, of the annual value of 60*l*. and tenable in the faculty of engineering of the University of Bristol, will be offered for competition for the first time this year. The scholarship has been established by the Engineering and the National Employers' Federations (West of England Association) as a memorial to a former president, and will be open to candidates who habitually reside within the area of the Association, which includes the counties of Gloucester, Somerset, Wilts, Devon, and Cornwall, as well as the city of Worcester and the towns of Hanley Castle, Malvern, Malvern Wells, Pershore, and Newport, Mon. The examination will be held at the Merchant Venturers' Technical College on Wednesday, July 4 next, and applications must be sent to Mr. A. Storey, director of the Association, not later than July 1.

CAMBRIDGE.—The Adams prize for an essay on "The Theory of the Tides" has been awarded to Mr. J. Proudman, Trinity College, director of the Liverpool University Tidal Institute. The essay submitted by Mr. H. Jeffreys, St. John's College, is highly commended.

Prof. H. A. Lorentz, of Haarlem University, will on May 15 deliver the Rede lecture on "Maxwell's Electromagnetic Theory."

On the conclusion of the last of the courses for naval officers held in the University since the termination of the war, the First Lord of the Admiralty has written to express the thanks of the Board of the Admiralty for the great service which the University has rendered the Navy. He expresses the hope that in some shape or other the intimate association between the two may still be kept alive for the mutual benefit of both.

Mr. M. B. R. Swann, University demonstrator in pathology, has been elected fellow and lecturer at Gonville and Caius College.

EDINBURGH.—On Thursday, March 1, the Right Hon. David Lloyd George delivered his address as Lord Rector to the students.

Mr. Lloyd George was afterwards entertained at lunch in the Union, and in replying to the toast of his health referred to the fact that seven of his colleagues in the late Government were graduates of Edinburgh. He dealt in an impressive manner with the relation of the universities to the War. He confessed that although he had known the part played by the universities in building up national efficiency, he never realised till the days of war what a national asset a great university was. He doubted very much whether the rich men of this country quite realised at the present moment what a national reserve a university is. After referring to the new kind of warfare developed by an enemy which was the most highly trained intellectual machine probably in the world, Mr. Lloyd George said the moment came when we called upon our universities, and they came to our rescue and poured out their trained minds—in the War Office, at the Admiralty, at the Ministry of Munitions—bringing the whole resources of their scientific knowledge, and, what was still more, knowing where to place their hands on people who had the training to enable them to take up the problems. He continued—"I don't know, I tell you now, what would have happened to us if we had not had the universities to fall back on in those dark days. I will tell you more. In the end our university brains beat theirs. War, you may say, is not what universities are for. I agree, but war is the great test of the nerve of a nation, of the muscle of a nation, of the heart of a nation. It tests every faculty of the human mind as well as the human body, and the test came; and in every particular, on land and sea, where scientific knowledge was required, where trained ingenuity was needed, we defeated the foe. That was due to the universities. Therefore I regard universities not merely as the great training-ground . . . I regard them as the fourth arm of defence for the security of this land."

Mr. Lloyd George warmly eulogised the services rendered by Principal Sir Alfred Ewing at the Intelligence Department, and stated that the work he did there gave information which ultimately brought America into the war.

LEEDS.—The Honorary Degree of Doctor of Laws was conferred upon Major the Right Hon. Edward Frederick Lindley Wood, president of the Board of Education, on March 5. Prof. Barbier, in presenting Mr. Wood, said: "The University desires to do honour to one who, the scion of a Yorkshire family of high distinction, is himself 'commended for the gifts that come from learning.' Mr. Edward Wood has won the respect of his fellow countrymen by the grave sincerity of his judgment. He holds an office of onerous responsibility in our public education. And by his unselfish generosity he has given to the transfer of an historic mansion the grace of a great benefaction to the city of Leeds."

LONDON.—Applications are invited by the senate for the Ramsay Memorial chair of chemical engineering tenable at University College. Particulars are obtainable from the Academic Registrar, University of London, South Kensington, S.W.7.

SHEFFIELD.—At the meeting of the Council on March 9 the following appointments were made: Mr. G. Grant Allan, to be assistant bacteriologist; and Mr. H. P. Lewis, to be assistant lecturer in mining geology.

Societies and Academies.

LONDON.

Royal Society, March 8.—A. B. **Wood**, H. E. **Browne**, and C. **Cochrane**: Determination of velocity of explosion-waves in sea-water; variation of velocity with temperature. An accurate determination of the velocity of explosion-waves in the sea gives:

(*a*) $V=4955 \cdot 5$ (± 1) ft./sec., at $16 \cdot 95$ ($\pm 0 \cdot 1$)° C. and salinity 35 per cent.

(*b*) $V=4836$ (± 2) ft./sec., at $6 \cdot 0$ ($\pm 0 \cdot 1$)° C. and salinity $35 \cdot 1$ per cent.

(*c*) $V=4847$ ($\pm 1 \cdot 5$) ft./sec., at $7 \cdot 0$ ($\pm 0 \cdot 1$)° C. and salinity $35 \cdot 2$ per cent.

In the new technique developed, it is unnecessary to know the exact position of charge relative to receivers. The results lead to a mean value of $10 \cdot 9$ ft./sec. per ° C. as the temperature-coefficient of velocity in the range 6° C. to 17° C. The following expression represents the velocity at any temperature t° C. within this range, and at any salinity S (parts per thousand):

$$V=4627+13 \cdot 7t-0 \cdot 12t^2+3 \cdot 73S.$$

The salinity-coefficient is approximately 3 to 4 ft./sec. per 1 per cent. increase of salinity, the theoretical value being $3 \cdot 73$ ft./sec. per 1 per cent. No change was detected for charges varying in weight from 9 oz. to 300 lb. of explosive and no variation with depth. The coefficient of adiabatic compressibility of sea-water at $16 \cdot 95$° C. and 35 per cent. is $C_p=42 \cdot 744$ ($\pm 0 \cdot 02$) $\times 10^{-6}$. Combining this with Ekman's value of C_θ, the ratio of the specific heats of sea-water under these conditions of temperature and salinity is $\gamma=1 \cdot 0094 \pm 0 \cdot 0005$, in good agreement with $1 \cdot 0090$, deduced from thermo-dynamic data.—P. M. S. **Blackett**: The study of forked alpha-ray tracks. Forked alpha-ray tracks obtained by the Wilson condensation method were studied. The lengths of the tracks of the recoil atoms yield information concerning the relative ionisation due to different kinds of ionising particles, and of the average charge carried by them. Measurements of the angles between different parts of the tracks gave the masses of the recoil atoms in three particularly favourable cases.—A. **Egerton**: On the vapour pressure of lead.—I. The vapour pressure is measured by effusion of vapour at low pressure through a hole of measured area. Temperature is maintained constant by a selenium cell relay arrangement within 1/3° C. for many hours at about 800° C. Pressures were measured to 10^{-5} mm. The vapour pressure of ordinary lead between 1200-600° absolute is expressed by the equation $\log p=7 \cdot 908-9932/T$. The latent heat of vaporisation of lead (λ_0) is $47{,}000 \pm 1000$ cal. The chemical constant of lead is $1 \cdot 84 \pm 0 \cdot 2$, agreeing well with the theoretical value ($1 \cdot 853$) obtained from the relation $3/2 \log M - C_0 = C$. The vapour pressures of lead and the uranium-lead isotope appear to differ by 2 per cent., but the result is rendered uncertain by an unexplained lowering of vapour pressure which lead undergoes on prolonged heating *in vacuo*.—A. C. **Egerton** and W. B. **Lee**: (1) Some density determinations. The Archimedes method of determining densities is rendered more accurate by utilising certain mobile and heavy organic liquids which avoid air bubbles and damping difficulties, and increase the weight of liquid displaced. Ethylene dibromide and carbon tetrachloride were employed with accuracy. A satisfactory sample of metal for density determination is prepared by filtering, casting, and heating *in vacuo*. The density of lead is $11 \cdot 3437$ at 20° C. The probable error of the nine determinations on three different samples is 1 part in 100,000. The maximum departure from the mean value for any single determination is less than 1 part in 12,000. A sample of uranium-lead would have an atomic weight of $206 \cdot 26$ from the density obtained. (2) Separation of isotopes of zinc. Two sets of distillations of pure zinc have been carried out in high vacuum, under conditions to obtain a slightly different concentration of the isotopes in the final residue of the final distillate. The samples are cast *in vacuo* and seeded with a particular kind of zinc. The first distillations gave a residue of slightly increased density, but the distillate possessed the same density as the original zinc. The second distillations gave a residue of increased density (about 1 part in 3700) and a distillate of decreased density (about 1 part in 3000). Determinations on seven samples of ordinary zinc give the density of zinc (prepared in the described way) as $7 \cdot 1400$ (the probable error being less than 1 part in 100,000). Flaws, allotropes, different physical conditions, and impurities are improbable. The amount of the separation agrees with Dempster's observations of isotopes of weights extending over six units (namely, 64-70), but is not so great as might be found for equal parts of 64 and of atoms of weights 66, 68, and 70.—E. **Hatschek** and P. C. L. **Thorne**: Metal sols in non-dissociating liquids. I.—Nickel in toluene and benzene. Very stable sols of nickel in a medium free from ions can be produced by decomposing nickel carbonyl dissolved in mixtures of toluene and benzene, containing a small amount of rubber, at 100° C. In the electric field the particles of disperse phase move to, and deposit on, *both* electrodes. Electrophoresis in fields of different strengths, all other factors being equal, shows that the amounts deposited are proportional to the first, or a lower, power of the potential gradient. Therefore positively and negatively charged particles are originally present in the sol. The sol resembles typical protected aqueous sols, inasmuch as it is coagulated by liquids which are not solvents for the protective colloid, *i.e.* rubber. The coagulum is only very imperfectly peptised again by rubber solvents, such as toluene or benzene.—H. **Hirata**: Constitution of the X-ray spectra belonging to the L series of the elements.

Zoological Society, February 6.—Sir S. F. Harmer, vice-president, in the chair.—Oldfield **Thomas**: (1) A new rock-kangaroo, *Petrogale godmani*, sp. n. It is like *P. assimilis*, but with a whitish tail, broader nasals, and larger secator. Its habitat is Black Mountain, near Cooktown, N. Queensland. (2) Skull of a pygmy fruit-bat from Sumatra. The generic name Æthalops is proposed.—C. A. Adair **Dighton**: Coat-colour in greyhounds.—E. G. **Boulenger**: The experiments of Dr. Kammerer and others upon amphibians and insects.—E. Leonard **Gill**: The Permian fishes of the genus Acentrophorus.—Charles F. **Sonntag**: On the vagus and sympathetic nerves of the terrestrial carnivora.—E. P. **Allis**: The postorbital articulation of the palato-quadrate with the neurocranium in the Cœlacanthidæ.—G. S. **Giglioli**: On the linguatulid arachnid, *Raillietiella furcocerca* (Diesing, 1835), Sambon, 1922.—Mrs. Rita **Markbreiter**: Some Microfilaria found in the blood of birds dying in the Zoological Gardens, 1920–1922.

February 20.—Dr. A. Smith Woodward, vice-president, in the chair.—D. **Seth-Smith**: Sexual display of the Magnificent Bird-of-Paradise (*Diphyllodes magnifica hunsteini*).—Einar **Lönnberg**: Remarks on some palearctic bears.—E. W. **Shann**: The embryonic development of the porbeagle-shark, *Lamna cornubica*.—Robert **Gurney**: Some notes on *Leander longirostris*, M.-Edwards, and other British prawns.

Faraday Society, February 19.—Sir Robert Robertson, president, in the chair.—A. W. **Porter** and J. J. **Hedges**: The law of distribution of particles in colloidal suspensions with special reference to Perrin's investigations. Pt. ii. The behaviour of particles specifically lighter than the medium has been examined in regard to distribution with height, using for the purpose emulsions of paraffin in water. The change of concentration occurs only at the bottom of the containing vessel. There is an increase of concentration with height reckoned from the bottom. A type of curve is suggested which fits closely the experimental results.—D. B. **Macleod**: On a relation between surface tension and density. The empirical relation $\gamma/(\rho_l-\rho_v)^4=C$, where γ is the surface tension at any temperature, ρ_l and ρ_v the densities of the liquid and the vapour at the same temperature and C is a constant for each liquid, fits the experimental figures with remarkable accuracy for temperatures ranging from the melting-point to the critical temperature.—D. B. **Macleod**: (1) On a relation between the viscosity of a liquid and its coefficient of expansion. If x_0 be the volume of the free space in 1 c.cm. of a liquid at 0° C. and $1-x_0$ the volume occupied by the molecules, it is assumed that at a temperature $t°$ C. the volume of the free space is $x_0+\alpha t+\beta t^2+\gamma t^3$ —the volume of the molecules remaining constant. The viscosity of liquids is expressed as a function of the free space, thus $\eta_t x_t^A=C$. For normal liquids A is nearly unity. For associated liquids it has a higher value. The values obtained for the free space for various liquids at their boiling-points are practically constant and of the order required by Van der Waal's theory. An expression is given for the viscosity of liquids at different temperatures and pressures. (2) On the viscosity of liquid mixtures showing maxima. The viscosity of liquid mixtures is a function of the free space of the constituents and of the mixture. In the case of liquid mixtures showing a maximum, the increase of viscosity is due mainly to the increase of density, which in turn is due to the chemical affinity between the constituents. It is probable that complexes which are formed further reduce the free space and consequently increase the viscosity.—F. H. **Jeffery**: Electrolysis with an aluminium anode, the anolyte being (1) solutions of sodium nitrite, (2) solutions of potassium oxalate. With solutions of sodium nitrite probably the primary product of reaction at the anode is aluminium nitrite which is hydrolysed rapidly to hydrated aluminium oxide and nitrous acid, the latter giving rise to nitric oxide and nitric acid. With solutions of potassium oxalate the product of reaction at the anode is a complex anion derived from aluminium. The salt $K_3\{Al(C_2O_4)_3\}\cdot 3H_2O$ can be derived from the anolytes after electrolysis. It is probable that the salt is a true complex salt comparable with potassium chromioxalate, and if this be true, the alumini-oxalate complex can be represented in three dimensions just as Werner represented the chromioxalate. The isolation of a complex salt from an anolyte does not imply necessarily that the constitution of the anionic part of this salt is identical with that of the complex anion present in the anolyte after electrolysis.—Maurice **Cook**: Crystal growth in cadmium. Evidence has been obtained that unworked crystals can grow under certain conditions. The usual methods of preparing metallic specimens for microscopic examination are useless, since the specimen cannot be regarded as unworked after it has been sawn off the original, ground, and polished. In these experiments the metal is cooled in such a way as to be free from the stresses usually set up during solidification. The results obtained indicate that during annealing considerable crystal growth has taken place. Irregularity in the shape of the grains is probably a factor greatly facilitating crystal growth.—S. D. **Muzaffar**: Electric potential of antimony-lead alloys. Measurements of the electric potential of the antimony-lead alloys were made by means of a quadrant electrometer against a calomel electrode in N KOH, N $Pb(NO_3)_2$, and tartar emetic with tartaric acid solutions. The results reveal an identity of potential up to 98 per cent. antimony with that of lead, which show the formation of no solid solution and no chemical compound between the two metals.

Royal Microscopical Society, February 21.—Prof. F. J. Cheshire, president, in the chair.—Sir W. M. **Bayliss**: Colloids and staining. The histologist is concerned with the staining of particles, large or small, sometimes present in the living cell, sometimes formed by fixing agents. The process is a complex one; but, as would be expected from the heterogeneous nature of the systems concerned, adsorption is the chief factor, especially in its electrical aspect; chemical combination seems to be of less importance. Thus, surfaces with a positive charge take negative ("acidic") dyes, those with negative charge take "basic" or positive dyes. The degree depends on the magnitude of the charge, as shown by the effect of electrolytes, alcohol, heat, isoelectric point, etc. The removal of the amino groups from proteins has no effect on the process. Adsorption can be distinguished from chemical combination in certain cases, such as silk dyed with the acid of Congo-red. The fixation of stains by heat is difficult to explain. The action of mordants is also obscure; chemical combination as "lakes" is only a partial explanation, since these are stated to be resistant to acids. Differentiation appears usually to be a process of colloidal dispersion of the "lake." In a few cases, as the staining of fat by Soudan III., partition in accordance with solubility is the main factor.—A. **Mallock**: The resolving power and definition of optical instruments. Resolving power is taken as indicating the least distance (angular or linear) at which two points can be seen as separate in the field of the instrument; definition is the ratio of that area of the field over which the resolving power is maintained to the whole area, or, shortly, the dimensions of the least objects appreciable and the range over which the appreciability extends. Optical images are formed when and where a number of paths from one point to another have the same optical length, in which case either point may be considered as the image of the other. By optical length is meant the length measured in wave-lengths in the medium through which the path proceeds. The constancy of this length causes all the waves emanating from one of the points to arrive at the other in the same phase, and this condition may be used to determine the form of the reflecting or refracting surfaces required to make one point the image of another. Resolving power depends on the rapidity with which the length of the optical path varies as the distance from the geometrical focus is increased: the more rapid the variation the greater is the concentration of the light and the smaller the luminous area which forms the image of a point. For telescopes where the angular aperture of the lens is small the variation is proportional to the diameter of the object glass, and a perfect lens one inch in diameter should have a resolving power of 4 in. of arc. For microscopes where the angular aperture of the lens is large the least appreciable distance is about $\lambda/2$ or 1/100,000 in. with ordinary light. Test plates for microscope objectives consist of groups of fine lines ruled on films of anilin colour, the thickness of which is only a small fraction of a wave-length of light.

PARIS.

Academy of Sciences, February 19.—M. Albin Haller in the chair.—G. Urbain: Celtium, element of atomic number 72. A discussion as to the priority of Coster and Hevesy. The author cites the earlier work of Dauvillier and himself, and concludes that Coster and Hevesy were not the discoverers of element 72, but have only found a material in which it is present in a relatively high proportion. The author claims that the name celtium has priority over hafnium for this element.—J. L. Breton: Spark-gaps in which the spark in a gaseous dielectric is deflected by a strong air current. Two types of spark-gap are described. The simpler of the two consists of a conducting disc of metal or graphite rotating with a high velocity in a hermetically closed cylinder filled with coal gas or the vapour of alcohol. The sparks play between this disc and two graphite electrodes. Long uninterrupted working is secured by water-cooling or by a fan. The apparatus has been successfully applied to the working of a high-frequency-induction furnace.—Jules Andrade: Isochronism and quadratic friction.—Georges Friedel: Cholesteric bodies.—C. Sauvageau: The prolonged quiescent state of an ephemeral Alga (Mesogloia).—M. W. C. Brögger was elected a foreign associate in the place of the late M. Schwendener.—A. Myller: Systems of curves on a surface and the parallelism of M. Levi-Cività.—M. Juvet: A generalisation of Jacobi's theorem.—M. Malaval: Permanent deformations by extension and compression.—M. Mesnager: Observations on the preceding note.—P. Dumanois: An aerodynamical arrangement for testing motors. The usual fan resistance does not permit of continuous variation. The author encloses the fan in a cylindrical drum closed by two plane parallel walls, one of which is constructed of radiating shutters. By partially opening the shutters, when fixed to a 12 h.p. motor, the number of turns per minute can be varied between 950 and 1470, a sufficient variation for practical conditions of use.—M. Rateau: Remarks on the preceding communication. M. Dumanois' apparatus has advantages over the Froude brake.—A. Weinstein: The unicity of sliding movements.—Charles Bohlin: The autologous series belonging to the problems of two and three bodies.—Ernest Pasquier: A simple expression of the acceleration of mercury in the case of the problem of two bodies, taking into consideration the movement of the perihelion of the planet.—Thadée Peczalski: The relation between Young's modulus and the ratio of density to atomic mass. The relation $E=B(\delta/M)^2$ is deduced, in which E is Young's modulus, δ is the density, M the atomic mass, and B a constant (8×10^5 kilograms per sq. mm.). The calculated and experimental values are compared for nine metals.—A. Marcelin: Superficial fluids. The unlimited extension of oleic acid. A study of the "superficial pressure" exerted by a thin layer of oleic acid on water. When the layer of oleic acid is one molecule thick the acid may be regarded as being in an intermediate state between the free and dissolved states, to which the name of "superficial solution" is given.—St. Procopiu: The appearance of the flame, arc and spark lines in the arc-spectra of metals in a vacuum.—Albert Portevin and François Le Chatelier: A phenomenon observed during the test by extension of alloys in course of transformation. The peculiarity observed was confined to aluminium alloys of the duralumin type with or without the addition of other metals (manganese, zinc). The elongation of the test pieces, instead of increasing continuously with the pull, progressed by repeated oscillations of an amplitude amounting to 4 per cent. of the load and with a frequency of several oscillations per second. The phenomenon attained its maximum amplitude immediately after tempering.—A. Bigot: The action of heat on kaolins, clays, etc. Black pottery. A study of the black pottery from the Bouchets Cave (Ardèche), from Basutoland, and of Etruscan black vessels.—André Brochet: The hydrogenation and dehydrogenation of castor oil and its derivatives. Castor oil with active nickel was treated with hydrogen at 150° C. under pressure. The pressure showed a series of oscillations which can be interpreted by assuming a series of hydrogenations and dehydrogenations. The fully hydrogenated product gave off hydrogen on heating with nickel to about 280°, but the product finally obtained did not correspond with the original oil.—René Locquin and Sung Wouseng: the hydration of the dialkylethinyl-carbinols and the preparation of the α-hydroxymethyl ketones. Tertiary acetylenic alcohols of the type $RR.C(OH).C{\equiv}CH$ are readily converted into the ketones $PR.C(OH).CO.CH_3$ by Denigès' reagent (acid sulphate of mercury). Details of the method are given and a description of five ketones prepared by this general method.—Henry Joly: Stratigraphical observations on the Oxfordian and Lusitanian at certain points in the Celtiberic chain (Spain).—Léon Bertrand and Antonin Lanquine: The large Provençal sheets of Audibergue and Cheiron (Maritime Alps).—E. Schnæbelé: The present structure of the primary Vosges. The application to the whole of the Vosges of observations made especially to the north of the valley of Villé.—L. Giraux: The geological position of the neolithic workshops of the forest of Montmorency.—J. Beauverie: The relations existing between the development of wheat rust and climate. The sharp contrast between the climatic conditions in 1921 and 1922 showed that *Puccinia triticina* is especially the rust of dry seasons and *P. graminis* is the rust of wet seasons, the latter doing the most damage from the point of view of yield of grain.—M. Rose, J. Dragoiu, and F. Vlès: The reversibility of the phenomena of arrest by lowering the pH in the evolution of the eggs of the sea urchin.—M. and Mme. G. Villedieu.—The action of insoluble oxides on the mildew of potato (*Phytophthora infestans*). It is generally admitted that for a substance to act on a living organism it must first be rendered soluble. Experiments on the toxic action of the insoluble oxides of various metals (magnesium, cadmium, nickel, cobalt, zinc, copper, mercury) on the conidia of potato mildew are in direct contradiction with this hypothesis.—R. Herpin: Comparison between the sexual behaviour of some nereidians from the coasts of the Channel.—Ch. Gravier: Remarks on the preceding communication.—Auguste Lumière: The possibility of realising intestinal disinfection. An account of some experiments with sodium argentothioglycerine sulphonate, $AgS.CH_2.CH(OH).CH_2.O.SO_3Na$. Experiments on a dog showed that while a dose of 1 gm. of benzonaphthol per day had no effect on the number of organisms in the fæcal matter, the administration of the same weight of the silver compound sterilised the intestine in four days.

Official Publications Received.

Report of the Canadian Arctic Expedition, 1913-18. Vol. 6: Fishes and Tunicates. Part B: Ascidiacea. (Southern Party, 1913-16.) By A. G. Huntsman. Pp. 14. Vol. 7: Crustacea. Part G: Euphyllopoda. By Frits Johansen. Pp. 34. Part N: The Crustacean Life of some Arctic Lagoons, Lakes, and Ponds. (Southern Party, 1913-16.) By Frits Johansen. Pp. 31. Vol. 8: Mollusks, Echinoderms, Cœlenterates, etc. Part G: Alcyonaria and Actinaria. By Prof. A. E. Verrill. Pp. 164. Part I: Hydroids. By C. McLean Fraser. Pp. 5. (Ottawa.)

Minutes and Proceedings of the Institution of Civil Engineers; with other Selected Papers. Edited by Dr. H. H. Jeffcott. Vol. 214. Pp. iv+362+6 plates. (London: Gt. George Street.)

Department of Fisheries, Ceylon. Bulletins of the Ceylon Fisheries. Vol. 1, Bulletins 1-3. Edited by Dr. J. Pearson. Pp. iv+134. (Colombo.)

Forest Bulletin No. 48: Note on Kindal or Hongal (*Terminalia paniculata*, W. and A.). By R. S. Pearson. Pp. 12. (Calcutta: Government Printing Office.) 6 annas.

Forest Bulletin No. 52: Classification of Thinnings. Pp. 5+7 plates. (Calcutta: Government Printing Office.) 6 annas.

Department of Agriculture and Natural Resources: Weather Bureau. Annual Report of the Weather Bureau for the Year 1919. Part 4: Hourly Results of the Observations made at the Magnetic Observatory of Antipolo, near Manila, P.I., during the Calendar Year 1919. Pp. 47. (Manila: Bureau of Printing.)

The Journal of the Institute of Metals. Edited by G. Shaw Scott. Vol. 28. Pp. ix+1010. (London: 36 Victoria Street.) 31*s.* 6*d.* net.

Diary of Societies.

SATURDAY, MARCH 17.

BRITISH MYCOLOGICAL SOCIETY (in Botany Department, University College), at 11.—Rev. P. J. Alexander: An Ecological and Phenological Account of the Mycetozoa of Surrey.—Miss M. H. Carré, Dr. A. S. Horne, Miss H. M. Judd, and Mrs. H. S. Williamson: Eidamia.—Dr. J. S. B. Elliott and Miss O. Stansfield: The Life History of *Polythrincium Trifolii* Kunze.—J. Ramsbottom: (1) The Correspondence of Berkeley and Broome; (2) Mycology at the British Empire Exhibition (1924).

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Atomic Projectiles and their Properties (5).

MONDAY, MARCH 19.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge, Kensington Gore), at 5.—Col. M. N. MacLeod, Squadron-Leader F. C. V. Laws, and Major Griffiths: Recent Developments of Air Photo-topography.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—H. T. Young and others: Discussion on the Need for Co-operation between Electrical Manufacturers and Contractors.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section), at 7.—R. C. Bond: The Walschaert Locomotive Valve-gear.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—G. E. S. Streatfeild: The Hammersmith Housing Scheme.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Miss H. D. Oakeley and others: Discussion on Prof. Wildon Carr's A Theory of Monads.

ROYAL SOCIETY OF ARTS, at 8.—J. E. Sears, jun.: Accurate Length Measurement (3) (Cantor Lecture).

CHEMICAL INDUSTRY CLUB (at Whitehall Court), at 8.

TUESDAY, MARCH 20.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Lecture: Diseases of the Prehistoric Britons.

ROYAL SOCIETY OF MEDICINE, at 5.—General Meeting.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. A. J. Hall: Encephalitis Lethargica (Epidemic Encephalitis) (2) (Lumleian Lecture).

ROYAL STATISTICAL SOCIETY, at 5.15.

NEWCOMEN SOCIETY (at Prince Henry's Room, 17 Fleet Street), at 5.30.—D. Brownlie: The Early History of the Gas Process.

INSTITUTE OF TRANSPORT (at Institution of Electrical Engineers), at 5.30.—Lecture on Town-planning and Re-modelling in Relation to Traffic.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Sushil Ch. Sarkar: A Comparative Study of the Buccal Glands and Teeth of Opisthoglyph Snakes, and a Discussion on the Evolution of the Order from Aglypha.—O. Thomas and M. A. C. Hinton: The Mammals obtained in Darfur by the Lynes-Lowe Expedition.—R. I. Pocock: (1) The External Characters of Elaphurus, Hydropotes, Pudu, and other Cervidæ; (2) The Classification of the Sciuridæ.

INSTITUTION OF CIVIL ENGINEERS, at 6.

INSTITUTE OF MARINE ENGINEERS, INC., at 6.30.—J. Lamb: Operation of the Marine Diesel Engine—Cylinders and Pistons.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—W. F. A. Ermen: The Preparation of Metol and its Homologues.

MEDICO-LEGAL SOCIETY (at Medical Society of London), at 8.30—Dr. H. A. Burridge and others: Discussion on State Effort to rescue Drug Victims, with special reference to the Dangerous Drugs Act.

WEDNESDAY, MARCH 21.

INSTITUTION OF NAVAL ARCHITECTS (at Royal United Service Institution), at 11.—Sir Eustace T. d'Eyncourt and J. H. Narbeth: A Proposed Aircraft-carrying Mail Steamer.—Sir John E. Thornycroft and Lieut. Bremner: Coastal Motor Boats in War-time.—At 3.—A. C. F. Henderson: Remarks on Some of the Present-day Problems in the Design of Ships.

WOMEN'S ENGINEERING SOCIETY (at 26 George Street, W.1), at 6.15.—Dr. R. S. Hutton: Scientific Studies of Manual Work (Motion Study and Vocational Training).

ROYAL MICROSCOPICAL SOCIETY (Industrial Applications Section), at 7.—E. Hatschek: The Standard Methods of Ultra-microscopy.—Dr. A. C. Thaysen: The Destruction of Cotton and other Fabrics by Bacteria, and the Importance of the Microscope in the Study of this Destruction.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—G. M. B. Dobson: The Characteristics of the Atmosphere up to 200 km., as obtained from Observations of Meteors.

ROYAL SOCIETY OF ARTS, at 8.—Dr. F. W. Edridge-Green: Some Curious Phenomena of Vision and their Practical Importance.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

ROYAL SOCIETY OF MEDICINE (Social Evening), at 9.—Dr. H. C. Cameron: The Mystery of Lord Byron's Lameness.

THURSDAY, MARCH 22.

INSTITUTION OF NAVAL ARCHITECTS (at Royal United Service Institution), at 11.—The Hon. Sir Charles A. Parsons, S. S. Cook, and H. M. Duncan: Mechanical Gearing.—W. Le Roy Emmet: Electric Ship Propulsion. At 3.—G. S. Baker and W. C. S. Wigley: Model Screw Propeller Experiments with Mercantile Ship Forms. At 8.—K. C. Barnaby: The Powering of Motor Ships.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Lt.-Col. E. F. Strange: Japanese and Chinese Lacquer (2).

ROYAL SOCIETY, at 4.30.—G. Hewett: The Dusuns of British North Borneo.—L. T. Hogben and F. R. Winton: The Pigmentary Effector System. III. Colour Response in the Hypophysectomised Frog.—H. R. Hewer: Studies on Amphibian Colour Change.—J. Walton: On Rhexoxylon, Bancroft. A Triassic Genus of Plants exhibiting a Liane-type of Vascular Organisation.—Margaret Tribe: The Development of the Hepatic Venous System and the Postcaval Vein in the Marsupialia.—J. Gray: The Mechanism of Ciliary Movement. III. The Effect of Temperature.—E. Ponder: The Inhibitory Effect of Blood Serum on Hæmolysis.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. A. J. Hall: Encephalitis Lethargica (Epidemic Encephalitis) (3) (Lumleian Lecture).

FELLOWSHIP OF MEDICINE (at Royal Society of Medicine), at 5.30.—Dr. H. W. Barber: The Investigation of certain Diseases of the Skin in the Light of Recent Research.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. H. C. Miller: The New Discipline.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—Dr. L. C. Martin: Surveying and Nautical Instruments from an Historical Standpoint.

CAMERA CLUB, at 8.15.—T. Bell: Portraiture.

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.—S. Joly: Diverticulum of the Bladder with special reference to Operative Treatment.

FRIDAY, MARCH 23.

INSTITUTION OF NAVAL ARCHITECTS (at Royal United Service Institution), at 11.—Prof. T. B. Abell: The Behaviour of Stiffened Thin Plating under Water Pressure.—Dr. J. Montgomerie: Further Experiments on Large-size Riveted Joints.—J. Anderson: The Influence of Form upon the Stability and Propulsion of Passenger Ships.—At 3.—W. Thomson: The Effect of Variations in Loading on Longitudinal Structural Stresses in Ships.—E. V. Telfer: Graphical Trim Calculation and a Trim Nomogram.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Theatre, Imperial College of Science and Technology), at 2.30.—Prof. J. H. Priestley: The Causal Anatomy of the Potato Tuber.—E. H. Richards: Cellulose Decomposition: its Control and Applications.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5.—Dr. W. J. H. Moll: A Moving-coil Galvanometer of Rapid Indication.—Dr. W. J. H. Moll: A Thermopile for measuring Radiation.—Capt. C. W. Hume: Aberration and the Doppler Effect on the Theory of Relativity;—and the following Experimental Demonstrations:—C. R. Darling and the Hon. F. W. Stopford: The Production of E.M.F.'s by Heating Junctions of Single Metals.—R. H. Humphry: The Double Refraction due to Motion in a Vanadium Pentoxide Sol, and some Applications.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—R. J. Siddall: History and Development of the Underground Railway.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 8.—F. G. Newmarch: A Tramp through Corsica.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir Ernest Rutherford: Life History of an Alpha Particle from Radium.

SATURDAY, MARCH 24.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Atomic Projectiles and their Properties (6).

BRITISH PSYCHOLOGICAL SOCIETY (at King's College), at 3.15.—Miss Mary Sturt: The Estimate of Duration.

PUBLIC LECTURES.

SATURDAY, MARCH 17.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. A. Abram: Travelling in the Middle Ages.

TUESDAY, MARCH 20.

SCHOOL OF ORIENTAL STUDIES, at 5.—Sheikh Abd el Razek: The Study in Europe of Moslem Civilisation.

WEDNESDAY, MARCH 21.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 5.—Lord Sumner of Ibstone: The Public and the Architect.

SATURDAY, MARCH 24.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. W. A. Cunnington: The Natural History of Lobsters and Prawns.